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Application Number: 18606980 Document Date: 03/15/2024

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Form Revision Date: March 1, 2019

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Espacenet

Bibliographic data: JPH11316395 (A) — 1999-11-16

ELECTROCHROMIC ELEMENT

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Classification: **- international:** ***G02F1/155; G09F9/30;*** (IPC1-7): G02F1/155; G09F9/30

- cooperative:

Application number: JP19980195525 19980710

Priority number(s): JP19980195525 19980710 ; JP19980053435 19980305

Abstract of JPH11316395 (A)

PROBLEM TO BE SOLVED: To make the ratio of the light transmittance at the time of decoloring to that at the time of coloring, i.e., a switching ratio larger and a life longer by a first juncture which electrically connects both of a first lower electrode layer and a second lower electrode layer and a second juncture which electrically connects both of a first upper electrode layer and a second upper electrode layer. SOLUTION: The lower electrode layer 11 of an electrochromic layer 1 and the lower electrode layer 21 of an electrochromic layer 2 are common in the juncture which is an electrode take-out port. The upper electrode layer 12 of the electrochromic layer 1 and the upper electrode layer 22 of the electrochromic layer 2 are common in the juncture of electricity. Voltage is impressed on the common juncture of the lower electrode layers and the common juncture of the upper electrode layers, by which both of the electrochromic layer 1 and the electrochromic layer 2 are simultaneously colored and decolored. As a result, the electrochromic element having the larger transmitted light quantity at the time of coloring and decoloring, i.e., switching ratio, than the element having just one set of the electrochromic layer 1 is obtd.

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DESCRIPTION JPH11316395A

[0001]

13 BACKGROUND OF THE INVENTION 1. Field of the Invention The present invention relates to an electrochromic device used for light amount control, display, and optical switches.

[0002]

18 2. Description of the Related Art When a voltage is applied to a substance, a reversible electrolytic oxidation or electrolytic reduction reaction occurs, and the phenomenon of reversibly coloring or decoloring the substance is called electrochromism.

21 Using an electrochromic substance that exhibits this phenomenon, we have created an electrochromic element that changes color and fades when voltage is manipulated, and we have developed an electrochromic element that uses a light control element (for example, a dimming glass or an anti-glare mirror) or a 7-segment. Attempts to use it in numeric display elements have been made for more than 20 years.

[0003]

29 Electrochromic devices can be broadly classified into solution type, gel type, all-solid-state type, etc., depending on the material form of each layer that makes up the electrochromic device. Among these, all-solid-state electrochromic devices have a structure in which each layer is entirely in the form of a thin film. It is formed by laminating.

33 Therefore, all-solid-state electrochromic devices are not only easy to increase in size, but also require that each layer be formed on a separate substrate and the two substrates bonded together, as in the case of manufacturing solution-type or gel-type electrochromic devices. It has excellent productivity because it does not require any process or sealing process for liquid or gel materials.

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[0004]

41 For example, an all-solid-state type in which a transparent electrode layer (cathode), a tungsten trioxide thin film layer (electrochromic layer), a silicon dioxide thin film layer (insulating layer), and an electrode layer (anode) are sequentially laminated on a glass substrate. An electrochromic device is described in Japanese Patent Publication No. 52-46098.

45 When a voltage (coloring voltage) is applied to this electrochromic element, the tungsten trioxide (WO3) thin film layer is colored blue. Thereafter, when a voltage with the opposite polarity (decolorizing voltage) is applied to this electrochromic element, the blue color of the tungsten trioxide thin film layer disappears and it returns to colorless. Although the mechanism of this discoloration has not been elucidated in detail, a small amount of water contained in the tungsten trioxide thin film layer and the insulating layer (ion conductive layer) controls the discoloration of the tungsten trioxide thin film layer. It is understood that

[0005]

55 The coloring reaction formula is estimated as follows.

56 H2O →H + +OH- (WO3 layer = cathode side) WO3 +nH+ +ne- → HnWO3 Colorless and transparent Blue colored (insulating layer = anode side) OH- →(1/2)H2O+(1/4)O2 ↑+e - Therefore, Such display elements have the following properties: (1) During the coloring reaction, a side reaction of oxygen gas generation occurs, and this oxygen gas is released from the inside of the film, so that the moisture content is consumed by this side reaction; (2) Due to the reverse decoloring reaction, water is not produced because oxygen, which is a material, is not present inside the film. Therefore, the water inside the membrane is consumed for coloring and decoloring, and water needs to be replenished from the atmosphere for repeated coloring and decoloring. Particularly due to the latter reason (2), this type of element has the disadvantage that the reproducibility of coloring is affected by moisture in the atmosphere.

[0006]

69 In order to solve the above drawbacks, the same amount of water as consumed by the coloring reaction is produced by the decoloring reaction, and therefore coloring and decoloring can be repeated without the need for water supply from the outside world. JP-A-52-73749 describes an all-solid-state electrochromic device in which the repeated coloring density is not affected by the external environment.

74 This element basically consists of a transparent electrode layer as an electrode, an electroreductive coloring thin film layer such as a tungsten trioxide thin film layer as an electrochromic layer, and an electrolytic oxidation coloring thin film layer such as a chromium oxide (Cr2O3) film. It is formed by sequentially laminating a layer and a counter electrode.

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[0007]

81 In addition, the above-mentioned Japanese Patent Application Laid-open No. 52-73749 states that after connecting a DC power source to the electrodes of this element and the counter electrode and applying a DC voltage to color the element, if the connection with the DC power source is cut off, the color will change. However, by providing an insulating layer such as a thin film of silicon dioxide or magnesium fluoride at an arbitrary position between the transparent electrode and the other electrode, the color gradually disappears after the voltage is removed. It is also stated that this element is given the property of preserving the coloring (this is called memory property).

89 Japanese Patent Publication No. 62-52845 describes the assumption that this insulating layer is a layer of an ionically conductive material, which is a material that is not a good conductor of electrons but allows free movement of protons and hydroxy ions. Furthermore, Japanese Patent Publication No. 62-52845 states that it is most desirable to arrange an insulating layer, that is, an ion conductive layer between an electrolytic reduction color forming thin film layer and an electrolytic oxidation color forming thin film layer, and that It is stated that both of the electrolytic oxidation color-forming thin film layers do not need to be color-forming, and it is sufficient if either one of them changes color so that the change can be recognized from the outside.

[0008]

101 A pair of electrodes that directly or indirectly sandwich the electrochromic layer of an electrochromic element allow light to enter the colored and decolored electrochromic layer, and furthermore, take out the emitted light to the outside of the element. Must be transparent.

105 In particular, in the case of a transmissive electrochromic device, both electrodes must be transparent.

[0009]

110 At present, SnO2, In2O3, ITO (a mixture of In2O3 and SnO2), ZnO, etc. are known as transparent electrode layer materials, but these materials have relatively high light absorption, so it is difficult to meet the required transmittance. To obtain this, the film thickness must be reduced, and electrochromic devices are usually formed as a thin film on a substrate (eg, a glass plate or a plastic plate).

[0010]

118 The pair of electrodes is provided with a lead-out electrode that is a connecting portion with external wiring in order to apply a voltage from an external power source.

120 When a transparent electrode layer is used as an electrode, since the transparent electrode layer has high resistance to external wiring, a low-resistance lead-out electrode is often

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provided overlapping (that is, in contact with) the transparent electrode layer.

123 Usually, a band-shaped low-resistance electrode is provided around the transparent electrode layer located at the edge of the substrate surface (for example, by attaching a metal clip, plating with a low-resistance metal material, or using vacuum thin film forming technology). It is used as a low-resistance extraction electrode.

[0011]

130 Also, depending on the application, electrochromic devices are used by placing a sealing substrate to protect the device so as to face the device substrate, and sealing the device using, for example, epoxy resin, acrylic resin, urethane resin, etc. .

[0012]

136 [Problems to be Solved by the Invention] As mentioned above, the all-solid-state electrochromic device has characteristics such as excellent coloring/decoloring properties and the ability to be made large.

139 However, although the ratio of light transmittance when coloring to when decolorizing, that is, the switching ratio, is at a level that is satisfactory for normal use, the conventional switching ratio is not sufficient to further expand the range of use. There was a problem.

[0013]

145 Conventionally, in order to improve the switching ratio, it is known to increase the driving voltage to increase the coloring density, but if the driving voltage is increased beyond the limit voltage, the element will only cause film peeling and break down. First, even if film peeling or destruction does not occur, excessively increasing the driving voltage will shorten the device life.

150 Additionally, in order to improve the switching ratio, it is known to increase the coloring density by increasing the thickness of the electrochromic layer. At a film thickness of , the coloring density becomes saturated.

[0014]

156 The present invention has been made in view of these conventional problems, and aims to provide an electrochromic element with a long life and a large ratio of light transmittance when coloring to when decoloring, that is, a switching ratio. .

[0015]

162 [Means for Solving the Problems] In order to solve the above problems, the present invention first provides an electrochromic device that includes a first substrate and a first lower

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electrode arranged in a laminated manner on the first substrate. a first electrochromic member having a first electrochromic layer, a first electrochromic layer, a first upper electrode layer, a second substrate, a second lower electrode layer and a second electrochromic member disposed in a laminated manner on the second substrate in order. a second electrochromic member having a layer and a second upper electrode layer; a first connection portion and a second connection portion at an end of the electrochromic element; is connected to the first upper electrode layer surface and the second upper electrode layer surface facing each other via a sealing resin, and the first connecting portion is a contact between the first lower electrode layer and the second lower electrode layer. and the second connection portion is electrically connected to both the first upper electrode layer and the second upper electrode layer (claim 1). do.

[0016]

178 Second, in an electrochromic device, a substrate, an electrochromic layer disposed in a laminated manner on the substrate, a pair of electrode layers sandwiching the electrochromic layer, and a sealing substrate bonded via a sealing resin are described. and a plurality of connection parts electrically connected to the electrode layer at an end of the electrochromic element, wherein the plurality of electrochromic members are connected to the substrate surface or the sealing member. The sealing substrate surface is integrally bonded to the substrate surface or the sealing substrate surface via an adhesive, and the connecting portion is electrically connected to two or more of the electrode layers. An electrochromic device characterized by the following features (claim 2).

[0017]

190 Thirdly, "In an electrochromic element, a plurality of electrochromic members each having a substrate, an electrochromic layer disposed in a laminated manner on the substrate, and a pair of electrode layers sandwiching the electrochromic layer, and one sheet of sealing material are used. a sealing substrate; and a plurality of connecting portions electrically connected to the electrode layer at the ends of the electrochromic element, wherein the plurality of electrochromic members and the sealing substrate form each layer of the substrate. and the surface on which each layer is not formed, and the surface on which each layer of the substrate is formed and the surface of the sealing substrate are all bonded and integrated via a sealing resin, and at least one of the connection portions is connected to two or more of the connection portions. An electrochromic element (claim 3) characterized in that the electrochromic element is electrically connected to an electrode layer.

[0018]

204 Fourthly, "In an electrochromic element, a substrate, two or more types of electrochromic layers and a total of two or more layers arranged in a laminated manner on the substrate,

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and an electrode layer whose number is one layer greater than the number of the electrochromic layers. and a plurality of connection parts electrically connected to the electrode layer at the end of the electrochromic element, each of the electrochromic layers being sandwiched between two of the electrode layers. and the layer closest to the substrate surface and the layer farthest from the substrate surface of the thin film portion are each composed of an electrode layer, and at least one of the connection portions is electrically connected to two or more of the electrode layers. An electrochromic device (claim 4)" is provided.

[0019]

217 Fifth, "If the number of the connecting parts is two, and applying a constant DC voltage between the two connecting parts, all the electrochromic layers will be colored, and if a certain DC voltage of opposite polarity is applied, all the electrochromic layers will be colored." There is provided an electrochromic device according to any one of claims 2, 3, and 4 (claim 5), wherein the electrochromic layer is decolored.

[0020]

225 Sixthly, ``An electrochromic device includes a first substrate, a first lower electrode layer, a first electrochromic layer, and a first upper electrode layer arranged in a laminated manner on the first substrate. An electrochromic member, a second substrate, a second lower electrode layer, a second electrochromic layer, and a second upper electrode layer arranged in a laminated manner on the second substrate, and a sealing member bonded to the second substrate through a sealing resin. a second electrochromic member having a stop substrate; a first connection portion and a second connection portion at an end of the electrochromic element; the first electrochromic member and the second electrochromic member are connected to the first substrate; The layer-forming surface of the second substrate and the non-layer-forming surface of the second substrate are bonded to each other via a sealing resin, and the first connecting portion is electrically connected to two of the four electrode layers in total. , the second connection part is electrically connected to the remaining two electrode layers, and when a constant DC voltage is applied between the first connection part and the second connection part, the first electrochromic An electrochromic device characterized in that both the first electrochromic layer and the second electrochromic layer are colored, and both the first electrochromic layer and the second electrochromic layer are decolored when a constant DC voltage of opposite polarity is applied. (Claim 6) is provided.

[0021]

245 Seventhly, ``Claims 1, 2, and 3, wherein the connecting portion, the first connecting portion, and the second connecting portion include a conductive thin film or a conductive paste, and a conductive clip. The electrochromic device according to any one of items 4, 5, and 6 (claim

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7) is provided.

[0022]

252 DESCRIPTION OF THE PREFERRED EMBODIMENTS In the present invention, one electrochromic element has two or more sets of electrochromic layers, but the number of electrode connection parts is equal to one set of electrochromic layers. The feature is that it is the same as the element used in the previous model.

256 The electrochromic layer commonly used in the following explanation is composed of multiple thin film layers, and there are two types in terms of the order of lamination.

258 The first type is a type in which an electrolytic oxidation color forming thin film layer, an ion conductive layer, and an electrolytic reduction color forming thin film layer are laminated in order.The second type is a type in which an electrolytic oxidation color forming layer, an ion conductive layer, and an electrolytic oxidation color forming thin film layer are laminated in order. It is a laminated type.

[0023]

266 Embodiments of the electrochromic device of the present invention will be described below with reference to the drawings, but the present invention is not limited to these drawings.

268 As an example of the first embodiment of the present invention, an electrochromic element having two sets of electrochromic layers will be described.

270 Each of the two sets of electrochromic layers is sandwiched between a pair of electrode layers.

272 The electrode layer closer to the glass substrate is used as the lower electrode, and the other electrode is used as the upper electrode.

274 In FIG. 1, each electrochromic layer is designated as 1 and 2, respectively.

275 Let 11 and 21 be the lower electrode layers, and 12 and 22 be the upper electrode layers, respectively.

277 Among the layers constituting the electrochromic layer, the layer in contact with the lower electrode layer is formed as an electrolytic oxidation color-forming thin film layer, and the layer closer to the upper electrode is formed as an electrolytic reduction color-forming thin film layer.

281 Of course, conversely, the layer in contact with the lower electrode layer may be formed as an electrolytic reduction coloring thin film layer, and the layer closer to the upper electrode may be formed as an electrolytic oxidation coloring thin film layer.

284 The lower electrode layer 11 of the electrochromic layer 1 and the lower electrode layer 21 of the electrochromic layer 2 have a common connection part that is an electrode outlet, and the upper electrode layer 12 of the electrochromic layer 1 and the lower electrode layer 21 of the electrochromic layer The upper electrode layer 22 of layer 2 has a common electrode connection portion.

289 By applying a voltage to the connection portion of the common lower electrode layer and the

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connection portion of the common upper electrode layer, both the electrochromic layer 1 and the electrochromic layer 2 are colored and decolored at the same time. Therefore, an electrochromic element having a larger transmission light amount ratio, ie, a switching ratio during coloring and decoloring, can be obtained than an electrochromic element having only one set of electrochromic layers. Furthermore, in this electrochromic device, since the connection portions of the electrode layers of the two electrochromic layers are common, the number of connection portions is the same as in the case of an device having only one set of electrochromic layers.

[0024]

301 The method for manufacturing the electrochromic device of the present invention may be, for example, the following method.

303 A lower electrode layer 11 is formed on one side of the glass substrate 3. An electrochromic layer 1 is formed thereon, and an upper electrode layer 12 is further formed. Further, on one side of another glass substrate 4, a lower electrode layer 21, an electrochromic layer 2, and an upper electrode layer 22 are formed in the same manner as described above. When bonding the two substrates together, make sure that the extensions of the lower electrode layers 11 and 21 of the two substrates are close to each other, and that the extensions of the upper electrode layers 12 and 22 of the two substrates are close to each other. A lower electrode layer and an upper electrode layer of two element substrates are formed so as to be close to each other. Formed in this way, the two upper electrode extension parts of the two sets of electrochromic layers are electrically connected to one connection part, and the two lower electrode extension parts are electrically connected to the other connection part. do. (Corresponding to Claim 1) Furthermore, two sets of electrochromic elements may be produced, and then the two electrochromic elements may be bonded together to be integrated. In this case as well, when the upper electrode layer and lower electrode layer for each electrochromic element are bonded together, the lead-out portions of the electrodes are electrically connected to the common connection portion. (Corresponding to claim 2) Furthermore, one of the two sets of electrochromic elements in the previous stage is not sealed with the sealing substrate, and the layer formation surface of the unsealed electrochromic element and the sealed electrochromic element It may also be integrated by bonding the two substrates together. In this case as well, when the upper electrode layer and lower electrode layer for each electrochromic element are bonded together, the lead-out portions of the electrodes are electrically connected to the common connection portion. (Corresponding to Claim 3) Furthermore, as shown in FIG. The layer in contact with the electrode may be an electrolytic oxidation color-forming thin film layer. In this case, the first connecting portion electrically connects the extended portion of the lower electrode layer 11 and the extended portion of the upper electrode layer 22, and the extended portion of the upper electrode layer 12 and the extended portion of the lower electrode layer 21 are electrically connected. A second connection portion is formed to be connected to. In this case as well, by applying a voltage between the first connection part and the second connection

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part, the electrochromic layer 1 and the electrochromic layer 2 are simultaneously colored and decolored. (Corresponding to Claim 1) Alternatively, two sets of electrochromic elements may be manufactured, and then both elements may be bonded together to integrate them. In this case as well, when the upper electrode layer and lower electrode layer for each electrochromic element are bonded together, the lead-out portions of the electrodes are electrically connected to the common connection portion.

338 (Corresponding to claim 2) Furthermore, one of the two sets of electrochromic elements in the previous stage is not sealed with the sealing substrate, and the layer formation surface of the unsealed electrochromic element and the sealed electrochromic element are It may be integrated with the substrate by bonding it together. In this case as well, when the upper electrode layer and lower electrode layer for each electrochromic element are bonded together, the lead-out portions of the electrodes are electrically connected to the common connection portion. (Corresponding to Claim 3) An electrochromic device according to a second embodiment of the present invention will be explained by taking as an example an electrochromic device having two sets of electrochromic layers as described above. In FIG. 3, two sets of electrochromic layers 1 and 2 are each sandwiched between a pair of electrode layers, but the entire electrode layer 12 is shared by the two sets of electrochromic layers, and the connection part is electrically connected. It is connected to the. Further, the electrode layers 11 and 21, which do not share the entire electrode layer, share a connection portion where electrical connection is made. In this case, the constituent layers of the electrochromic layers adjacent to the shared electrode layer are either both electrolytic reduction color-forming thin film layers or both electrolytic oxidation color-forming thin film layers. With this configuration, the electrochromic layer 1 and the electrochromic layer 2 can be separated by applying a DC voltage to the connecting portion of the electrode layer 12, which shares the entire electrode layer, and the connecting portion of the electrodes 11 and 21. Colors and decolors at the same time. Therefore, an electrochromic device can be obtained in which the range of color change is larger than that of an electrochromic device having only one set of electrochromic layers. Furthermore, since the electrode layers or connection portions of the electrode layers of the electrochromic layers 1 and 2 are common, the number of connection portions is the same as in the case of an element having only one set of electrochromic layers. (Corresponding to Claim 4) Examples of the method for manufacturing the above electrochromic device include the following method. A lower electrode layer 11 is formed on one side of the element substrate 3. Thereon, an electrochromic layer 1 is formed, and an upper electrode layer 12 is further formed. At this time, the electrochromic layer 1 is of a type in which the electrolytic reduction coloring thin film layer is in contact with the upper electrode layer. An electrochromic layer 2 is further formed on the upper electrode layer 12. At this time, the electrochromic layer 2 is of a type in which the electrolytic reduction coloring thin film layer is in contact with the upper electrode layer. Further, a lower electrode layer 21 is formed thereon.

371 At this time, a common connection portion is provided for the lower electrode layer 11 and the lower electrode layer 21, and a connection portion for the upper electrode layer 12 is further provided. By forming them in this way, it is possible to color and decolor the two sets

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of electrochromic layers at the same time by applying a constant DC voltage to these connecting portions.

[0025]

379 The materials used in the electrochromic device will be explained below.

380 As the material for the electrode and the counter electrode, transparent electrode materials such as SnO2, In2O3, ITO (a mixture of In2O3 and SnO2), and ZnO are preferably used. Metal materials or carbon may be used depending on usage conditions. Preferred metal materials include gold, silver, aluminum, chromium, tin, zinc, nickel, ruthenium, rhodium, stainless steel, etc., but are not limited to these. The metal electrode layer has the advantage of having a much lower resistance than the electrode layer formed from the transparent electrode material described above. Such an electrode layer is generally formed by vacuum thin film forming techniques such as vacuum evaporation, ion plating, and sputtering.

[0026]

391 For the electrolytic reduction color forming thin film layer, WO3, MoO3, a mixture thereof, or the like is preferably used, but the present invention is not limited thereto.

393 For the ion conductive layer, silicon oxide, tantalum oxide, titanium oxide, aluminum oxide, niobium oxide, zirconium oxide, hafnium oxide, lanthanum oxide, magnesium fluoride, etc. are preferably used, but are not limited to these.

[0027]

399 The ion conductive layer is an insulator for electrons, but a good conductor for protons (H +) and hydroxy ions (OH-).

401 Cations are required for the coloring/decoloring reaction of the electrochromic layer, and it is necessary to contain H + or Li + in the electrochromic layer and other parts. H + does not need to be an ion from the beginning; it is sufficient that H + is generated when a voltage is applied. Therefore, water may be contained instead of H + . Very little of this water is sufficient, and often even moisture that naturally enters from the atmosphere will fade the color.

[0028]

410 The electrolytic oxidation color forming thin film layer includes iridium oxide, iridium hydroxide, nickel oxide, nickel hydroxide, chromium oxide, chromium hydroxide, vanadium oxide, vanadium hydroxide, ruthenium oxide, ruthenium hydroxide, rhodium oxide, rhodium hydroxide. , etc. are preferably used, but are not limited to these.

414 Other electrochromic substances include metal oxides and metal sulfides such as titanium oxide, cobalt oxide, iron oxide, silicon oxide, lead oxide, copper oxide, iron sulfide, bismuth

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oxide, niobium sulfide, and hydroquinone derivatives. , iron berlinate derivatives, metal phthalocyanine derivatives (Co, Fe, Zn, Ni, Cu phthalocyanine derivatives), Prussian blue, Prussian blue analogs, indium nitride, tin nitride, zirconium chloride nitride, viologen-based organic electrochromic materials, Styryl-based organic electrochromic materials, polyaniline, etc. can be used for the electrochromic layer.

[0029]

424 Other examples of ion-conductive layers include layers having ion-conductivity and adhesive properties, such as (A) poly(2-acrylamido-2-methylpropanesulfonic acid), poly(styrene-sulfonic acid).), poly(ethylene-sulfonic acid), polyvinylsulfonic acid, fluorinated copolymer, etc., (B) first monomer (e.g., vinylsulfonic acid, sodium vinylsulfonate, vinylsulfonyl fluoride)) and a second monomer (e.g., vinyl pyrrolidinone, butyl vinyl ether, ethyl vinyl ether, isopropyl vinyl ether, cyclohexyl vinyl ether, isobutylene), (C) the first monomer and the second monomer (D) Hydrophilic acrylate monomers (e.g., poly(ethylene oxide) dimethacrylate, ethoxytriethylene, glycol methacrylate, ethylene oxide-dimethylcyclohexane acrylate, hydroxypropyl acrylate, ethyl acrylate)) and a sulfonic acid monomer (for example, 2-acrylamido-2-methylpropanesulfonic acid, styrene-sulfonic acid, ethylene-sulfonic acid, vinylsulfonic acid), etc.

[0030]

438 Since electrochromic elements are susceptible to deterioration if left exposed, they are used by being sealed between two substrates.

440 For example, when an electrochromic element is formed on one substrate, the exposed electrochromic element is sealed with a sealing resin and a sealing substrate.

442 Transparent materials such as epoxy resins, urethane resins, acrylic resins, vinyl acetate resins, and modified polymers are preferably used as the sealant, but are not limited thereto. Hereinafter, the present invention will be explained in more detail with reference to examples, but the present invention is not limited to these examples.

[0031]

449 [Example] [Example 1] (1) An ITO film was formed as an electrode 11 on a glass substrate 3.

450 On top of that, as electrochromic layer 1, a mixed film of iridium oxide and tin oxide (electrolytic oxidation coloring thin film layer), tantalum oxide film (ion conductive layer), and tungsten oxide film (electrolytic reduction coloring thin film layer) are formed in order. An ITO film was further formed thereon as an upper electrode layer 12 to produce a first electrochromic member. (Fig. 1 (b-1)) (2) As in (1), on the glass substrate 4, an ITO film is used as the lower electrode layer 21, a mixed film of iridium oxide and tin oxide, a tantalum oxide film, and a tungsten oxide film are used as the electrochromic layer 2. A film was formed, and an ITO film was further formed as the upper electrode layer 22 to produce a

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second electrochromic member. (FIG. 1(b-2)) (3) Using epoxy resin 5, attach the substrates of (1) and (2) above to the lead-out portion of the upper electrode layer 12 of the first electrochromic member as shown in FIG. 1(a). and the extended portion of the upper electrode layer 22 of the second electrochromic member are close to each other, and the extended portion of the lower electrode layer 11 of the first electrochromic member and the extended portion of the lower electrode layer 21 of the second electrochromic member are adjacent to each other. Then, it was pasted and sealed. (4) Apply gold paste 6 to each end where there is a lead-out part of the adjacent electrode, make both lead-out parts conductive, and clip the glass substrate 3 and glass substrate 4 so that they are in contact with the gold paste layer. 7 was attached, and a pair of connection parts were made. (Figure 1 (a)) (5) Of the pair of connection parts, the connection part connected to the electrode layer in contact with the tungsten oxide film (electrolytic reduction coloring thin film layer) is connected to the cathode of an external DC power supply, When the connection part connected to the electrode layer in contact with the iridium oxide and tin oxide mixed film (electrolytic oxidation color forming thin film layer) is connected to the anode of an external DC power supply and a voltage of 1.3V is applied, the electrochromic element Colored blue. When a voltage of -1.3V was applied to this element, the blue color disappeared and the element returned to transparency. The transmittance when colored was 6%, and the transmittance when decolored was 60%. (1) An ITO film was formed on the glass substrate 3 as the lower electrode layer 11. On top of that, as electrochromic layer 1, a mixed film of iridium oxide and tin oxide (electrolytic oxidation coloring thin film layer), tantalum oxide film (ion conductive layer), and tungsten oxide film (electrolytic reduction coloring thin film layer) are formed in order. An ITO film was further formed thereon as an upper electrode layer 12 to produce a first electrochromic member. (Figure 5 (b-1)) (2) On the glass substrate 4, an ITO film is used as the lower electrode layer 21, a tungsten oxide film (electrolytic reduction color forming thin film layer), and a tantalum oxide film (ion conductive layer) as the electrochromic layer 2. A mixed film of iridium oxide and tin oxide (electrolytic oxidation color-forming thin film layer) was sequentially formed, and an ITO film was further formed as the upper electrode layer 22 to produce a second electrochromic member.

487 (FIG. 5(b-2)) (3) Using epoxy resin 5, attach the substrates of (1) and (2) above to the lead-out portion of the upper electrode layer 12 of the first electrochromic member as shown in FIG. 5(a). and the extension part of the lower electrode layer 21 of the second electrochromic member are close to each other, and the extension part of the lower electrode layer 11 of the first electrochromic member and the extension part of the upper electrode layer 22 of the second electrochromic member are close to each other. Then, it was pasted and sealed. (4) Apply gold paste 6 to each end where there is a lead-out part of the adjacent electrode, make both lead-out parts conductive, and clip the glass substrate 3 and glass substrate 4 so that they are in contact with the gold paste layer. 7 was attached, and a pair of connection parts were made. (Figure 5 (a)) (5) Of the pair of connection parts, the connection part connected to the electrode layer in contact with the tungsten oxide film (electrolytic reduction coloring thin film layer) is connected to the cathode of an external DC power supply, When the connection part connected to the electrode layer in contact with the iridium oxide and tin

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oxide mixed film (electrolytic oxidation color forming thin film layer) is connected to the anode of an external DC power supply and a voltage of 1.3V is applied, the electrochromic element Colored blue. When a voltage of -1.3V was applied to this element, the blue color disappeared and the element returned to transparency. The transmittance when colored was 6%, and the transmittance when decolored was 60%. (1) As shown in FIG. 2, an ITO film was formed on the glass substrate 3 as the lower electrode layer 11. A mixed film of iridium oxide and tin oxide, a tantalum oxide film, and a tungsten oxide film were sequentially formed thereon as an electrochromic layer 1, and an ITO film was further formed thereon as an upper electrode layer 12. Next, the device was sealed with a sealing glass substrate 8 and an epoxy resin 5 to produce a first electrochromic member. (2) A lower electrode layer 21 was formed on the glass substrate 4. A mixed film of iridium oxide and tin oxide, a tantalum oxide film, and a tungsten oxide film were sequentially formed thereon as an electrochromic layer 2, and an ITO film was further formed thereon as an upper electrode layer 22. Next, the device was sealed with a sealing glass substrate 9 and an epoxy resin 5 to produce a second electrochromic member. (3) As shown in FIG. 2, the first electrochromic member and the second electrochromic member are connected such that the lead-out portion of the upper electrode 12 of the first electrochromic member and the lead-out portion of the upper electrode 22 of the second electrochromic member are Then, they were bonded together using epoxy resin 5 so that the extended portion of the lower electrode 11 and the extended portion of the lower electrode 21 were brought close to each other.

520 (4) Apply gold paste 6 to each end where there is a lead-out part of the adjacent electrode, make both lead-out parts conductive, and sandwich the glass substrate 3 and sealing substrate 9 while making contact with the gold paste layer. Clip 7 was attached, and a pair of connection parts were made. (Figure 2) (5) Of the pair of connection parts, the connection part connected to the electrode layer in contact with the tungsten oxide film is connected to the cathode of an external DC power supply, and is in contact with the mixed film of iridium oxide and tin oxide. The other connection part connected to the electrode layer was connected to the anode of an external DC power source, and when a voltage of 1.3 V was applied, the electrochromic element was colored blue. When a voltage of -1.3V was applied to this element, the blue color disappeared and the element returned to transparency. The transmittance when colored was 6%, and the transmittance when decolored was 60%. (1) As shown in FIG. 3, a lower electrode layer 11 was formed on a glass substrate 3. A mixed film of iridium oxide and tin oxide, a tantalum oxide film, and a tungsten oxide film were formed thereon in this order as an electrochromic layer 1, and an ITO film was further formed as an upper electrode layer 12 on the tungsten oxide film. On the ITO film, a tungsten oxide film, a tantalum oxide film, and a mixed film of iridium oxide and tin oxide are formed in order as an electrochromic layer 2, and an ITO film is formed as a lower electrode layer 21 on the mixed film of iridium oxide and tin oxide. was formed. At this time, the pattern of the lower electrode layer 21 was determined so that the extended portion of the lower electrode layer 21 was close to the extended portion of the lower electrode layer 11. (2) The device was sealed with a sealing glass substrate 8 and an epoxy resin 5. (3) Apply gold paste 6 to each end where there is a lead-out part of the adjacent electrode, make both lead-out parts

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conductive, and sandwich the glass substrate 3 and sealing board 8 while making contact with the gold paste layer. Clip 7 was attached, and a pair of connection parts were made. (Figure 3) (4) Of the pair of connection parts, the connection part connected to the electrode layer in contact with the tungsten oxide film is connected to the cathode of an external DC power supply, and is in contact with the mixed film of iridium oxide and tin oxide. When the other connection part connected to the electrode layer was connected to the anode of an external direct power source and a voltage of 1.3 V was applied, both electrochromic layers 1 and 2 were colored blue. When a DC voltage of -1.3V was applied to this element, the blue color disappeared and the electrochromic element returned to transparency. The transmittance when colored was 6%, and the transmittance when decolored was 60%. (1) As shown in FIG. 6, a lower electrode layer 11 was formed on a glass substrate 3.

553 A mixed film of iridium oxide and tin oxide, a tantalum oxide film, and a tungsten oxide film are sequentially formed thereon as an electrochromic layer 1, and an ITO film is further formed as an upper electrode layer 12 on top of this, and a first electrochromic member is formed. was created. (2) A lower electrode layer 21 is formed on a glass substrate 4, and a mixed film of iridium oxide and tin oxide, a tantalum oxide film, and a tungsten oxide film are formed in this order as an electrochromic layer 2 on the lower electrode layer 21, and then an upper An ITO film was formed as the electrode layer 22. The layer-forming surface of the glass substrate 4 and the sealing glass substrate 9 were bonded to each other with epoxy resin 5, thereby producing a second electrochromic member. (3) The first electrochromic member and the second electrochromic member are connected as shown in FIG. Then, the surface on which each layer of the first electrochromic member was formed and the surface on which each layer was not formed on the glass substrate 4 were bonded together with epoxy resin 5, facing each other so that the drawn-out part of the lower electrode 11 and the drawn-out part of the lower electrode 21 were close to each other. . (4) Apply gold paste 6 to each end where there is a lead-out part of the adjacent electrode, make both lead-out parts conductive, and sandwich the glass substrate 3 and sealing substrate 9 while making contact with the gold paste layer. Clip 7 was attached, and a pair of connection parts were made. (Figure 6) (5) Of the pair of connection parts, the connection part connected to the electrode layer in contact with the tungsten oxide film is connected to the cathode of an external DC power supply, and is in contact with the mixed film of iridium oxide and tin oxide. When the other connection part connected to the electrode layer was connected to the anode of an external DC power source and a voltage of 1.3 V was applied, both electrochromic layers 1 and 2 were colored blue. When a DC voltage of -1.3V was applied to this element, the blue color disappeared and the electrochromic element returned to transparency. The transmittance when colored was 6%, and the transmittance when decolored was 60%.

[0032]

581 As described above, in Examples 1 to 5, gold paste was used as a relay electrode for electrical connection between the extraction part of each electrode and the clip, but instead of gold paste, a conductive thin film created by vacuum thin film forming technology was used.

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Needless to say, good results can be obtained.

585 (1) As shown in FIG. 4, an ITO film was formed on the glass substrate 3 as the lower electrode film 11. A mixed film of iridium oxide and tin oxide, a tantalum oxide film, and a tungsten oxide film were sequentially formed as an electrochromic layer on the ITO film, and an ITO film was further formed as an upper electrode layer 12 on the tungsten oxide film. (2) The substrate of (1) above was sealed with epoxy resin 5 and sealing glass substrate 8. (3) Apply gold paste to the end of the sealed element where the electrode extension part is present, make both the extension parts conductive, and sandwich the glass substrate 3 and the sealing substrate 8 while making contact with the gold paste layer. A clip was attached and a pair of connections were made. (Figure 4) (4) Of the pair of connection parts, the connection part connected to the electrode layer in contact with the tungsten oxide film is connected to the cathode of an external DC power supply, and is in contact with the mixed film of iridium oxide and tin oxide. The other connection part connected to the electrode layer was connected to the anode of an external DC power source, and when a voltage of 1.3 V was applied, the electrochromic element was colored blue. When a DC voltage of -1.3V was applied to this element, the blue color disappeared and the electrochromic element returned to transparency. The transmittance when colored was 25%, and the transmittance when decolored was 80%.

[0033]

605 Effects of the Invention As explained above, the electrochromic device of the present invention has an extremely large transmittance change ratio, that is, a switching ratio. It can be applied to various fields, expanding the scope of application.

[0034]

611 Furthermore, the electrochromic element of the present invention can perform coloring and decoloring by simply providing exactly the same number of connections as the conventional electrochromic element, so the element structure is simple, has a long life, and High cost performance.

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(19)日本国特許庁（ＪＰ）　(12) **公開特許公報（Ａ）**　(11)特許出願公開番号

特開平11－316395

(43)公開日　平成11年(1999)11月16日

(51)Int.Cl.[6]	識別記号	ＦＩ	
Ｇ０２Ｆ　1/155		Ｃ０２Ｆ　1/155	
Ｇ０９Ｆ　9/30	３８８	Ｃ０９Ｆ　9/30	３８８

審査請求　未請求　請求項の数７　ＯＬ　（全 10 頁）

(21)出願番号　特願平10－195525

(22)出願日　平成10年(1998)７月10日

(31)優先権主張番号　特願平10－53435

(32)優先日　平10(1998)３月５日

(33)優先権主張国　日本（ＪＰ）

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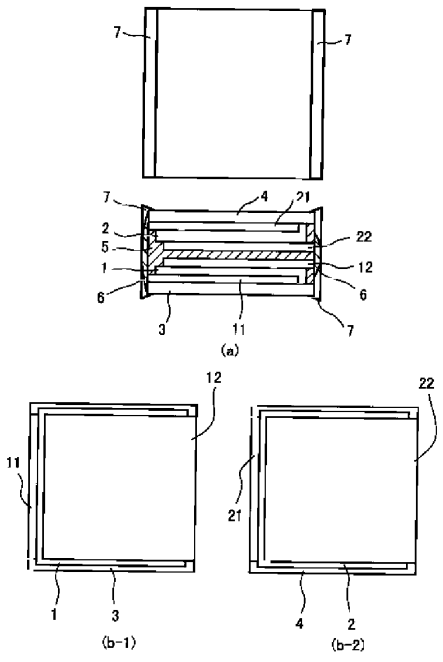
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(54)【発明の名称】　エレクトロクロミック素子

(57)【要約】

【課題】　従来のエレクトロクロミック素子は着色時に対する消色時の光透過率の比、即ちスイッチング比が、高々数倍であるため、光量制御、光スイッチ、ディスプレイ、等の分野に於ける高度な要求仕様に対しては必ずしも対応できないことがあった。

【解決手段】素子を複数のエレクトロクロミック層と、各エレクトロクロミック層に対する狭持する一対の電極層と、各電極層の引き出し部の複数を共通に接続する接続部の一対とを設ける構造とし、これら接続部間に直流電圧を印加することによって高いスイッチング比を得られるようになった。



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【特許請求の範囲】
【請求項１】エレクトロクロミック素子において、第一基板と第一基板上に順番に積層状に配置された第一下部電極層と第一エレクトロクロミック層と第一上部電極層とを有する第一エレクトロクロミック部材と、第二基板と第二基板上に順番に積層状に配置された第二下部電極層と第二エレクトロクロミック層と第二上部電極層とを有する第二エレクトロクロミック部材と、前記エレクトロクロミック素子の端部に第一接続部と第二接続部とを具え、第一エレクトロクロミック部材と第二エレクトロクロミック部材とが前記第一上部電極層面と前記第二上部電極層面とを対向して封止樹脂を介して接合され、前記第一接続部は前記第一下部電極層と前記第二下部電極層との双方と、そして前記第二接続部は前記第一上部電極層と前記第二上部電極層との双方と電気的接続がなされていることを特徴とするエレクトロクロミック素子。
【請求項２】エレクトロクロミック素子において、基板と前記基板上に積層状に配置されたエレクトロクロミック層とこれを狭持する一対の電極層と封止樹脂を介して接合された封止基板とを有するエレクトロクロミック部材の複数個と、前記エレクトロクロミック素子の端部に前記電極層との電気的接続がなされた複数の接続部とを具え、前記複数個のエレクトロクロミック部材が前記基板面または前記封止基板面を、前記基板面または前記封止基板面と対向して接着剤を介して全て接合一体化され、前記接続部が二つ以上の前記電極層と電気的に接続されていることを特徴とするエレクトロクロミック素子。
【請求項３】エレクトロクロミック素子において、基板と前記基板上に積層状に配置されたエレクトロクロミック層とこれを狭持する一対の電極層とを有するエレクトロクロミック部材の複数個と、一枚の封止基板と、前記エレクトロクロミック素子の端部に前記電極層との電気的接続がなされた複数の接続部とを具え、前記複数個のエレクトロクロミック部材と前記封止基板とが前記基板の各層形成面と各層非形成面とを並びに前記基板の各層形成面と前記封止基板面とを対向して封止樹脂を介して全て接合一体化され、少なくとも一つの前記接続部が二つ以上の前記電極層と電気的に接続されていることを特徴とするエレクトロクロミック素子。
【請求項４】エレクトロクロミック素子において、基板と、前記基板上に積層状に配置された２種類以上且つ合計２層以上のエレクトロクロミック層と前記エレクトロクロミック層よりも１層多い層数の電極層とを有する薄膜部と、前記エレクトロクロミック素子の端部に前記電極層との電気的接続がなされた複数の接続部とを具え、各々の前記エレクトロクロミック層は前記電極層の二つに狭持され、前記薄膜部の基板面に最も近い層と最も遠い層とが各々電極層からなり、少なくとも一つの前記接続部が二つ以上の前記電極層と電気的に接続されていることを特徴とするエレクトロクロミック素子。
【請求項５】前記接続部の個数が二つであり、二つの前記接続部間に一定の直流電圧を印加すると全てのエレクトロクロミック層が着色し、一定の逆極性の直流電圧を印加すると全てのエレクトロクロミック層が消色することを特徴とする請求項２、３、４何れか１項記載のエレクトロクロミック素子。
【請求項６】エレクトロクロミック素子において、第一基板と第一基板上に順番に積層状に配置された第一下部電極層と第一エレクトロクロミック層と第一上部電極層とを有する第一エレクトロクロミック部材と、第二基板と第二基板上に順番に積層状に配置された第二下部電極層と第二エレクトロクロミック層と第二上部電極層と封止樹脂を介して接合された封止基板とを有する第二エレクトロクロミック部材と、前記エレクトロクロミック素子の端部に第一接続部と第二接続部とを具え、第一エレクトロクロミック部材と第二エレクトロクロミック部材とが前記第一基板の各層形成面と前記第二基板の各層非形成面とを対向し封止樹脂を介して接合され、前記第一接続部が計四層の前記電極層のうち二層の電極層と電気的に接続され、前記第二接続部が残りの二層の電極層と電気的に接続され、前記第一接続部と前記第二接続部との間に一定の直流電圧を印加すると第一エレクトロクロミック層と第二エレクトロクロミック層との両方が着色し、一定の逆極性の直流電圧を印加すると第一エレクトロクロミック層と第二エレクトロクロミック層との両方が消色することを特徴とするエレクトロクロミック素子。
【請求項７】前記接続部と前記第一接続部と前記第二接続部とが導電性薄膜または導電性ペーストと、導電性クリップとを有することを特徴とする請求項１、２、３、４、５、６何れか１項記載のエレクトロクロミック素子。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、光量制御や表示や光スイッチに使用されるエレクトロクロミック素子に関する。
【０００２】
【従来の技術】電圧を物質に印加すると可逆的に電解酸化または電解還元反応が起こり、可逆的に着色または消色する現象をエレクトロクロミズムという。この現象を示すエレクトロクロミック物質を用いて、電圧操作により着消色するエレクトロクロミック素子を作り、このエレクトロクロミック素子を光量制御素子（例えば、調光ガラスや防眩ミラーなど）や７セグメントを利用した数字表示素子に利用する試みは、２０年以上前から行われている。
【０００３】エレクトロクロミック素子は、エレクトロクロミック素子を構成する各層の材料形態によって、溶

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液型、ゲル型、全固体型等に大別する事ができ、その中でも全固体型エレクトロクロミック素子は、各層が全て薄膜状に積層して形成されている。そのため、全固体型エレクトロクロミック素子は大型化が容易であるばかりでなく、溶液型やゲル型のエレクトロクロミック素子を作製するときのような、各層を別々の基板に形成して両基板を貼り合わせる工程や液状あるいはゲル状の材料の密封工程が不要であるため生産性に優れる。

【０００４】例えば、ガラス基板の上に、透明電極層（陰極）、三酸化タングステン薄膜層（エレクトロクロミック層）、二酸化ケイ素薄膜層（絶縁層）、及び電極層（陽極）を順次積層してなる全固体型エレクトロクロミック素子が特公昭５２－４６０９８に記載されている。このエレクトロクロミック素子に電圧（着色電圧）を印加すると、三酸化タングステン（WO_3）薄膜層が青色に着色する。その後、このエレクトロクロミック素子に極性が逆の電圧（消色電圧）を印加すると、三酸化タングステン薄膜層の青色が消えて、無色に戻る。この着消色する機構は詳しく解明されてはいないが、三酸化タングステン薄膜層及び絶縁層（イオン導電層）中に含まれる少量の水分が三酸化タングステン薄膜層の着消色を支配していると理解されている。

【０００５】着色の反応式は、以下のように推定されている。

$$H_2O \rightarrow H^+ + OH^-$$

（WO_3層＝陰極側）$WO_3 + nH^+ + ne^- \rightarrow HnWO_3$

無色透明　　青着色

（絶縁層＝陽極側）　$OH^- \rightarrow (1/2)H_2O + (1/4)O_2 \uparrow + e^-$

従って、このような表示素子は、（１）着色反応の際、酸素ガス発生という副反応を起こし、この酸素ガスが膜の内部から離脱するので、この副反応により含有水分が消費されるという性質、及び（２）逆の消色反応によって、材料となる酸素が膜の内部に存在しないため、水が生成されないという性質を有する。そのため、着色消色のためには膜の内部の水を消費し、着色消色の繰り返しには大気中からの水の補給が必要という欠点がある。特に後者（２）の理由により、このタイプの素子には、着色の再現性が大気中の水分の影響を受ける欠点がある。

【０００６】以上の欠点を解決するため、着色反応により消費される水の量と同じ量の水が消色反応により生成され、従って外界からの水の補給を必要とせずに着色消色を繰り返す事ができ、しかも繰り返される着色濃度が外界の影響を受けない全固体型エレクトロクロミック素子が特開昭５２－７３７４９に記載されている。この素子は、基本的には電極としての透明電極層と、エレクトロクロミック層としての三酸化タングステン薄膜層のような電解還元発色性薄膜層及び酸化クロム（Cr_2O_3）膜のような電解酸化発色性薄膜層と、対向電極とを順次積層してなるものである。

【０００７】また、前記特開昭５２－７３７４９公報には、この素子の電極と対向電極とに直流電源を接続し直流電圧を印加して素子を着色した後、直流電源との接続を切った場合、着色が自然放電により徐々に消色する現象が見られるが、透明電極ともう一方の電極との間の任意の位置に絶縁層例えば二酸化ケイ素、フッ化マグネシウムなどの薄膜を設ける事により、電圧解除後も着色が保存される性質（これをメモリー性という）がこの素子に付与される事が記載されている。特公昭６２－５２８４５には、この絶縁層が、電子の良導体ではないが、プロトン、及びヒドロキシイオンの移動は自由にできる物質、つまりイオン導電物質の層であろうとの推察が記載されている。さらに、特公昭６２－５２８４５には、絶縁層即ちイオン導電層は電解還元発色性薄膜層と電解酸化発色性薄膜層との間に配置する事が最も望ましい事、並びに電解還元発色性薄膜層と電解酸化発色性薄膜層とは、両者とも発色性である必要がなく、いずれか一方が外部より変化が識別できるような変色をすれば足りる事が記載されている。

【０００８】エレクトロクロミック素子のエレクトロクロミック層を直接または間接的に挟む一対の電極は、着消色したエレクトロクロミック層に光を入射し、さらには出射した光を素子の外部に取り出すため、少なくとも一方の電極は透明でなければならない。特に、透過型エレクトロクロミック素子の場合は両電極とも透明でなければならない。

【０００９】透明な電極層材料としては、現在のところSnO_2、In_2O_3、ITO（In_2O_3とSnO_2の混合物）、ZnO等が知られているが、これらの材料は光吸収率が比較的高いため、必要な透過率を得るために膜厚を薄くせねばならず、エレクトロクロミック素子は基板（例えば、ガラス板やプラスチック板）の上に薄膜として形成されるのが普通である。

【００１０】一対の電極には、外部電源から電圧を印加するために、外部配線との接続部である取り出し電極を設ける。電極として透明電極層を使用した場合は、透明電極層が外部配線に対して高抵抗であるので、透明電極層に重ねて（即ち、接触させて）低抵抗のとりだし電極を設ける事が多い。通常は、基板表面端部に位置する透明電極層の周辺に帯状に低抵抗電極部を設けて（例えば、金属性クリップを装着したり、低抵抗金属材料をメッキしたり、真空薄膜形成技術により成膜したりする）、低抵抗の取り出し電極としている。

【００１１】また、エレクトロクロミック素子は用途によって、素子を保護するための封止基板を素子基板と対向するように配置し、例えばエポキシ樹脂、アクリル樹脂、ウレタン樹脂、等を用いて密封封止して用いられ

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る。

【００１２】

【発明が解決しようとしている課題】前述の様に、全固体型エレクトロクロミック素子は着消色特性に優れ、大型化も可能であるなどの特徴を持つ。しかしながら、着色時に対する消色時の光透過率の比、即ちスイッチング比は、通常の利用に対しては満足できるレベルにあるが、利用範囲をさらに拡大するためには従来のスイッチング比は充分でないという問題があった。

【００１３】従来よりスイッチング比を向上させるために、駆動電圧を上げて着色濃度を濃くする方法が知られているが、限界電圧を超えて駆動電圧を上げると、素子が膜剥離を起こして破壊するのみならず、膜剥離・破壊に到らなくも駆動電圧を過度に上げることは素子寿命の短縮に繋がる。また、スイッチング比を向上させるために、エレクトロクロミック層の膜厚を厚くして着色濃度を濃くする方法も知られているが、ある一定膜厚までは確かに着色濃度が濃くなるが、それ以上の膜厚では着色濃度が飽和してしまう。

【００１４】本発明はこのような従来の問題点に鑑みてなされたものであり、着色時に対する消色時の光透過率の比、即ちスイッチング比が大きく、長寿命のエレクトロクロミック素子の提供を目的とする。

【００１５】

【課題を解決するための手段】上記課題を解決するため本発明は第一に、「エレクトロクロミック素子において、第一基板と第一基板上に順番に積層状に配置された第一下部電極層と第一エレクトロクロミック層と第一上部電極層とを有する第一エレクトロクロミック部材と、第二基板と第二基板上に順番に積層状に配置された第二下部電極層と第二エレクトロクロミック層と第二上部電極層とを有する第二エレクトロクロミック部材と、前記エレクトロクロミック素子の端部に第一接続部と第二接続部とを具え、第一エレクトロクロミック部材と第二エレクトロクロミック部材とが前記第一上部電極層面と前記第二上部電極層面とを対向して封止樹脂を介して接合され、前記第一接続部は前記第一下部電極層と前記第二下部電極層との双方と、そして前記第二接続部は前記第一上部電極層と前記第二上部電極層との双方と電気的接続がなされていることを特徴とするエレクトロクロミック素子（請求項１）」を提供する。

【００１６】第二に、「エレクトロクロミック素子において、基板と前記基板上に積層状に配置されたエレクトロクロミック層とこれを狭持する一対の電極層と封止樹脂を介して接合された封止基板とを有するエレクトロクロミック部材の複数個と、前記エレクトロクロミック素子の端部に前記電極層との電気的接続がなされた複数の接続部とを具え、前記複数個のエレクトロクロミック部材が前記基板面または前記封止基板面を、前記基板面または前記封止基板面と対向して接着剤を介して全て接合一体化され、前記接続部が二つ以上の前記電極層と電気的に接続されていることを特徴とするエレクトロクロミック素子（請求項２）」を提供する。

【００１７】第三に、「エレクトロクロミック素子において、基板と前記基板上に積層状に配置されたエレクトロクロミック層とこれを狭持する一対の電極層とを有するエレクトロクロミック部材の複数個と、一枚の封止基板と、前記エレクトロクロミック素子の端部に前記電極層との電気的接続がなされた複数の接続部とを具え、前記複数個のエレクトロクロミック部材と前記封止基板とが前記基板の各層形成面と各層非形成面とを並びに前記基板の各層形成面と前記封止基板面とを対向して封止樹脂を介して全て接合一体化され、少なくとも一つの前記接続部が二つ以上の前記電極層と電気的に接続されていることを特徴とするエレクトロクロミック素子（請求項３）」を提供する。

【００１８】第四に、「エレクトロクロミック素子において、基板と、前記基板上に積層状に配置された２種類以上且つ合計２層以上のエレクトロクロミック層と前記エレクトロクロミック層よりも１層多い層数の電極層とを有する薄膜部と、前記エレクトロクロミック素子の端部に前記電極層との電気的接続がなされた複数の接続部とを具え、各々の前記エレクトロクロミック層は前記電極層の二つに狭持され、前記薄膜部の基板面に最も近い層と最も遠い層とが各々電極層からなり、少なくとも一つの前記接続部が二つ以上の前記電極層と電気的に接続されていることを特徴とするエレクトロクロミック素子（請求項４）」を提供する。

【００１９】第五に、「前記接続部の個数が二つであり、二つの前記接続部間に一定の直流電圧を印加すると全てのエレクトロクロミック層が着色し、一定の逆極性の直流電圧を印加すると全てのエレクトロクロミック層が消色することを特徴とする請求項２、３、４何れか１項記載のエレクトロクロミック素子（請求項５）」を提供する。

【００２０】第六に、「エレクトロクロミック素子において、第一基板と第一基板上に順番に積層状に配置された第一下部電極層と第一エレクトロクロミック層と第一上部電極層とを有する第一エレクトロクロミック部材と、第二基板と第二基板上に順番に積層状に配置された第二下部電極層と第二エレクトロクロミック層と第二上部電極層と封止樹脂を介して接合された封止基板とを有する第二エレクトロクロミック部材と、前記エレクトロクロミック素子の端部に第一接続部と第二接続部とを具え、第一エレクトロクロミック部材と第二エレクトロクロミック部材とが前記第一基板の各層形成面と前記第二基板の各層非形成面とを対向し封止樹脂を介して接合され、前記第一接続部が計四層の前記電極層のうち二層の電極層と電気的に接続され、前記第二接続部が残りの二層の電極層と電気的に接続され、前記第一接続部と前記

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第二接続部との間に一定の直流電圧を印加すると第一エレクトロクロミック層と第二エレクトロクロミック層との両方が着色し、一定の逆極性の直流電圧を印加すると第一エレクトロクロミック層と第二エレクトロクロミック層との両方が消色することを特徴とするエレクトロクロミック素子（請求項６）を提供する。

【００２１】第七に、「前記接続部と前記第一接続部と前記第二接続部とが導電性薄膜または導電性ペーストと、導電性クリップとを有することを特徴とする請求項１、２、３、４、５、６何れか１項記載のエレクトロクロミック素子（請求項７）」を提供する。

【００２２】

【発明の実施の形態】本発明においては、１つのエレクトロクロミック素子内にエレクトロクロミック層を２組以上有し、にもかかわらず、電極の接続部の数が、エレクトロクロミック層を１組有している素子の時と変わらないことが特徴である。以下の説明で共通して用いるエレクトロクロミック層は多層薄膜層から構成され、積層順から見て二つのタイプがある。第一は電解酸化発色性薄膜層、イオン導電層、電解還元発色性薄膜層が順番に積層されるタイプ、第二は電解還元発色性層、イオン導電層、電解酸化発色性薄膜層が順番に積層されるタイプである。

【００２３】以下、図を用いて本発明のエレクトロクロミック素子の実施の形態を説明するが、本発明はこれらの図に限定されるものではない。本発明の第一の実施の形態の例として、２組のエレクトロクロミック層を有しているエレクトロクロミック素子について説明する。２組のエレクトロクロミック層はそれぞれ、一対の電極層に狭持されている。ガラス基板に近い方の電極層を、下部電極とし、もう一方の電極を上部電極とする。図１において、各エレクトロクロミック層を各々１、２とする。それぞれの下部電極層を１１、２１、上部電極層を１２、２２とする。エレクトロクロミック層を構成する層のうち、下部電極層と接している層を電解酸化発色性薄膜層、上部電極に近い方を電解還元発色性薄膜層になるよう形成しておく。もちろん、逆に、下部電極層と接している層を電解還元発色性薄膜層、上部電極に近い方を電解酸化発色性薄膜層になるよう形成しておいてもよい。エレクトロクロミック層１の下部電極層１１と、エレクトロクロミック層２の下部電極層２１は、電極の取り出し口である接続部が共通であり、また、エレクトロクロミック層１の上部電極層１２と、エレクトロクロミック層２の上部電極層２２は、電極の接続部が共通である。共通の下部電極層の接続部と共通の上部電極層の接続部に電圧を印加することにより、エレクトロクロミック層１も、エレクトロクロミック層２も同時に着消色する。よって、エレクトロクロミック層を１組しか有していないエレクトロクロミック素子よりも着消色時に於ける透過光量比即ちスイッチング比が大きいエレクトロクロミック素子が得られる。さらに本エレクトロクロミック素子は二つのエレクトロクロミック層の電極層の接続部が共通のため、エレクトロクロミック層が１組しかない素子の場合と接続部の数は変わらない。

【００２４】本発明のエレクトロクロミック素子の製造方法には、例えば、以下の方法を取ることができる。ガラス基板３の片面に下部電極層１１を形成する。その上にエレクトロクロミック層１を形成し、さらに上部電極層１２を形成する。さらに別のガラス基板４上の片面にも上記と同様に、下部電極層２１、エレクトロクロミック層２、上部電極層２２を形成する。ここで、２枚の基板を貼り合わせる際に、２枚の基板の下部電極層１１及び２１の引き出し部が近接するように、また、２枚の基板の上部電極層１２および２２の引き出し部が近接するように、２枚の素子基板の下部電極層と上部電極層とを形成しておく。この様に形成しておき、２組のエレクトロクロミック層の二つの上部電極引き出し部を電気的に一方の接続部に接続し、二つの下部電極の引き出し部を電気的に他の接続部に接続する。（請求項１対応）

さらに、エレクトロクロミック素子を２組作製し、その後二つのエレクトロクロミック素子を貼り合わせて一体化してもよい。この場合も、各エレクトロクロミック素子に対する上部電極層と下部電極層は、貼り合わせたときに電極の引き出し部が共通の接続部に電気的に接続されるようにする。（請求項２対応）

また、前段の二組のエレクトロクロミック素子の一つが封止基板で封止されていず、封止されていないエレクトロクロミック素子の各層形成面と、封止されたエレクトロクロミック素子の基板とを貼り合わせて一体化しても良い。この場合も、各エレクトロクロミック素子に対する上部電極層と下部電極層は、貼り合わせたときに電極の引き出し部が共通の接続部に電気的に接続されるようにする。（請求項３対応）

また、図５に示すように、エレクトロクロミック層１を構成する層のうち下部電極層に接する層を電解酸化発色性薄膜層、エレクトロクロミック層２を構成する層のうち上部電極に接する層を電解酸化発色性薄膜層としてもよい。この場合は、下部電極層１１の引き出し部と上部電極層２２の引き出し部とを電気的に接続する第一接続部、上部電極層１２の引き出し部と下部電極層２１の引き出し部とを電気的に接続する第二接続部を形成しておく。この場合も第一接続部と第二接続部との間に電圧を印加することにより、エレクトロクロミック層１と、エレクトロクロミック層２は同時に着消色する。（請求項１対応）

また、エレクトロクロミック素子を２組作製し、その後両素子を貼り合わせて一体化する形態をとることができる。この場合も、各エレクトロクロミック素子に対する上部電極層と下部電極層は、貼り合わせたときに電極の引き出し部が共通の接続部に電気的に接続されるように

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する。（請求項２対応）
また、前段の二組のエレクトロクロミック素子の一つが封止基板で封止されず、封止されていないエレクトロクロミック素子の各層形成面と、封止されたエレクトロクロミック素子の基板とを貼り合わせて一体化しても良い。この場合も、各エレクトロクロミック素子に対する上部電極層と下部電極層は、貼り合わせたときに電極の引き出し部が共通の接続部に電気的に接続されるようにする。（請求項３対応）
本発明の第二の実施形態のエレクトロクロミック素子について、上記と同様２組のエレクトロクロミック層を有しているエレクトロクロミック素子を例にとって説明する。図３に於いて２組のエレクトロクロミック層１及び２はそれぞれ一対の電極層に狭持されているが、電極層１２は電極層全体が２組のエレクトロクロミック層に共有され接続部に電気的に接続されている。また、電極層全体が共有されていない電極層１１及び２１は電気的接続がされた接続部が共有されている。この場合、共有されている電極層に隣接するそれぞれのエレクトロクロミック層の構成層を、両方共電解還元発色性薄膜層か両方共電解酸化発色性薄膜層かに統一する。このような構成にすれば、電極層全体が共有されている電極層１２の接続部と、電極１１及び２１の接続部に直流電圧を印加することによりエレクトロクロミック層１と、エレクトロクロミック層２は同時に着色し、且つ同時に消色する。よって、エレクトロクロミック層が１組しか有しないエレクトロクロミック素子よりも着消色の変化幅が大きいエレクトロクロミック素子が得られる。さらに、エレクトロクロミック層１及び２の電極層あるいは電極層の接続部が共通のため、エレクトロクロミック層が１組しかない素子の場合と接続部の数は変わらない。（請求項４対応）
上記のエレクトロクロミック素子の製造方法には、たとえば、以下の方法が挙げられる。素子基板３の片面に下部電極層１１を形成する。そのうえにエレクトロクロミック層１を形成し、さらに上部電極層１２を形成する。このとき、このエレクトロクロミック層１を、電解還元発色性薄膜層が上部電極層に接するタイプとする。上部電極層１２の上に、さらにエレクトロクロミック層２を形成する。このとき、このエレクトロクロミック層２を、電解還元発色性薄膜層が上部電極層に接するタイプとする。更に、その上に、下部電極層２１を形成する。このとき、下部電極層１１と下部電極層２１に対して共通な接続部を設け、さらに上部電極層１２に対する接続部を設ける。この様に形成しておくことにより、これらの接続部に一定の直流電圧を印加することによって２組のエレクトロクロミック層を同時に着消色させることができる。
【００２５】以下、エレクトロクロミック素子で用いられる材料について説明する。電極及び対極電極の材料としては、例えば、SnO_2、In_2O_3、ITO（In_2O_3とSnO$_2$との混合物）、ZnO などの透明電極材料が好ましく使用される。使用条件によっては金属材料または炭素が使用される。金属材料としては、金、銀、アルミニウム、クロム、スズ、亜鉛、ニッケル、ルテニウム、ロジウム、ステンレス等が好ましく使用されるが、これらに限定されるものではない。金属電極層は、上記のごとき透明電極材料から形成した電極層よりも遙に低抵抗であるという長所がある。この様な電極層は、一般には、真空蒸着、イオンプレーテイング、スパッタリング、等の真空薄膜形成技術で形成される。
【００２６】電解還元発色性薄膜層には、WO_3、MoO_3またはこれらの混合物、等が好ましく使用されるが、これらに限定されるものでない。イオン導電層には、酸化ケイ素、酸化タンタル、酸化チタン、酸化アルミニウム、酸化ニオブ、酸化ジルコニウム、酸化ハフニウム、酸化ランタン、フッ化マグネシウム、等が好ましく使用されるが、これらに限定されるものでない。
【００２７】イオン導電層は、電子に対して絶縁体であるが、プロトン（H^+）及びヒドロキシイオン（OH^-）に対しては良導体となる。エレクトロクロミック層の着消色反応にはカチオンが必要とされ、H^+やLi$^+$をエレクトロクロミック層その他に含有させる必要がある。H^+は初めからイオンである必要はなく、電圧が印加されたときにH^+が生じればよく、したがってH^+の代わりに水を含有させてもよい。この水は非常に少なくて十分であり、しばしば大気中から自然に侵入する水分でも着消色する。
【００２８】電解酸化発色性薄膜層としては、酸化イリジウム、水酸化イリジウム、酸化ニッケル、水酸化ニッケル、酸化クロム、水酸化クロム、酸化バナジウム、水酸化バナジウム、酸化ルテニウム、水酸化ルテニウム、酸化ロジウム、水酸化ロジウム、等が好ましく使用されるが、これらに限定されるものではない。その他のエレクトロクロミック物質として、例えば、酸化チタン、酸化コバルト、酸化鉄、酸化ケイ素、酸化鉛、酸化銅、硫化鉄、酸化ビスマス、硫化ニオブ、等の金属酸化物や金属硫化物のほか、ハイドロキノン誘導体、ベルリン酸鉄誘導体、金属フタロシアニン誘導体（Co、Fe、Zn、Ni、Cuの各フタロシアニン誘導体）、プルシアンブルー、プルシアンブルー類似化合物、窒化インジウム、窒化スズ、窒化塩化ジルコニウム、ビオロゲン系有機エレクトロクロミック材料、スチリル系有機エレクトロクロミック材料、ポリアニリン、等がエレクトロクロミック層に使用できる。
【００２９】イオン導電層のその他の例としては、イオン導電性及び接着性を有する層が使用可能であり、例えば、（Ａ）ポリ（２－アクリルアミド－２－メチルプロパンスルホン酸）、ポリ（スチレン－スルホン酸）、ポリ（エチレン－スルホン酸）、ポリビニルスルホン酸、

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フッ素化共重合体等からなる重合体、（Ｂ）第一の単量体（例えば、ビニルスルホン酸、ビニルスルホン酸ナトリウム、ふっ化ビニルスルホニル）と第二の単量体（例えば、ビニルピロリジノン、ブチルビニルエーテル、エチルビニルエーテル、イソプロピルビニルエーテル、シクロヘキシルビニルエーテル、イソブチレン）との共重合体、（Ｃ）前記第一の単量体及び第二の単量体とスチレンスルホン酸ナトリウムとの共重合体、（Ｄ）親水性アクリレート単量体（例えば、ポリ（エチレンオキシド）ジメタクリレート、エトキシトリエチレン、グリコールメタクリレート、エチレンオキシド－ジメチルシクロヘキサンアクリレート、ヒドロキシプロピルアクリレート、エチルアクリレート）とスルホン酸単量体（例えば、２－アクリルアミド－２－メチルプロパンスルホン酸、スチレン－スルホン酸、エチレン－スルホン酸、ビニルスルホン酸）との共重合体、等からなる層がある。

【００３０】エレクトロクロミック素子は剥き出しのままでは劣化しやすいので、２枚の基板間に封止して使用される。例えば、１枚の基板上にエレクトロクロミック素子を形成した場合、露出したエレクトロクロミック素子を封止樹脂及び封止基板により封止する。前記封止剤には、例えば、エポキシ樹脂、ウレタン系樹脂、アクリル系樹脂、酢酸ビニール系樹脂、変性ポリマー系等の透明材料が好ましく使用されるが、これらに限定されるものではない．以下、実施例により更に詳細に説明するが、本発明はこれらの例に限定されるものではない。

【００３１】

【実施例】［実施例１］

（１）ガラス基板３に電極１１としてITO 膜を形成した。その上にエレクトロクロミック層１として酸化イリジウムと酸化スズの混合膜（電解酸化発色性薄膜層）、酸化タンタル膜（イオン導電層）、酸化タングステン膜（電解還元発色性薄膜層）を順番に形成し、その上にさらに上部電極層１２としてITO 膜を形成し、第一エレクトロクロミック部材を作製した。（図１（ｂ－１））

（２）ガラス基板４に（１）と同様に下部電極層２１としてITO 膜、エレクトロクロミック層２として酸化イリジウムと酸化スズの混合膜、酸化タンタル膜、酸化タングステン膜を形成し、さらに上部電極層２２としてITO 膜を形成し、第二エレクトロクロミック部材を作製した。（図１（ｂ－２））

（３）エポキシ樹脂５にて上記（１）及び（２）の基板を図１（ａ）のように、第一エレクトロクロミック部材の上部電極層１２の引き出し部と第二エレクトロクロミック部材の上部電極層２２の引き出し部が近接すると共に、第一エレクトロクロミック部材の下部電極層１１の引き出し部と第二エレクトロクロミック部材の下部電極層２１の引き出し部が近接するように、貼り合わせて封止した。

（４）近接した電極の引き出し部が存在する各端部に金ペースト６を塗布し、両引き出し部を導通させると共に、金ペースト層に接触させつつガラス基板３とガラス基板４を挟むようにクリップ７を装着し、接続部を一対作製した。（図１（ａ））

（５）一対の接続部のうち、酸化タングステン膜（電解還元発色性薄膜層）に接している電極層に接続された接続部を外部直流電源の陰極に接続し、酸化イリジウムと酸化スズの混合膜（電解酸化発色性薄膜層）に接してる電極層に接続された接続部を外部直流電源の陽極に接続し、１．３Ｖの電圧を印加すると、エレクトロクロミック素子は青色に着色した。この素子に－１．３Ｖの電圧を印加すると青色は消え、素子は透明に戻った。着色時の透過率は6 %、消色時の透過率は60%であった。

［実施例２］

（１）ガラス基板３に下部電極層１１としてITO 膜を形成した。その上にエレクトロクロミック層１として酸化イリジウムと酸化スズの混合膜（電解酸化発色性薄膜層）、酸化タンタル膜（イオン導電層）、酸化タングステン膜（電解還元発色性薄膜層）を順番に形成し、その上にさらに上部電極層１２としてITO 膜を形成し、第一エレクトロクロミック部材を作製した。（図５（ｂ－１））

（２）ガラス基板４に下部電極層２１としてITO 膜、エレクトロクロミック層２として、酸化タングステン膜（電解還元発色性薄膜層）、酸化タンタル膜（イオン導電層）、酸化イリジウムと酸化スズの混合膜（電解酸化発色性薄膜層）を順番に形成し、さらに上部電極層２２としてITO 膜を形成し、第二エレクトロクロミック部材を作製した。（図５（ｂ－２））

（３）エポキシ樹脂５にて上記（１）及び（２）の基板を図５（ａ）のように、第一エレクトロクロミック部材の上部電極層１２の引き出し部と第二エレクトロクロミック部材の下部電極層２１の引き出し部が近接すると共に、第一エレクトロクロミック部材の下部電極層１１の引き出し部と第二エレクトロクロミック部材の上部電極層２２の引き出し部が近接するように、貼り合わせて封止した。

（４）近接した電極の引き出し部が存在する各端部に金ペースト６を塗布し、両引き出し部を導通させると共に、金ペースト層に接触させつつガラス基板３とガラス基板４を挟むようにクリップ７を装着し、接続部を一対作製した。（図５（ａ））

（５）一対の接続部のうち、酸化タングステン膜（電解還元発色性薄膜層）に接している電極層に接続された接続部を外部直流電源の陰極に接続し、酸化イリジウムと酸化スズの混合膜（電解酸化発色性薄膜層）に接してる電極層に接続された接続部を外部直流電源の陽極に接続し、１．３Ｖの電圧を印加すると、エレクトロクロミック素子は青色に着色した。この素子に－１．３Ｖの電圧を印加すると青色は消え、素子は透明に戻った。着色時

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の透過率は6 ％、消色時の透過率は60％であった。
［実施例３］
（１）図２に示すように、ガラス基板３に下部電極層１１としてITO 膜を形成した。その上にエレクトロクロミック層１として酸化イリジウムと酸化スズの混合膜、酸化タンタル膜、酸化タングステン膜を順番に形成し、その上にさらに上部電極層１２としてITO 膜を形成した。次に、封止ガラス基板８とエポキシ樹脂５にて素子を封止し、第一エレクトロクロミック部材を作製した。
（２）ガラス基板４に下部電極層２１を形成した。その上にエレクトロクロミック層２として酸化イリジウムと酸化スズの混合膜、酸化タンタル膜、酸化タングステン膜を順番に形成し、その上にさらに上部電極層２２としてITO 膜を形成した。次に、封止ガラス基板９とエポキシ樹脂５にて素子を封止し、第二エレクトロクロミック部材を作製した。
（３）第一エレクトロクロミック部材と第二エレクトロクロミック部材とを図２で示すように、第一エレクトロクロミック部材の上部電極１２の引き出し部と第二エレクトロクロミック部材の上部電極２２の引き出し部とが、そして下部電極１１の引き出し部と下部電極２１の引き出し部とが近接するようエポキシ樹脂５で貼り合わせた。
（４）近接した電極の引き出し部が存在する各端部に金ペースト６を塗布し、両引き出し部を導通させると共に、金ペースト層に接触させつつガラス基板３と封止基板９を挟むようにクリップ７を装着し、接続部を一対作製した。（図２）
（５）一対の接続部のうち、酸化タングステン膜に接している電極層に接続された接続部を外部直流電源の陰極に接続し、酸化イリジウムと酸化スズの混合膜に接してる電極層に接続されているもう一方の接続部を外部直流電源の陽極に接続し、１．３Ｖの電圧を印加すると、エレクトロクロミック素子は青色に着色した。この素子に－１．３Ｖの電圧を印加すると青色は消え、素子は透明に戻った。着色時の透過率は6 ％、消色時の透過率は60％であった。
［実施例４］
（１）図３に示すように、ガラス基板３に下部電極層１１を形成した。その上にエレクトロクロミック層１として酸化イリジウムと酸化スズの混合膜、酸化タンタル膜、酸化タングステン膜を順番に形成し、酸化タングステン膜上にさらに上部電極層１２としてITO 膜を形成した。ITO 膜上に、更にエレクトロクロミック層２として酸化タングステン膜、酸化タンタル膜、酸化イリジウムと酸化スズの混合膜を順番に形成し、酸化イリジウムと酸化スズの混合膜上に下部電極層２１としてITO 膜を形成した。このとき下部電極層２１の引き出し部が下部電極層１１の引き出し部に近接するよう下部電極層２１のパターンを決めた。
（２）封止ガラス基板８とエポキシ樹脂５にて素子を封止した。
（３）近接した電極の引き出し部が存在する各端部に金ペースト６を塗布し、両引き出し部を導通させると共に、金ペースト層に接触させつつガラス基板３と封止基板８を挟むようにクリップ７を装着し、接続部を一対作製した。（図３）
（４）一対の接続部のうち、酸化タングステン膜に接している電極層に接続された接続部を外部直流電源の陰極に接続し、酸化イリジウムと酸化スズの混合膜に接してる電極層に接続されているもう一方の接続部を外部直電源の陽極に接続し、１．３Ｖの電圧を印加すると、エレクトロクロミック層１、２は両方とも青色に着色した。この素子に－１．３Ｖの直流電圧を印加すると青色は消え、エレクトロクロミック素子は透明に戻った。着色時の透過率は6 ％、消色時の透過率は60％であった。
［実施例５］
（１）図６に示すように、ガラス基板３に下部電極層１１を形成した。その上にエレクトロクロミック層１として酸化イリジウムと酸化スズの混合膜、酸化タンタル膜、酸化タングステン膜を順番に形成し、その上にさらに上部電極層１２としてITO 膜を形成し、第一エレクトロクロミック部材を作製した。
（２）ガラス基板４に下部電極層２１を形成し、その上にエレクトロクロミック層２として酸化イリジウムと酸化スズの混合膜、酸化タンタル膜、酸化タングステン膜を順番に形成し、その上にさらに上部電極層２２としてITO 膜を形成した。ガラス基板４の各層形成面と封止ガラス基板９を対向してエポキシ樹脂５で貼り合わせ、第二エレクトロクロミック部材を作製した。
（３）第一エレクトロクロミック部材と第二エレクトロクロミック部材とを図６で示すように、第一エレクトロクロミック部材の上部電極１２の引き出し部と第二エレクトロクロミック部材の上部電極２２の引き出し部とが、そして下部電極１１の引き出し部と下部電極２１の引き出し部とが近接するよう第一エレクトロクロミック部材の各層形成面とガラス基板４の各層非形成面とを対向してエポキシ樹脂５で貼り合わせた。
（４）近接した電極の引き出し部が存在する各端部に金ペースト６を塗布し、両引き出し部を導通させると共に、金ペースト層に接触させつつガラス基板３と封止基板９を挟むようにクリップ７を装着し、接続部を一対作製した。（図６）
（５）一対の接続部のうち、酸化タングステン膜に接している電極層に接続された接続部を外部直流電源の陰極に接続し、酸化イリジウムと酸化スズの混合膜に接してる電極層に接続されているもう一方の接続部を外部直流電源の陽極に接続し、１．３Ｖの電圧を印加すると、エレクトロクロミック層１、２は両方とも青色に着色した。この素子に－１．３Ｖの直流電圧を印加すると青色

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は消え、エレクトロクロミック素子は透明に戻った。着色時の透過率は6 %、消色時の透過率は６０%であった。

【００３２】以上、実施例１～５では各電極の引き出し部とクリップとの電気的接続の中継用電極として金ペーストを用いたが、金ペーストの替わりに真空薄膜形成技術で作成された導電性薄膜を用いても良い結果が得られることは言うまでもない。

［比較例］

（１）図４に示すように、ガラス基板３に下部電極膜１１としてITO 膜を形成した。ITO 膜上にエレクトロクロミック層として酸化イリジウムと酸化スズの混合膜、酸化タンタル膜、酸化タングステン膜を順番に形成し、酸化タングステン膜上にさらに上部電極層１２としてITO 膜を形成した。

（２）エポキシ樹脂５と、封止ガラス基板８で上記（１）の基板を封止した。

（３）封止した素子の電極引き出し部が存在する端部に金ペーストを塗布し、両引き出し部を導通させると共に、金ペースト層に接触させつつガラス基板３と封止基板８を挟むようにクリップを装着し、接続部を一対作製した。（図４）

（４）一対の接続部のうち、酸化タングステン膜に接している電極層に接続された接続部を外部直流電源の陰極に接続し、酸化イリジウムと酸化スズの混合膜に接してる電極層に接続されているもう一方の接続部を外部直流電源の陽極に接続し、１．３Vの電圧を印加すると、エレクトロクロミック素子は青色に着色した。この素子に－１．３Vの直流電圧を印加すると青色は消え、エレクトロクロミック素子は透明に戻った。着色時の透過率は２５%、消色時の透過率は８０%であった。

【００３３】

【発明の効果】以上説明したように、本発明のエレクトロクロミック素子は透過率変化比即ちスイッチング比が極めて大きいので、従来のエレクトロクロミック素子では応用できなかった光量制御、ディスプレイ、光スイッチ、等の分野に応用することが出来、応用範囲が拡大する。

【００３４】更に本発明になるエレクトロクロミック素子は接続部の数を従来のエレクトロクロミック素子と全く同じ数だけ設けるだけで着色消色の駆動をすることが出来るので、素子構造がシンプルで、長寿命で、且つコストパーフォーマンスが高い。

【図面の簡単な説明】

【図１】本発明の実施例１のエレクトロクロミック素子の構造を示す図である。（請求項１、７対応）

【図２】本発明の実施例３のエレクトロクロミック素子の構造を示す図である。（請求項２、５、７対応）

【図３】本発明の実施例４のエレクトロクロミック素子の構造を示す図である。（請求項４、５、７対応）

【図４】従来のエレクトロクロミック素子（比較例）の構造を示す図である。

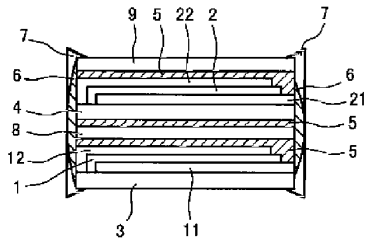
【図５】本発明の実施例２のエレクトロクロミック素子の構造を示す図である。（請求項１対応）

【図６】本発明の実施例５のエレクトロクロミック素子の構造を示す図である。（請求項３、５、６、７対応）

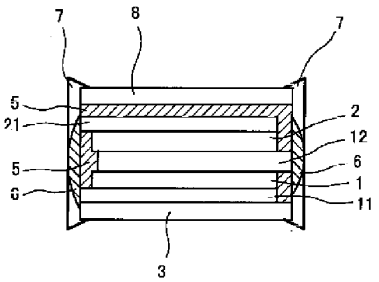
【符号の説明】

１　エレクトロクロミック層
２　エレクトロクロミック層
１１　エレクトロクロミック層１の下部電極層
１２　エレクトロクロミック層１の上部電極層
２１　エレクトロクロミック層２の下部電極層
２２　エレクトロクロミック層２の上部電極層
３　ガラス基板
４　ガラス基板
５　エポキシ樹脂
６　金ペースト
７　クリップ
８　封止ガラス基板
９封止ガラス基板

【図２】

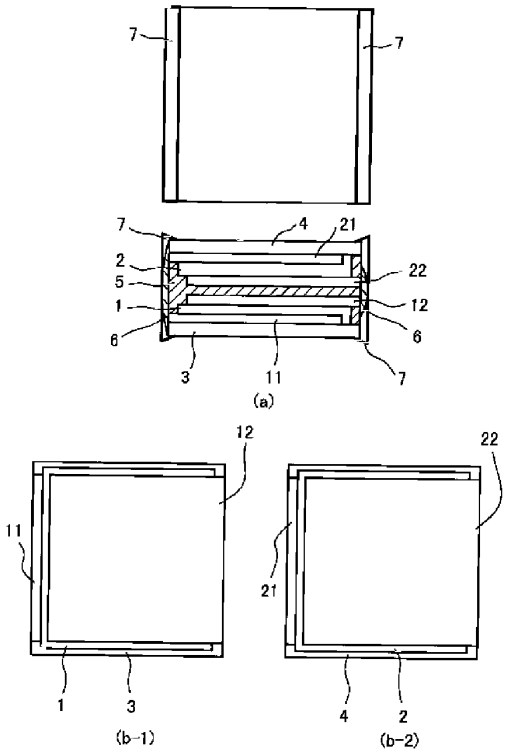


【図３】

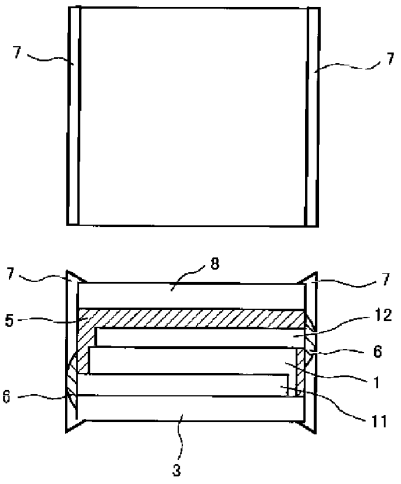


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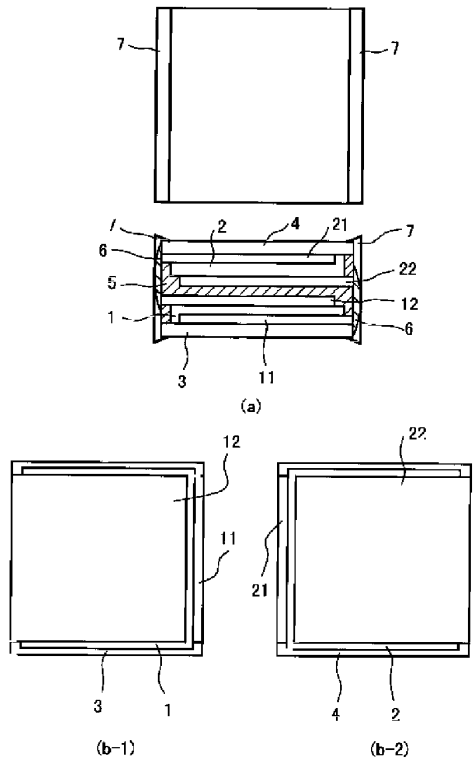
【図１】



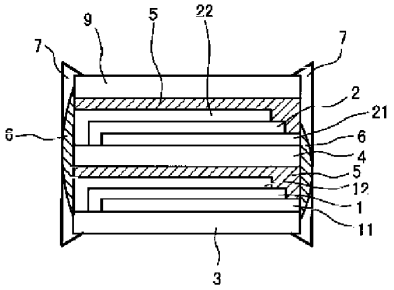
【図４】



【図５】



【図６】



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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/606,980	**03/15/2024 05:17:54 PM Z ET**	**50WF-383698-US**

Title of Invention

ELECTROCHROMIC FILMS WITH EDGE PROTECTION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9999	FILED BY	Chizu Sato
PATENT CENTER #	64708538	AUTHORIZED BY	PJ Shang
CUSTOMER #	139780	FILING DATE	-
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Zhao CHEN

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
DA / 504561	**E20243EH19018847**	**Chizu Sato**

PRE-AUTHORIZED ACCOUNT	PRE-AUTHORIZED CATEGORY
504561	**37 CFR 1.16 (National application filing, search, and examination fees); 37 CFR 1.17 (Patent application and reexamination processing fees); 37 CFR 1.19 (Document supply fees); 37 CFR 1.20 (Post Issuance fees); 37 CFR 1.21 (Miscellaneous fees and charges)**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
2111	UTILITY PATENT APPL. SEARCH FEE	280.00	1	280.00
4011	BASIC FILING FEE- UTILITY	64.00	1	64.00
2311	EXAMINATION OF ORIGINAL PATENT APPLICATION	320.00	1	320.00
			TOTAL AMOUNT:	**$664.00**

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National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/08a (02-18)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99**)		
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	First Named Inventor	Zhao CHEN
	Art Unit	
	Examiner Name	
	Attorney Docket Number	50WF-383698-US

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	1	5818625		1998-10-06	Forgette et al.	
	2	5406414		1995-04-11	O'farrell et al.	
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	1	20130010347		2013-01-10	Tajima et al.	
	2	20160282645		2016-09-29	Wang et al.	
	3	20170298682		2017-10-19	Wang et al.	
	4	20170299932		2017-10-19	Wang et al.	

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	Filing Date	
	First Named Inventor	Zhao CHEN
	Art Unit	
	Examiner Name	
	Attorney Docket Number	50WF-383698-US

	5	20120013969		2012-01-19	Wang et al.	
	6	20150323849		2015-11-12	Han	
	7	20150301367		2015-10-22	Mennig	
	8	20160357082		2016-12-08	Kubo et al.	

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	1	2010/032068	WO	A1	2010-03-25	PILKINGTON GROUP LTD		☐
	2	104698715	CN	A	2015-06-10	ZHUHAI SINGYES GREEN BUILDING TECHNOLOGY CO LTD		☒
	3	2014/134714	WO	A2	2014-09-12	SWITCH MATERIALS INC.		☐
	4	2000231125	JP	A	2000-08-22	MURAKAMI CORP		☒
	5	2001033830	JP	A	2001-02-09	MURAKAMI CORP		☒

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	Filing Date	
	First Named Inventor	Zhao CHEN
	Art Unit	
	Examiner Name	
	Attorney Docket Number	50WF-383698-US

	6	2011095406	JP	A	2011-05-12	TOKAI RIKA CO LTD		☒
	7	H11316395	JP	A	1999-11-16	NIKON CORP		☒

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	Search Report for European Application No 19206363.4 mailed on February 20, 2020, 9 pages.	☐
	2	Office Action for European Application No. 19206363.4 mailed on April 30, 2021, 5 pages.	☐
	3	First Search for Chinese Application No.: 201911095986.4 mailed on July 15, 2022. [**new]	☐
	4	Supplemental Search Report for Chinese Application No. 201911095986.4 mailed on February 2, 2023.	☐
	5	Extended European Search Report for European Patent Application No 23164353.7 mailed on June 9, 2023.	☐
	6	Non-Final Office Action for U.S. Application No. 18/326,866 mailed on December 20, 2023.	☐

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	Application Number	
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	First Named Inventor	Zhao CHEN
	Art Unit	
	Examiner Name	
	Attorney Docket Number	50WF-383698-US

EXAMINER SIGNATURE			
Examiner Signature		Date Considered	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	Zhao CHEN
	Art Unit	
	Examiner Name	
	Attorney Docket Number	50WF-383698-US

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Pengju Shang/	Date (YYYY-MM-DD)	2024-03-15
Name/Print	Pengju Shang	Registration Number	80050

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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Espacenet

Bibliographic data: JP2000231125 (A) — 2000-08-22

ELECTROCHROMIC DEVICE

Inventor(s): KIKUCHI HIDEYUKI ± (KIKUCHI HIDEYUKI)

Applicant(s): MURAKAMI CORP ± (MURAKAMI CORP)

Classification: **- international:** ***B60R1/04; G02F1/15;*** (IPC1-7): B60R1/04; G02F1/15

- cooperative:

Application number: JP19990007087 19990113

Priority number(s): JP19990007087 19990113 ; JP19980351092 19981210

Also published as: JP3556850 (B2)

Abstract of JP2000231125 (A)

PROBLEM TO BE SOLVED: To improve the responsiveness of coloring and decolorizing of an electrochromic device and to increase the reflectance range. SOLUTION: This device is produced by forming transparent conductive films 4, 5 on the inner faces of two transparent substrates 2, 3 facing each other, forming a metal reflection film 14 on the outer face of the transparent substrate, applying a protective film 15 on the metal film 14, supplying an electrolytic liquid 6 and an electrochromic layer 7 between the transparent conductive films 4, 5, and sealing with sealing films 8, 9. The electrolytic liquid 6 consists of a nonwater solvent, a solute containing a Li salt as a Li ion source, metallocene and N,N'-diphenylbenzidine, and an UV absorbent.

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Notice

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DESCRIPTION JP2000231125A

[0001]

13 TECHNICAL FIELD The present invention relates to an electrochromic element, particularly an electrochromic element used in anti-glare mirrors for automobiles, etc., and in particular, to an electrochromic element having a wide reflectance range and responsiveness in coloring and decoloring. This invention relates to a rapid self-erasing electrochromic device.

[0002]

20 2. Description of the Related Art In recent years, electrochromic elements used in anti-glare mirrors for automobiles, display devices, etc. have been actively developed.

22 During normal driving, anti-glare mirrors for automobiles turn the electrochromic elements into a decolored (colorless) state to increase the reflectance and function as a mirror, but when strong light from rear headlights etc. When exposed, it becomes colored and has an anti-glare effect, keeping the reflectance low.

[0003]

29 Already known techniques regarding electrochromic elements include JP-A-58-30729, JP-A-62-294225, JP-A-63-106730, and US Pat. No. 5,724,187. .

[0004]

34 By the way, in electrochromic elements, the performance of anti-glare mirrors and display devices is better when the decoloring and coloring states are close to 100% perfect.

36 In particular, when looking at anti-glare mirrors, the degree of decoloring and coloring is a change in reflectance, and the wider the reflectance range (e.g. 70-8%), the better the anti-

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glare mirror will be. The reflective and anti-glare functions of the lens can be fully demonstrated.

[0005]

43 In addition, in electrochromic devices, a coloring reaction is performed by applying a voltage using a drive circuit, and a decoloring reaction is performed by applying a reverse voltage or shorting between electrodes, but in anti-glare mirrors, display devices, etc. Rapid response to coloring and decoloring is required.

[0006]

50 In particular, when anti-glare mirrors for automobiles have an anti-glare effect, a voltage (coloring voltage) is applied to quickly color the electrochromic element and reduce the reflectance, but then a reverse voltage (decoloring voltage) is applied or the electrode Safe driving of automobiles requires quick responsiveness for coloring and decoloring, which involves short-circuiting the mirror and quickly decoloring the mirror to restore the mirror's original reflective function.

[0007]

59 Furthermore, if the drive circuit fails in a tinted state, it may remain tinted and the reflective function cannot be restored, or the color may slowly fade and the restoration of the reflective function of the automobile anti-glare mirror may be delayed. This is extremely problematic in terms of safe driving of automobiles.

63 In such a case, a fail-safe function that quickly self-decolorizes from a colored state to a decolored state is required.

[0008]

68 However, the known techniques have not been particularly conscious of the problems of rapid response and rapid self-erasing in the event of a failure, and have not provided any means for solving them.

71 In order to solve the above conventional problems, the present invention uses metallocene (ferrocene, nickelocene, etc.) and N,N'-diphenylbenzidine, which are oxidized coloring agents, in addition to Li salt as a solute in an electrolytic solution. By using these in combination, while ensuring a sufficient reflectance range, we aim to improve the responsiveness of coloring and decoloring in particular, as well as self-decolorization, which quickly erases color even in the event of a failure. This is the issue.

[0009]

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80 [Means for Solving the Problems] In order to solve the above problems, the present invention provides two opposing transparent substrates, and two opposing transparent substrates formed inside each of the two transparent substrates. An electrochromic element comprising two transparent conductive films, and an electrolytic solution and an electrochromic layer disposed and sealed between the two transparent conductive films, wherein the electrolytic solution is a non-containing electrochromic element. Provided is an electrochromic device comprising an aqueous solvent, a solute containing a Li salt as a Li ion source, a metallocene, and N,N'-diphenylbenzidine as an oxidized color former, and an ultraviolet absorber.

[0010]

91 A metal reflective film formed on the outer surface of one of the two transparent substrates, between the one transparent substrate and the transparent conductive film, or on the inner surface of the transparent conductive film inside the upper one transparent substrate. It is characterized in that it can be used as an anti-glare mirror.

[0011]

98 The present invention is characterized in that a drive circuit connected to or short-circuited to a DC power source is provided between the two transparent conductive films.

[0012]

103 Furthermore, in order to solve the above problems, the present invention provides two transparent substrates facing each other, a metal reflective film formed on the inner surface of one of the two transparent substrates, and a metal reflective film formed on the inner surface of the other transparent substrate. An electrochromic element comprising a transparent conductive film formed on the inner surface, an electrochromic layer and an electrolyte disposed between the metal reflective film and the transparent conductive film and sealed, the electrolyte comprising: Provided is an electrochromic device comprising a non-aqueous solvent, a solute containing a Li salt serving as a Li ion source, metallocene and N,N'-diphenylbenzidine as oxidized color formers, and an ultraviolet absorber.

[0013]

115 The present invention is characterized in that a drive circuit is provided between the transparent conductive film and the metal reflective film to be connected to or short-circuited to a DC power source by a changeover switch.

[0014]

121 The non-aqueous solvent is characterized in that it is one or more selected from the group

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including sulfolane, propylene carbonate, and γ-butyrolactone.

[0015]

126 The metallocene is characterized in that it is one or more selected from the group including ferrocene and nickelocene.

[0016]

131 The Li salt is characterized in that it is one or more selected from the group including LiBF4 and LiClO4.

[0017]

136 The ultraviolet absorber is characterized in that it is one or more selected from the group including salicylic acid-based ultraviolet absorbers, benzophenone-based ultraviolet absorbers, benzotriazole-based ultraviolet absorbers, and cyanoacrylate-based ultraviolet absorbers.

[0018]

143 The concentration of the solute is 0.001 to 1.0 mol/l.

[0019]

147 DESCRIPTION OF THE PREFERRED EMBODIMENTS Embodiments of the present invention will be described with reference to the drawings.

149 FIG. 1 is a diagram showing a specific structure of an electrochromic device according to the present invention and an anti-glare mirror using this device.

151 In FIG. 1(a), an electrochromic device 1 has two glass plates 2 and 3 facing each other.

152 Transparent conductive films 4, 5 made of ITO, SnO2, etc. are formed on the inner surfaces of the two glass plates 2, 3 (transparent substrates).

[0020]

157 An electrolytic solution 6 and an electrochromic layer 7 are disposed between two opposing transparent conductive films 4 and 5.

159 Both outer surfaces of the electrolytic solution 6 and the electrochromic layer 7 are sealed by forming sealing films 8 and 9 using a material such as an epoxy adhesive.

161 The electrochromic layer 7 is composed of a metal oxide such as WO3 or MoO3, which is a reduced coloring agent.

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[0021]

166 A DC power supply E for applying an electrochromic drive voltage is connected between the two transparent conductive films 4 and 5 by a circuit line 11 via a changeover switch 10, thereby forming a drive circuit 12.

169 As a result, when coloring, the two conductive films are connected in the state shown in FIG. 1, and a driving voltage is applied between the two conductive films, and when decoloring, the selector switch 10 is switched and short-circuited.

172 A suitable coloring drive voltage is 1.0 to 1.5V.

[0022]

176 The electrolytic solution uses sulfolane, propylene carbonate, γ-butyrolactone, etc. as a non-aqueous solvent, and Li salts as Li+ ion sources such as LiBF4 and LiClO4 as solutes, and metallocenes such as ferrocene and nickelocene as oxidative color formers. N,N'-diphenylbenzidine was used, and an ultraviolet absorber was further added.

180 The concentration of this solute is preferably 0.001 to 1.0 mol/l.

[0023]

184 Ultraviolet absorbers are the photoelectrochromic phenomenon of electrochromic substances such as WO3 and MoO3 (a phenomenon in which they change color when exposed to light and return to their original color in the dark).

187) is added to the electrolyte to prevent

188 When added in combination with an ultraviolet stabilizer and a hindered amine light stabilizer, weather resistance is improved.

[0024]

193 Examples of the ultraviolet absorber of the present invention include salicylic acid ultraviolet absorbers such as phenyl salicylate and p-octylphenyl salicylate, 2,2',4,4'-tetrahydroxybenzophenone, 2,4-dihydroxybenzophenone, and 2-hydroxybenzophenone. -Benzophenone UV absorbers such as methoxybenzophenone, benzotriazole UV absorbers such as 2-(2'-hydroxy-5'-methylphenyl)benzotriazole, 2-(2'-hydroxy-5'-tert-butylphenyl)benzotriazole, etc. , 2-ethylhexy-2-cyano-3,3'-diphenylacrylate, and ethyl-2-cyano-3,3'-diphenylacrylate.

200 In addition, there are ultraviolet stabilizers and hindered amine light stabilizers as substances that are not ultraviolet absorbers but can improve weather resistance when used in combination with ultraviolet absorbers.

203 Examples of the ultraviolet stabilizer include nickel bis(octylphenyl) sulfide, [2,2'-thiobis(4-tert-octylphenolate)]-n-butylamine nickel, and the like.

205 Further, as a light stabilizer, there are hindered amine light stabilizers such as Sanol LS-770

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and Tinuvin-622.

[0025]

210 FIG. 1(b) is a diagram showing the structure of an anti-glare mirror 13 using the electrochromic device 1 of the present invention.

212 A metal reflective film 14 made of any material such as Al, Ag, or Cr is formed on the outer surface of the glass plate 2, which is one of the two opposing glass plates, by vapor deposition or sputtering. As a rust-proofing treatment for the metal film, the outer surface of the metal film is coated with a protective film 15 so as to surround it, thereby constructing an anti-glare mirror 13 that reflects light incident from the other glass plate 3 side.

217 As the material for the protective film 15, paints such as acrylic resin, urethane resin, silicone resin, and epoxy resin, or rubber such as silicone rubber and vinyl chloride rubber are used.

[0026]

222 FIG. 2 shows a modification of the anti-glare mirror by the arrangement of glass plates 2, 3, conductive films 4, 5, electrolytic solution 6, electrochromic layer 7, metal reflective film 14, etc.

225 FIG. 2A shows a structure in which a reflective metal film 14 is formed on the inner surface of a glass plate 2, and a transparent conductive film 4 is formed on the inner surface.

227 In this modification, the reflective metal film 14 has a structure in which the glass plate 2 and the transparent conductive film 4 prevent it from coming into contact with the atmosphere.

[0027]

232 FIG. 2(b) shows a structure in which a metal reflective film 14 is formed on the inner surface of the transparent conductive film 4 so as to be in contact with the electrolytic solution 6.

234 In FIG. 2C, a metal reflective film 14 is formed on the inner surface of the glass plate 2, and the metal reflective film 14 also serves as a conductive film.

236 The electrochromic layer is in contact with the inner surface of this metal reflective film.

237 One end of the circuit line 11 of the drive circuit 12 is coupled to the surface of the metal reflective film 14.

239 The metal reflective film 14 is sealed by the glass plate 2 and the sealing film 8, and has a structure that does not come into contact with the atmosphere.

[0028]

244 The operation of the electrochromic device of the present invention having the above configuration will be explained in the case where it is used in an anti-glare mirror.

246 Now, the reduced coloring agent WO3 is used as the electrochromic layer, and the solute of the electrolyte contains Li salt, metallocene (ferrocene, nickelocene, etc.) which is an oxidized

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coloring agent, and N,N'-diphenylbenzidine. When $LiClO_4$ is used and ferrocene is used as the metallocene, in FIG. 1(b), when the switch 10 is closed and a voltage of 1.0 to 1.5 V is applied, ClO_4 adsorption occurs at the interface between the conductive thin film and the electrolyte during coloring. Then, the oxidation reaction (coloring reaction) of N,N'-diphenylbenzidine shown below occurs, resulting in a green color, and at the same time, the oxidation reaction (coloring reaction) of ferrocene shown below occurs.

[0029]

257 On the other hand, electrons are injected into the electrochromic layer 7 from the transparent conductive film side 4, Li^+ ions in the electrolytic solution 6 are injected into the electrochromic layer 7, and a reduction reaction (coloring reaction) as shown below occurs, and WO_3 is Color it blue.

[0030]

264 Next, after coloring, when the two thin conductive films are short-circuited using the changeover switch 10, the oxidized coloring agent N,N'-diphenylbenzidine shown below undergoes a reduction reaction (decolorization reaction) and decolorizes. At the same time, ferrocene, which is an oxidized color former shown below, undergoes a reduction reaction and loses its color.

269 Then, the reduced color forming agent WO_3 shown below undergoes an oxidation reaction (decoloring reaction), reaches zero potential equilibrium, and decolors.

[0032]

274 The anti-glare mirror is normally in a decolored state, and light incident from the glass plate 3 side passes through the electrolytic solution 6 and the electrochromic layer 7 and is reflected by the metal reflective film 14, resulting in a highly reflective mirror. state and functions as a mirror.

278 When colored, the transmittance of light decreases, resulting in a state of low reflectance, and the amount of reflected light decreases, resulting in an anti-glare function.

[0033]

283 Figure 3 shows the change in reflectance over time of voltage application and drive circuit short circuit, and shows the reflectance characteristics when the compound used in addition to Li salt as a solute in the electrolyte of the present invention is changed. This is comparative experimental data.

287 (A) shows the configuration of the present invention, in which N,N'-diphenylbenzidine and ferrocene are used in combination in addition to Li salt.

289 (b) shows the reflectance characteristic curve when N,N'-diphenylbenzidine alone is used in

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addition to Li salt, and (c) shows the reflectance characteristic curve when ferrocene is used alone in addition to Li salt. ing.

[0034]

295 According to the experimental data shown in FIG. 3, in (a) according to the present invention, the reflectance rapidly decreases from about 70% to 9% by voltage application, and reflection can be rapidly suppressed, so it can be prevented quickly. It can cause a dazzling function.

298 Furthermore, when the drive circuit is short-circuited, the reflectance increases rapidly compared to (b) and (c) where N,N'-diphenylbenzidine and ferrocene are used alone, and the reflectance remains higher. Therefore, it can fully exhibit its reflective function as a mirror.

[0035]

304 FIG. 4 shows that the electrochromic device described in "EXAMPLE 1" in US Pat. The applicant faithfully created it within the scope of the description, measured the state of change in reflectance due to voltage application and elapsed time of short circuit, and used it as an "experimental example" for comparison, and used this as the measured value according to the present invention. This is the applicant's experimental comparative data in comparison with the above.

[0036]

313 The dotted line in FIG. 4 is the "experimental example" related to the electrochromic device described in "EXAMPLE 1" above, and the solid line is the measured value related to the electrochromic device (product of the present application) according to the present application.

317 According to FIG. 4, when a voltage of 1.4 V is applied, the product of the present application becomes colored more quickly than the experimental example, and the reflectance decreases, and conversely, when the drive circuit is shorted, the product of the present application discolors more quickly than the experimental example. Reflectance increases.

[0037]

324 From the above, when the electrochromic and chromic elements of the present invention are used in an anti-glare mirror, the coloring during anti-glare and the mutual switching during normal use are quickly performed in response to voltage application and short circuit.

[0038]

330 Next, a case will be described in which the drive circuit fails and the current is cut off in the colored state.

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332 Examples of failures include a short circuit or open circuit due to burnt parts, an open circuit due to solder cracks (damage), an open circuit due to disconnection of a harness, an open circuit due to disconnection of a connector, etc.

[0039]

338 Figure 5 shows the changes in reflectance over time when the voltage is applied and the drive circuit is short-circuited. This is experimental data comparing the reflectance characteristics when voltage is applied and when the circuit is short-circuited or open.

[0040]

344 According to Fig. 5, in the case of a short circuit due to normal operation or an accident (indicated by a solid line).

346), the reflectance quickly increases (quickly becomes a decolored state) after a short circuit, and the anti-glare mirror recovers its reflective function.

348 Also, in the case of an open circuit due to an accident (indicated by a dotted line).

349), the rise in reflectance is a little slower than in the case of a short circuit, but the reflectance returns to an almost normal state (70%) after about 1 minute, which is preferable from the viewpoint of safe driving of a car.

[0041]

355 [Embodiment 1] Next, a specific embodiment will be explained.

356 Two ITO substrates (transmittance 80%, resistance value 8 Ω/□) of the size of an automobile inner mirror (280×80 mm) were used, and a 6000 angstrom thick WO3 film was formed on one side by vacuum evaporation.

359 After film formation, the two substrates were bonded together with epoxy resin with a cell gap of 80 μm.

[0042]

364 Add 0.4 mol/1 of lithium perchlorate (LiClO4), 0.05 mol/l of N,N-diphenylbenzidine, and 2,2',4,4'-tetrahydroxybenzophenone to this empty cell using γ-butyrolactone as a solvent. An electrolytic solution was prepared using 2 wt % as a solute, and an empty cell was filled with the electrolytic solution by a vacuum injection method to produce an electrochromic device.

[0043]

372 Aluminum (Al) was deposited on one side of the glass by vacuum evaporation to form a reflective electrochromic element.

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374 The reflectance change of this electrochromic element showed a characteristic of 70% decolorization and 8% coloration by a driving voltage of 1.4 V during decolorization.

[0044]

379 [Example 2] Into the empty cell of Example 1, γ-butyrolactone was used as a solvent, and 0.4 mol/1 of lithium perchlorate (LiCl04), 0.05 mol/l of N,N-diphenylbenzidine, and 0.01 mol/l of ferrocene were added. An electrolytic solution was prepared using 2 wt% of l,2,2',4,4'-tetrahydroxybenzophenone as a solute, and an empty cell was filled with the electrolytic solution by a vacuum injection method to produce an electrochromic device.

[0045]

387 Aluminum (Al) was deposited on one side of the glass by vacuum evaporation to form a reflective electrochromic element.

389 The change in reflectance of this electrochromic element showed a characteristic of 70% decolorization and 9% coloration when driven at 1.4 V during decolorization.

[0046]

394 Although the embodiments of the present invention have been described above together with the examples, it goes without saying that the present invention is not limited to the above-described embodiments or examples, and there are various other aspects within the technical scope of the claims.

[0047]

401 Effects of the Invention The present invention uses metallocene and N,N'-diphenylbenzidine in combination as solutes in the electrolytic solution, instead of using them individually. It not only provides a quick anti-glare function against instantaneous increases in irradiance, but also functions as a mirror with a high reflectance when used as a regular mirror. can do.

[0048]

408 Regarding the above response, in particular, when the drive voltage is short-circuited, the increase in reflectance due to self-decolorization occurs extremely quickly. Even if the mirror is colored and is short-circuited or opened due to a failure in the drive voltage circuit, power supply, etc., self-decolorization occurs quickly, so the reflective function as a mirror is restored extremely quickly, and the reflector's It is possible to avoid danger to the driver due to malfunction, and has a great effect on safe driving.

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(19)日本国特許庁（ＪＰ）　(12) **公開特許公報**（Ａ）　(11)特許出願公開番号
特開2000－231125
（P2000－231125A）
(43)公開日　平成12年８月22日(2000.8.22)

(51)Int.Cl.⁷		識別記号	Ｆ Ｉ			ﾃｰﾏｺｰﾄﾞ(参考)
Ｇ０２Ｆ	1/15	５０８	Ｃ０２Ｆ	1/15	５０８	２Ｋ００１
Ｂ６０Ｒ	1/04		Ｂ６０Ｒ	1/04	Ｄ	

審査請求　未請求　請求項の数10　ＯＬ　（全 ８ 頁）

(21)出願番号　特願平11－7087

(22)出願日　平成11年１月13日(1999.1.13)

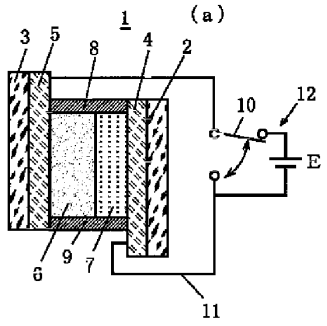
(31)優先権主張番号　特願平10－351092
(32)優先日　平成10年12月10日(1998.12.10)
(33)優先権主張国　日本（ＪＰ）

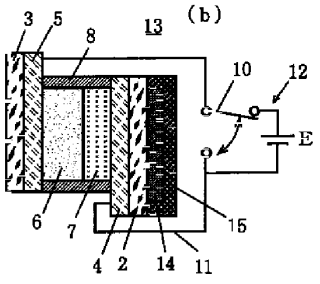
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Ｆターム(参考)　2K001 AA10 CA19 CA20 CA31 CA32
CA33 CA50 DA02 DA23

(54)【発明の名称】　エレクトロクロミック素子

(57)【要約】
【課題】　エレクトロクロミック素子の着色、消色の応答性を向上させ、反射率レンジを広くする。
【解決手段】　対向する二枚の透明基板２、３より内面に透明導電膜４、５を形成し、透明基板の外面に金属反射膜１４を成膜し、金属膜１４を保護膜１５によりコーティングし、透明導電膜４、５の間に電解液６及びエレクトロクロミック層７を配設し封止膜８、９で封止し、電解液６は、非水溶媒と、Ｌｉイオン源となるＬｉ塩、メタロセン及びＮ，Ｎ’－ジフェニルベンジジンを含む溶質と、紫外線吸収剤とから構成される。





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【特許請求の範囲】
【請求項１】　対向する二枚の透明基板と、該二枚の透明基板の夫々より内側に位置して形成された対向する二枚の透明導電膜と、該二枚の透明導電膜の間の位置に配設され封止された電解液及びエレクトロクロミック層とを備えて成るエレクトロクロミック素子であって、
上記電解液は、非水溶媒と、Ｌｉイオン源となるＬｉ塩、酸化発色剤であるメタロセン及びＮ，Ｎ’－ジフェニルベンジジンを含む溶質と、紫外線吸収剤とを含むことを特徴とするエレクトロクロミック素子。
【請求項２】　上記二枚の透明基板の一方の透明基板の外面、上記一方の透明基板と透明導電膜との間、又は上記一方の透明基板の内側の透明導電膜の内面に成膜された金属反射膜を有し、防眩ミラーとして利用できることを特徴とする請求項１記載のエレクトロクロミック素子。
【請求項３】　上記２枚の透明導電膜の間に、切り換えスイッチにより直流電源接続される又は短絡される駆動回路を設けて成ることを特徴とする請求項１又は２記載のエレクトロクロミック素子。
【請求項４】　対向する二枚の透明基板と、該二枚の透明基板の一方の透明基板の内面に成膜された金属反射膜と、他方の基板の内面に形成された透明導電膜と、上記金属反射膜と上記透明導電膜との間にエレクトロクロミック層及び電解液が配設され封止されて成るエレクトロクロミック素子であって、
上記電解液は、非水溶媒と、Ｌｉイオン源となるＬｉ塩並びに酸化発色剤であるメタロセン及びＮ，Ｎ’－ジフェニルベンジジンを含む溶質と、紫外線吸収剤とを含むことを特徴とするエレクトロクロミック素子。
【請求項５】　上記透明導電膜と上記金属反射膜の間に、切り換えスイッチにより直流電源に接続される又は短絡される駆動回路を設けて成ることを特徴とする請求項４記載のエレクトロクロミック素子。
【請求項６】　上記非水溶媒は、スルホラン、炭酸プロピレン、γ－ブチロラクトンを含む群から選択された１種以上であることを特徴とする請求項１～５のいずれかに記載のエレクトロクロミック素子。
【請求項７】　上記メタロセンは、フェロセン及びニッケロセンを含む群から選択された１種以上であることを特徴とする請求項１～６のいずれかに記載のエレクトロクロミック素子。
【請求項８】　上記Ｌｉ塩は、$LiBF_4$及び$LiClO_4$を含む群から選択された１種以上であることを特徴とする請求項１～７のいずれかに記載のエレクトロクロミック素子。
【請求項９】　上記紫外線吸収剤は、サリチル酸系紫外線吸収剤、ベンゾフェノン系紫外線吸収剤、ベンゾトリアゾール系紫外線吸収剤及びシアノアクリレート系紫外線吸収剤を含む群から選択された１種以上であることを特徴とする請求項１～８のいずれかに記載のエレクトロクロミック素子。
【請求項１０】　上記溶質の濃度は、０．００１～１．０ｍｏｌ／ｌであることを特徴とする請求項１～９のいずれかに記載のエレクトロクロミック素子。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、エレクトロクロミック素子、特に、自動車用防眩ミラー等に利用されるエレクトロクロミック素子に関し、特に、広い反射率レンジを有し、着色、消色の応答性が迅速な自己消色型のエレクトロクロミック素子に関する。
【０００２】
【従来の技術】近年、自動車用防眩ミラーや表示装置等に利用されるエレクトロクロミック素子が活発に開発されている。 自動車用防眩ミラーでは、通常の走行時には、エレクトロクロミック素子を消色（無色）状態として反射率を大きくしてミラーとしての反射機能を発揮させるが、後方からのヘッドライト等の強い光が照射されると着色状態となり反射率を低く抑え防眩作用を行うものである。
【０００３】すでに、エレクトロクロミック素子についての公知の技術としては、❶特開昭５８－３０７２９号公報、❷特開昭６２－２９４２２５号公報、❸特開昭６３－１０６７３０号公報、❹米国特許第５７２４１８７号明細書等がある。
【０００４】
【発明が解決しようとする課題】ところで、エレクトロクロミック素子では、消色、着色状態が１００％完璧に近い方が、防眩ミラーや表示装置の性能としてはすぐれている。特に、防眩ミラーについてみれば、消色、着色の度合いは反射率の変化の変化となり、その反射率の領域（反射率レンジ）が広い（例えば、７０～８％）方が、防眩ミラーの持つ反射及び防眩の夫々の機能が十分発揮できる。
【０００５】又、エレクトロクロミック素子では、駆動回路により電圧を印加して着色反応を行わせ、逆電圧の印加又は電極間の短絡により消色反応を行わせるが、防眩ミラー、表示装置等においては、この着色、消色の応答性が迅速であることが要求される。
【０００６】特に、自動車用防眩ミラーでは、防眩作用時には、電圧（着色電圧）を印加しエレクトロクロミック素子を迅速に着色させて反射率を低下させるが、その後逆電圧（消色電圧）を印加又は電極間を短絡して迅速に消色してミラー本来の反射機能を復帰させるという、着色・消色のための迅速な応答性が、自動車の安全運転に要求される。
【０００７】さらに、着色状態において駆動回路が故障した場合、着色状態のままで反射機能の復帰が不可能となったり、あるいはゆっくりと消色し自動車用防眩ミラ

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ーの反射機能の回復が遅くなったりしては、自動車の安全運転上きわめて問題である。このような場合に、着色状態から消色状態に迅速に自己消色するフェイルセーフ機能が要求される。

【０００８】ところが、公知技術は、特に応答の迅速性や故障時の迅速な自己消色性の問題を意識し、解決手段を与えるものではなかった。本発明は、上記の従来の問題を解決することを目的として、電解液の溶質として、Ｌｉ塩に加えて、酸化発色剤であるメタロセン（フェロセン、ニッケロセン等）及びＮ，Ｎ’ージフェニルベンジジンとを組み合わせて使用することにより、反射率レンジを十分確保しながらも、特に、着色、消色の応答性をより迅速にするとともに、故障時でも迅速に消色する自己消色性の向上を図ることを課題とするものである。

【０００９】

【課題を解決するための手段】本発明は、上記課題を解決するために、対向する二枚の透明基板と、該二枚の透明基板の夫々より内側に位置して形成された対向する二枚の透明導電膜と、該二枚の透明導電膜の間の位置に配設され封止された電解液及びエレクトロクロミック層とを備えて成るエレクトロクロミック素子であって、上記電解液は、非水溶媒と、Ｌｉイオン源となるＬｉ塩並びにメタロセン及び酸化発色剤であるＮ，Ｎ’ージフェニルベンジジンを含む溶質と、紫外線吸収剤とを含むことを特徴とするエレクトロクロミック素子を提供する。

【００１０】上記二枚の透明基板の一方の透明基板の外面、上記一方の透明基板と透明導電膜との間、又は上一方の透明基板の内側の透明導電膜の内面に成膜された金属反射膜を有し、防眩ミラーとして利用できることを特徴とする。

【００１１】上記２枚の透明導電膜の間に、切り換えスイッチにより直流電源接続される又は短絡される駆動回路を設けて成ることを特徴とする。

【００１２】又、本発明は、上記課題を解決するために、対向する二枚の透明基板と、該二枚の透明基板の一方の透明基板の内面に成膜された金属反射膜と、他方の基板の内面に形成された透明導電膜と、上記金属反射膜と上記透明導電膜との間にエレクトロクロミック層及び電解液が配設され封止されて成るエレクトロクロミック素子であって、上記電解液は、非水溶媒と、Ｌｉイオン源となるＬｉ塩並びに酸化発色剤であるメタロセン及びＮ，Ｎ’ージフェニルベンジジンを含む溶質と、紫外線吸収剤とを含むことを特徴とするエレクトロクロミック素子を提供する。

【００１３】上記透明導電膜と上記金属反射膜の間に、切り換えスイッチにより直流電源に接続される又は短絡される駆動回路を設けて成ることを特徴とする。

【００１４】上記非水溶媒は、スルホラン、炭酸プロピレン、γーブチロラクトンを含む群から選択された１種以上であることを特徴とする。

【００１５】上記メタロセンは、フェロセン及びニッケロセンを含む群から選択された１種以上であることを特徴とする。

【００１６】上記Ｌｉ塩は、$LiBF_4$及び$LiClO_4$を含む群から選択された１種以上であることを特徴とする。

【００１７】上記紫外線吸収剤は、サリチル酸系紫外線吸収剤、ベンゾフェノン系紫外線吸収剤、ベンゾトリアゾール系紫外線吸収剤及びシアノアクリレート系紫外線吸収剤を含む群から選択された１種以上であることを特徴とする。

【００１８】上記溶質の濃度は、０．００１～１．０ｍｏｌ／ｌであることを特徴とする。

【００１９】

【発明の実施の形態】本発明の実施の形態を図面を参照して説明する。図１は本発明に係るエレクトロクロミック素子及びこの素子を利用した防眩ミラーの具体的な構造を示す図である。図１（ａ）において、エレクトロクロミック素子１は、対向する二枚のガラス板２、３を有する。二枚のガラス板２、３（透明基板）の内面には、ＩＴＯ、SnO_2等の透明導電膜４、５が形成されている。

【００２０】対向する二枚の透明導電膜４、５の間に、電解液６とエレクトロクロミック層７が配設されている。電解液６とエレクトロクロミック層７の両外側面はエポキシ接着剤等の材料により封止膜８、９が形成され封止されている。エレクトロクロミック層７は還元発色剤であるWO_3、MoO_3等の金属酸化物で構成される。

【００２１】二枚の透明導電膜４、５の間に、エレクトロクロミックの駆動電圧を印加する直流電源Ｅが切換スイッチ１０を介し回路線１１で接続され駆動回路１２が構成されている。これにより、着色時には図１の状態で接続され、二枚の導電膜の間に駆動電圧が印加され、消色時には切換スイッチ１０が切り換えられて短絡される。着色駆動電圧として１．０～１．５Ｖが適切である。

【００２２】電解液は、非水溶媒として、スルホラン、炭酸プロピレン、γーブチロラクトン等を用い、溶質として、$LiBF_4$、$LiClO_4$等のLi^+イオン源となるＬｉ塩と、酸化発色剤であるフェロセン、ニッケロセン等のメタロセン及びＮ，Ｎ’ージフェニルベンジジンとを用い、さらに紫外線吸収剤を添加して構成した。この溶質の濃度は、０．００１～１．０ｍｏｌ／ｌが望ましい。

【００２３】紫外線吸収剤は、WO_3、MoO_3等のエレクトロクロミック物質のフォトエレクトロクロミック現象（光を照射すると色を変え、暗所で再びもとの色に戻る現象。）を防止するために電解液中に添加される。そして、紫外線安定剤、ヒンダードアミン系光安定剤と

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併用して添加すると、耐候性が向上する。

【００２４】本発明の紫外線吸収剤としては、フェニルサリシレート、ｐ－オクチルフェニルサリシレート等のサリチル酸系紫外線吸収剤、２，２’，４，４’－テトラヒドロキシベンゾフェノン、２，４－ジヒドロキシベンゾフェノン、２－ヒドロキシ－４－メトキシベンゾフェノン等のベンゾフェノン系紫外線吸収剤、２－（２’－ヒドロキシ－５’－メチルフェニル）ベンゾトリアゾール、２－（２’－ヒドロキシ－５’－ｔｅｒｔ－ブチルフェニル）ベンゾトリアゾール等のベンゾトリアゾール系紫外線吸収剤、２－エチルヘキシル－２－シアノ－３，３’－ジフェニルアクリレート、エチル－２－シアノ－３，３’－ジフェニルアクリレート等のシアノアクリレート系紫外線吸収剤等がある。又、紫外線吸収剤ではないが、紫外線吸収剤と併用して使用することにより耐候性を向上させる物質として、紫外線安定剤、ヒンダードアミン系光安定剤がある。紫外線安定剤として、ニッケルビス（オクチルフェニル）サルファイド、〔２，２’－チオビス（４－ｔｅｒｔ－オクチルフェノラート）〕－ｎ－ブチルアミンニッケル等がある。又、光安定剤として、Ｓａｎｏｌ ＬＳ－７７０、Ｔｉｎｕｖｉｎ－６２２等のヒンダードアミン系光安定剤がある。

【００２５】図１（ｂ）は、本発明のエレクトロクロミック素子１を利用した防眩ミラー１３の構造を示す図である。対向する二枚のガラス板の一方のガラス板２の外面に、Ａｌ、Ａｇ、Ｃｒ等のいずれかの材料から成る金属反射膜１４を蒸着やスパッタリング等により成膜し、このＡｌ、Ａｇ、Ｃｒ等の金属膜の防錆処理として、その外表面を囲うように保護膜１５でコーティングして、他方のガラス板３側から入射する光を反射する防眩ミラー１３が構成される。保護膜１５の材料としては、アクリル樹脂系、ウレタン樹脂系、シリコン樹脂系、エポキシ樹脂系等の塗料、又はシリコン系ゴム、塩化ビニル系ゴム等のゴムを利用する。

【００２６】図２は、ガラス板２、３、導電膜４、５、電解液６、エレクトロクロミック層７、金属反射膜１４等の配置による、防眩ミラーの変形例を示す。図２（ａ）は、ガラス板２の内面に反射金属膜１４を成膜し、その内面に透明導電膜４を形成した構造である。この変形例では、反射金属膜１４は、ガラス板２、透明導電膜４により大気に接触しないような構造となっている。

【００２７】図２（ｂ）は、金属反射膜１４を透明導電膜４の内面に電解液６に接するように成膜して成る構造である。図２（ｃ）は、ガラス板２の内面に金属反射膜１４を成膜し、金属反射膜１４が導電膜を兼ねた構成としている。エレクトロクロミック層は、この金属反射膜の内面に接している。駆動回路１２の回路線１１の一端はこの金属反射膜１４の表面に結合されている。金属反射膜１４は、ガラス板２と封止膜８により封止され、大気に接触しない構造となっている。

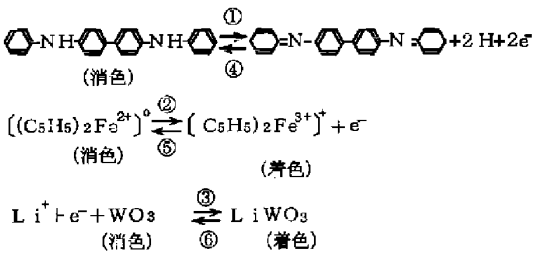
【００２８】以上の構成から成る本発明のエレクトロクロミック素子の作用を、防眩ミラーに利用した場合で説明する。今、エレクトロクロミック層として還元発色剤WO_3を使用し、電解液の溶質は、Ｌｉ塩、酸化発色剤であるメタロセン（フェロセン、ニッケロセン等）及びＮ，Ｎ’－ジフェニルベンジジンを含み、このＬｉ塩として$LiClO_4$を、メタロセンとしてフェロセンを使用した場合、図１（ｂ）において、スイッチ１０を閉じ電圧１．０～１．５Ｖを印加すると、導電薄膜と電解液との界面では着色時に、ClO_4^-の吸着と、下記④に示す、Ｎ，Ｎ’－ジフェニルベンジジンの酸化反応（着色反応）が生じ緑色に着色し、同時に、下記②に示す、フェロセンの酸化反応（着色反応）が生じる。

【００２９】一方、透明導電膜側４から、電子がエレクトロクロミック層７に注入され、電解液６中のLi^+イオンがエレクトロクロミック層７に注入されて、下記③に示す、還元反応（着色反応）が生じWO_3は青色に着色する。

【００３０】次に、着色後、切換スイッチ１０により二枚の薄膜導電膜間を短絡させると、下記④に示す、酸化発色剤であるＮ，Ｎ’－ジフェニルベンジジンは還元反応（消色反応）が生じ消色し、同時に、下記⑤に示す、酸化発色剤であるフェロセンは還元反応が生じ消色する。そして、下記⑥に示す還元発色剤WO_3は酸化反応（消色反応）が生じゼロ電位平衡となって消色する。

【００３１】

【化１】



【００３２】防眩ミラーでは、通常は消色状態にあり、ガラス板３側から入射した光は、電解液６、エレクトロクロミック層７内を通過して金属反射膜１４により反射され高反射率の状態になり、ミラーとしての機能を発揮する。そして、着色時には、光の透過率が低下して低反射率の状態となり、反射光が低下して防眩機能を生じ

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る。

【００３３】図3は、電圧印加及び駆動回路の短絡の時間経過による反射率との変化について、本発明の電解液の溶質として、Ｌｉ塩に加えて使用される化合物を変えた時の、反射率特性の比較実験データである。（イ）は、本発明の構成を示すものであり、Ｌｉ塩に加えて、Ｎ，Ｎ’ージフェニルベンジジンとフェロセンとを組み合わせて使用した場合である。（ロ）は、Ｌｉ塩に加えて、Ｎ，Ｎ’ージフェニルベンジジン単体で使用した場合、（ハ）は、Ｌｉ塩に加えて、フェロセン単体で使用した場合の夫々の反射率特性曲線を示している。

【００３４】この図3の実験データによると、本発明による（イ）では、電圧印加により、反射率がほぼ７０％から９％へと急激に低下して反射を急激に抑えることができるから迅速に防眩機能を生じることができる。又、駆動回路を短絡すると、Ｎ，Ｎ’ージフェニルベンジジンとフェロセンとを夫々単体で使用する（ロ）、（ハ）に比較して急激に反射率が上昇し、しかも反射率はより高く維持されるから、ミラーとしての反射機能を十分発揮することができる。

【００３５】図4は、本件発明と公知技術との効果を対比するという試験研究の目的に沿って、米国特許第５、７２４、１８７号明細書中の「ＥＸＡＭＰＬＥ１」に記載さたエレクトロクロミック素子を、本件出願人においてその記載の範囲内で忠実に作成し、電圧印加及び短絡の経過時間による反射率の変化の状態を測定して比較の対象である「実験例」とし、これを本件発明による測定値と対比した本件出願人実験比較データである。

【００３６】図4中の点線は、上記「ＥＸＡＭＰＬＥ１」に記載さたエレクトロクロミック素子に係る「実験例」であり、実線は本出願に係るエレクトロクロミック素子（本出願品）に係る測定値である。図4によると、１．４Ｖの電圧を印加すると本出願品は実験例より迅速に着色し反射率が低下し、逆に駆動回路を短絡すると、本出願品は実験例より迅速に消色し反射率が上昇する。

【００３７】以上から、本発明のエレクロとクロミック素子を防眩ミラーに利用した場合に、電圧印加、短絡に応答して防眩時の着色と通常使用時の相互の切り換えが、迅速に行われる。

【００３８】次に、着色状態で、駆動回路が故障し電流が途絶えた場合について説明する。故障の例としては、部品の焼損による回路の短絡又は開放、半田のクラック（破損）による回路の開放、ハーネスの切断による回路の開放、コネクタの抜けによる回路の開放等がある。

【００３９】図5は、電圧印加及び駆動回路の短絡の時間経過による反射率との変化について、本発明において、回路が短絡した場合の自己消色（短絡消色）と開放した場合の自己消色（開放消色）について、電圧印加時及び回路の短絡又は開放時の反射率特性の比較実験データである。

【００４０】図5によると、通常の操作又は事故による短絡の場合（実線で示されている。）は、短絡後迅速に反射率が上昇（迅速に消色状態となる）し、防眩ミラーはその反射機能を回復する。又、事故による回路の開放の場合（点線で示されている。）は、短絡の場合より若干反射率の立ち上がりは遅いが、約１分経過すれば反射率はほぼ正常の状態（７０％に）に回復するから、自動車の安全運転の観点から好ましい。

【００４１】

【実施例１】次に、具体的な実施例を説明する。自動車用インナーミラーサイズ（２８０×８０ｍｍ）のＩＴＯ基板（透過率８０％、抵抗値８Ω／□）を２枚用い、片側にWO3膜を真空蒸着法にて６０００オングストロームに成膜した。成膜後２枚の基板をエポキシ樹脂にて８０μｍのセルギャップにて接着した。

【００４２】この空セルにγーブチロラクトンを溶媒として、過塩素酸リチウム（$LiClO_4$）０．４ｍｏｌ／１、Ｎ，Ｎ−ジフェニルベンジジン０．０５ｍｏｌ／１、２，２’，４，４’ーテトラヒドロキシベンゾフェノン２ｗｔ％を溶質として電解液を作製し、真空注入法により、電解液を空セルに充填し、エレクトロクロミック素子を作製した。

【００４３】一方のガラスの片側にアルミ（Ａｌ）を真空蒸着法より成膜し、反射型エレクトロクロミック素子とした。このエレクトロクロミック素子の反射率変化は消色時１．４Ｖの駆動電圧により、消色７０％、着色８％の特性を示した。

【００４４】

【実施例２】実施例１の空セルに、γーブチロラクトンを溶媒として、過塩素酸リチウム（$LiClO_4$）０．４ｍｏｌ／１、Ｎ，Ｎ−ジフェニルベンジジン０．０５ｍｏｌ／１、フェロセン０．０１ｍｏｌ／１、２，２’，４，４’ーテトラヒドロキシベンゾフェノン２ｗｔ％を溶質として電解液を作製し、真空注入法により、電解液を空セルに充填し、エレクトロクロミック素子を作製した。

【００４５】一方のガラスの片側にアルミ（Ａｌ）を真空蒸着法より成膜し、反射型のエレクトロクロミック素子とした。このエレクトロクロミック素子の反射率変化は消色時１．４Ｖの駆動により、消色７０％、着色９％の特性を示した。

【００４６】以上本発明の実施の形態を実施例とともに説明したが、特許請求の範囲の技術事項の範囲内では、上記実施の形態又は実施例にに限らず色々な態様があることは言うまでもない。

【００４７】

【発明の効果】本発明は、電解液の溶質として、メタロセンと、Ｎ，Ｎ’ージフェニルベンジジンの夫々を単体として使用せずに両者を組み合わせて使用したので、着色、消色の応答性を向上させ、しかも反射率レンジを広

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げることができ、瞬間的な照射量の増大に対する迅速な防眩機能を発揮するばかりでなく、通常のミラーとしての使用時には高い反射率をもってミラーとしての機能を発揮することができる。

【００４８】上記応答性について、特に、駆動電圧を短絡した場合の自己消色による反射率の上昇が、きわめて迅速に行われるので、通常の使用時における消色切換の迅速性はもちろんのこと、エレクトロクロミックミラーが着色状態で駆動電圧回路、電源等の故障により短絡した場合若しくは開放した場合にでも、自己消色は迅速に行われるから、ミラーとしての反射機能の回復はきわめて迅速に行われ、反射鏡の機能不全による運転者の危険を回避でき、安全運転に多大の効果を奏する。

【図面の簡単な説明】

【図１】本発明のエレクトロクロミック素子及びこの素子を利用した防眩ミラーを説明する図である。

【図２】本発明のエレクトロクロミック素子を利用した防眩ミラーの変形例を示す図である。

【図３】電圧印加及び駆動回路の短絡の時間経過による反射率との変化について、本発明の電解液の溶質として、Ｌｉ塩に加えて使用される化合物を変えた時の、反射率特性の比較実験データである。

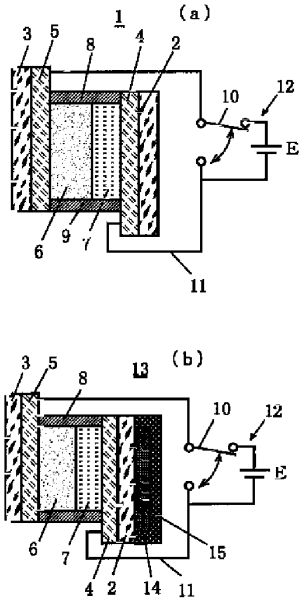
【図４】電圧印加及び駆動回路の短絡の時間経過による反射率との変化について、公知例と本発明のエレクトロクロミック素子との本件出願人において測定し作成した比較実験データである。

【図５】電圧印加及び駆動回路の短絡の時間経過による反射率との変化について、本発明に係るエレクトロクロミック素子の駆動回路を短絡し消色した場合（短絡消色）と開放し消色した場合（開放消色）の比較実験データである。

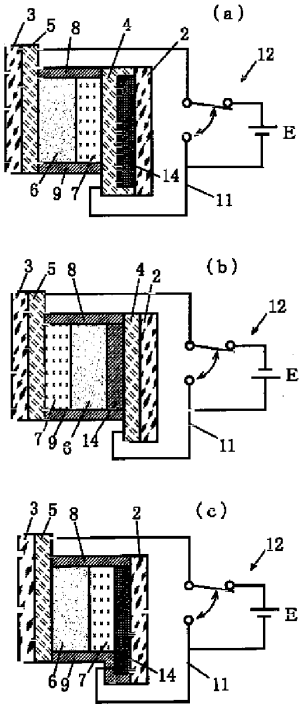
【符号の説明】

１　エレクトロクロミック素子
２、３　ガラス板
４、５　透明導電膜
６　電解液
７　エレクトロクロミック層
８、９　封止膜
１０　切換スイッチ
１１　回路線
１２　駆動回路
１３　防眩ミラー
１４　金属反射膜
１５　保護膜

【図１】

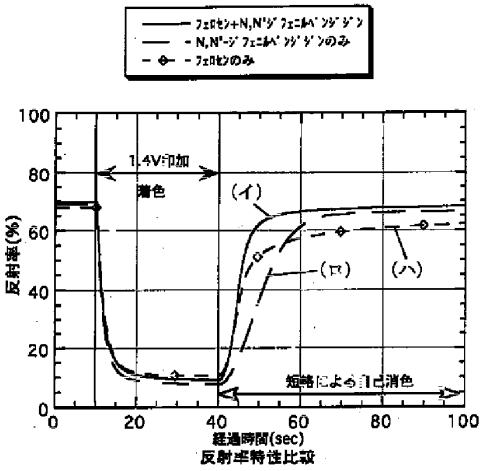


【図２】



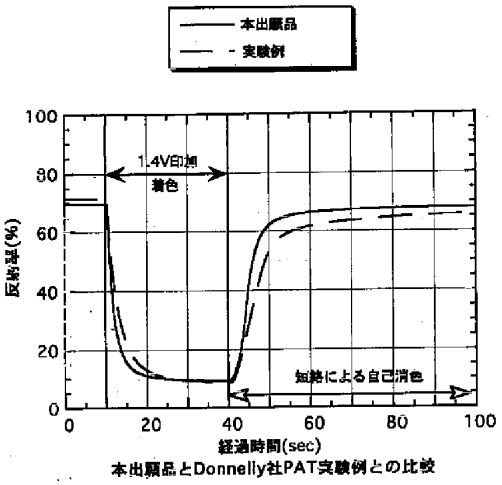
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【図3】



反射率特性比較

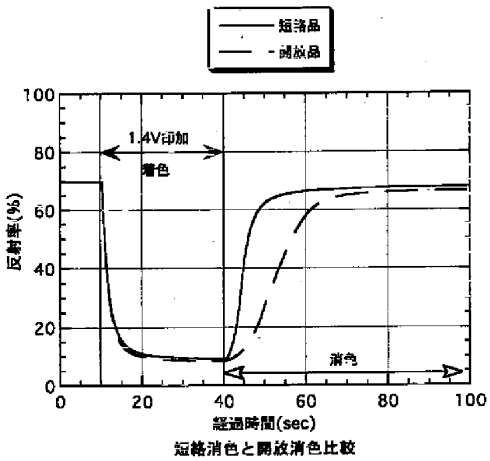
【図4】



本出願品とDonnelly社PAT実験例との比較

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【図5】



短絡消色と開放消色比較

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Doc Code: PA..
Document Description: Power of Attorney

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Application Number	Herewith
Filing Date	Herewith
First Named Inventor	Zhao CHEN
Title	ELECTROCHROMIC FILMS WITH EDGE PROTECTION
Art Unit	To be assigned
Examiner Name	To be assigned
Attorney Docket Number	50WF-383698-US

SIGNATURE of Applicant or Patent Practitioner

Signature	/Pengju Shang/	Date (Optional)	March 15, 2024
Name	Pengju Shang	Registration Number	80050
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

■ Practitioners associated with Customer Number: 139780

OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignments documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

■ The address associated with Customer Number: 139780

OR

☐	Firm or Individual Name			
	Address			
	City		State	Zip
	Country			
	Telephone		Email	

Assignee Name and Address: Furcifer Inc.
1455 Adams Drive, Suite 1650
Menlo Park, CA 94025

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be Filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of The practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature	Yan Zhou	Date	3/30/2016
Name	Yan Zhou	Telephone	530-574-4429
Title	CEO		

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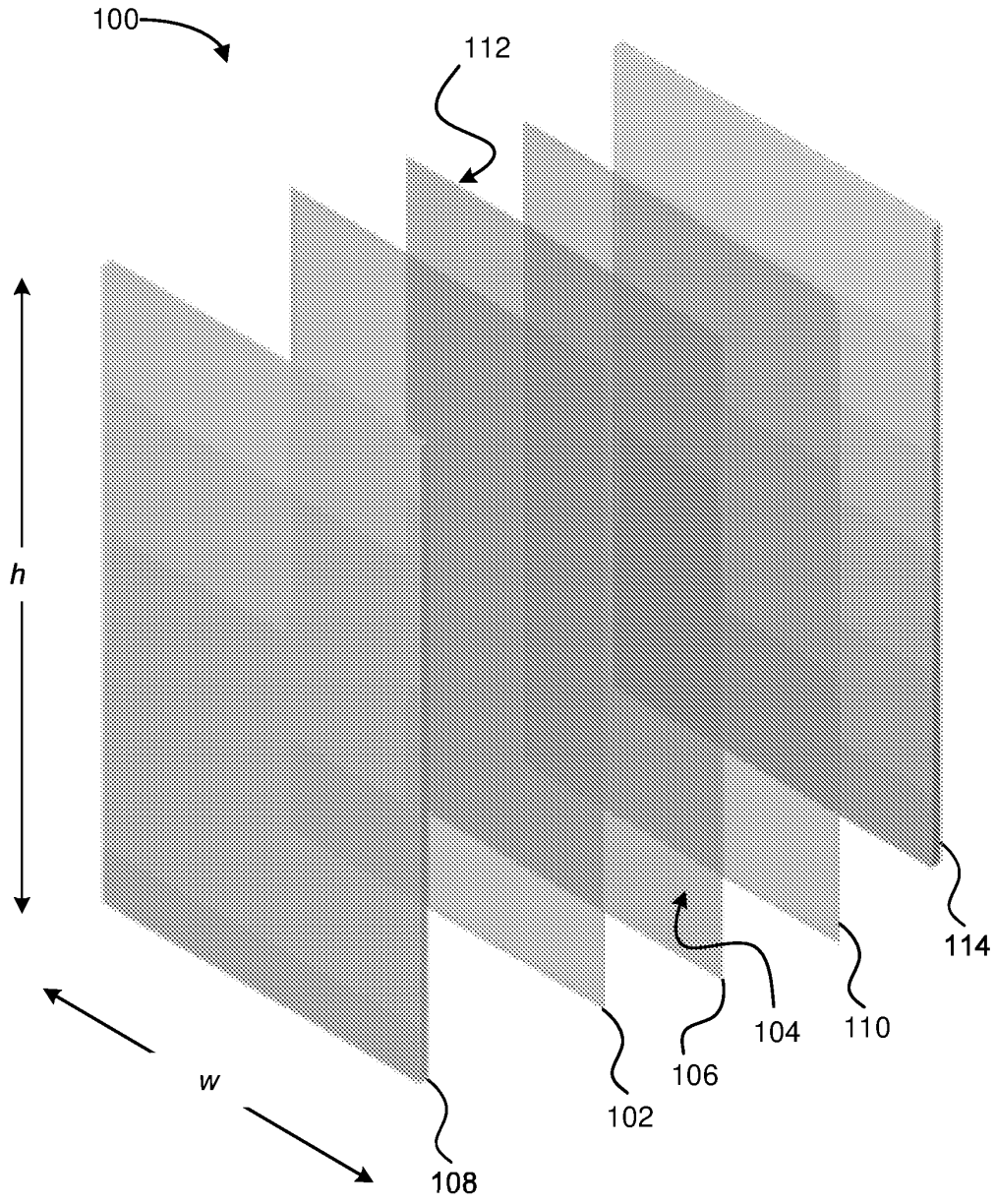


FIG. 1

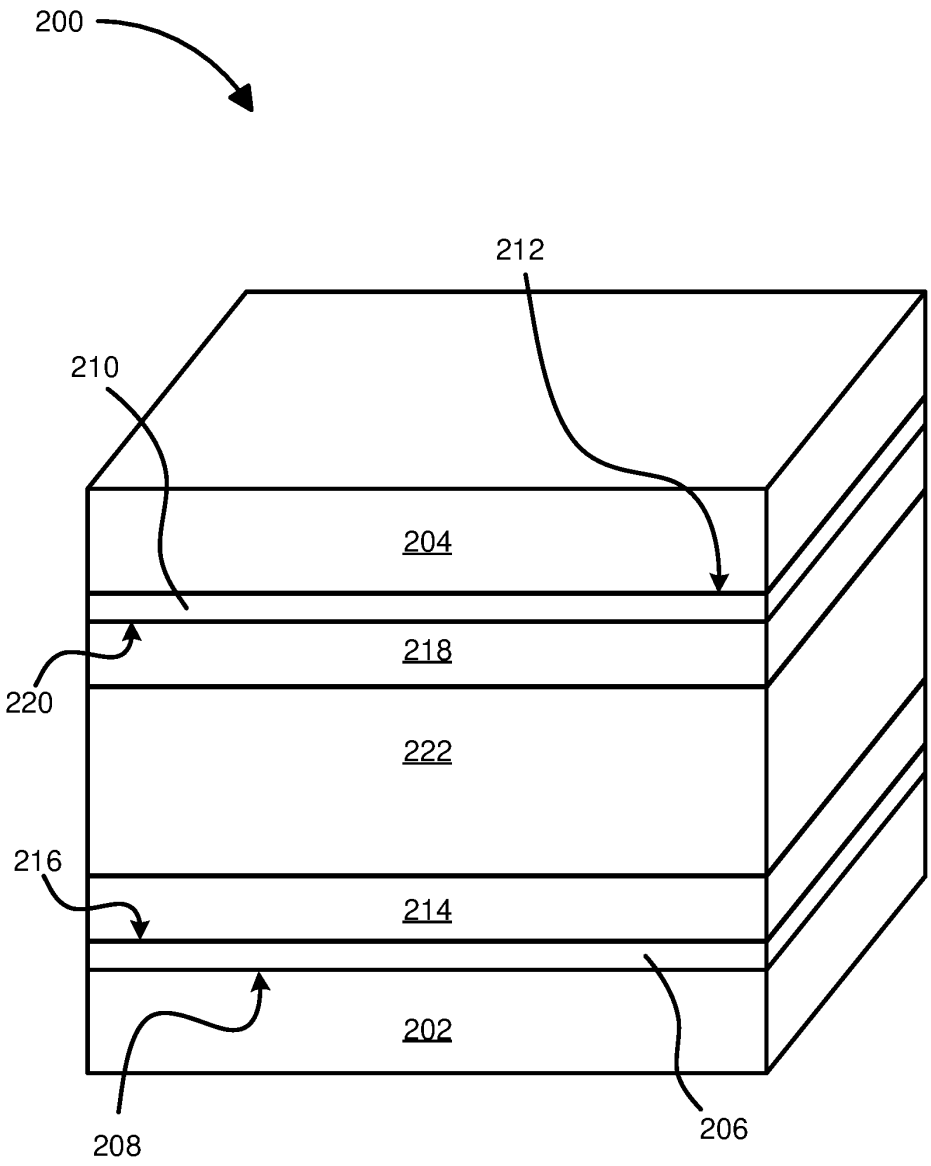


FIG. 2

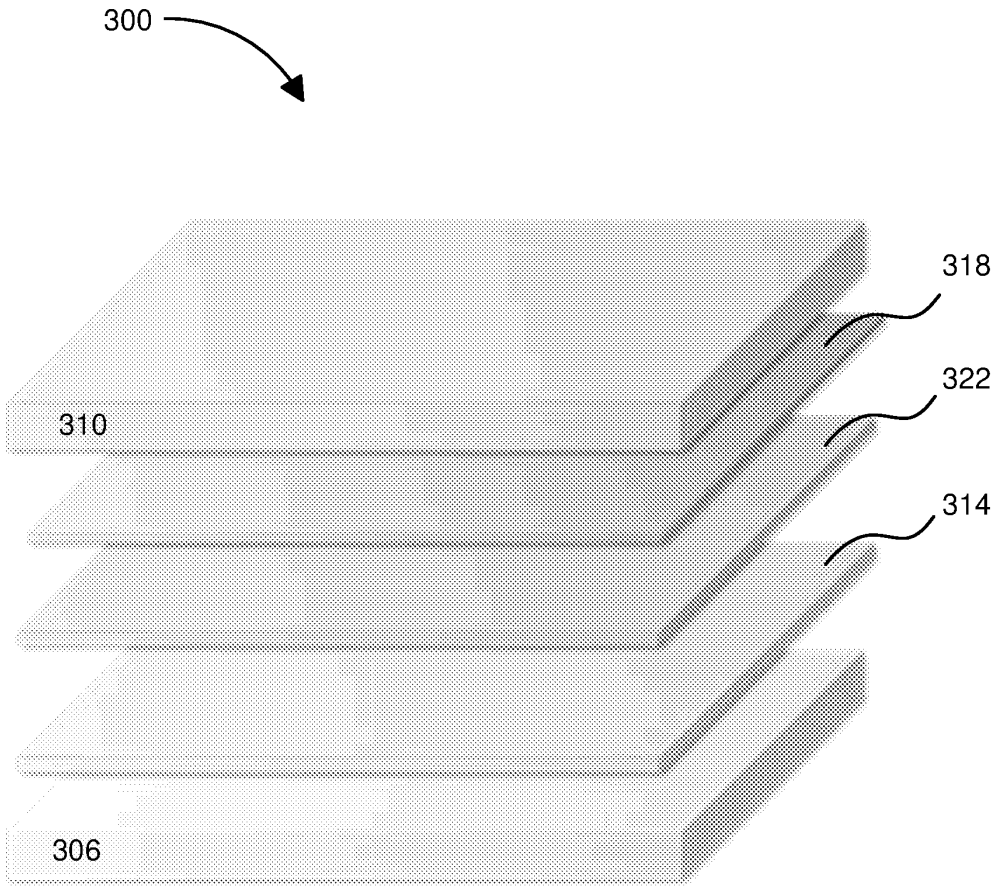


FIG. 3

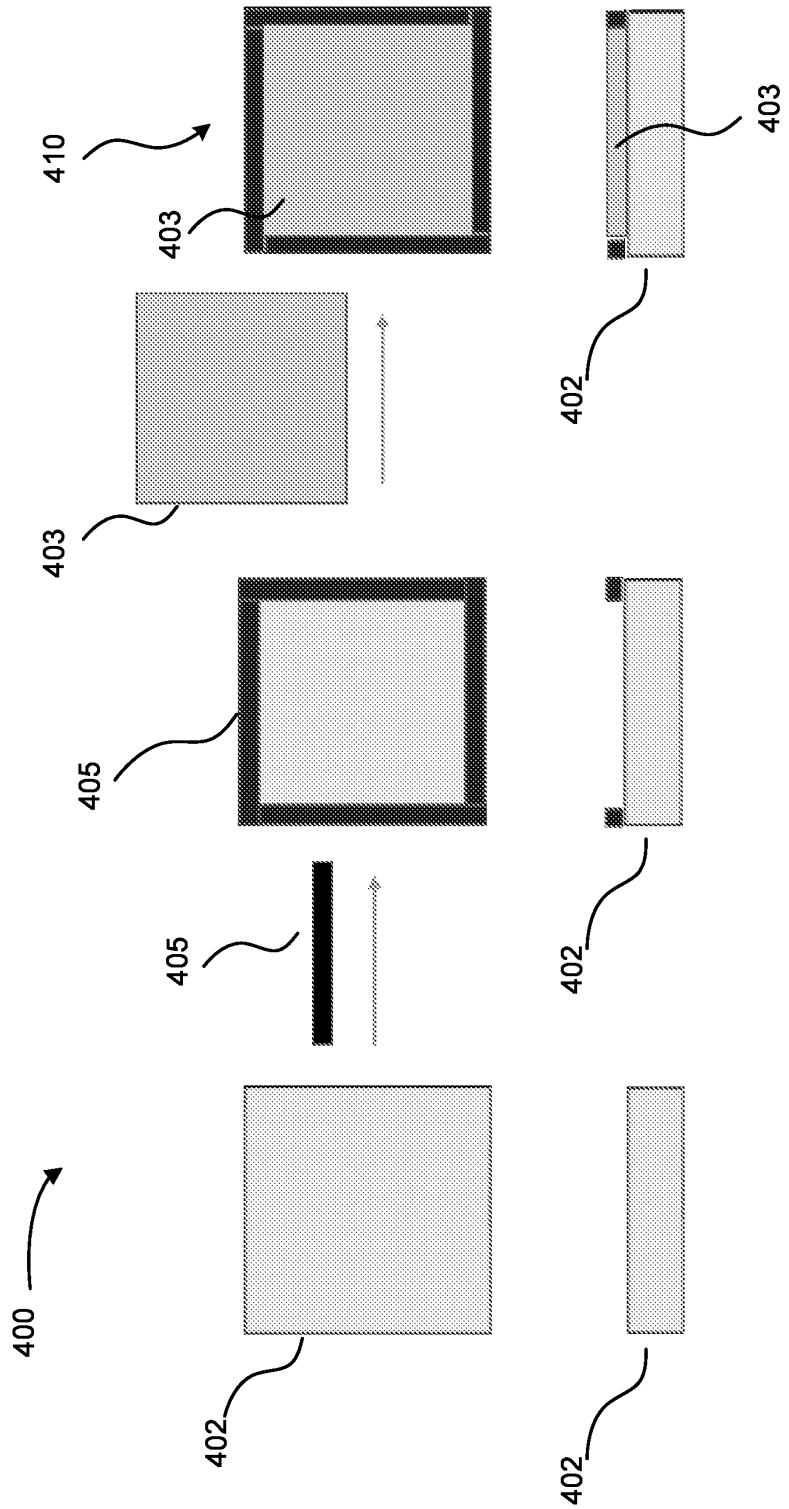


FIG. 4A

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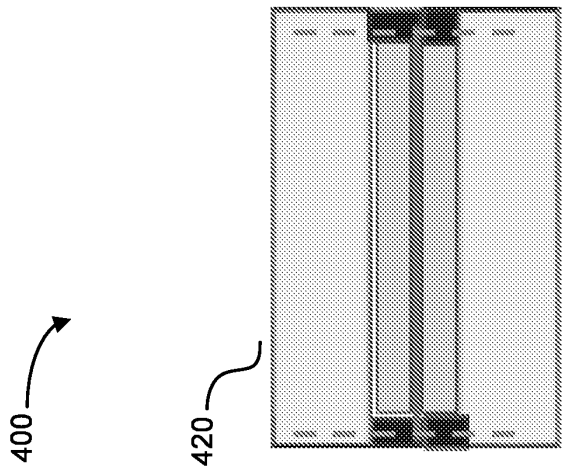


FIG. 4C

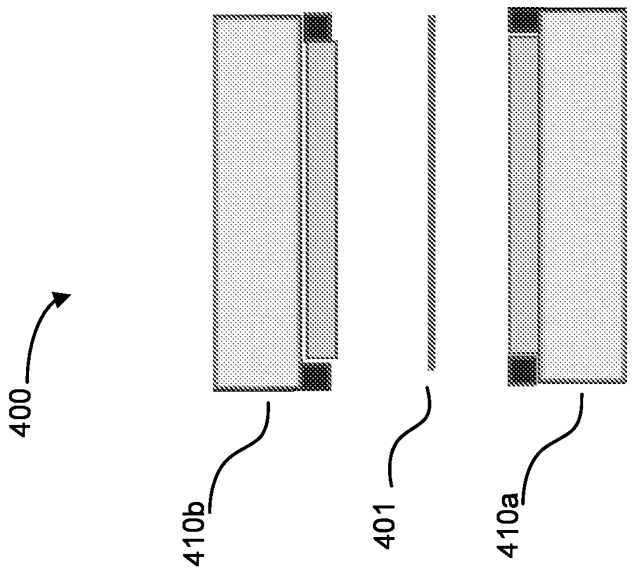


FIG. 4B

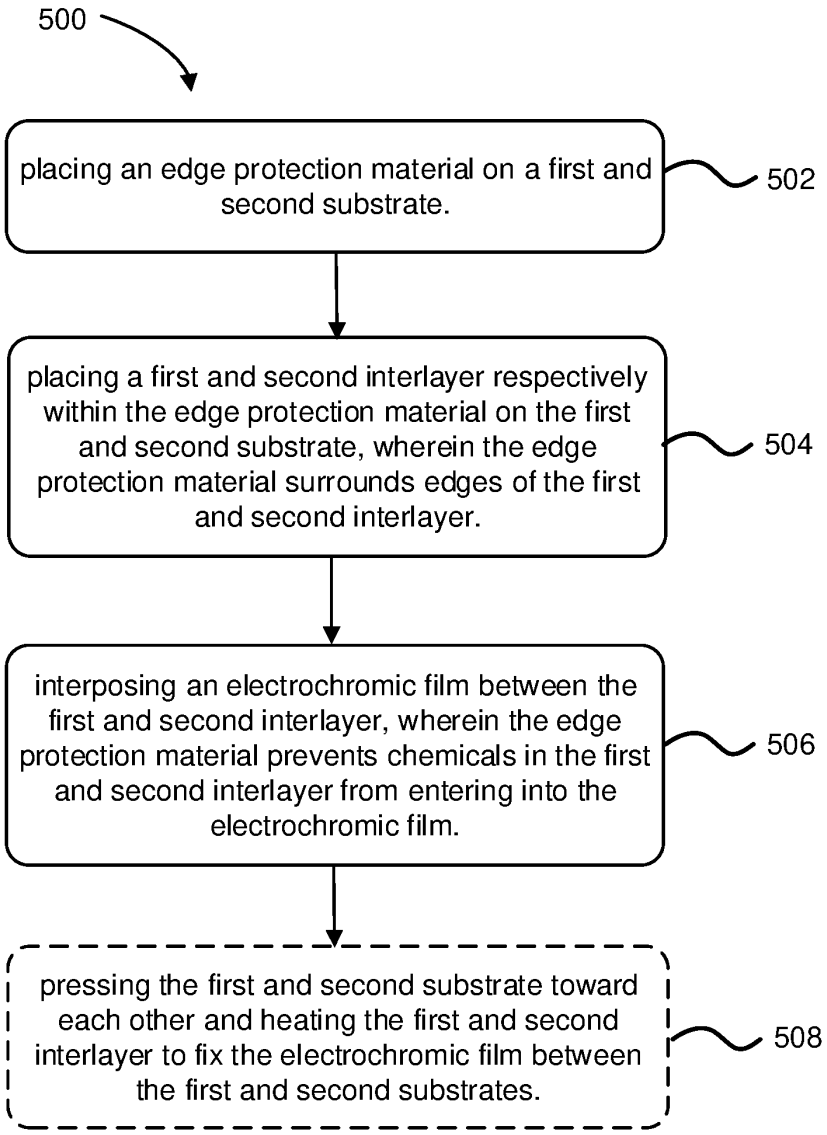

500
placing an edge protection material on a first and second substrate.
502
placing a first and second interlayer respectively within the edge protection material on the first and second substrate, wherein the edge protection material surrounds edges of the first and second interlayer.
504
interposing an electrochromic film between the first and second interlayer, wherein the edge protection material prevents chemicals in the first and second interlayer from entering into the electrochromic film.
506
pressing the first and second substrate toward each other and heating the first and second interlayer to fix the electrochromic film between the first and second substrates.
508

FIG. 5

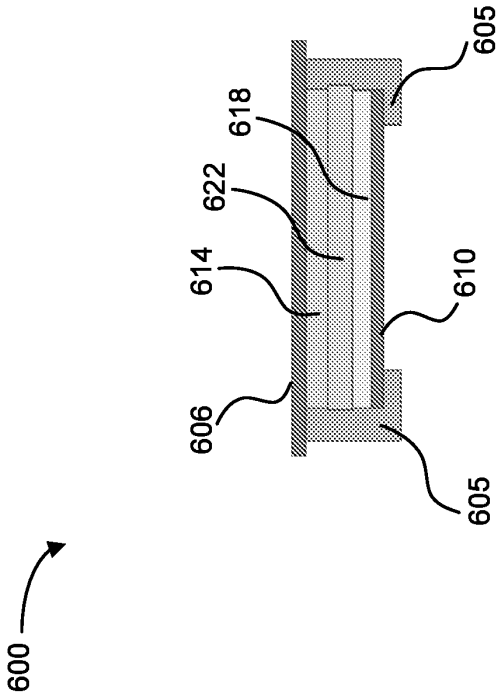


FIG. 6

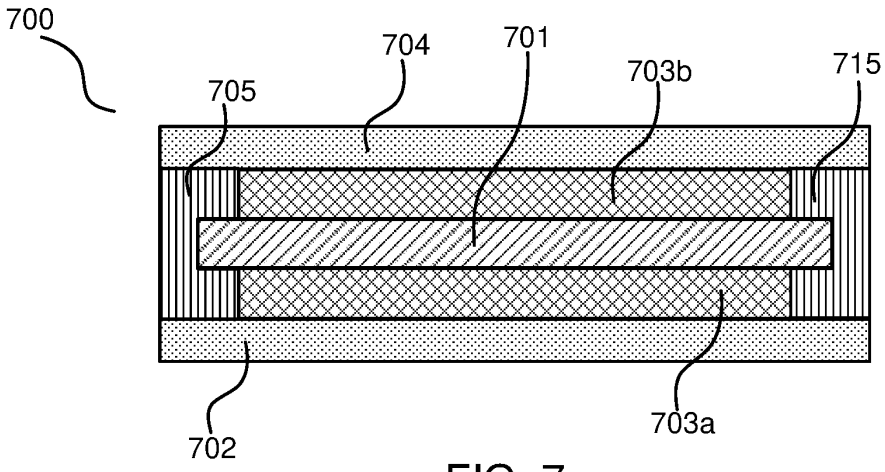


FIG. 7

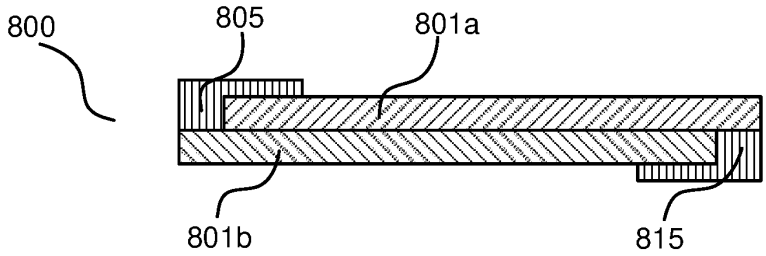


FIG. 8

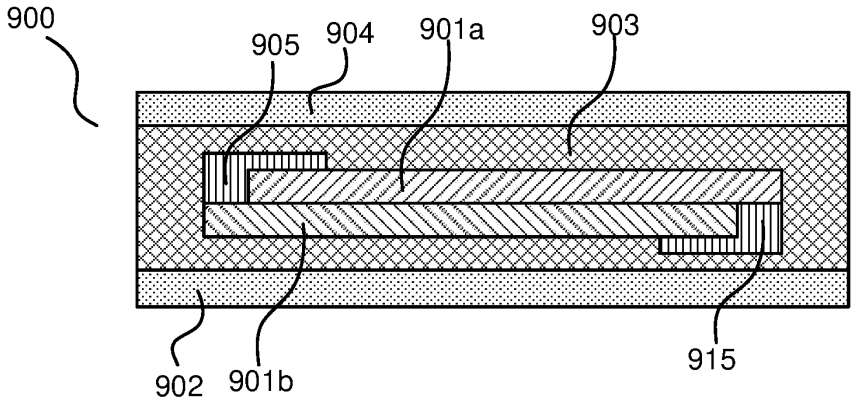


FIG. 9

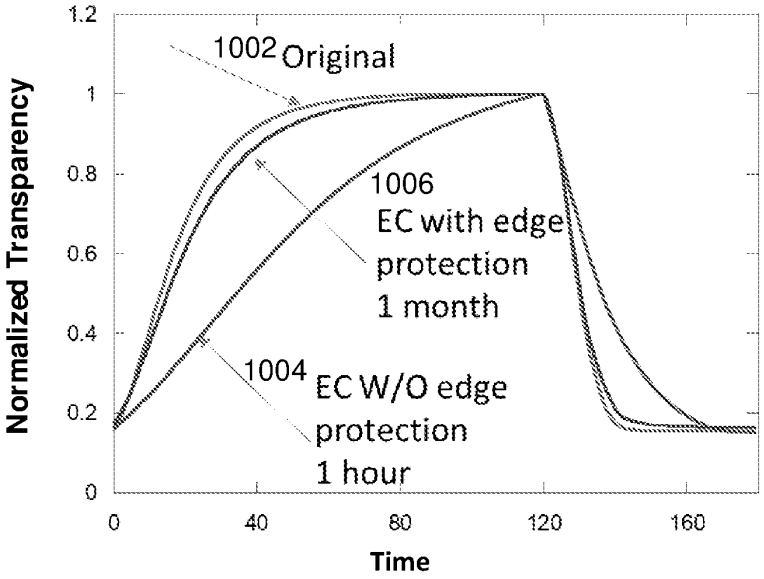


FIG. 10A

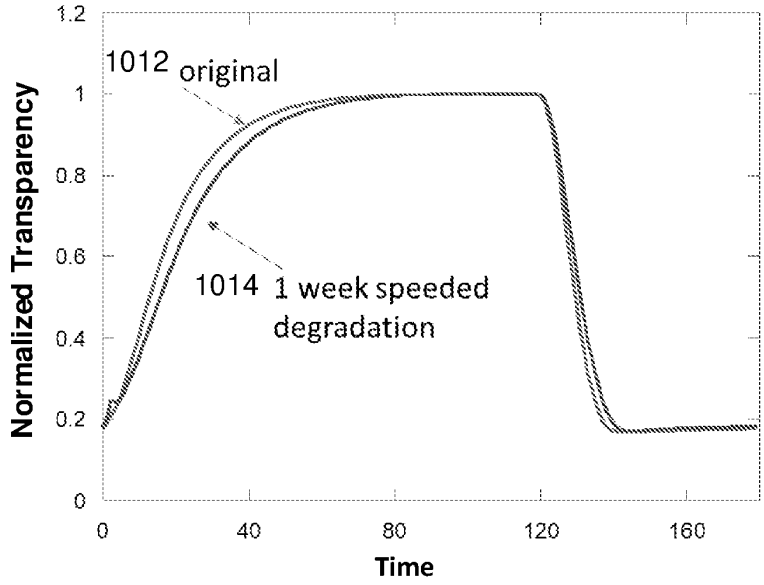


FIG. 10B

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	50WF-383698-US
	Application Number	
Title of Invention	ELECTROCHROMIC FILMS WITH EDGE PROTECTION	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

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☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Zhao		CHEN	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Camarillo	State/Province	CA	Country of Residence	US

Mailing Address of Inventor:

Address 1	4670 Del Rayo Ct.		
Address 2			
City	Camarillo	State/Province	CA
Postal Code	93012	Country	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Jian		WANG	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Fremont	State/Province	CA	Country of Residence	US

Mailing Address of Inventor:

Address 1	38034 Village Cmn, Apt. 213		
Address 2			
City	Fremont	State/Province	CA
Postal Code	94536	Country	US

Inventor 3 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Yan		ZHOU	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	50WF-383698-US
	Application Number	
Title of Invention	ELECTROCHROMIC FILMS WITH EDGE PROTECTION	

City	Fremont	State/Province	CA	Country of Residence	US

Mailing Address of Inventor:

Address 1	38271 Paseo Padre Parkway		
Address 2			
City	Fremont	State/Province	CA
Postal Code	94536	Country	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

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For further information see 37 CFR 1.33(a).

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Application Information:

Title of the Invention	ELECTROCHROMIC FILMS WITH EDGE PROTECTION		
Attorney Docket Number	50WF-383698-US	Small Entity Status Claimed	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	9	Suggested Figure for Publication (if any)	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	50WF-383698-US
	Application Number	
Title of Invention	ELECTROCHROMIC FILMS WITH EDGE PROTECTION	

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Customer Number	139780		

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When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	18152033	2023-01-09

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
18152033	Continuation of	16190723	2018-11-14	11571878	2023-02-07

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	Application Number	
Title of Invention	ELECTROCHROMIC FILMS WITH EDGE PROTECTION	

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

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Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
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	Application Number	
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Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	50WF-383698-US
	Application Number	
Title of Invention	ELECTROCHROMIC FILMS WITH EDGE PROTECTION	

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Applicant 1 Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◉ Assignee	○ Legal Representative under 35 U.S.C. 117	○ Joint Inventor
○ Person to whom the inventor is obligated to assign.	○ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	Furcifer Inc.		
Mailing Address Information For Applicant:			
Address 1	46717 Fremont Blvd.		
Address 2			
City	Fremont	**State/Province**	CA
Country	US	Postal Code	94538
Phone Number		Fax Number	
Email Address			

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Assignee Information including Non-Applicant Assignee Information:

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If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

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Signature	/Pengju Shang/			Date (YYYY-MM-DD)	2024-03-15
First Name	Pengju	Last Name	Shang	Registration Number	80050

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	50WF-383698-US
	Application Number	
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Espacenet

Bibliographic data: CN104698715 (A) — 2015-06-10

All-solid electrochromic device

Inventor(s): CHEN YI; WU WENXUAN; XU ZHENG; DENG HENGTAO; LUO DUO ± (CHEN YI, ; WU WENXUAN, ; XU ZHENG, ; DENG HENGTAO, ; LUO DUO)

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Classification: **- international:** ***G02F1/153***
- cooperative: **G02F1/1508 (CN)**

Application number: CN201310640917 20131204 Global Dossier

Priority number(s): CN201310640917 20131204

Abstract of CN104698715 (A)

The invention discloses an all-solid electrochromic device which can change color with the variations of the polarity and the strength of an external electric field. The all-solid electrochromic device sequentially comprises a transparent non-conducting base, a transparent conducting electrode layer, an electrochromic material layer, a polymer electrolyte layer, an ion storage layer, another conducting electrode layer and another non-conducting base, wherein the polymer electrolyte layer is a material layer composed of lithium salt, an organic solvent, a high-molecular polymer material, a prepolymer, a monomer, a photoinitiator and glass beads which are mixed according to a certain proportion, and then solidified through UV-irradiation. Finally, the device is sealed through non-conducting glue. Therefore, the all-solid electrochromic device is formed.

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DESCRIPTION CN104698715A

10 An all-solid-state electrochromic device

[0001]

14 technical field

[0002]

18 The invention relates to an electrochromic device, in particular to an all-solid-state electrochromic device using a polymer electrolyte.

[0003]

23 Background technique

[0004]

27 Electrochromic devices refer to the reversible change of the color of the electrochromic material and its reflection or transmission intensity of incident light with the change of the polarity and intensity of the applied electric field, so that the intensity of the transmitted solar radiation can be controlled. a device.

30 Since the electrochromic device can only change the color using a relatively low DC voltage (generally no more than ±5V), and has a memory effect, that is, after the external electric field is withdrawn, the current coloring can be maintained for a long time (generally more than 8 hours) or faded state, so the device consumes very little power.

34 If this kind of device is applied to the outer wall of the building, people can actively control the intensity of the transmitted solar radiation according to the change of season and time, which greatly saves the energy consumption of the building.

37 Other applications include: sunglasses, car sunroofs and side windows, anti-glare rear and side mirrors, aircraft

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portholes, electronic displays, etc.

[0005]

42 Electrochromic devices generally have a 5-layer structure: a transparent conductive electrode layer, an electrochromic material layer, an electrolyte layer, an ion storage layer, and another conductive electrode layer.

44 Electrochromic devices can be divided into two categories: liquid electrolytes and solid electrolytes according to the electrolytes used. For example, the electrochromic devices disclosed in the patents CN203012308U and CN101493625B all use liquid electrolytes, which are relatively simple to implement and have low cost. But there are also many problems, including corrosion and leakage of the electrolyte solution, difficult packaging, easy generation of air bubbles, and the thickness of the fabricated device is large. Patent CN100498493 uses the low temperature magnetron sputtering method to make all the film layers of the device including the lithium-containing thin film electrolyte layer. Although the thickness of the device is greatly reduced, the quality of the coating film is very high, and short-circuits are prone to occur. low and high cost. In addition, all-solid-state electrochromic devices can also be fabricated using a lithium-containing polymer electrolyte followed by curing. For example, patents US8218225B2 and CN101510038B disclose a thermal curing method for preparing an all-solid-state electrochromic device with a lithium-containing polymer electrolyte. In this method, when preparing the electrolyte layer, the lithium salt is first dissolved in an organic solvent, and then After mixing with two or more organic monomers, an initiator is added, and then the temperature is raised to promote the polymerization and crosslinking of the oligomer monomers to achieve the purpose of curing. However, the curing speed of this method is slow, time-consuming, high energy consumption, and complex process.

[0006]

63 SUMMARY OF THE INVENTION

[0007]

67 In view of the above problems, the present invention adopts the method of ultraviolet curing, first dissolving the lithium salt in the organic solvent, adding a certain amount of high molecular polymer material to adjust the viscosity of the solution and enhancing the conductivity of lithium ions, and then adding a pre- After the polymer, monomer, photoinitiator and glass microbeads to control the thickness of the interlayer of the device are fully mixed, the mixture is coated between the electrochromic material layer and the ion storage layer of the electrochromic device, and then the ultraviolet light is used. The energy of the polymer electrolyte is cured at room temperature, and finally the device is sealed with transparent non-conductive encapsulation glue to make an all-solid electrochromic device.

75 This method has high efficiency, low energy consumption, high repeatability, simplifies the packaging process of the device, is suitable for high-speed automated coating production, and can greatly improve production efficiency.

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[0008]

81 As shown in FIG. 1, the all-solid-state electrochromic device of the present invention includes a transparent non-conductive substrate, a transparent conductive electrode layer, an electrochromic material layer, another non-conductive substrate, a conductive electrode layer, an ion storage layer, and A polymer electrolyte layer between the electrochromic material layer and the ion storage layer.

[0009]

88 In an embodiment of the present invention, the transparent non-conductive substrate of the device may be an inorganic material, such as glass, or an organic material, such as: polyethylene terephthalate (Polythylene terephthalate), polyethylene Carbonate (Polycarbonate), polymethyl methacrylate (PMMA), etc.

[0010]

94 A transparent conductive electrode layer, such as: In 2 O 3 :Sn(ITO), SnO 2 :F(FTO), ZnO:Al(AZO), is formed on the above-mentioned transparent non-conductive substrate.

[0011]

99 In one embodiment of the present invention, the other non-conductive substrate can be a material that is transparent to visible light or a material that is opaque to visible light.

101 The conductive electrode layer formed on the above non-conductive substrate can be a conductive material transparent to visible light, such as: In 2 O 3 :Sn(ITO), SnO 2 :F(FTO), ZnO:Al(AZO), or It is a metal material with high reflectivity to visible light, such as: silver, aluminum, titanium, chromium, nickel, molybdenum, etc.

[0012]

108 In one embodiment of the present invention, the electrochromic material layer can be a cathodically colored electrochromic material, including organic electrochromic materials, transition metal oxides or Prussian blue, and can be: Vilogen, Pyrazoline, Poly(aniline), Tetrathiafulvalene, WO 3 , MoO 3 , Nb 2 O 5 , TiO 2 , V 2 O 5 , Fe 4 [Fe(CN) 6] 3 .

[0013]

115 In one embodiment of the present invention, the ion storage layer may be a weakly cathodically colored electrochromic material or an anodic colored electrochromic material.

117 Including: NiO, TiO 2 , V 2 O 5 , Co 2 O 3 , Rh 2 O 3 , IrO 2 , etc.

[0014]

121 In one embodiment of the present invention, the polymer electrolyte layer is composed of lithium salts,

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organic solvents, high molecular polymer materials, prepolymers, monomers and photoinitiators, and glass microspheres for controlling the thickness of the device interlayer , mixed in a certain proportion, and then cured by ultraviolet light to form a material layer.

[0015]

128 The above-mentioned lithium salt can be: lithium perchlorate (LiClO 4), lithium tetrafluoroborate (LiBF 4), lithium hexafluorophosphate (LiPF 6), lithium trifluoromethanesulfonate (LiCF 3 SO 3), bis(trifluoromethyl) sulfonic acid) lithium imide (LiN(CF 3 SO 2) 2) and the like.

[0016]

134 The above-mentioned organic solvent can be a solvent or a mixture of several solvents, including: Propylene carbonate, Dimethyl carbonate, Ethylene carbonate, Dimethyl formamide), Acetamide, Dimethyl acetamide, etc.

[0017]

140 The above-mentioned high molecular polymer can be: poly(methyl meth-acrylate), poly(ethylene oxide), poly(ethylene glycol), polycyclic Oxypropane (Poly(propylene oxide)), etc.

[0018]

145 The above-mentioned prepolymer is a reactive low-molecular-weight polymer, which can be polyester acrylate, epoxy acrylate, urethane acrylate, unsaturated polyester, polyolefin/thiol, and the like.

[0019]

150 The above-mentioned monomers are also called active diluents, and their main functions are to adjust the viscosity and participate in the polymerization reaction, and can be a mixture of one or several monomers such as: styrene, butyl acrylate, isooctyl acrylate, isobornyl acrylate, Tripropylene glycol diacrylate, hexanediol diacrylate, trimethylolpropane triacrylate and N-vinylpyrrolidone, etc.

[0020]

157 The function of the above-mentioned photoinitiator is to decompose and generate free radicals after absorbing the energy of ultraviolet light (wavelength 250-400nm), which in turn initiates the polymerization of monomers and prepolymers, so that the mixture changes from liquid to solid.

160 The photoinitiator can be: dibenzoyl, benzophenone, benzoin and its ether compounds such as benzoin dimethyl ether, benzoin ethyl ether, benzoin butyl ether and the like.

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[0021]

165 In this way, when the device is running, an electric field is applied at both ends of the device through the conductive electrodes, and by changing the polarity and intensity of the applied electric field, the lithium ions in the polymer electrolyte layer can reversibly enter and leave the electrochromic material layer, and the electrochromic material The color change of the device results in a continuous gradient adjustment of the transmittance or reflectance of the visible light.

[0022]

173 Electrochromic devices fabricated using this method have the following beneficial effects:

[0023]

177 1、The use of polymer electrolytes to prepare all-solid electrochromic devices can avoid the leakage problem of liquid electrolytes;

[0024]

182 2、Adding high molecular polymer can increase the viscosity of the electrolyte solution, which can improve the production efficiency of the coating process; it can also improve the conductivity of lithium ions and reduce the reaction time of the device;

[0025]

188 3、The use of glass beads to control the thickness of the interlayer of the device greatly reduces the thickness of the device, and also avoids the short circuit phenomenon of the device caused by the film defects caused by dust during coating;

[0026]

194 4、The polymer electrolyte is cured by using the energy of ultraviolet light. Compared with the thermal curing method, the energy consumption is low, the process is simple, and it is suitable for automatic coating production, which can greatly improve the production efficiency.

[0027]

200 Description of drawings

[0028]

204 Below in conjunction with accompanying drawing and embodiment, the present invention is further described:

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[0029]

209 FIG. 1 is a basic structural diagram of an all-solid-state electrochromic device.

210 In the figure, 101 is a transparent non-conductive substrate, 102 is a transparent conductive electrode layer, 103 is an electrochromic material layer, 201 is another non-conductive substrate, 202 is a conductive electrode layer, 203 is an ion storage layer, and 300 is a polymer electrolyte Layers, 401 and 402 are transparent non-conductive adhesives for device encapsulation.

[0030]

217 Detailed ways

[0031]

221 Implementation example 1: the specific implementation steps are as follows:

[0032]

225 （1）As shown in FIG. 1 , a transparent conductive electrode layer 102 is fabricated on a transparent non-conductive substrate 101 by a magnetron sputtering method, such as: ITO (In 2 O 3 :Sn), FTO (SnO:F) or AZO (ZnO: Al), its thickness is between 100nm-200nm, the sheet resistance is less than 20W/□, and the light transmittance is greater than 80%;

[0033]

232 （2）The electrochromic material layer 103 is made by magnetron sputtering method or vacuum evaporation method, such as: WO 3 , MoO 3 , and its thickness is between 100nm-500nm;

[0034]

237 （3）A transparent conductive electrode layer 202, such as ITO (In 2 O 3 :Sn), FTO (SnO:F) or AZO (ZnO:Al), is fabricated on another transparent non-conductive substrate 201 by magnetron sputtering. Between 100nm-200nm, the sheet resistance is less than 20W/□, and the light transmittance is greater than 80%;

[0035]

244 （4）Adopt magnetron sputtering method or vacuum evaporation method to make ion storage layer 203, such as: NiO, TiO 2 , V 2 O 5 , and its thickness is between 50nm-300nm;

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[0036]

249 （5）Prepolymer epoxy acrylate, monomer trimethylolpropane trimethacrylate and N-vinylpyrrolidone are prepared into a mixed solution according to the ratio of 3:1:2;

[0037]

254 （6）The benzoin dimethyl ether and benzophenone are prepared into a mixed photoinitiator according to the ratio of 2:1;

[0038]

259 （7）In the mixed solution of above-mentioned prepolymer and monomer, add above-mentioned mixed photoinitiator, and the weight ratio of photoinitiator is between 3%-5%;

[0039]

264 （8）

265 The lithium salt lithium perchlorate is dissolved in the organic solvent propylene carbonate, and magnetic stirring makes it completely dissolved, and the lithium salt concentration is between 0.1M/L and 1M/L.

267 Then add the high molecular polymer material polymethyl methacrylate with a weight ratio of 5% to 30%, and if necessary, heat the solution to 40-70 o C to make the solution mix uniformly;

[0040]

272 （9）In the mixed solution of above-mentioned lithium salt and macromolecular polymer, add above-mentioned mixed solution of prepolymer, monomer and photoinitiator according to the weight ratio of 3:1, and magnetically stir to make it evenly mixed;

[0041]

278 （10）Add glass beads (with a diameter of 10 microns to 100 microns) with a weight ratio of 3/1000, and magnetically stir to mix them evenly;

[0042]

283 （11）

284 Apply the mixed solution prepared in step 10 on the substrate 101 that has been plated with the film layers 102 and 103, put another substrate 201 that has been plated with the film layers 202 and 203 on it, and use a certain pressure to make the two The substrates are tightly bonded, and no air bubbles exist in the interlayer.

287 And the thickness of this interlayer is controlled by the diameter of the glass beads;

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[0043]

（12）The device is irradiated with ultraviolet light, and the solid polymer electrolyte layer 300 is formed after the mixed solution prepared in step 10 is cured;

[0044]

（13）Then, the transparent non-conductive adhesive glue is used to seal the device to make an all-solid electrochromic device.

[0045]

The device adopts a transparent substrate and transparent conductive electrodes on both sides, and is a transmissive electrochromic device.

[0046]

Example 2: When it is necessary to make a reflective electrochromic device, it is only necessary to replace the transparent conductive electrode layer 202 on another non-conductive substrate 201 in Example 1 with a metal material with high reflectivity, such as silver, Aluminum, titanium, chromium, nickel, molybdenum, etc. can be used.

Other steps are the same as in Example 1.

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(19)中华人民共和国国家知识产权局

(12)发明专利申请

(10)申请公布号 CN 104698715 A
(43)申请公布日 2015.06.10

(21)申请号 201310640917.3

(22)申请日 2013.12.04

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(51)Int.Cl.
G02F 1/153(2006.01)

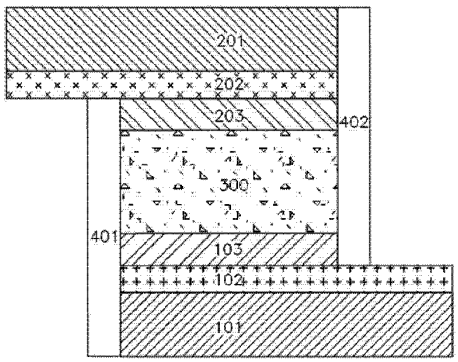
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(54)发明名称

一种全固态电致变色器件

(57)摘要

本发明公开了一种可以随着外加电场的极性和强度变化而改变颜色的全固态电致变色器件。本器件依次包括透明非导电基底、透明导电电极层、电致变色材料层、聚合物电解质层、离子存储层、另一导电电极层及另一非导电基底。其中所述聚合物电解质层是由锂盐、有机溶剂、高分子聚合物材料、预聚物、单体及光引发剂及玻璃微珠，按照一定比例混合，然后经过紫外光照射后固化形成的材料层。最后由透明不导电胶水将器件密封，从而制成全固态的电致变色器件。



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1. 一种全固态电致变色器件，其特征在于，包括：透明非导电基底；透明导电电极层，其形成于所述透明非导电基底之上；电致变色材料层，其形成于透明导电电极之上；另一非导电基底；导电电极层，其形成于所述另一非导电基底之上；离子存储层，其形成于导电电极层之上；聚合物电解质层，其形成于电致变色材料层和离子存储层之间，其特征在于：包含锂盐、有机溶剂、高分子聚合物材料、预聚物、单体及光引发剂，以及控制器件夹层厚度的玻璃微珠，按照一定比例混合，然后经过紫外光照射后固化形成的材料层。

2. 根据权利要求 1 所述的全固态电致变色器件，其特征在于，所述锂盐包括：高氯酸锂($LiClO_4$)、四氟硼酸锂($LiBF_4$)、六氟磷酸锂($LiPF_5$)、三氟甲基磺酸锂($LiCF_3SO_3$)、二(三氟甲基磺酸)亚胺锂($LiN(CF_3SO_2)_2$)。

3. 根据权利要求 1 所述的全固态电致变色器件，其特征在于，所述有机溶剂可以是一种溶剂或几种溶剂的混合物，包括：碳酸丙烯酯(Propylene carbonate)、碳酸二甲酯(Dimethyl carbonate)、碳酸乙烯酯(Ethylene carbonate)、二甲基甲酰胺(Dimethyl formamide)、乙酰胺(Acetamide)、二甲基乙酰胺(Dimethyl acetamide)。

4. 根据权利要求 1 所述的全固态电致变色器件，其特征在于，所述高分子聚合物包括：聚甲基丙烯酸甲酯(Poly(methyl meth-acrylate))、聚氧化乙烯(Poly(ethylene oxide))、聚乙稀乙二醇 Poly (ethylene glycole))、聚环氧丙烷(Poly(propylene oxide))。

5. 根据权利要求 1 所述的全固态电致变色器件，其特征在于，所述预聚物包括：聚酯丙烯酸酯、环氧丙烯酸酯、聚氨酯丙烯酸酯。

6. 根据权利要求 1 所述的全固态电致变色器件，其特征在于，所述单体可以是一种或几种单体的混合物，包括：苯乙烯、丙烯酸丁酯、丙烯酸异辛酯、丙烯酸异冰片酯、二缩三丙二醇二丙烯酸酯、已二醇二丙烯酸酯、三羟甲基丙烷三丙烯酸酯和 N- 乙烯基吡咯烷酮。

7. 根据权利要求 1 所述的全固态电致变色器件，其特征在于，所述光引发剂包括：联苯甲酰、二苯甲酮、安息香二甲醚、安息香乙醚、安息香丁醚。

8. 根据权利要求 1 所述的全固态电致变色器件，其特征在于，所述透明非导电基底，包括：玻璃，聚对苯二甲酸乙二醇酯(Polythylene terephthalate)、聚碳酸酯(Polycarbonate)、聚甲基丙烯酸甲酯(PMMA)。

9. 根据权利要求 1 所述的全固态电致变色器件，其特征在于，所述电致变色材料层包括：Vilogen、Pyrazoline、Poly(aniline)、Tetrathiafulvalene、WO_3、MoO_3、Nb_2O_5、TiO_2、V_2O_5、$Fe_4[Fe(CN)_6]_3$。

10. 根据权利要求 1 所述的全固态电致变色器件，其特征在于，所述离子存储层包括：NiO、TiO_2、V_2O_5、Co_2O_3、Rh_2O_3、IrO_2。

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一种全固态电致变色器件

技术领域

[0001] 本发明涉及一种电致变色器件，特别是一种采用聚合物电解质的全固态电致变色器件。

背景技术

[0002] 电致变色器件(Electrochromic Devices)是指随着外加电场极性和强度的变化，电致变色材料的颜色及其对入射光线的反射或透射强度发生可逆的改变，从而可以控制透过太阳辐射强度的一种器件。由于电致变色器件仅使用较低的直流电压(一般不超过±5V)即可改变颜色，并且具有记忆效应，即在外加电场撤销后，还可以长时间(一般超过 8 小时)保持当前的着色或褪色状态，因此器件的能耗非常少。这种器件如果应用于建筑物的外墙面，人们可以根据季节和时间的变化，主动控制透过的太阳辐射强度，大大节省建筑物的能耗。其他应用还包括：太阳眼镜、汽车天窗和侧窗、防眩目后视镜和侧视镜，飞机的舷窗、电子显示屏等。

[0003] 电致变色器件一般为 5 层结构：透明导电电极层、电致变色材料层、电解质层、离子存储层和另一导电电极层。电致变色器件按照使用的电解质可以分为液态电解质和固态电解质两大类。如专利 CN203012308U 和 CN101493625B 中公开的电致变色器件均采用液态电解质，实现起来比较简单，成本较低。但也存在许多问题，包括电解质溶液的腐蚀和漏液，封装困难，容易产生气泡，而且制作的器件厚度较大等等。专利 CN100498493 采用低温磁控溅射的方法制作包括含锂的薄膜电解质层在内的器件的所有膜层，虽然器件厚度大大减小，但是对镀膜质量要求很高，容易出现短路的情况，成品率低，而且成本也较高。此外，使用含锂的聚合物电解质然后固化的方法也可以制备全固态电致变色器件。如专利 US8218225B2 和 CN101510038B 中公开了用含锂的聚合物电解质制备全固态电致变色器件的热固化方法，这种方法是在制备电解质层时，将锂盐先溶解于有机溶剂之中，然后再和两种以上的有机单体混合后加入引发剂，再提高温度促使低聚物单体聚合和交联以达到固化的目的。但是这种方式固化速度较慢、耗时长，能耗高，工艺也复杂。

发明内容

[0004] 针对以上问题，本发明采用紫外固化的方式，将锂盐先溶于有机溶剂之中，加入一定量的高分子聚合物材料以调节溶液的粘稠度和增强锂离子的传导率，然后加入预聚物、单体、光引发剂以及控制器件夹层厚度的玻璃微珠并充分混合后，将此混合物涂布于电致变色器件的电致变色材料层和离子存储层之间，再利用紫外光的能量在室温下进行聚合物电解质的固化，最后利用透明不导电封装胶水将器件周围密封起来，制成全固态的电致变色器件。这种方式效率高、能耗低、可重复性高、简化了器件的封装工艺，适合高速自动化涂布生产，可以大大提高生产效率。

[0005] 如附图 1 所示，本发明所述的全固态电致变色器件包括透明非导电基底，透明导电电极层、电致变色材料层，另一非导电基底，导电电极层，离子存储层，以及处于电致变色

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材料层和离子存储层之间的聚合物电解质层。

[0006] 在本发明的一种实施方案中，所述器件的透明非导电基底，可以是无机材料，如玻璃，也可以是有机材料，如：聚对苯二甲酸乙二醇酯(Polythylene terephthalate)、聚碳酸酯(Polycarbonate)、聚甲基丙烯酸甲酯(PMMA)等。

[0007] 在上述透明非导电基底上形成透明导电电极层，如：In_2O_3:Sn(ITO)，SnO_2:F(FTO)，ZnO:Al(AZO)。

[0008] 在本发明的一种实施方案中，所述另一非导电基底可以是对可见光透明的材料，也可以是对可见光不透明的材料。在上述非导电基底上形成的导电电极层，可以是对可见光透明的导电材料，如：In_2O_3:Sn(ITO)，SnO_2:F(FTO)，ZnO:Al(AZO)，也可以是对可见光反射率较高的金属材料，如：银、铝、钛、铬、镍、钼等。

[0009] 在本发明的一种实施方案中，所述电致变色材料层可以是阴极着色电致变色材料，包括有机电致变色材料、过渡金属氧化物或普鲁士蓝，可以是：Vilogen、Pyrazoline、Poly(aniline)、Tetrathiafulvalene、WO_3、MoO_3、Nb_2O_5、TiO_2、V_2O_5、$Fe_4[Fe(CN)_6]_3$。

[0010] 在本发明的一种实施方案中，所述离子存储层可以是弱阴极着色电致变色材料或阳极着色电致变色材料。包括：NiO、TiO_2、V_2O_5、Co_2O_3、Rh_2O_3、IrO_2 等。

[0011] 在本发明的一种实施方案中，所述聚合物电解质层是由锂盐、有机溶剂、高分子聚合物材料、预聚物、单体及光引发剂，以及控制器件夹层厚度的玻璃微珠，按照一定比例混合，然后经过紫外光照射后固化形成的材料层。

[0012] 上述锂盐可以是：高氯酸锂($LiClO_4$)、四氟硼酸锂($LiBF_4$)、六氟磷酸锂($LiPF_6$)、三氟甲基磺酸锂($LiCF_3SO_3$)、二(三氟甲基磺酸)亚胺锂($LiN(CF_3SO_2)_2$) 等。

[0013] 上述有机溶剂可以是一种溶剂或几种溶剂的混合物，包括：碳酸丙烯酯(Propylene carbonate)、碳酸二甲酯(Dimethyl carbonate)、碳酸乙烯酯(Ethylene carbonate)、二甲基甲酰胺(Dimethyl formamide)、乙酰胺(Acetamide)、二甲基乙酰胺(Dimethyl acetamide) 等。

[0014] 上述高分子聚合物可以是：聚甲基丙烯酸甲酯(Poly(methyl meth-acrylate))、聚氧化乙烯(Poly(ethylene oxide))、聚乙稀乙二醇 Poly (ethylene glycole))、聚环氧丙烷(Poly(propylene oxide)) 等。

[0015] 上述预聚物是具有反应活性的低分子聚合物，可以是：聚酯丙烯酸酯、环氧丙烯酸酯、聚氨酯丙烯酸酯、不饱和聚酯、聚烯烃 / 硫醇等。

[0016] 上述单体又叫活性稀释剂，其主要作用是调节粘度和参加聚合反应，可以是一种或几种单体的混合物如：苯乙烯、丙烯酸丁酯、丙烯酸异辛酯、丙烯酸异冰片酯、二缩三丙二醇二丙烯酸酯、已二醇二丙烯酸酯、三羟甲基丙烷三丙烯酸酯和 N- 乙烯基吡咯烷酮等。

[0017] 上述光引发剂的作用是在吸收紫外光(波长 250 ～ 400nm)能量后，分解产生自由基，进而引发单体及预聚物的聚合反应，使混合物由液态转变为固体。光引发剂可以是：联苯甲酰、二苯甲酮、安息香及其醚化合物如安息香二甲醚、安息香乙醚、安息香丁醚等。

[0018] 这样，在器件运行时，通过导电电极在器件两端加上电场，通过改变外加电场的极性和强度，聚合物电解质层中的锂离子可以可逆地进出电致变色材料层，电致变色材料的颜色改变导致器件对可见光的透过率或反射率实现连续的渐变式调节。

[0019] 使用这种方法制作的电致变色器件具有以下有益效果：

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1、使用聚合物电解质制备全固态电致变色器件，可以避免液态电解质的漏液问题；

2、加入高分子聚合物可以增加电解质溶液的粘稠度，可提高涂布工艺的生产效率；还可以提高锂离子的传导率，减少器件的反应时间；

3、采用玻璃微珠控制器件的夹层厚度，使器件厚度大大减少，并且还可以避免由于镀膜期间的灰尘引起的薄膜缺陷而导致的器件短路现象；

4、利用紫外光的能量实现聚合物电解质的固化，相比热固化的方法，能耗低、工艺简单、适合自动化涂布生产，可以大大提高生产效率。

附图说明

[0020] 下面结合附图和实施实例对本发明进一步说明：

附图 1 为全固态电致变色器件的基本结构图。图中，101 是透明非导电基底、102 是透明导电电极层、103 是电致变色材料层、201 是另一非导电基底、202 是导电电极层、203 是离子存储层、300 是聚合物电解质层，401 和 402 是器件封装用透明不导电粘合胶。

具体实施方式

[0021] 实施实例 1：具体实施步骤如下：

（1）如附图 1 所示，采用磁控溅射法在透明非导电基底 101 上制作透明导电电极层 102，如：ITO（In_2O_3:Sn），FTO（SnO:F）或 AZO(ZnO:Al)，其厚度在 100nm-200nm 之间，方块电阻小于 20W/ □，且透光率大于 80%；

（2）采用磁控溅射法或真空蒸镀法制作电致变色材料层 103，如：WO_3、MoO_3，其厚度在 100nm-500nm 之间；

（3）采用磁控溅射法在另一透明非导电基底 201 上制作透明导电电极层 202，如：ITO（In_2O_3:Sn），FTO（SnO:F）或 AZO(ZnO:Al)，其厚度在 100nm-200nm 之间，方块电阻小于 20W/ □，且透光率大于 80%；

（4）采用磁控溅射法或真空蒸镀法制作离子存储层 203，如：NiO、TiO_2，V_2O_5，其厚度在 50nm-300nm 之间；

（5）将预聚物环氧丙烯酸酯、单体三羟甲基丙烷三甲基丙烯酸酯和 N- 乙烯基吡咯烷酮按照 3:1:2 的比例配成混合溶液；

（6）将安息香二甲醚和二苯甲酮按照 2:1 的比例配成混合光引发剂；

（7）在上述预聚物和单体的混合溶液中加入上述混合光引发剂，光引发剂的重量比为 3%-5% 之间；

（8）将锂盐高氯酸锂，溶解于有机溶剂碳酸丙烯酯之中，磁力搅拌使其完全溶解，锂盐浓度为 0.1M/L 至 1M/L 之间。再加入重量比为 5% 至 30% 的高分子聚合物材料聚甲基丙烯酸甲酯，必要时将溶液加温至 40-70°C 使溶液混合均匀；

（9）在上述锂盐和高分子聚合物的混合溶液中按照 3:1 的重量比加入上述由预聚物、单体和光引发剂组成的混合溶液，磁力搅拌使其混合均匀；

（10）加入重量比为千分之三的玻璃微珠（直径为 10 微米至 100 微米之间），磁力搅拌使其混合均匀；

（11）将步骤 10 中配备的混合溶液涂布于已经镀有膜层 102 和 103 的基底 101 之上，将

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另一已经镀有膜层 202 和 203 的基底 201 置于其上，使用一定压力，使两个基底紧密结合，没有气泡存在夹层之中。并且此夹层厚度由玻璃微珠的直径控制；

（12）采用紫外光对器件进行照射，步骤 10 中配备的混合溶液固化后形成固态聚合物电解质层 300；

（13）然后再利用透明不导电粘合胶水，将器件密封，制成全固态的电致变色器件。

[0022] 此器件两边都采用透明基底和透明导电电极，为透射型电致变色器件。

[0023] 实施实例 2：在需要制作反射型电致变色器件时，只需将实例 1 中的在另一非导电基底 201 上的透明导电电极层 202 换成具有高反射率的金属材料，如：银、铝、钛、铬、镍、钼等即可。其他步骤跟实例 1 中相同。

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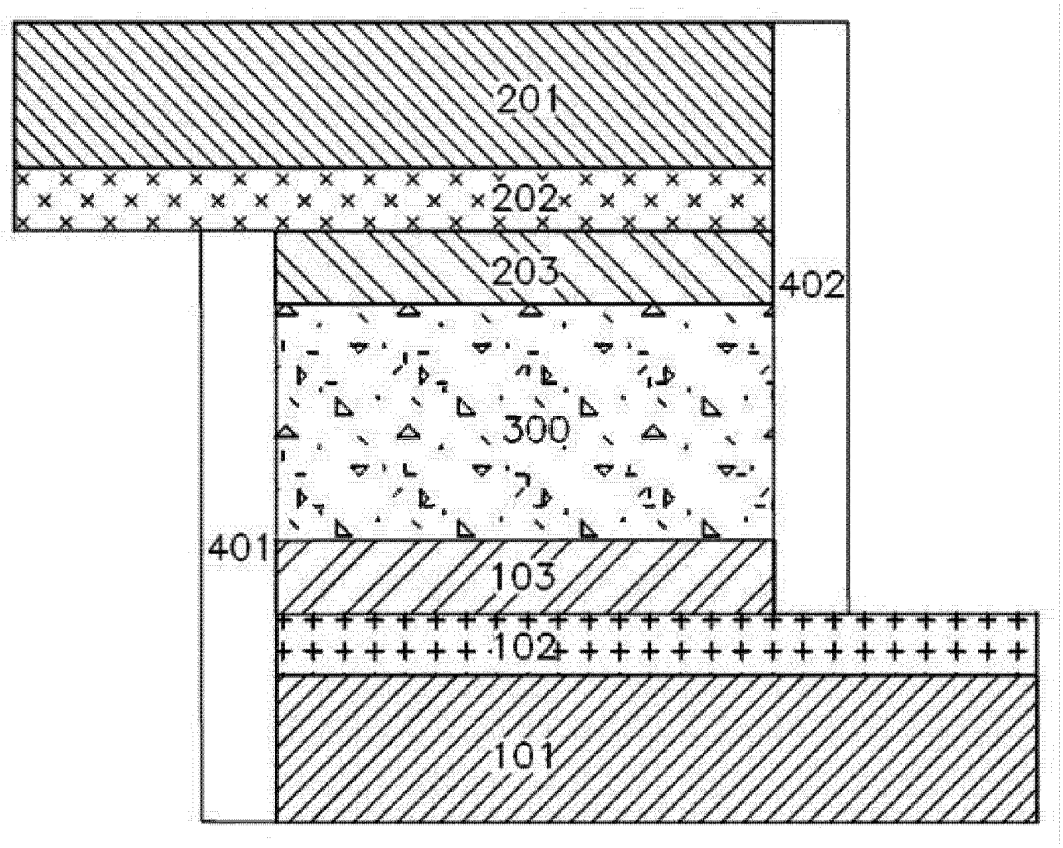


图 1

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UNITED STATES
PATENT AND TRADEMARK OFFICE

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www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/606,980	**03/15/2024 05:17:54 PM Z ET**	**50WF-383698-US**

Title of Invention

ELECTROCHROMIC FILMS WITH EDGE PROTECTION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9999	FILED BY	Chizu Sato
PATENT CENTER #	64708538	FILING DATE	-
CUSTOMER #	139780	FIRST NAMED INVENTOR	Zhao CHEN
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	PJ Shang

Documents

TOTAL DOCUMENTS: 20

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
Furcifer12USC3_50WF-383698-US_ADS_SMALL.pdf	9	Application Data Sheet	2174 KB
Furcifer12USC3_50WF-383698-US_Drawings_DRW.pdf	9	Drawings-only black and white line drawings	295 KB
Furcifer12USC3_50WF-383698-US_Specification-APP.TEXT.docx	17	Application body structured text document	55 KB
Furcifer12USC3_50WF-383698-US_POA.pdf	2	Power of Attorney	421 KB
Furcifer12USC3_50WF-383698-US_SignedDeclaration-	3	Oath or Declaration filed	1754 KB

parent_OATH.pdf			
Furcifer12USC3_50WF-383698-US_IDS.pdf	6	Information Disclosure Statement (IDS) Form (SB08)	1011 KB
NPL_Furcifer12CN_1stSearchReport.pdf	3	Non Patent Literature	71 KB
NPL_EPOA_2021-04-30.pdf	5	Non Patent Literature	317 KB
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Digest

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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
25 March 2010 (25.03.2010)

PCT

(10) International Publication Number
WO 2010/032068 A1

(51) **International Patent Classification**:
E06B 9/24 (2006.01)

(21) **International Application Number**:
PCT/GB2009/051232

(22) **International Filing Date**:
22 September 2009 (22.09.2009)

(25) **Filing Language**: English

(26) **Publication Language**: English

(30) **Priority Data**:
0817299.1 22 September 2008 (22.09.2008) GB

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(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

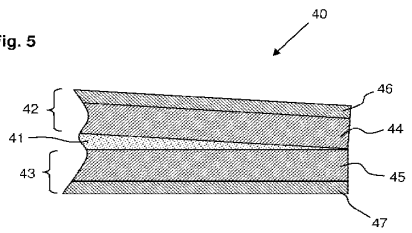
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— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

WO 2010/032068 A1

(54) **Title**: SWITCHABLE GLAZING

Fig. 5



(57) **Abstract**: An edge sealed switchable film assembly is disclosed. The assembly comprises an active portion, the optical transmission of which changes with an applied voltage, laminated between first and second planar electrode layers. The planar electrode layers comprise a plastics substrate material having an electrically conductive coating disposed on at least a portion of one surface thereof, and an edge seal adapted to prevent leakage or contamination of the active layer material provided around at least a portion of the periphery of the switchable film. At least the second planar electrode layer has the ply of plastics material in contact with the active portion.

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SWITCHABLE GLAZING

The present invention relates to switchable films and glazings containing such films, in particular, to the connection of such films to external power supplies.

In recent years, glazings having some form of additional functionality have become increasingly popular and sought-after. Typically, additional functionality is provided by using at least one ply of coated or tinted glass within a laminated glazing structure, to provide heat or UV-reflective properties. However, additional functionality can also be provided by including a functional device or film within a laminated glazing structure. Such devices or films may include lighting devices, such as LEDs (light emitting diodes), or switchable films, having an active layer whose optical transmittance can be altered, such as, LCDs (liquid crystal devices), or SPDs (suspended particle devices).

An SPD film, such as that described in WO2005/102688 and available under licence from Research Frontiers is a film comprising a plurality of particles suspended within a liquid suspension medium, which are held within a polymer medium. The film is switchable between a dark state (when no is voltage applied), and a highly transparent state (when voltage is applied). The degree of relative alignment between the particles is determined by the applied AC voltage, such that an SPD-based device exhibits a variable optical transmission when a variable voltage is applied.

The construction of a conventional SPD film is shown in Figure 1a. Figure 1a is a schematic cross-sectional view of a conventional SPD film assembly. The SPD film 1 has a laminated structure comprising an active layer of a suspended particle emulsion 2 arranged to lie between a first planar electrode 3a and a second planar electrode 3b. The optical transmission of the active layer changes with an applied voltage. The active layer may have an overcoat layer (not shown) on each surface thereof. Each planar electrode comprises a ply of a plastics substrate material 4a, 4b, generally a ply of polyethylene terephthalate (PET), having an electrically conductive coating 5a, 5b, generally an indium tin oxide coating (ITO) disposed on at least a portion of one surface thereof. The electrically conductive coatings 5a, 5b enable a direct electrical contact between the

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suspended particle emulsion 2 and an external power supply (not shown) to be provided via suitable electrical connectors.

DE 100 43 141 discloses a glazing for use as a rooflight, which incorporates an SPD layer. Two plies of glass are formed into a double glazing structure having a partial vacuum in the gap between the plies, with an SPD layer deposited on the inner side of the lower glass ply. The SPD is switchable between a dark state and a light state.

It is preferable to be able to include a functional device, such as an SPD film within a laminated glazing structure, as the whole, or part of, the interlayer, as described in, for example, US2004/0257649, rather than using a partially evacuated double glazing structure. The interlayer used in typical laminated glazing constructions is a PVB (poly vinyl butyral) interlayer. In order to protect the SPD film within the interlayer, it is preferable that the edges of the film do not reach the edges of the glass. It is known to use a "picture frame" design, where three interlayers, rather than the usual one, are used to laminate a functional film within a glazing. A central layer, approximately the same thickness of the functional film, is cut such that the film can be placed within an interlayer frame. The film and interlayer frame are then placed between two further interlayers, and laminated between two plies of glass.

Figure 1b is a schematic drawing showing the construction of a glazing having an SPD film assembly laminated therein. The glazing 6 has an SPD film assembly 1 laminated within an interlayer structure 7, which is itself laminated between two plies of glass 8a, 8b. The laminated structure 7 comprises three layers of interlayer material, 9a, 9b, 9c. The first interlayer 9a has a region cut of the centre in which the SPD film assembly sits, such that the first interlayer 9a forms the "picture frame". Preferably the thickness of the SPD film assembly 1 is of the same order as the first interlayer 9a. The first interlayer 9a is laminated between second 9b and third 9c interlayers, which are co-extensive with the plies of glass 8a, 8b.

Generally, polyvinyl butyral-based interlayer materials are not suitable for use in laminating SPD films owing to their incompatibility. This is believed to be caused by

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migration of the plasticiser within the PVB material into the SPD film during lamination and subsequent exposure to heat. This results in a degradation in the switching properties of the switchable film over time. This problem is described, for example, in WO2005/102688 and WO2007/122428.

One solution to this problem is to provide a physical barrier layer around the periphery of the switchable film to prevent ingress of mobile plasticiser components during lamination or subsequently. In addition, such barrier seals prevent leakage of the active layer components when laminated in a glazing. Four such barrier seals are shown in Figures 2a, 2b, 2c and 2d.

Figure 2a is a schematic cross-section of a one-part edge seal around the exposed edge of an SPD film. A piece of tape 20 is adhered to an exposed surface of a first electrode 21 of the SPD film 22 and to the exposed surface of a second electrode 23 of the SPD film 22. The tape 20 stretches across the exposed edge of the SPD film 22. This creates a barrier along the exposed edge of the SPD film 22, all around its periphery.

Figure 2b is a schematic cross-section of a two-part edge seal around the exposed edge of an SPD film. In this case, a first piece of tape 24 is adhered to the exposed surface of the first electrode 21 and, and second piece of tape 25 is adhered to the exposed surface of the second electrode 23. The first 24 and second 25 pieces of tape are pressed together to form a joint 26. This forms a barrier all around its periphery.

Figure 2c is a schematic cross-section of a hot-melt barrier seal around the exposed edge of an SPD film. In this case, hot melt 27 is applied along the exposed edge of the SPD film 22, overlapping onto the exposed surfaces of both the first 21 and second 23 electrode. This forms a barrier all around the periphery of the SPD film 22.

Figure 2d is a schematic cross-section of a crimped seal around the exposed edge of an SPD film. In this case, the first 21 electrode and the second electrode 23 are pinched or melted together at their edges 28, effectively encapsulating the SPD emulsion within the SPD film 22. Again, this creates a barrier all around the periphery of the SPD film 22.

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However, each of these solutions may be disadvantageous, as the SPD film is soft and has a tendency to deform. In particular, around the edge region, the SPD emulsion is easily squashed during application of the barrier and/or subsequent processing. The main issue with this is that with the addition pressure applied to the periphery of the film during lamination, the SPD emulsion may be compressed enough that the electrically conductive surfaces of the two electrodes come into contact, leading to a short circuit.

Therefore it is desirable to be able to create a seal around the edge of the SPD or other switchable film that minimises the occurrences of short circuits whilst providing an effective barrier layer against chemical penetration.

The present invention aims to address these problems by providing an edge sealed switchable film assembly comprising an active portion, the optical transmission of which changes with an applied voltage, laminated between first and second planar electrode layers, the planar electrode layers comprising a plastics substrate material having an electrically conductive coating disposed on at least a portion of one surface thereof, and an edge seal adapted to prevent leakage or contamination of the active layer material provided around at least a portion of the periphery of the switchable film, wherein at least the second planar electrode layer has the ply of plastics material in contact with the active portion.

By reversing one of the planar electrodes such that the electrically conductive coating is no longer in contact with the active portion of the switchable film, the possibility of shorting when the periphery of the film is compressed is removed.

The optical transmission of the active portion may be changed by changing the absorption properties or the scattering properties of the active portion.

Preferably, the first and second planar electrode layers have the ply of plastics material in contact with the active portion.

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Preferably the plastics substrate material of the first planar electrode layer is in between the active portion and the electrically conductive coating of the first planar electrode layer, and the electrically conductive coating of the second planar electrode layer is in between the active portion and the plastics substrate material of the second planar electrode layer.

Preferably the active portion comprises an active layer having at least one overcoat layer on one or both major surfaces thereof.

Preferably the active portion comprises a layer of a suspended particle emulsion or a layer of a liquid crystal.

Preferably, the switchable film is one of: a suspended particle device film or a liquid crystal device film.

Preferably the edge seal extends around the entire periphery of the switchable film.

The present invention also provides a laminated glazing comprising such an the edge-sealed switchable film assembly, the edge-sealed switchable film assembly being located within a frame formed from a ply of an interlayer material, the frame being laminated between first and second plies of an interlayer material, the first and second plies of interlayer material, the frame and the edge sealed switchable frame assembly being laminated between two plies of a glazing material.

Preferably, the edge seal is further adapted to prevent the ingress of mobile plasticiser components within the plies of interlayer materials into the active portion.

Preferably, the plies of interlayer material are one of: polyvinyl butyral (PVB); ethylene vinyl acetate co-polymer (EVA); polyurethane (PU) or poly vinyl chloride (PVC) interlayer materials.

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Preferably, the edge seal is formed by one of: a plastics material; a hot melt material or crimping.

Preferably, the glazing material is silicate float glass. The silicate float glass may be toughened, semi-toughened or annealed. Desirably, at least one of the glazing material and the interlayer materials are tinted.

The present invention will now be described by way of example only, and with reference to the accompanying drawings, in which:

Figure 1a (referred to above) is a schematic cross-sectional view of a conventional SPD film assembly;

Figure 1b (referred to above) is a schematic drawing showing the construction of a glazing having an SPD film assembly laminated therein;

Figure 2a (referred to above) is a schematic cross-section of a two-part edge seal around the exposed edge of an SPD film;

Figure 2b (referred to above) is a schematic cross-section of a one-part edge seal around the exposed edge of an SPD film;

Figure 2c (referred to above) is a schematic cross-section of a hot-melt barrier seal around the exposed edge of an SPD film;

Figure 2d is a schematic cross-section of a crimped seal around the exposed edge of an SPD film;

Figure 3 is a schematic cross-section showing an SPD film assembly that may be edge sealed in accordance with the present invention;

Figure 4 shows the edge sealed film assembly of figure 3;

Figure 5 is a schematic cross-section showing another edge sealed SPD film assembly in accordance with the present invention; and

Figure 6 is a schematic cross-section of a laminated glazing comprising an edge-sealed switchable of the type shown in figure 5.

In the present invention, it has been realised that it is possible to prevent contact of the electrically conductive surfaces of the planar electrode layers of an SPD film whilst maintaining the ability to drive the switching behaviour using an external power supply.

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The present invention adopts a re-designed film structure that enables the utilisation of remote electrical connections. A remote electrical connection is one that is not in contact with the active layer of the switchable film to be driven by an external power supply. The remote electrical connector enables an electric field to be projected through the active layer, driving the switching process. Such remote electrical connections may be capacitive in nature, as discussed in more detail below.

By using such remote electrical connectors, a direct, galvanic contact with the SPD emulsion within the SPD film is no longer necessary, and so can be removed. Removing the planar electrode layers that are normally in contact with the SPD emulsion ensures that there is no shorting of the film, even if the layers around the periphery are crimped or sealed tightly together. Whilst there may be electrically insulating overcoat layers on the surfaces of the SPD emulsion, such overcoat layers are typically of insufficient thickness to prevent electrical shorting of an edge sealed SPD film of the type shown in figure 1.

Although in each of the examples given, an SPD film is used as the switchable film, the invention is equally applicable to other switchable films incorporated into glazings or other laminated structures, where the optical transmission of an active layer changes when a voltage is applied. Such films include LCD films, other layered electronic devices, such as OLEDs (organic light emitting diodes) or electrochromic materials included in laminated glazings.

Figure 3 is a schematic cross-section showing an SPD film assembly that may be edge sealed in accordance with a first embodiment of the present invention.

The SPD film assembly 30 comprises an active layer 31, (containing the suspended particle emulsion), laminated between first 32 and second 33 planar electrode layers. Each planar electrode layer 32, 33 comprises a PET substrate 34, 35 having an electrically conductive ITO coating 36, 37 disposed thereon. In this embodiment, the orientation of the first planar electrode layer 32 is reversed, such that the PET substrate 34 contacts the active layer 31, and the ITO coating 36 is exposed. Thus the ITO coating 36 is contactable with a layer of an adhesive interlayer material, such as polyvinyl butyral (not

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shown) when the film assembly is included in a laminated glazing. The ITO coating 37 of the second planar electrode layer 33 remains in contact with the active layer 31.

The optical transmission of the active layer may be switched by projecting an electric field therethrough. The SPD film assembly may be connected to a suitable power supply by direct galvanic connections to each ITO coating 36, 37. A direct galvanic connection may be made to the ITO coating 37 by first removing a portion of the PET substrate 34. Alternatively, an electrically conductive region may be positioned on the uncoated surface of the PET substrate 35 such that a capactive connection may be made to the ITO coating 37. Suitable electrical connectors are tinned copper strips, attached to the surface of the ITO coatings 36, 37 by means of electrically conductive silver paint and electrically conductive tape.

By reversing the orientation of the electrode layer 32, the PET substrate 34 provides sufficient electrical insulation to prevent the ITO coatings 36, 37 from electrically shorting when the SPD film assembly 30 is edge sealed at the periphery of the film.

Figure 4 shows the SPD film assembly 30 having an edge seal produced by crimping (see figure 2d). Since the orientation of the electrode layer 32 has been reversed relative to the orientation of the electrode layer 33, the PET substrate 34 forms an electrically insulating barrier between the ITO coatings 36, 37 thereby preventing electrical shorting.

Figure 5 is a schematic cross-section showing an SPD film assembly 40 that may be edge sealed in accordance with a second embodiment of the present invention.

The SPD film assembly 40 comprises an active layer 41, (containing the suspended particle emulsion), laminated between first 42 and second 43 planar electrode layers. Each planar electrode layer 42, 43 comprises a PET substrate 44, 45 having an electrically conductive ITO coating 46, 47 disposed thereon. In this embodiment, the orientation of the first planar electrode layer 42 is reversed, such that the PET substrate 44 contacts the active layer 41, and the ITO coating 46 is exposed. Thus the ITO coating 46 is contactable with a layer of an adhesive interlayer material, such as polyvinyl butyral (not

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shown) when the film assembly is included in a laminated glazing. The orientation of the second planar electrode layer 43 is also reversed, such that the PET substrate 45 contacts the active layer 41, and the ITO coating 47 is exposed. Thus the ITO coating 47 is contactable with a layer of an adhesive interlayer material, such as polyvinyl butyral (not shown) when the film assembly 40 is included in a laminated glazing.

To connect the SPD film assembly to a power supply, direct galvanic connections made be made to the exposed ITO coatings 46, 47. Suitable electrical connectors are formed from tinned copper strips, attached to the surface of the ITO coatings 46, 47 by means of electrically conductive silver paint and electrically conductive tape.

The SPD film assembly has been edge sealed by crimping (see figure 2a). Shorting of the electrode layers 42, 43at the periphery of the SPD film 40 when sealed together is prevented because of the electrically insulating effect of the PET substrates 44, 45.

Figure 6 is a schematic cross-section of a laminated glazing comprising an edge-sealed switchable film in accordance with the present invention. The glazing 50 comprises a switchable film, such as an SPD film 51 laminated within a picture-frame construction 52 comprising three plies of interlayer material 53a, 53b, 53c. The switchable film 51 is held within a frame of interlayer material 53a, which in turn is laminated between first 53b and second 53c plies of interlayer material. These first 53b and second 53c layers of interlayer material serve to bond the switchable film 51 to two plies of glazing material 54a, 54b, such as silicate float glass. The switchable film 51 itself comprises an active layer 55 containing an emulsion of switchable film particles, and two planar electrode layers 56a, 56b. Each planar electrode layer 56a, 56b comprises a substrate of a plastics material 57a, 57b supporting an electrically conductive ITO coating 58a, 58b. Each substrate of plastics material 57a, 57b is in contact with the active layer 55, and each electrically conductive ITO coating 58a, 58b is in contact with a ply of interlayer material 53b, 53c. A barrier material 59 is provided around the periphery of the switchable film 51, to avoid any leakage of the switchable film emulsion in the active layer 55 into the laminated glazing 50 structure, and to prevent contact with the picture frame layer 53a.

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In order to drive the switchable film 51, busbars 60a, 60b are attached to the electrically conductive ITO coatings 58a, 58b of the planar electrode layers 56a, 56b. The busbars 60a, 60b are formed from tinned copper strips, attached to the surface of the ITO coatings 58a, 58b by means of electrically conductive silver paint and electrically conductive tape. Applying a voltage creates an electric field through the SPD film 51, driving the switching behaviour of the active layer 55.

The switchable film is not limited to any particular switchable film design, construction or materials. For example, the planar electrode layers may comprise materials other than PET and ITO.

Typically, glazings comprising switchable films having electrical connections in accordance with the present invention include rooflights, backlights, sidelights and privacy windows (fitted into the interior of a vehicle). However, the switchable film may be included within a windscreen to replace a sunshade or sun visor. In any of these situations, preferably the glazing material is a ply of silicate float glass having a thickness in the range of 1.2 to 3.0mm, giving an overall glazing thickness in the range of 3.0mm to 8.0mm. Alternatively, the glazing material may be a plastics material, such as polycarbonate. Although the adhesive interlayer films described above are preferably polyvinyl butyral, other suitable interlayer materials such as EVA (a co-polymer of ethylene vinyl acetate), ionomer and ionoplast materials may be used instead. Preferably the layer of adhesive interlayer material used has a thickness in the range of 0.3 to 0.8mm.

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CLAIMS

1. An edge sealed switchable film assembly comprising an active portion, the optical transmission of which changes with an applied voltage, laminated between first and second planar electrode layers, the planar electrode layers comprising a plastics substrate material having an electrically conductive coating disposed on at least a portion of one surface thereof, and an edge seal adapted to prevent leakage or contamination of the active portion material provided around at least a portion of the periphery of the switchable film, wherein at least the second planar electrode layer has the ply of plastics material in contact with the active portion.

2. The edge sealed switchable film assembly of claim 1, wherein the first and second planar electrode layers have the ply of plastics material in contact with the active portion.

3. The edge sealed switchable film assembly of claim 1, wherein the plastics substrate material of the first planar electrode layer is in between the active portion and the electrically conductive coating of the first planar electrode layer, and wherein the electrically conductive coating of the second planar electrode layer is in between the active portion and the plastics substrate material of the second planar electrode layer.

4. The edge sealed switchable film assembly of any preceding claim, wherein the active portion comprises a layer of a suspended particle emulsion or a layer of a liquid crystal.

5. The edge sealed switchable film assembly of any preceding claim, wherein the switchable film is one of: a suspended particle device film or a liquid crystal device film.

6. The edge sealed switchable film assembly of any of the preceding claims, wherein the edge seal extends around the entire periphery of the switchable film.

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7. A laminated glazing comprising the edge-sealed switchable film assembly of any of the claims 1 to 6, the edge-sealed switchable film assembly being located within a frame formed from a ply of an interlayer material, the frame being laminated between first and second plies of an interlayer material, the first and second plies of interlayer material, the frame and the edge sealed switchable frame assembly being laminated between two plies of a glazing material.

8. The laminated glazing of claim 7, wherein the edge seal is further adapted to prevent the ingress of mobile plasticiser components within the plies of interlayer materials into the active portion.

9. The laminated glazing of claim 7 or 8, wherein the plies of interlayer material are one of: polyvinyl butyral (PVB); ethylene vinyl acetate co-polymer (EVA); polyurethane (PU) or poly vinyl chloride (PVC) interlayer materials.

10. The laminated glazing of claim 7, 8 or 9, wherein the edge seal formed by one of: a plastics material; a hot melt material or crimping.

11. The laminated glazing of any of claims 7 to 10, wherein the glazing material is silicate float glass.

12. The laminated glazing of claim 11, wherein the silicate float glass is toughened, semi-toughened or annealed.

13. The laminated glazing of any of claims 7 to 12, wherein at least one of the glazing material and the interlayer materials are tinted.

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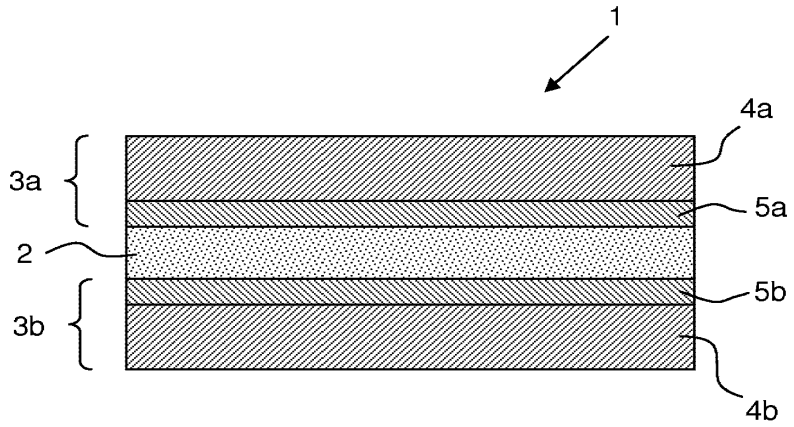


Fig. 1a

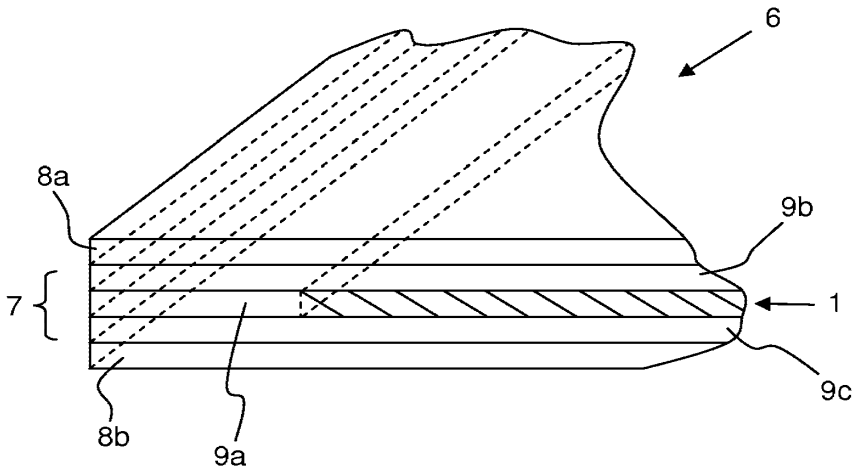


Fig. 1b

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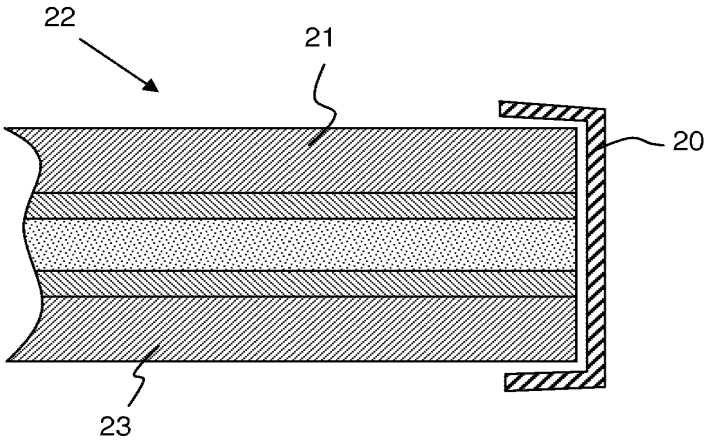


Fig. 2a

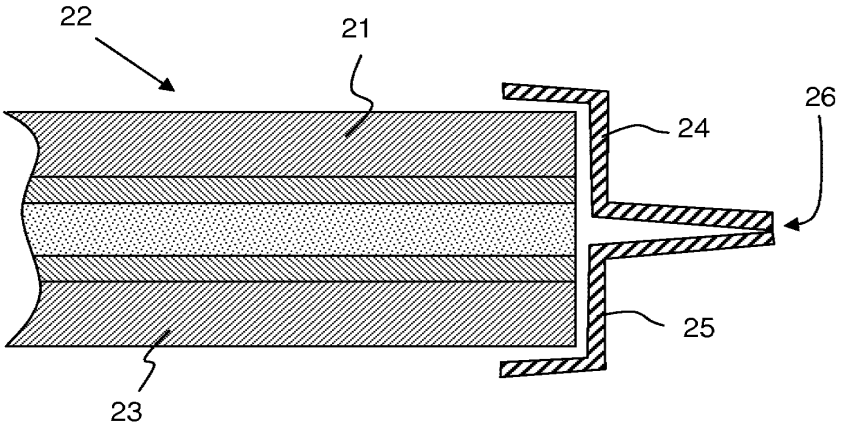


Fig. 2b

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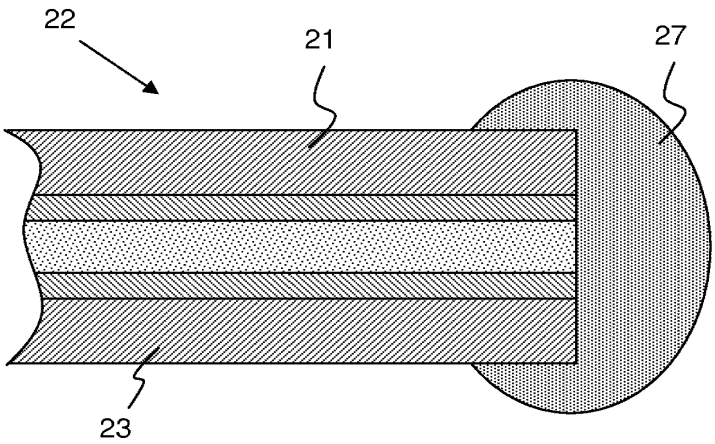


Fig. 2c

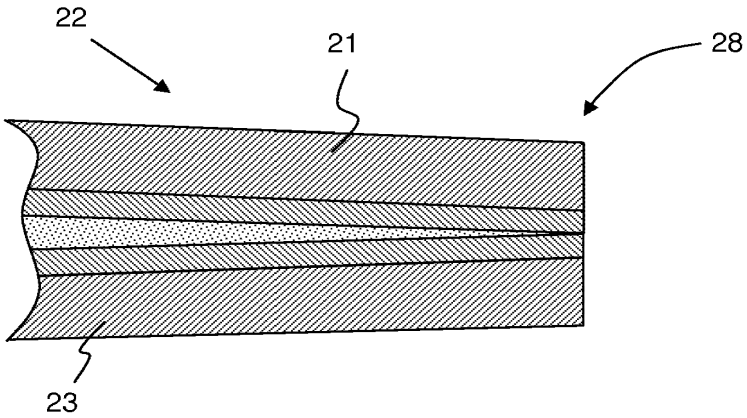


Fig. 2d

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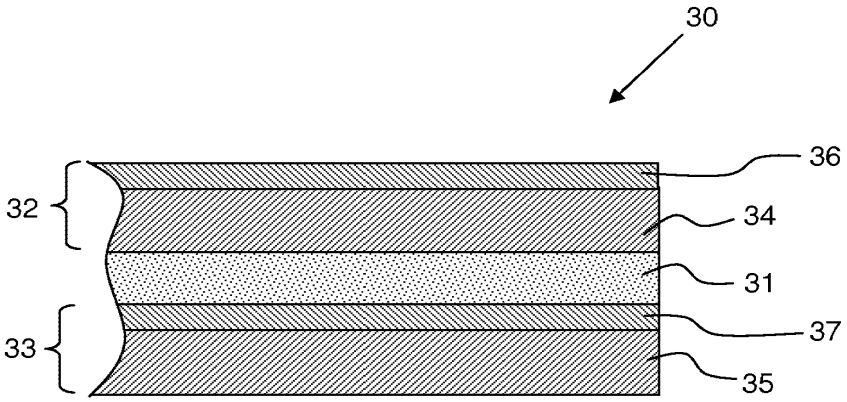


Fig. 3

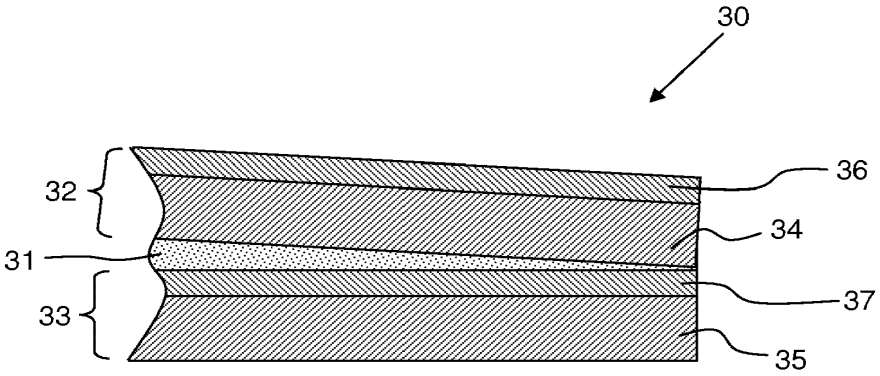


Fig. 4

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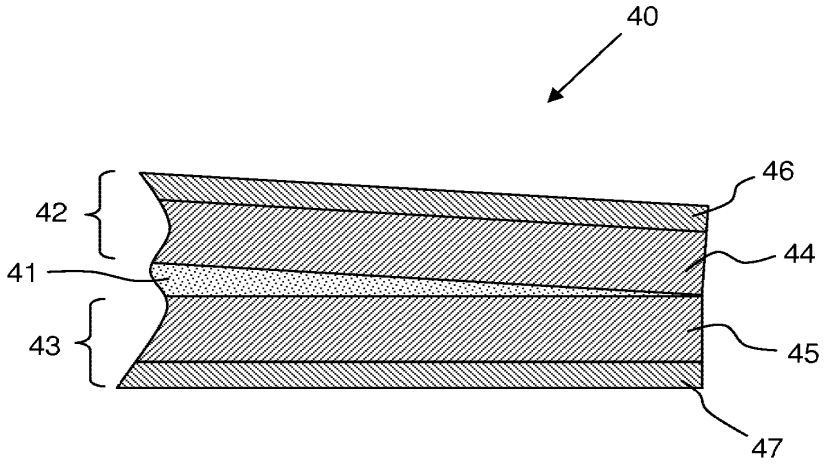


Fig. 5

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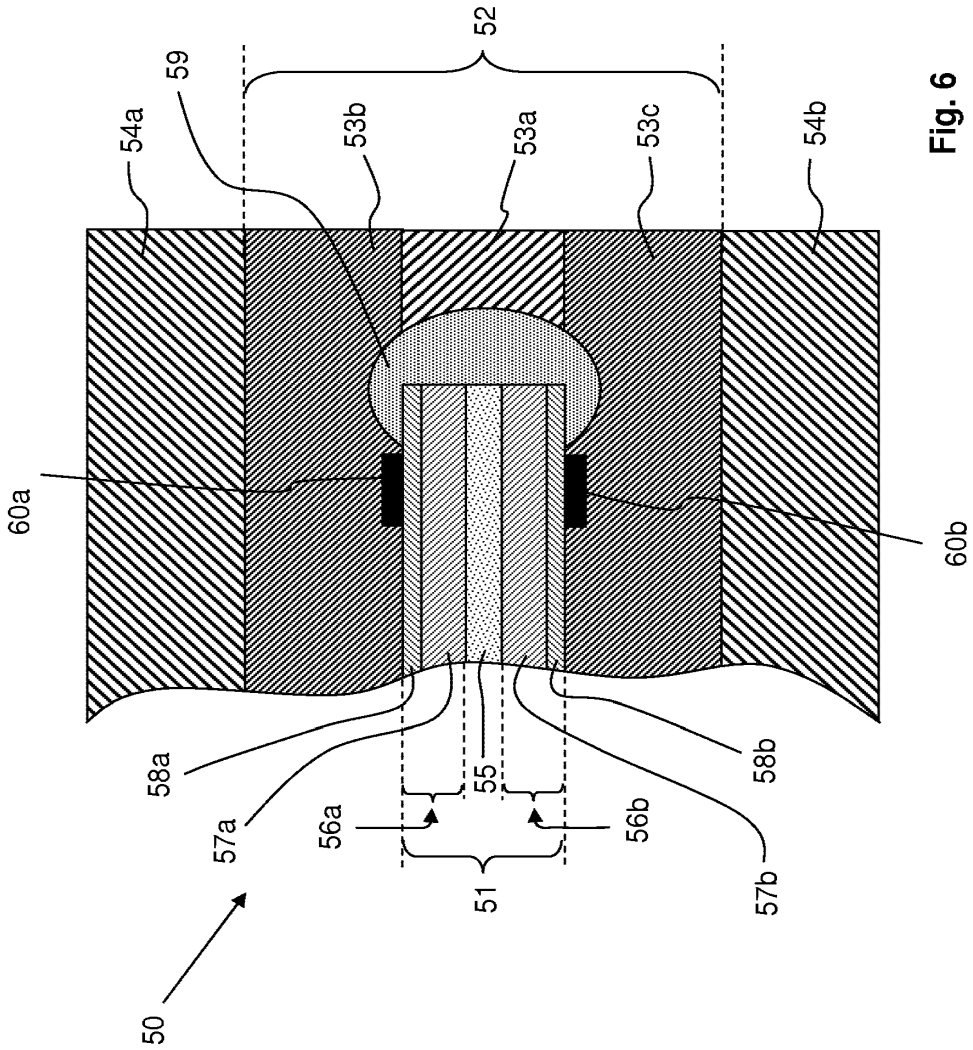


Fig. 6

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INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2009/051232

A. CLASSIFICATION OF SUBJECT MATTER
INV. E06B9/24

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E06B G02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 3 773 684 A (MARKS A) 20 November 1973 (1973-11-20) paragraph [0012] column 2, line 3 - line 6 column 11, line 42 - line 43; figures 1,2 column 23, line 12 - line 24; figure 14	1,2,4-6 7,9-13
Y	WO 02/08826 A (GENTEX CORP [US]) 31 January 2002 (2002-01-31) paragraph [0012]	7,9-13
Y	EP 1 484 634 A (FIAT RICERCHE [IT]) 8 December 2004 (2004-12-08) paragraph [0010]	9
A	DE 196 44 913 A1 (FINKEISSEN EKKEHARD [DE]) 30 April 1998 (1998-04-30) the whole document	1-13

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 January 2010	15/01/2010

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Aichmayr, Günther

Form PCT/ISA/210 (second sheet) (April 2005)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/GB2009/051232

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ELECTROCHROMIC FILMS WITH EDGE PROTECTION

CROSS-REFERENCE OF RELATED APPLICATION(S)

[0001] This application is a continuation of U.S. Patent Application No. 18/152,033 filed on January 9, 2023, which is a continuation of U.S. Patent Application No. 16/190,723 filed on November 14, 2018, now issued as U.S. Patent No. 11,571,878, and titled "ELECTROCHROMIC FILMS WITH EDGE PROTECTION". The entire content of the above-identified applications are incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The invention generally relates to electrochromic devices, and in particular, to electrochromic devices with edge protection and methods for making the same.

BACKGROUND

[0003] Electrochromism generally refers to a reversible change in optical properties of a material upon application of a potential. In particular, electrochromic materials exhibit a reversible color change due to an electrochemical reduction-oxidation (redox) reaction caused by application of an electric field.

[0004] Electrochromic materials are useful for a variety of applications, including photovoltaic devices, field effect transistors, organic light emitting diodes, general printed electronics, anti-glare windows, display systems, etc.

[0005] Usually, electrochromic materials are sandwiched between rigid substrates to make devices. The electrochromic films based on flexible substrates have advantages over the traditional electrochromic glasses in terms of weight, ease of transportation, ability to apply on curved surface, etc.

[0006] For applications involving smart window technology, the electrochromic materials need to be integrated with a glass substrate (e.g., a glass window) to be serviceable. The integration process usually requires that the electrochromic film be sandwiched between two glass panels with interlayers such as polyvinyl butyral (PVB) and SentryGlas etc. Then, those packages would be pressed and heated at certain pressure and temperature. After the lamination

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process, the interlayers will be cured and will fix the electrochromic film between glass panels. There are certain additives within the interlayers for the purpose of chemical and physical property modifications. Those additives can infiltrate into the multilayer electrochromic films and adversely affect the electrochromic films. As a result, the performance and lifetime of electrochromic films can be severely compromised.

[0007] Therefore, there is a need for an improved design of electrochromic films to address the above and other problems.

SUMMARY

[0008] The present disclosure provides a method of preparing an electrochromic film having edge protection to protect the edges of the electrochromic film from being infiltrated by undesired materials as well as oxygen and moisture. An electrochromic film may include a first electrode, a second electrode, an electrochromic material deposited on at least the first electrode, a charge storage layer deposited on the second electrode, and a solid polymer electrolyte disposed between the electrochromic material and the charge storage layer.

[0009] An electrochromic film generally may be interposed between two interlayers and laminated between two glass panels. In some embodiments, the edges of electrochromic film and the interlayers are covered by an edge protection material protecting the electrochromic film from being exposed to undesired materials from the interlayers and from the ambient environment. Those undesired materials include certain additives inside the interlayers and oxygen and moisture from the ambient environment, which may adversely affect the performance and lifetime of the electrochromic film.

[0010] According to one embodiment of the present disclosure, a method for preparing an electrochromic device includes placing an edge protection material on a first and second substrates, placing a first and second interlayers respectively within the edge protection material on the first and second substrates, wherein the edge protection material surrounds edges of the first and second interlayers, interposing an electrochromic film between the first and second interlayers, wherein the edge protection material prevents chemicals in the first and second interlayers from entering into the electrochromic film. The method may also include pressing the first and second substrates toward each other and heating the first and second interlayers to fix the electrochromic film between the first and second substrates.

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[0011] According to another embodiment of the present disclosure, an electrochromic film includes a first electrode, a second electrode, an electrochromic material deposited on at least the first electrode, a charge storage layer deposited on the second electrode, and a solid polymer electrolyte disposed between the electrochromic material and the charge storage layer. In this embodiment, at least edges of the electrochromic material are covered by an edge protection material.

[0012] According to yet another embodiment of the present disclosure, an electrochromic device includes a first glass panel, a first interlayer on the first glass panel, a second glass panel, a second interlayer on the second glass panel, and an electrochromic film between the first interlayer and the second interlayer. The electrochromic film may include a first electrode, a second electrode, an electrochromic material deposited on at least the first electrode, a charge storage layer deposited on the second electrode, and a solid polymer electrolyte disposed between the electrochromic material and the charge storage layer. At least edges of the electrochromic material are covered by an edge protection material.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Preferred and non-limiting embodiments of the invention may be more readily understood by referring to the accompanying drawings in which:

[0014] FIG. **1** is a simplified schematic of a laminated structure having an electrochromic film disposed therein, according to one exemplary embodiment.

[0015] FIG. **2** is a simplified schematic of an electrochromic film, according to one exemplary embodiment.

[0016] FIG. **3** is a perspective view of an electrochromic film, according one exemplary embodiment.

[0017] FIGs. **4A-4C** illustrate a method of preparing an electrochromic film with edge protection according to an exemplary embodiment.

[0018] FIGs. **5** illustrates a flowchart of a method for preparing an electrochromic device according to an exemplary embodiment.

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[0019] FIG. **6** illustrate an electrochromic film with edge protection according to an exemplary embodiment.

[0020] FIG. **7** illustrates a laminated electrochromic film with edge protection according to one exemplary embodiment.

[0021] FIG. **8** illustrates an unlaminated electrochromic film with edge protection according to another exemplary embodiment.

[0022] FIG. **9** illustrates another laminated electrochromic film with edge protection according to another exemplary embodiment.

[0023] FIG. **10A** illustrates performance and lifetime comparison of a laminated electrochromic film with edge protection according to an embodiment and one without edge protection.

[0024] FIG. **10B** illustrates performance and lifetime comparison of an unlaminated electrochromic film with edge protection according to an embodiment and one without edge protection.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0025] In the following description, certain specific details are set forth in order to provide a thorough understanding of various embodiments of the invention. However, one skilled in the art will understand that the invention may be practiced without these details. Moreover, while various embodiments of the invention are disclosed herein, many adaptations and modifications may be made within the scope of the invention in accordance with the common general knowledge of those skilled in this art. Such modifications include the substitution of known equivalents for any aspect of the invention in order to achieve the same result in substantially the same way.

[0026] Unless the context requires otherwise, throughout the present specification and claims, the word "comprise" and variations thereof, such as, "comprises" and "comprising" are to be construed in an open, inclusive sense, that is as "including, but not limited to." Recitation of numeric ranges of values throughout the specification is intended to serve as a shorthand notation of referring individually to each separate value falling within the range inclusive of the values defining the range, and each separate value is incorporated in the specification as it were

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individually recited herein. Additionally, the singular forms "a," "an" and "the" include plural referents unless the context clearly dictates otherwise.

[0027] Reference throughout this specification to "one embodiment" or "an embodiment" means that a particular feature, structure or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, the appearances of the phrases "in one embodiment" or "in an embodiment" in various places throughout this specification are not necessarily all referring to the same embodiment, but may be in some instances. Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more embodiments.

[0028] A simplified schematic of a laminated structure with an electrochromic film interposed therein is shown in FIG. **1,** according to one exemplary embodiment. For clarity purposes only, the various components of the laminated structure (e.g., substrates, adhesive layers, and electrochromic film) are shown spaced apart.

[0029] As shown in FIG. **1**, the laminated structure **100** includes a first adhesive interlayer **102** interposed between a first surface **104** of an electrochromic film **106** and a first substrate **108**. The laminated structure **100** also includes a second adhesive interlayer **110** interposed between a second surface **112** of the electrochromic film **106** and a second substrate **114**. As seen in the embodiment of FIG. **1**, the first and second surfaces **104**, **112** correspond to opposing surfaces of the electrochromic film **106**.

[0030] The first and/or second adhesive interlayers **102**, **110** may include a material (e.g., a thermosetting polymer material) configured to securely bond (e.g., cross-link) the electrochromic film **106** with the first and second substrates **108**, **114**. As such, the first and/or second adhesive interlayers **102**, **110** are configured to keep the laminated structure **100** together even when shattered/broken, and prevent the laminated structure **100** from breaking up into large, sharp pieces.

[0031] An exemplary, non-limiting schematic of an electrochromic film **200** is shown in FIG. **2**, according to one embodiment. It is important to note that the electrochromic film **200** of FIG. **2** may be implemented in combination with other devices/features/components described herein, such as those described with reference to other embodiments/aspects. The electrochromic film **200** may be used in various applications and/or in permutations, which may or may not be

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noted in the illustrative embodiments/aspects described herein. For instance, the electrochromic film **200** may include more or less features/components than those shown in FIG. 2, in some embodiments. Additionally, unless otherwise specified, one or more components of the electrochromic film **200** may be of conventional material, design, and/or fabricated using known techniques (e.g., sputtering, chemical vapor deposition (CVD), physical vapor deposition (PVD), plasma-enhanced chemical vapor deposition (PECVD), spray coating, slot-die coating, dip coating, spin coating, printing, etc.), as would be appreciated by skilled artisans upon reading the present disclosure.

[0032] As shown in FIG. **2**, the electrochromic film **200** includes a first transparent substrate **202** and a second transparent substrate **204** in spaced, parallel relation with each other. The first and second substrates **202**, **204** may have the same or different dimensions, comprise the same or different materials, etc. Suitable materials for the first substrate **202** and/or the second substrate **204** may include, but are not limited to, glass, polymeric materials, plastic materials, and/or other materials which are transparent in at least part of the visible region of the electromagnetic spectrum. In some embodiments, the first and second substrates **202**, **204** may comprise glass.

[0033] As also shown in FIG. **2**, a first transparent electrically conductive film **206** is deposited on the interior surface **208** of the first substrate **202** to act as an electrode. A second transparent electrically conductive film **210** is also deposited on the interior surface **212** of the second substrate **204** to act as an electrode. The first and second electrically conductive films **206**, **210** may have the same or different dimensions, comprise the same or different material, etc. The first and second electrically conductive films **206**, **210** may also each independently have a single layer or multilayer structure. Suitable materials for the first and second electrically conductive films **206**, **210** may include, but are not limited to, tin doped indium oxide (ITO), fluorine doped indium oxide, antimony doped indium oxide, zinc doped indium oxide, aluminum doped zinc oxide, silver nanowires, metal mesh, combinations thereof, and/or other such transparent material exhibiting sufficient electrical conductance. In preferred aspects, the first and second electrically conductive films **206**, **210** may each include an electrode layer including tin doped indium oxide (ITO).

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[0034] The electrochromic device **200** may additionally include an electrical power supply (not shown) configured to supply voltage between the first and second electrically conductive films **206**, **210**.

[0035] As further shown in FIG. **2**, a layer **214** of electrochromic material is deposited on the interior surface **216** of the first electrically conductive film **206**. The layer **214** of electrochromic material is configured to cause a reversible color change upon reduction (gain of electrons) or oxidation (loss of electron) introduced by an applied electrical current. In some embodiments, the layer **214** of electrochromic material may be configured to change from a transparent state to a colored state, or from a colored state to another colored state, upon oxidation or reduction. In some embodiments, the layer **214** of electrochromic material may be a polyelectrochromic material in which more than two redox states are possible, and may thus exhibit several colors.

[0036] In some embodiments, the layer **214** of electrochromic material may comprise an organic electrochromic material, an inorganic electrochromic material, a mixture of both, etc. The layer **214** of electrochromic material may also be a reduction colored material (i.e., a material that becomes colored upon acquisition of electrons), or an oxidation colored material (i.e., a material that becomes colored upon the loss of electrons).

[0037] In some embodiments, the layer **214** of electrochromic material may include a metal oxide such as MoO_3, V_2O_5, Nb_2O_5, WO_3, TiO_2, $Ir(OH)_x$, $SrTiO_3$, ZrO_2, La_2O_3, $CaTiO_3$, sodium titanate, potassium niobate, combinations thereof, etc. In some embodiments, the layer **214** of electrochromic material may include a conductive polymer such as poly-3,4-ethylenedioxy thiophene (PEDOT), poly-2,2′-bithiophene, polypyrrole, polyaniline (PANI), polythiopene, polyisothianaphthene, poly(*o*-aminophenol), polypyridine, polyindole, polycarbazole, polyquinone, octacyanophthalocyanine, combinations thereof, etc. Moreover, in some embodiments, the layer **214** of electrochromic material may include materials, such as viologen, anthraquinone, phenocyazine, combinations thereof, etc. Additional examples of electrochromic materials, particularly those including multicolored electrochromic polymers, may be found in U.S. Patent Application No. 15/399,839, filed Jan 6, 2017, the entirety of which is herein incorporated by reference.

[0038] As additionally shown in FIG. **2**, a charge storage layer **218** is deposited on the interior surface **220** of the second electrically conductive film **210**. Suitable materials for the

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charge storage layer **218** may include, but are not limited to, vanadium oxide, binary oxides (e.g., CoO, IrO_2, MnO, NiO, and PrO_x), ternary oxides (e.g., $Ce_xV_yO_z$), etc.

[0039] In some embodiments, the charge storage layer **218** may be replaced with an optional second layer of electrochromic material. This optional second layer of electrochromic material may have the same or different dimensions, comprise the same or different composition, etc., as the first layer **214** of electrochromic material.

[0040] The electrochromic device **200** also includes an electrolyte layer **222** positioned between the layer **214** of electrochromic material and the charge storage layer **218**. In some embodiments, the electrolyte layer **222** may include a liquid electrolyte as known in the art. In some embodiments, the electrolyte layer **222** may include a solid state electrolyte, including but not limited to, Ta_2O_5, MgF, Li_3N, $LiPO_4$, $LiBO_2$-Li_2SO_4, etc. In some embodiments, the electrolyte layer **222** may include a polymer based electrolyte comprising an electrolyte salt (e.g., LiTFSI, $LiPF_6$, $LiBF_4$, $LiClO_4$, $LiCF_3SO_3$, $LiN(CF_3SO_2)_2$, LiSbFg, $LiAsF_6$, $LiN(CF_3CF_2SO_2)_2$, $(C_2H_5)_4NBF_4$, $(C_2H_5)_3CH_3NBF_4$, LiI, etc.), a polymer matrix (e.g., polyethylene oxide, poly(vinylidene fluoride(PVDF), poly(methyl methacrylate) (PMMA), polyethylene oxide (PEO), poly(acrylonitrile) (PAN), polyvinyl nitrile, etc.), and one or more optional plasticizers (e.g., glutaronitrile, succinonitrile, adiponitrile, fumaronitrile, etc.). Additional examples of electrolyte materials, particularly those including solid polymer electrolytes, may be found in U.S. Patent Applications No. 15/399,852, filed Jan 6, 2017 and No. 15/487,325, filed April 13, 2017, the entirety of which is herein incorporated by reference.

[0041] FIG. **3** is a perspective view of an electrochromic film **300**, according one exemplary embodiment. The difference between FIG. **2** and FIG. **3** is that in FIG. **3** only the electrochromic film **300** is shown in a perspective view, without the first transparent substrate **202** and the second transparent substrate **204** from FIG. **2**. Similar to FIG. **2**, the electrochromic film **300** includes a first transparent electrically conductive film **306** and a second transparent electrically conductive film **310**. Between the first transparent electrically conductive film **306** and the second transparent electrically conductive film **310**, the electrochromic film **300** further includes an electrolyte layer **322** positioned between an electrochromic material layer **314** and a charge storage layer **318**. In some embodiments, the polymer electrolyte layer **322** is a solid polymer

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electrolyte and the solid polymer electrolyte includes an electrolyte salt and a polymer matrix as discussed above with respect to the embodiment in FIG. **2**.

[0042] FIGs. **4A-4C** illustrate a method **400** of preparing a laminated electrochromic device with edge protection according to one exemplary embodiment. FIG. **4A** illustrates a process of making a glass panel with edge protection for laminating with an electrochromic film. In FIG. **4A**, a glass panel **402** is first prepared. Then four stripes of edge seal **405** made of an edge protection material are positioned on each of the four edges and on top of the glass panel **402**. The edge protection material may be selected from polyvinyl siloxane (PVS), Sentryglas, thermoplastic polyurethane (TPU), ethylene-vinyl acetate (EVA), etc. Next an interlayer **403** is placed on the center of the glass panel **402**, within the area confined by the four stripes of edge seal **405** to form a first interlayer-substrate portion **410**. The interlayer **403** may be made of polyvinyl butyral (PVB), UV Extraprotect PVB, or the like. As mentioned, the interlayer may contain undesired chemicals that may adversely affect the performance and lifetime of the electrochromic film. Usually, those chemicals may infiltrate the electrochromic film through the joint of the films, often via the electrolyte layer. With the edge protection, the interlayer **403**'s edges are sealed and the chemicals will not be able to enter into the electrochromic film. The same process can be used to form another interlayer-substrate. As shown in FIG. **4B**, two interlayer-substrate portions **410a**, **410b** are formed, each having an interlayer surrounded by edge protection materials. An electrochromic film **401** is positioned and laminated between the two interlayer-substrate portions **410a**, **410b**. The electrochromic film **401** can be made as described above with reference to FIGs. **1-3**. In FIG. **4C**, an electrochromic film **420** with edge protection laminated within two glass panels are shown. The interlayers can be cured by pressing glass panels and heating the electrochromic device.

[0043] FIG. **5** illustrates a flowchart **500** summarizing the steps shown in FIGS. **4A-4C**. In step **502**, an edge protection material is placed on a first and second substrates. In step **504**, placing a first and second interlayers respectively within the edge protection material on the first and second substrates, wherein the edge protection material surrounds edges of the first and second interlayers. In step **506**, interposing an electrochromic film between the first and second interlayers. The edge protection material may prevent chemicals in the first and second interlayers from entering into the electrochromic film. The method **500** may also include an

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optional step **508** of pressing the first and second substrates toward each other and heating the first and second interlayers to fix the electrochromic film between the first and second substrates.

[0044] FIG. **6** is a sectional view **600** of the two electrochromic films **606** and **610** where their joint and edges are covered by an edge projection material, e.g., a layer of epoxy **605**. In FIG. **6**, the two electrochromic films **606** and **610** are sandwiched with an electrochromic material layer **614**, an electrolyte layer **622**, and a charge storage layer **618**. After curing with heat or ultraviolet light, the epoxy **605** can work as an effective oxygen and moisture blocker. Using this method, an electrochromic film roll can be stored in an ambient environment for much longer time without sacrificing performance and lifetime. The epoxy can also be replaced by other suitable materials. In some embodiments, at least edges of one of the first electrode and second electrode, the electrochromic material, the solid polymer electrolyte, and the charge storage layer are covered by the edge protection material.

[0045] FIG. **7** illustrates a laminated electrochromic device **700** with edge protection according to one exemplary embodiment. The laminated electrochromic device **700** includes a first substrate **702** (e.g., a glass panel) at the bottom, a second substrate **704** (e.g., a glass panel) at the top, a first interlayer **703a** positioned above the first substrate **702**, a second interlayer **703b** positioned below the second substrate **704**, an electrochromic film **701**, and edge protection materials **705**, **715** between the first substrate **702** and the second substrate **704** and around the interlayers **703a** and **703b** and the electrochromic film **701**. The edge protection materials **705**, **715** are compatible with the electrochromic film **701** and the substrates but resistant to the chemicals of the interlayers **703a** and **703b**. The electrochromic film **701** is prepositioned so that its edges fit the edge protection materials **705**, **715**. Followed by normal laminating process such as autoclave, the electrochromic film **701**'s edges will be protected by the edge protection materials **705**, **715**.

[0046] FIG. **8** illustrates an electrochromic film **800** with edge protection according to another exemplary embodiment. The electrochromic film in FIG. **8** includes two sides **801a** and **801b**, one as an anode and the other as a cathode. The upper side **801a** is covered by an edge protection material on the left side and the lower side **801b** is covered by an edge protection material on the left side. The electrochromic film **800** with edges covered can be rolled and

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easily stored in an ambient environment for much longer time without sacrificing performance and lifetime.

[0047] FIG. **9** illustrates another electrochromic device **900** with edge protection according to another exemplary embodiment. Similar to FIG.**8**, the electrochromic film in FIG. **9** includes two sides **901a** and **901b**, one as an anode and the other as a cathode. The edges of the electrochromic film **901a** and **901b** are covered by an edge protection material, e.g., a layer of epoxy **905** and **915**. After curing with heat or ultraviolet light, the epoxy **905** and **915** can work as an effective oxygen and moisture blocker. Then, the electrochromic film can be laminated between two substrates (e.g., glass panels) with a lamination process as described above. Similar to FIG. **7**, the laminated electrochromic device 900 includes a first substrate **902** (e.g., a glass panel), a second substrate **904** (e.g., a glass panel), an interlayer **903** between the first substrate **902** and the second substrate **904**, and the electrochromic film with edge protection laminated within the interlayer **903**.

[0048] In some embodiments, the edge protection material, e.g., the epoxy **805/815/905/915,** may be electrically conductive so that it can function as the electrodes in the above-described embodiments. By using an electrically conductive material as the edge protection material, the electrochromic film fabrication process can save one step with respect to fabricating the electrodes. Alternatively, the electrically conductive edge protection material can conduct current to the electrode layer and/or charge storage layer.

[0049] FIG. **10A** illustrates performance and lifetime comparison of a laminated electrochromic film with edge protection according to an embodiment and one without edge protection. The curve **1002** is the original performance of a laminated electrochromic film, i.e., performance without degradation. It shows a behavior of normalized transparency as a function of time for a laminated electrochromic film with no degradation. The curve **1004** shows a behavior of normalized transparency as a function of time of a laminated electrochromic film without edge protection. The curve **1006** shows a behavior of normalized transparency as a function of time of a laminated electrochromic film with edge protection. With comparison among curves **1002**, **1004** and **1006** in FIG, **10A**, one can find that the device without edge protection (curve **1004**) shows very poor stability. After 1h speeded degradation at 100 ˚C, the device already slows down in switch response. In contrast, the device with edge protection

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(curve **1006**) only shows limited sign of degradation after 1 month of speeded degradation stress test. Therefore, with an edge protection, a laminated electrochromic film device can be better protected from degradation.

[0050] FIG. **10B** illustrates performance and lifetime comparison of an unlaminated electrochromic film with edge protection according to an embodiment and one without edge protection. The curve **1012** is the original performance of an unlaminated electrochromic film, i.e., performance without degradation. It shows a behavior of normalized transparency as a function of time for an unlaminated electrochromic film with no degradation. The curve **1014** shows a behavior of normalized transparency as a function of time of an unlaminated electrochromic film with edge protection. As shown in FIG. **10B**, after 1 week of speeded degradation stress, the device with edge protection (curve **1014**) still holds a reasonable good switch speed, i.e., similar to the original curve **1012**. Therefore, with an edge protection, an unlaminated electrochromic film can be protected from degradation, leaving a long process window for further lamination process.

[0051] This specification describes protecting edges of an electrochromic film that is usually fabricated by a roll-to-roll process with low cost. Since the electrochromic films need to be laminated between substrates (e.g., two glass panels) in their actual application, such as smart windows, without using the methods described above, the selection of lamination interlayer materials would be limited and the storage and transportation would require much more dedicated environment and conditions. The embodiments described above are useful in facilitating the application of electrochromic films in the window industry.

[0052] The invention described and claimed herein is not to be limited in scope by the specific preferred embodiments disclosed herein, as these embodiments are intended as illustrations of several aspects of the invention. Indeed, various modifications of the invention in addition to those shown and described herein will become apparent to those skilled in the art from the foregoing description. Such modifications are also intended to fall within the scope of the appended claims.

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CLAIMS

What is claimed is:

1. An electrochromic device comprising:

an electrochromic film comprising a first electrode layer and a second electrode layer facing the first electrode layer of the electrochromic film, wherein:

a first edge of the first electrode layer is cut such that a portion of an inner surface of the second electrode layer is exposed, and

a second edge of the second electrochromic file is cut such that a portion of an inner surface of the first electrode layer is exposed, the first edge and the second edge are opposing edges;

a first edge protection material sealing the exposed portion of the inner surface of the second electrode layer; and

a second edge protection material sealing the exposed portion of the inner surface of the first electrode layer.

2. The electrochromic device of claim 1, wherein:

the first edge protection material is in an L shape, further sealing a side surface of the first electrode layer and a portion of an external surface of the first electrode layer.

3. The electrochromic device of claim 1, wherein:

the second edge protection material is in an L shape, further sealing a side surface of the second electrode layer and a portion of an external surface of the second electrode layer.

4. The electrochromic device of claim 1, wherein:

the first edge protection material and the second edge protection material comprise epoxy.

5. The electrochromic device of claim 1, wherein

the first edge protection material and the second edge protection material comprise electrically conductive material.

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6. The electrochromic device of claim 1, wherein:

the first edge protection material and the second edge protection material are cured with heat or ultraviolet light, functioning as oxygen and moisture blockers.

7. The electrochromic device of claim 1, further comprising:

a first substrate;

a second substrate;

an interlayer between the first substrate and the second substrate, wherein:

the first electrode layer, the second electrode layer, the first edge protection material, and the second edge protection material are laminated within the interlayer.

8. The electrochromic device of claim 1, wherein the first electrode layer and the second electrode layer sandwich a layer of electrochromic material, a layer of electrolyte material, and a layer of charge storage material.

9. The electrochromic device of claim 8, wherein the first edge of the layer of electrochromic material, the layer of electrolyte material, and the layer of charge storage material are cut in a same way as the first edge of the first electrode layer to expose the portion of the inner surface of the second electrode layer.

10. The electrochromic device of claim 8, wherein the second edge of the layer of electrochromic material, the layer of electrolyte material, and the layer of charge storage material are cut in a same way as the second edge of the second electrode layer to expose the portion of the inner surface of the first electrode layer.

11. The electrochromic device of claim 1, wherein the first electrode layer comprises a first electrode layer including tin doped indium oxide (ITO).

12. The electrochromic device of claim 1, wherein the second electrode layer comprises a second electrode layer including tin doped indium oxide (ITO).

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13. An electrochromic device comprising:

an electrochromic film comprising a first electrode layer and a second electrode layer facing the first electrode layer, wherein a first edge and a second edge of the second electrode layer are cut such a first portion and a second portion of an inner surface of the first electrode layer respectively at the first edge and the second edge are exposed; and

a first edge protection material sealing the first portion of the inner surface of the first electrode layer; and

a second edge protection material sealing the second portion of the inner surface of the first electrode layer.

14. The electrochromic device of claim 13, wherein:

the first electrode layer and the second electrode layer sandwich a layer of electrochromic material, a layer of electrolyte material, and a layer of charge storage material.

15. The electrochromic device of claim 14, wherein:

the first edges of the layer of electrochromic material, the layer of electrolyte material, and the layer of charge storage material are cut in a same way as the first edge of the second electrochromic film, and

the first edge protection material seals the first edges of the layer of electrochromic material, the layer of electrolyte material, and the layer of charge storage material.

16. The electrochromic device of claim 14, wherein:

the second edges of the layer of electrochromic material, the layer of electrolyte material, and the layer of charge storage material are cut in a same way as the second edge of the electrochromic film, and

the second edge protection material seals the second edges of the layer of electrochromic material, the layer of electrolyte material, and the layer of charge storage material.

17. The electrochromic device of claim 13, wherein:

the first edge protection material comprises epoxy.

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18. The electrochromic device of claim 13, wherein:

the first edge protection material comprises electrically conductive material.

19. The electrochromic device of claim 13, wherein the first electrode layer comprises a first electrode layer including tin doped indium oxide (ITO).

20. The electrochromic device of claim 13, wherein the second electrode layer comprises a second electrode layer including tin doped indium oxide (ITO).

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ABSTRACT

The present application discloses a method for preparing an electrochromic device. The method includes placing an edge protection material on a first and second substrates, placing a first and second interlayers respectively within the edge protection material on the first and second substrates, wherein the edge protection material surrounds edges of the first and second interlayers, and interposing an electrochromic film between the first and second interlayers. The edge protection material prevents chemicals in the first and second interlayers from entering into the electrochromic film.

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Espacenet

Bibliographic data: JP2001033830 (A) — 2001-02-09

SEALING STRUCTURE OF ELECTROCHROMIC ELEMENT

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Classification: **- international:** ***B60R1/04; G02F1/15; G02F1/153;*** (IPC1-7): B60R1/04; G02F1/15; G02F1/153

- cooperative:

Application number: JP19990206970 19990722

Priority number(s): JP19990206970 19990722

Abstract of JP2001033830 (A)

PROBLEM TO BE SOLVED: To prevent damages externally added to an electrochromic layer or deterioration in the functions without using a sealing glass by applying a silicone rubber on the back face of the electrochromic layer and a metal film to cover and protect it. SOLUTION: The electrochromic layer 4 and the metal film 5 are covered on the back face, that is, the both side faces and back face of these layers are wholly covered with a silicon rubber 12 having a U-shaped cross section and having resistance to weather, heat, chemicals and oil. Further, the back face of the silicone rubber 12 is covered with a polymer film. In this sealing structure, the silicone rubber 12 flexibly covers and supports the element while keeping its mechanical strength and it also exhibits a protective function to improve the corrosion resistance. The siloxane coupling of the silicone rubber 12 shuts off the water content, chemicals, oil or the like from the outside and prevents damages on the elecrochromic layer 4 due to the water content, chemicals, oil or the like externally added or deterioration in the functions due to decrease in the coloring and decoloring reaction.

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DESCRIPTION JP2001033830A

[0001]

13 BACKGROUND OF THE INVENTION 1. Field of the Invention The present invention relates to an electrochromic device used as an anti-glare mirror such as various display devices or an inner or outer mirror of an automobile, and more particularly to a sealing structure for an electrochromic device.

[0002]

20 Electrochromic elements are elements that apply voltage to cause oxidation and reduction reactions in electrochromic substances to cause changes such as coloring and decoloring. It is used as an anti-glare mirror such as an inner mirror or an outer mirror of a device or a car.

23 For example, there are JP-A-2-134521, JP-A-8-292457, JP-A-59-13223, US Pat.

[0003]

27 FIG. 1 is a diagram illustrating a basic example of a conventional sealing structure for an electrochromic element. Specifically, FIG. 1 is a cross-sectional view of a conventional example applied to a sealing structure for an electrochromic anti-glare mirror. It is.

[0004]

33 In FIG. 1, an electrochromic anti-glare mirror 1 has a transparent conductive film 3, an electrochromic layer 4, and a metal film 5 functioning as an electrode and reflective film successively laminated on the back side of a transparent substrate glass 2. The layer 4 and the metal reflective film 5 are coated with a sealing resin 6 such as an epoxy resin from the back, both side surfaces and the back in a generally U-shape, and a sealing glass is further coated on

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the back of the sealing resin 6. 7 are pasted together.

[0005]

42 The electrochromic layer 4 is constructed by sequentially laminating an oxidized coloring film 8 such as IrOx or NiO, a solid electrolyte film 9 such as Ta2O5, and a reduction coloring film 10 such as WO3 or MO3.

45 The metal film 5 is made of a metal film such as Al, Ag, or Cr.

46 As the transparent conductive film 3, a film of ITO, SnO2, etc. is used.

[0006]

50 In this conventional example, the electrochromic layer 4 is formed by sequentially laminating an Ir oxide film as the oxidation coloring film 8, a Ta2O5 film as the solid electrolyte film 9, and a WO3 film as the reduction coloring film 10. Decolorization reaction will be explained.

53 In the Ir oxide film 8, H2O exists as iridium hydroxide Ir(OH)n.

[0007]

57 Now, the terminals of the transparent conductive film 3 are connected to a DC power source (not shown).

59), and when the terminal of the metal film 5 is connected to the negative terminal of the DC power source, in the Ir oxide film 8, proton H+ transfer to the Ta2O5 film 9 and electron emission to the transparent conductive film 3 occurs. The next oxidation reaction progresses and the Ir oxide film 8 becomes colored.

63 Ir(OH)n → IrOx(OH)n-x (coloring) +xH++xe-...

[0008]

67 On the other hand, the protons H+ in the Ta2O5 film 9 move into the WO3 film 10, and electrons are injected from the metal film 5 into the WO3 film 10. In the WO3 film 10, the next reduction reaction proceeds and the WO3 film 10 is colored.

70 WO3+xH++xe-→HxWO3 (coloring)...

[0009]

74 Then, when the connection between the positive and negative electrodes of the DC power supply is switched, a reduction reaction proceeds in the opposite direction to the above in the Ir oxide film 8 and the color disappears, and an oxidation reaction proceeds in the WO3 film 10 in the opposite direction to the above. Decolorize.

78 Note that the Ta2O5 film 9 contains H2O, which is ionized when connected to the DC power source, and also contains protons H+ and OH- ions, which contribute to the coloring and

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decoloring reactions described above. .

[0010]

84 The sealing glass 7 supports the electrochromic layer 4 and metal film 5 sealed with the sealing resin 6 with mechanical strength from the back side, and also improves waterproofness, moisture permeability, corrosion resistance, etc. Has a protective function.

87 Furthermore, the sealing glass 7 has an ion-blocking property that prevents ions from going back and forth, and allows protons H+ (H+ ions) and OH- ions, which are present in a certain amount in the electrochromic layer 4 and which cause coloring and decoloring reactions, to go outside. The electrochromic layer 4 is prevented from elution and entry of ions from the outside, and the coloring and decoloring reactions of the electrochromic layer 4 function normally.

[0011]

96 By applying a voltage between the transparent electrode film 3 and the metal film 5 of the electrochromic anti-glare mirror 1 having such a structure, a coloring reaction is caused in the Ir oxide film 8 and the WO3 film 10, and the metal The incident light and reflected light on the film 5 are weakened, reducing the reflectance of the electrochromic anti-glare mirror 1.

[0012]

103 By utilizing such an anti-glare function, the electrochromic anti-glare mirror 1 is designed to provide an anti-glare effect against the headlights of a following vehicle when driving at night.

106 By applying a voltage in the opposite direction to the above, the electrochromic anti-glare mirror 1 is made colorless (decolorized) by a reaction in the opposite direction to the above-mentioned oxidation-reduction reaction. Make it reflective.

[0013]

112 However, the conventional electrochromic anti-glare mirror shown in FIG. 1 has the following problems.

114 (1) A manufacturing process for the sealing glass 7 is required, and the weight of the sealing glass 7 makes the entire electrochromic anti-glare mirror 1 heavy.

[0014]

119 (2) The electrochromic layer 4 is easily damaged by moisture, chemicals, oil, etc. from the outside. In particular, when moisture enters the electrochromic layer 4 from the outside, the coloring and decoloring reactions described above decrease. The anti-glare function

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deteriorates.

[0015]

126 The problems of damage and functional deterioration caused by moisture, chemicals, oil, etc. will be explained in more detail.

128 In the electrochromic layer 4, there are a certain amount of protons H+ and OH- ions that cause a coloring/decoloring reaction.

130 In particular, a large amount of protons H+ and OH- ions are present at the interface between the metal film 5 and the sealing resin 6.

132 In order for the coloring and decoloring reaction to function normally, it is necessary to prevent fluctuations in the amount of ions, and in particular, it is necessary to prevent an increase in moisture due to moisture absorption from the outside.

[0016]

138 Conventionally, in order to prevent the electrochromic layer 4 from being damaged by moisture, chemicals, oil, etc. from the outside, and from functional deterioration due to a decrease in the coloring and decoloring reactions, sealing with epoxy resin or the like has been used. It is sealed with sealing glass 7 via resin 6.

142 However, as described above, the sealing glass 7 is heavy and requires a manufacturing process.

[0017]

147 Furthermore, since the sealing resin 6 is provided solely for the purpose of sealing on the premise that the sealing glass 7 is provided, the conventional sealing resin is a general resin such as epoxy resin. resin was selected.

150 However, since such general resins are single polymers and are linearly polymerized, they have low density, high water absorption and hygroscopicity, and cannot prevent an increase in moisture from the outside. Furthermore, such an epoxy resin generates heat during curing, and after curing, its hardness reaches a Shear hardness of nearly 90, which tends to damage the electrochromic layer 4.

[0018]

158 Therefore, the present invention eliminates the use of a sealing structure using sealing glass or epoxy resin, which is the cause of the conventional problems, and prevents damage to the electrochromic layer from external moisture, chemicals, oil, etc. It is an object of the present invention to provide a sealing structure for an electrochromic element that can prevent functional deterioration due to the decline in the coloring and decoloring reactions described above, and can also be made lighter.

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[0019]

167 Means for Solving the Problems In order to solve the above problems, the present invention includes a transparent conductive film, a coloring film that develops color through oxidation or reduction reaction, and an electrolyte film on the back side of a transparent substrate glass. A sealing structure for sealing an electrochromic element formed by sequentially laminating an electrochromic layer containing a metal film and a metal film, wherein the electrochromic layer and metal film are stacked from the back side including the back and side surfaces. The entire body is covered, protected and sealed with silicone rubber that has weather resistance, heat resistance, chemical resistance, and oil resistance, and the back side of the silicone rubber has a material that has water resistance, moisture resistance, abrasion resistance, and heat resistance. is attached, and the outer peripheral surfaces of the substrate glass, the transparent conductive film, the electrochromic layer, the metal film, the silicone rubber, and the members having water resistance, moisture resistance, abrasion resistance, and heat resistance are coated with a moisture-proof material. The silicone rubber and the member having water resistance, moisture resistance, abrasion resistance, and heat resistance are a member with silicone rubber that is integrally formed in advance, and the silicone rubber of the member with silicone rubber is There is provided a sealing structure for an electrochromic element, characterized in that the electrochromic layer and the metal film are attached to the back and side surfaces so as to be wrapped therein.

[0020]

188 The water-resistant, moisture-resistant, abrasion-resistant, and heat-resistant member is selected from the group consisting of polyester, polyethylene, aluminum-polyethylene terephthalate (PET), vinylidene chloride copolymer, nylon 12, and SiOx-PET. Polymer films may also be used.

[0021]

195 The moisture retarder may be formed from a material selected from the group consisting of silicone rubber paint, butyl rubber, and UV curable resin.

[0022]

200 The electrochromic layer 4 may have a structure in which an oxidation coloring film, an electrolyte film, and a reduction coloring film are sequentially laminated.

[0023]

205 The electrochromic layer 4 may have a structure in which an Ir oxide film functioning as an

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oxidation coloring film, a Ta2O5 film functioning as an electrolyte film, and a WO3 film functioning as a reduction coloring film are sequentially laminated.

[0024]

211 On the back side of the silicone rubber, a rubber-based adhesive sheet or polymer film having water resistance, humidity resistance, abrasion resistance, and heat resistance is adhered to prevent deterioration of the silicone rubber, and It may be configured to have enhanced water resistance, moisture resistance, and scratch resistance.

[0025]

218 The polymer film may be attached or coated on the back surface of the silicone rubber using an adhesive.

[0026]

223 DESCRIPTION OF THE PREFERRED EMBODIMENTS Embodiments of the present invention will be described below based on examples with reference to the drawings.

225 FIG. 2 is a sectional view showing an example in which the electrochromic element sealing structure according to the present invention is applied to an electrochromic anti-glare mirror sealing structure.

[0027]

231 In FIG. 2, an electrochromic anti-glare mirror 11 according to an embodiment of the present invention has a transparent conductive film 3 on the back side of a transparent substrate glass 2, similar to the electrochromic anti-glare mirror 1 shown in the above-mentioned prior art. An electrochromic layer 4 and a metal film 5 which functions as an electrode and a reflective film in the anti-glare mirror are laminated in order toward the rear.

[0028]

239 The electrochromic layer 4, like the conventional electrochromic anti-glare mirror 1, is made up of an oxidation coloring film 8 such as IrOx or NiO, a solid electrolyte film 9 such as Ta2O5, and a reduction coloring film 10 such as WO3, which are laminated in sequence. and configured.

243 The metal film 5 is made of Al, Ag, Cr, or the like.

[0029]

247 The key point of the structure of the present invention is that a new sealing structure is

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adopted in place of the sealing resin 6 and sealing glass 7, which were the causes of the above-mentioned problems that had conventionally occurred.

250 In this sealing structure, the electrochromic layer 4 and the metal film 5 are formed from the back side, that is, from both sides and the back side, in a substantially U-shape as a whole. At the same time, the back surface of the silicone rubber 12 is covered with a polymer film 13.

[0030]

256 That is, in the present invention, instead of providing the sealing resin 6 and the sealing glass 7 as in the conventional electrochromic anti-glare mirror 1, the electrochromic layer 4 is formed using the silicone rubber 12 which has both functions. The structure is such that the metal film 5 is flexibly wrapped and sealed from the back side in a generally U-shape.

[0031]

263 The polymer film 13 used is a polymer film selected from the group consisting of polyester, polyethylene, aluminum-polyethylene terephthalate (PET), vinylidene chloride copolymer, nylon 12, and SiOx-PET.

[0032]

269 Here, the feature of the present invention is that the structure in which the electrochromic layer 4 is sealed with the silicone rubber 12 and the polymer film 13 on the back side is such that the silicone rubber 12 is formed on the polymer film 13 in advance. It is formed by pasting an electrochromic layer 4 and a metal film 5 from the back side of an integrated polymer film with silicone rubber.

[0033]

277 In any case, if a polymer film with silicone rubber is used, the electrochromic layer 4 and the metal film 5 can be sealed in a very simple process of just pasting.

279 As such a polymer film with silicone rubber, "Kiju" (trade name) manufactured by Mitsubishi Plastics Co., Ltd., "Roll Covering Tape No. 5461" (trade name) manufactured by Sumitomo 3M Limited, etc. are used.

[0034]

285 In actual manufacturing, a polymer film with silicone rubber is cut into a shape almost the same as the planar shape of an element such as an electrochromic mirror to be manufactured, and the film is pasted from the back side of the electrochromic layer 4 and metal film 5. good.

289 In this case, the electrochromic layer 4 and the metal film 5 are extremely thin at about 1.5

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μm, and the silicone rubber 12 itself is flexible and stretchable, so the polymer film 13 and the silicone rubber 12 are the same material cut out together. Regardless of the size, the silicone rubber 12 can sufficiently wrap the sides of the electrochromic layer 4 and metal film 5.

[0035]

297 Although a polymer film with silicone rubber was used in this example, it is not necessary to use the polymer film 13, but it can be used as a member that has water resistance, moisture resistance, abrasion resistance, and heat resistance, and also has conventional properties. Heavy components such as sealing glass and applications that result in weight (e.g.

301 Use in thick structures.

302), rubber, metal (light-weight metal members or light-weight metal structural members with guaranteed strength), ceramics (excluding conventional encapsulated glass).

304) etc. may be used.

305 That is, a member with silicone rubber in which these members and silicone rubber are integrated may be used.

[0036]

310 Further, from the outer side of the silicone rubber 12 and the polymer film 13, in order to suppress the influence of external moisture, similar materials such as silicone rubber, butyl rubber with excellent moisture resistance, or UV curing resin, etc. are applied. It is covered with a moisture-proof material 14 and sealed.

[0037]

317 The operation of the sealing structure of the electrochromic anti-glare mirror 11 according to the present invention having the above structure will be explained below.

319 The coloring and decoloring reactions of the electrochromic layer 4 are the same as those of the conventional electrochromic anti-glare mirror 1, so a description thereof will be omitted here.

322 In the sealing structure of the electrochromic anti-glare mirror 11, the silicone rubber 12 flexibly wraps the electrochromic layer 4 and supports it with mechanical strength, and also has a protective function of improving corrosion resistance.

[0038]

328 The siloxane bonds of the silicone rubber 12 block moisture, chemicals, oil, etc. from the outside, and protect the electrochromic layer 4 from damage caused by moisture, chemicals, oil, etc. from the outside, and from the above-mentioned coloring and decoloring. Prevents functional deterioration due to decreased reaction.

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[0039]

335 That is, the silicone rubber 12 and polymer film 13 of the present invention have water resistance, weather resistance, heat resistance, chemical resistance, oil resistance, abrasion resistance, etc., as well as the conventional sealing glass 7. This prevents moisture, chemicals, oil, etc. from entering from the outside, and allows the coloring and decoloring reactions of the electrochromic layer 4 to function normally.

[0040]

343 By the way, in the sealing structure of the present invention, if the silicone rubber 12 and the polymer film 13 are separated and attached later, a gap will be created on the attachment surface because the silicone rubber 12 has poor adhesion. It may cause peeling.

346 Furthermore, if the silicone rubber 12 is exposed without covering the polymer film 13 integrally, the silicone rubber 12 itself has no abrasion resistance and is therefore susceptible to contact with other equipment, mounting members, etc. Problems arise in its handling.

[0041]

353 However, in the present invention, the electrochromic layer 4 and the metal film 5 are attached from the back side of the polymer film 13 with silicone rubber, in which the silicone rubber 12 is formed and integrated with the polymer film 13 in advance, and the film is sealed. Therefore, not only is it extremely easy to form a sealing structure, but it can also cover the difficult-to-handle parts of silicone rubber 12, such as poor adhesion and lack of abrasion resistance, as well as the handling problems mentioned above, such as poor adhesion and lack of wear resistance. Improves processability and versatility.

[0042]

363 (Experimental Example) Next, a sealing structure for an electrochromic device according to the present invention was specifically manufactured and an experiment was conducted.

365 This experimental example will be explained below.

366 In this experimental example, a 1000 Å IrOx film, a 6000 Å Ta2O5 film, and a 6000 Å WO3 film were formed on an ITO glass substrate (transmittance 80%, resistance 8 Ω/□) of the size of an automobile inner mirror (280 x 80 mm). An electrochromic layer 4 and an Al film of 1000 Å were sequentially formed by vacuum evaporation.

370 Then, a film with silicone rubber "Kiju" (trade name) made by Mitsubishi Plastics Co., Ltd. is pasted on the Al film, and the surrounding area is covered with silicone rubber "KE402" (trade name) made by Shin-Etsu Chemical Co., Ltd. It was sealed and an electrochromic device was created.

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[0043]

377 When the reflectance characteristics were confirmed, the reflectance characteristics were 10% when colored and 75% when decolored at a driving voltage of 1.5V.

379 In addition, no color unevenness was observed.

380 Furthermore, an operation test was conducted in which coloring and decoloring were repeated by driving at a driving voltage of 1.5 V (voltage application time was 20 seconds each).

383), it was confirmed that even after 100,000 operations, the reflectance characteristics remained unchanged from the initial measurement, and no color unevenness was observed, confirming high durability. Ta.

[0044]

389 The electrochromic element sealing structure according to the present invention has been described above using an example in which it is applied to an electrochromic anti-glare mirror sealing structure, but the electrochromic element to which this sealing structure is applied is as follows: Needless to say, the present invention is not limited to anti-glare mirrors, and can be applied to various devices to which electrochromic elements can be applied, such as electrochromic element display devices.

[0045]

398 In addition, in the above embodiment, a configuration was explained in which the electrochromic anti-glare mirror is applied to a flat type anti-glare mirror in which the entire surface is flat, but since silicone rubber has elasticity, it It can also be applied to the sealing structure of an electrochromic element such as an electrochromic anti-glare mirror, which is entirely curved including the chromic layer and metal film.

[0046]

406 Since the present invention is constructed as described above, it produces the effects as described below.

[0047]

411 (1) Due to the structure that does not require sealing glass, the weight of the electrochromic device can be significantly reduced.

413 This eliminates the need for the manufacturing process of the sealing glass, and allows pre-prepared members with silicone rubber (e.g.

415 The simple manufacturing process of attaching a polymer film with silicone rubber is

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sufficient, reducing the number of steps and achieving significant cost reductions.

[0048]

420 (2) Since the electrochromic layer is flexibly wrapped and sealed with silicone rubber, unlike thermosetting resin, the electrochromic layer will not be adversely affected or damaged due to heat generation during curing and its high hardness. Also, since the siloxane bonds of silicone rubber function to block moisture, chemicals, oil, etc. from the outside, the electrochromic layer will not be damaged by moisture, chemicals, oil, etc. from the outside, and will not be colored or erased. Functional deterioration due to a decrease in color reaction can be prevented.

[0049]

430 (3) In addition to silicone rubber, members have water resistance, moisture resistance, abrasion resistance, and heat resistance (eg.

432 By covering the electrochromic element with a polymer film, it not only provides high strength and scratch resistance, but also further improves waterproofness and moisture resistance. It has improved processability and versatility, that is, it is easier to handle.

[0050]

438 (4) Since silicone rubber has elasticity, it can be applied not only to flat electrochromic anti-glare mirrors as in the above embodiments, but also to electrochromic anti-glare mirrors with an overall curvature. .

[0051]

444 Brief description of the drawing

[0052]

448 FIG. 1 shows a sectional view of a sealing structure of an electrochromic anti-glare mirror to which a conventional electrochromic element sealing structure is applied.

[0053]

453 FIG. 2 is an embodiment of the sealing structure of an electrochromic element according to the present invention, and shows a cross-sectional view of the sealing structure of an electrochromic anti-glare mirror.

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[0054]

459 Explanation of symbols

[0055]

463 1, 11 Electrochromic anti-glare mirror 2 Substrate glass 3 Transparent conductive film 4 Electrochromic layer 5 Metal film 6 Sealing resin 7 Sealing glass 12 Silicone rubber 13 Polymer film 14 Moisture-proofing material (silicone rubber, butyl rubber, UV curing resin, etc.)

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(19)日本国特許庁（ＪＰ）　(12) **公開特許公報（Ａ）**　(11)特許出願公開番号
特開2001－33830
（P2001－33830A）
(43)公開日　平成13年２月９日(2001.2.9)

(51)Int.Cl.[7]	識別記号	Ｆ Ｉ		テーマコード（参考）
Ｇ０２Ｆ　1/153		Ｇ０２Ｆ　1/153		２Ｋ００１
Ｂ６０Ｒ　1/04		Ｂ６０Ｒ　1/04	Ｄ	
Ｇ０２Ｆ　1/15	５０１	Ｇ０２Ｆ　1/15	５０１	

審査請求　未請求　請求項の数３　ＯＬ　（全　６　頁）

(21)出願番号　特願平11－206970

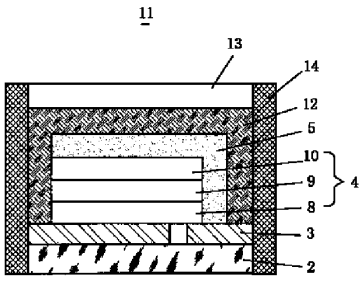
(22)出願日　平成11年７月22日(1999.7.22)

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Ｆターム(参考)　2K001 AA10 BB47 BB49 BB52 CA04
CA08 CA09 CA19 CA20 CA45
CA50 DA21

(54)【発明の名称】　エレクトロクロミック素子の封止構造

(57)【要約】
【課題】　封止ガラスを不要としてエレクトロクロミック素子の軽量化、低コスト化を図るとともに、外部からの水分、薬品、油等を遮断して、素子の損傷や、着色・消色機能の低下を防止する。
【解決手段】　エレクトロクロミック層４及び金属膜５は、その背面側から、耐候性、耐熱性、耐薬品性及び耐油性を有するシリコーンゴム１２と、シリコーンゴム１２と予め一体に形成されている耐水性、耐湿性、耐摩耗性及び耐熱性を有するポリマーフィルム１３により被覆され保護及び封止されている。



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【特許請求の範囲】

【請求項１】　透明な基板ガラスの背面に、透明導電膜と、酸化又は還元反応により発色する発色膜と電解質膜とを含むエレクトロクロミック層と、金属膜とが順次積層されて成るエレクトロクロミック素子を封止する封止構造であって、

上記エレクトロクロミック層及び金属膜は、その背面側から、背面及び側面も含めて全体的に、耐候性、耐熱性、耐薬品性及び耐油性を有するシリコーンゴムにより被覆され保護及び封止され、

シリコーンゴムの背面には耐水性、耐湿性、耐摩耗性及び耐熱性を有する部材が付設され、

上記基板ガラス、上記透明導電膜、上記エレクトロクロミック層、上記金属膜、上記シリコーンゴム並びに上記耐水性、耐湿性、耐摩耗性及び耐熱性を有する部材の外周面は防湿材で被覆されており、

上記シリコーンゴムと上記耐水性、耐湿性、耐摩耗性及び耐熱性を有する部材は、予め一体に形成されたシリコーンゴム付き部材が利用され、該シリコーンゴム付き部材の上記シリコーンゴムが、上記エレクトロクロミック層及び金属膜を包み込むように上記背面及び側面に貼着されていることを特徴とするエレクトロクロミック素子の封止構造。

【請求項２】　上記耐水性、耐湿性、耐摩耗性及び耐熱性を有する部材は、ポリエステル、ポリエチレン、アルミ－ポリエチレンテレフタレート（ＰＥＴ）、ビニリデンクロライドコポリマー、ナイロン１２及びSiOx-PETから成る群から選択されたポリマーフィルムであることを特徴とする請求項１記載のエレクトロクロミック素子の封止構造。

【請求項３】　上記防湿剤は、シリコーンゴム塗料、ブチルゴム及びＵＶ硬化樹脂から成る群から選択された材料から形成されたものであることを特徴とする請求項１又は２記載のエレクトロクロミック素子の封止構造。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、各種の表示装置や自動車のインナーミラー又はアウターミラー等の防眩ミラーとして用いられるエレクトロクロミック素子に関し、特にエレクトロクロミック素子の封止構造に関する。

【０００２】

【従来の技術】エレクトロクロミック素子は、電圧を印加してエレクトロクロミック物質の酸化、還元反応を起こさせて着色・消色等の変化を生じさせる素子であり、従来から、各種の表示装置や自動車のインナーミラー又はアウターミラー等の防眩ミラーとして用いられるところである。例えば、実開平２－１３４５２１号公報、特開平８－２９２４５７号公報、特開昭５９－１３２２３号公報、米国特許第４８５２９７９号明細書等がある。

【０００３】図１は、従来のエレクトロクロミック素子の封止構造の基本的な例を説明する図であり、具体的には、エレクトロクロミック防眩ミラーの封止構造に適用した従来例の断面図である。

【０００４】図１において、エレクトロクロミック防眩ミラー１は、透明な基板ガラス２の背面に透明導電膜３、エレクトロクロミック層４、電極兼反射膜として機能する金属膜５が順次積層され、エレクトロクロミック層４及び金属反射膜５は、その背面から、両側面及び背面が全体的に略コの字型にエポキシ樹脂等の封止樹脂６により被覆され、さらに封止樹脂６の背面に封止ガラス７が貼り合わされている。

【０００５】エレクトロクロミック層４は、ＩｒＯｘ、ＮｉＯ等の酸化発色膜８、Ta_2O_5 等の固体電解質膜９、及びWO_3、MO_3 等の還元発色膜１０が順次積層されて構成される。金属膜５は、Ａｌ、Ａｇ、Ｃｒ等の金属膜から形成されている。透明導電膜３は、ＩＴＯ、SnO_2 等の膜が使用される。

【０００６】この従来例において、エレクトロクロミック層４が、酸化発色膜８としてＩｒ酸化膜、固体電解質膜９としてTa_2O_5 膜及び還元発色膜１０としてWO_3 膜が順次積層されて構成される場合の着色、消色反応について説明する。Ｉｒ酸化膜８には、H_2O が水酸化イリジウム$Ir(OH)_n$ として存在する。

【０００７】今、透明導電膜３の端子を直流電源（図示せず。）の正極端子に接続し、金属膜５の端子を上記直流電源の負極端子に接続すると、Ｉｒ酸化膜８では、Ta_2O_5 膜９へのプロトンH^+ 移動及び透明導電膜３への電子放出が生じ、次の①の酸化反応が進んでＩｒ酸化膜８は着色する。

$$Ir(OH)_n \rightarrow IrO_x(OH)_{n-x}\text{（着色）}+xH^+ +xe^- \cdots ①$$

【０００８】一方、Ta_2O_5 膜９中のプロトンH^+ がWO_3 膜１０中へ移動し、金属膜５から電子がWO_3 膜１０に注入され、WO_3 膜１０では、次の②の還元反応が進んでWO_3 膜１０は着色する。

$$WO_3 +xH^+ +xe^- \rightarrow H_xWO_3\text{（着色）} \cdots ②$$

【０００９】そして、上記直流電源の正負極の接続を切り換えると、Ｉｒ酸化膜８では上記①と逆向きに還元反応が進んで消色し、WO_3 膜１０では上記②とは逆向きに酸化反応が進み消色する。なお、Ta_2O_5 膜９にはH_2O が含まれており、上記直流電源に接続することで電離し、プロトンH^+、OH^- イオンの状態でも含まれており、上記着色及び消色反応に寄与している。

【００１０】封止ガラス７は、封止樹脂６により封止されたエレクトロクロミック層４及び金属膜５を背面側から機械的強度をもって支持するとともに、防水性、防透湿性、耐食性等を向上する保護的な機能を有する。さらに、封止ガラス７は、イオンの行き来を阻止するイオン

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遮断性を有し、エレクトロクロミック層４中に一定量存在する着色及び消色反応を起こすプロトンH⁺（H⁺イオン）とOH⁻イオンの外部への溶出及び外部からのイオンの侵入を防ぎ、エレクトロクロミック層４の着色及び消色反応が正常に機能するようにしている。

【００１１】このような構成のエレクトロクロミック防眩ミラー１の透明電極膜３と金属膜５の間に電圧を印加することにより、Ｉｒ酸化膜８及びWO_3膜１０に着色反応を起こさせて、金属膜５の入射光及び反射光が弱められ、エレクトロクロミック防眩ミラー１の反射率を低下させる。

【００１２】このような防眩機能を利用して、エレクトロクロミック防眩ミラー１により夜間走行時における後続車のヘッドライト等に対する防眩作用を行わせるようにするものである。上記と逆方向の電圧を印加することにより、上記酸化還元反応と逆向きの反応による無色化（消色化）することにより、エレクトロクロミック防眩ミラー１の反射率を低下させることのない通常の反射状態にする。

【００１３】

【発明が解決しようとする課題】しかしながら、図１に示す従来のエレクトロクロミック防眩ミラーでは次のような問題点がある。

（１）封止ガラス７の製作工程を必要とするとともに、この封止ガラス７の重量により、エレクトロクロミック防眩ミラー１全体が重くなる。

【００１４】（２）エレクトロクロミック層４は、外部からの水分、薬品、油等により損傷しやすく、特に、外部からエレクトロクロミック層４内に水分が侵入すると、上記着色、消色反応が低下し防眩機能が劣化する。

【００１５】この水分、薬品、油等による、損傷や機能劣化の問題についてさらに詳説する。エレクトロクロミック層４中には着色消色反応を起こすプロトンH⁺とOH⁻イオンが一定量存在する。特に、金属膜５と封止樹脂６との界面にプロトンH⁺とOH⁻イオンが多量存在する。着色消色反応が正常に機能するためには、このイオン量の変動を防止する必要があり、特に、外部からの吸湿による水分の増加を防止する必要がある。

【００１６】従来は、上記エレクトロクロミック層４に対する、外部からの水分、薬品、油等により損傷や、上記着色、消色反応の低下による機能劣化を防止するためには、エポキシ樹脂等の封止樹脂６を介して封止ガラス７で封止している。しかし、封止ガラス７は、上記のとおり重量が嵩んだりその製造工程が必要である。

【００１７】又、封止樹脂６は、封止ガラス７を設けることを前提とし、単に封止機能を目的として配設されているために、従来の封止樹脂は、エポキシ樹脂等の一般的な樹脂が選択されていた。ところが、このような一般的な樹脂では、単一ポリマーであり直鎖状に重合されているために密度が低く、吸水、吸湿性が高く外部からの水分の増加を防止することはできない。さらに、このようなエポキシ樹脂であると、硬化時に発熱が生じ、硬化後はその硬度がシェアー硬度で９０近くとなり、エレクトロクロミック層４に損傷を与えやすいという問題がある。

【００１８】そこで、本発明は、上記従来の問題点の原因である封止ガラスやエポキシ樹脂等による封止構造を用いずに、エレクトロクロミック層に対する、外部からの水分、薬品、油等により損傷や、上記着色、消色反応の低下による機能劣化を防止し、しかも軽量化を図ることのできるエレクトロクロミック素子の封止構造を提供することを課題とする。

【００１９】

【課題を解決するための手段】本発明は、上記課題を解決するために、透明な基板ガラスの背面に、透明導電膜と、酸化又は還元反応により発色する発色膜と電解質膜とを含むエレクトロクロミック層と、金属膜とが順次積層されて成るエレクトロクロミック素子を封止する封止構造であって、上記エレクトロクロミック層及び金属膜は、その背面側から、背面及び側面も含めて全体的に、耐候性、耐熱性、耐薬品性及び耐油性を有するシリコーンゴムにより被覆され保護及び封止され、シリコーンゴムの背面には耐水性、耐湿性、耐摩耗性及び耐熱性を有する部材が付設され、上記基板ガラス、上記透明導電膜、上記エレクトロクロミック層、上記金属膜、上記シリコンーゴム並びに上記耐水性、耐湿性、耐摩耗性及び耐熱性を有する部材の外周面は防湿材で被覆されており、上記シリコーンゴムと上記耐水性、耐湿性、耐摩耗性及び耐熱性を有する部材は、予め一体に形成されたシリコーンゴム付き部材が利用され、該シリコーンゴム付き部材の上記シリコーンゴムが、上記エレクトロクロミック層及び金属膜を包み込むように上記背面及び側面に貼着されていることを特徴とするエレクトロクロミック素子の封止構造を提供する。

【００２０】上記耐水性、耐湿性、耐摩耗性及び耐熱性を有する部材は、ポリエステル、ポリエチレン、アルミーポリエチレンテレフタレート（ＰＥＴ）、ビニリデンクロライドコポリマー、ナイロン１２及びSiOx-PETから成る群から選択されたポリマーフィルムを利用してもよい。

【００２１】上記防湿剤は、シリコーンゴム塗料、ブチルゴム及びＵＶ硬化樹脂から成る群から選択された材料から形成されたものを利用してもよい。

【００２２】上記エレクトロクロミック層４は、酸化発色膜、電解質膜及び還元発色膜とが順次積層された構成としてもよい。

【００２３】上記エレクトロクロミック層４は、酸化発色膜として機能するＩｒ酸化膜、電解質膜として機能するTa_2O_5膜及び還元発色膜として機能するWO_3膜が順次積層された構成としてもよい。

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【００２４】上記シリコーンゴムは、その背面に、耐水性、耐湿性、耐摩耗性及び耐熱性を有するゴム系の粘着シート又はポリマーフィルムが被着され、上記シリコーンゴムの変質が防止されるとともに、耐水性、耐湿性、耐傷性が増強されるような構成としてもよい。

【００２５】上記ポリマーフィルムは、上記シリコーンゴムの背面に、粘着材により貼り付けられたもの又は塗布されて形成された構成としてもよい。

【００２６】

【発明の実施の形態】本発明の実施の形態を実施例に基づいて図面を参照して以下に説明する。図２は、本発明に係るエレクトロクロミック素子の封止構造を、エレクトロクロミック防眩ミラーの封止構造に適用した実施例を示す断面図である。

【００２７】図２において、本発明の実施例に係るエレクトロクロミック防眩ミラー１１は、上記従来技術で示したエレクトロクロミック防眩ミラー１同様に、透明な基板ガラス２の背面に透明導電膜３、エレクトロクロミック層４、防眩ミラーでは電極兼反射膜として機能する金属膜５が順次後方に向かって積層されている。

【００２８】エレクトロクロミック層４は、上記従来のエレクトロクロミック防眩ミラー１同様に、ＩｒＯｘ、ＮｉＯ等の酸化発色膜８、Ta_2O_5 等の固体電解質膜９、及びWO_3 等の還元発色膜１０が順次積層されて構成される。金属膜５は、Ａｌ、Ａｇ、Ｃｒ等の金属膜５から構成されている。

【００２９】本発明の構成のポイントは、従来生じていた上記問題の原因であった封止樹脂６及び封止ガラス７に代わる新規な封止構造を採用した点である。この封止構造では、エレクトロクロミック層４及び金属膜５を背面から、即ち両側面及び背面を全体的に略コの字型に耐候性、耐熱性、耐薬品性及び耐油性を有するシリコーンゴム１２で覆うとともに、シリコーンゴム１２の背面にポリマーフィルム１３で覆う構造としている。

【００３０】即ち、本発明では、従来のエレクトロクロミック防眩ミラー１におけるような封止樹脂６と封止ガラス７を設ける代わりに、その両者の機能を兼ね備えたシリコーンゴム１２により、エレクトロクロミック層４及び金属膜５を背面から全体的に略コの字型に柔軟に包み込んで封止する構造としている。

【００３１】ポリマーフィルム１３は、ポリエステル、ポリエチレン、アルミ－ポリエチレンテレフタレート（ＰＥＴ）、ビニリデンクロライドコポリマー、ナイロン１２及びSiOx-PETから成る群から選択されたポリマーフィルムが使用される。

【００３２】ここで、本発明の特徴とするところは、このシリコーンゴム１２とその背面のポリマーフィルム１３でエレクトロクロミック層４を封止する構造は、予めポリマーフィルム１３にシリコーンゴム１２が成膜され一体化されて成るシリコンーンゴム付きポリマーフィルムを、エレクトロクロミック層４及び金属膜５を背面から貼り付けることにより形成される点である。

【００３３】いずれにしろ、シリコーンゴム付きポリマーフィルムを用いれば、貼り付けるだけのきわめて簡単な工程でエレクトロクロミック層４及び金属膜５封止される。このようなシリコーンゴム付きポリマーフィルムとしては、三菱樹脂株式会社製の「珪樹」（商品名）、住友スリーエム株式会社製の「ロールカバリングテープＮｏ．５４６１」（商品名）等が使用される。

【００３４】実際の製造に際しては、シリコーンゴム付きポリマーフィルムから、製造されるべきエレクトロクロミックミラー等の素子の平面形状とほぼ同じ形状に切り取り、エレクトロクロミック層４及び金属膜５の背面から貼り付ければよい。この場合、エレクトロクロミック層４及び金属膜５は、１．５μｍ程度できわめて薄く、しかもシリコーンゴム１２自体は柔軟性、伸縮性があるからポリマーフィルム１３とシリコーンゴム１２とは一緒に切り出された同じサイズのものでも、シリコーンゴム１２でエレクトロクロミック層４及び金属膜５の側部を十分包み込むことができる。

【００３５】なお、この実施例では、シリコーンゴム付きポリマーフィルムを利用したが、ポリマーフィルム１３でなくても、耐水性、耐湿性、耐摩耗性及び耐熱性を有する部材であって、しかも従来の封止ガラスのような重量のある部材や重量の出てしまう用い方（例．厚い構造で利用する。）でなければ、ゴム、金属（軽量金属部材あるいは強度の担保された金属軽量構造部材。）、セラミックス（従来の封止ガラスを除く。）等の部材でもよい。即ち、これらの部材とシリコーンゴムが一体となったシリコーンゴム付き部材を利用してもよい。

【００３６】そして、シリコーンゴム１２とポリマーフィルム１３のさらに外側部から、外部の湿気等の影響を抑制するために、同類の材料であるシリコーンゴム、耐湿性の優れたブチルゴム、又はＵＶ硬化樹脂等の防湿材１４で被覆し封止する。

【００３７】以上のような構成から成る本発明に係るエレクトロクロミック防眩ミラー１１の封止構造の作用について以下説明する。エレクトロクロミック層４の着色、消色反応は、従来のエレクトロクロミック防眩ミラー１と同じであるから、ここでは説明を省略する。このエレクトロクロミック防眩ミラー１１の封止構造では、エレクトロクロミック層４をシリコーンゴム１２が柔軟に包み込み機械的強度をもって支持するとともに、耐食性を向上させる保護機能を有する。

【００３８】そして、シリコーンゴム１２のシロキサン結合が、外部からの水分、薬品、油等を遮断し、エレクトロクロミック層４に対する、外部からの水分、薬品、油等による損傷や、上記着色、消色反応の低下による機能劣化を防止する。

【００３９】即ち、本発明のシリコーンゴム１２とポリ

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マーフィルム１３は、従来の封止ガラス７と同様に、耐水性、耐候性、耐熱性、耐薬品性、耐油性、耐摩耗性等を有し、外部からの水分、薬品、油等の侵入を防止し、エレクトロクロミック層４の着色及び消色反応が正常に機能するようにしている。

【００４０】ところで、本発明の封止構造において、シリコーンゴム１２とポリマーフィルム１３を別体にして、後で貼り付けたりすると、シリコーンゴム１２は密着性が悪いために、貼着面に隙間ができ剥離の原因となったりする。又、ポリマーフィルム１３を一体にカバーしないでシリコーンゴム１２をむき出しにしている場合には、シリコーンゴム１２自体が耐摩耗性がないために他の機器や取り付け部材等との接触等に弱く、その取り扱い上の問題が生じる。

【００４１】しかしながら、本発明では、予めポリマーフィルム１３にシリコーンゴム１２が成膜され一体化されているシリコンーンゴム付きポリマーフィルム１３を、エレクトロクロミック層４及び金属膜５を背面から貼り付けて封止するために、封止構造の形成はきわめて簡単となるばかりでなく、上記取り扱い上の問題、即ち、密着性が悪い、耐摩耗性が無い等のシリコーンゴム１２の扱いにくい部分をカバーでき、二次加工性、汎用性が増す。

【００４２】（実験例）次に、本発明に係るエレクトロクロミック素子の封止構造を具体的に作製し、その実験を行った。この実験例を以下説明する。本実験例では、自動車用インナーミラーサイズ（２８０×８０ｍｍ）のＩＴＯガラス基板（透過率８０％、抵抗値８Ω／□）上に、１０００ÅのＩｒＯｘ膜、６０００ÅのTa_2O_5膜及び６０００ÅのWO_3膜から成るエレクトロクロミック層４、さらに１０００ÅのＡｌ膜を真空蒸着法にて順次成膜した。そして、Ａｌ膜上に三菱樹脂（株）製のシリコーンゴム付きフィルム「珪樹」（商品名）を貼着し、周辺を信越化学工業（株）製のシリコーンゴム「ＫＥ４０２」（商品名）で封止し、エレクトロクロミック素子を作成した。

【００４３】反射率特性を確認したところ、１．５Ｖの駆動電圧により、着色時１０％、消色時７５％の特性を示した。そして、色むらの発生も見られなかった。さらに、駆動電圧１．５Ｖの駆動により、着色・消色を繰り返す作動試験（電圧印加時間は各２０秒。）を行ったところ、１０万回程度の作動を行った後も、初期測定時の反射率特性と変化しない値を示し、色むらの発生もみられなく、高い耐久性のを持つことが確認された。

【００４４】以上、本発明に係るエレクトロクロミック素子の封止構造を、エレクトロクロミック防眩ミラーの封止構造に適用した実施例によって説明したが、この封止構造が適用されるエレクトロクロミック素子は、防眩ミラーに限るものではなく、エレクトロクロミック素子表示装置等、エレクトロクロミック素子が適用されるものであれば、いろいろな装置にも適用できることは言うまでもない。

【００４５】又、上記実施例では、エレクトロクロミック防眩ミラー全体が平坦なフラットタイプの防眩ミラーに適用した構成について説明したが、シリコーンゴムは弾性を有するから、基板ガラス、透明導電膜、エレクトロクロミック層及び金属膜を含め全体的に湾曲状のエレクトロクロミック防眩ミラー等のエレクトロクロミック素子の封止構造にも応用ができる。

【００４６】

【発明の効果】本発明は、以上説明したように構成されているので、以下に記載されるような効果を奏する。

【００４７】（１）封止ガラスを不要とする構造により、エレクトロクロミック素子を大幅に軽量化できる。そして、封止ガラスの製造工程を不要とし、予め用意したシリコーンゴム付き部材（例．シリコーンゴム付きポリマーフィルム）を貼着するという簡易な製造工程で済むために、工程数の低減となり、大幅な低コスト化が達成できる。

【００４８】（２）エレクトロクロミック層をシリコーンゴムで柔軟に包み込んで封止したので、熱硬化樹脂のように、硬化時の発熱やその高硬度化によって、エレクトロクロミック層に悪影響や損傷を与えることがなくなり、又シリコーンゴムのシロキサン結合が外部からの水分、薬品、油等を遮断するように機能するために、エレクトロクロミック層に対する外部からの水分、薬品、油等による損傷や、上記着色、消色反応の低下による機能劣化を防止することができる。

【００４９】（３）シリコーンゴムに加えて耐水性、耐湿性、耐摩耗性及び耐熱性を有する部材（例．ポリマーフィルム）を被着することにより、高い強度や耐傷性が付与されるとともに、防水性、防湿性等の一層の向上が図られる、エレクトロクロミック素子を他の部材に取り付けたりする場合等の二次加工性や汎用性等、即ち取扱い易くなる。

【００５０】（４）シリコーンゴムは、弾性を有するから、上記実施例のようなフラット型のエレクトロクロミック防眩ミラーだけでなく、全体的に曲率のついたエレクトロクロミック防眩ミラーにも応用ができる。

【図面の簡単な説明】

【図１】従来のエレクトロクロミック素子の封止構造を適用したエレクトロクロミック防眩ミラーの封止構造の断面図を示す。

【図２】本発明に係るエレクトロクロミック素子の封止構造の実施例であり、エレクトロクロミック防眩ミラーの封止構造の断面図を示す。

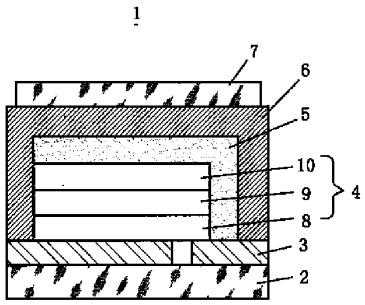
【符号の説明】

１、１１　エレクトロクロミック防眩ミラー
２　基板ガラス
３　透明導電膜

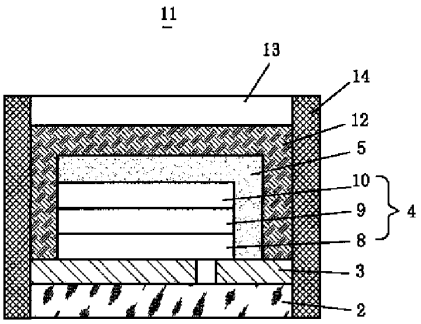
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４　エレクトロクロミック層
５　金属膜
６　封止樹脂
７　封止ガラス
１２　シリコーンゴム
１３　ポリマーフィルム
１４　防湿材（シリコーンゴム、ブチルゴム、ＵＶ硬化樹脂等）

【図１】



【図２】



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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	ELECTROCHROMIC FILMS WITH EDGE PROTECTION

As the below named inventor, I hereby declare that:

This declaration is directed to:
- [X] The attached application, or
- [ ] United States application or PCT international application number _____ filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

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LEGAL NAME OF INVENTOR

Inventor: Zhao CHEN Date (Optional): _____

Signature: _____

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LEGAL NAME OF INVENTOR

Inventor: Jian WANG Date (Optional): 11/12/2018

Signature: _____

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LEGAL NAME OF INVENTOR

Inventor: Yan ZHOU Date (Optional): _____

Signature: _____

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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
12 September 2014 (12.09.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/134714 A2

(51) International Patent Classification:
G02F 1/161 (2006.01)

(21) International Application Number:
PCT/CA2014/000191

(22) International Filing Date:
6 March 2014 (06.03.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/774,480 7 March 2013 (07.03.2013) US
61/910,261 29 November 2013 (29.11.2013) US

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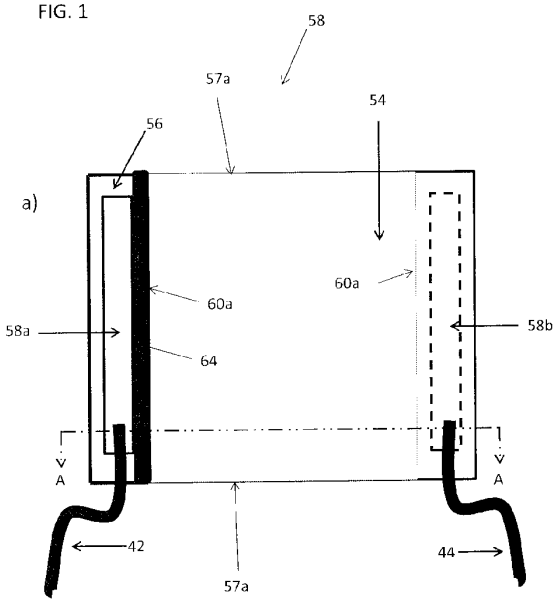
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,

[Continued on next page]

(54) Title: SEAL AND SEAL SYSTEM FOR A LAYERED DEVICE

FIG. 1



(57) Abstract: The disclosure provides, in part a seal system for sealing a film. The disclosure further provides, in part, a sealed film comprising a first and a second substrate; a first and a second electrode disposed on the surface of at least one of the substrates; a switching material disposed between the first and second substrates; a first seal and a second seal; the first seal disposed along an edge of the switching material, separating the switching material from the second seal.

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SEAL AND SEAL SYSTEM FOR A LAYERED DEVICE

This application claims the benefit of U.S. Provisional Application Nos. 61/774,480 filed March 7, 2013, and No. 61/910,261, filed November 29, 2013; both of which are incorporated herein by reference in their entirety.

TECHNICAL FIELD

[0001] The present disclosure relates to a seal system for a layered device. The layered device may have a switchable layer, and may include an optical filter or a laminated glass.

BACKGROUND

[0002] A switchable film may generally comprise two substrates, with a switchable material disposed therebetween. Depending on the nature of the switchable material, it may be advantageous to provide a seal around the perimeter of the switchable material to keep it separated from water, air, oxygen or other aspects of the external environment. This may be beneficial in preserving function, or preventing degradation or diminished performance.

[0003] The configuration of the seal, and the manner in which is it applied or assembled for the switchable film or switchable device may be governed, at least in part, by the nature of the switchable material and how it is applied. Some electrochromic devices (e.g. electrochromic mirrors) may have the substrates and seals assembled and cured, to first to provide a chamber. The chamber is subsequently filled by vacuum-pulling the switching material into the chamber. As the seal material is cured or solidified before exposure to the switching material, undesirable reactions of the switching material with a component of an uncured, or partially cured seal is avoided. For a switching material coated onto a moving web or film, that is to be cut to a desired shape, this method of pre-assembly of the chamber, although it may have a good seal, would not be appropriate, and other ways to avoid exposing a switching material to an uncured, or partially cured seal material may be sought.

[0004] A useful aspect in the mass production of device which comprise one or more seals or seal systems, is the ability to detect a failure of the seal during the production process. A breach of a seal in a device may result in a product with reduced durability or function, or a device that has, or will, fail. In some cases, the breach of a seal system may not be detected,

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or detectable, for some time after fabrication or after several hours, days, months or years of service. Sale or use of an article comprising the switchable film with a deficient seal may result in costly warranty and or safety issues. Thus, it may be beneficial to employ a seal or sealing system, in a switchable device that includes one or more detectors, or indicators built into the seal that would make the device identifiable, or attract the attention of an inspector or user in the event of a seal breach during production or storage, or in use.

SUMMARY

[0005] The present disclosure relates to a seal for a switchable film. The switchable film may be included in a switchable device, such as an optical filter or a switchable, laminated glass.

[0006] In accordance with one aspect, there is provided a seal for a switchable laminated glass, comprising: a first seal contacting an edge of a layer of switching material; the switching material laminated between a first and a second substrate and in contact with first and second electrodes distributed on the first, the second or the first and the second substrates.

[0007] In accordance with another aspect, there is provided a seal for a switchable laminated glass comprising: a first seal, adhereable to a conductive metal oxide electrode and compatible with a switching material of the switchable laminated glass.

[0008] In accordance with another aspect, there is provided an encapsulated switchable film comprising: a first substrate and a second substrate; a first electrode and a second electrode disposed upon the first, the second or the first and the second substrate; a layer of switching material disposed between the first and the second substrates; an electrical connector for electrically connecting the first and the second electrodes to a power source; and a first seal contacting an edge of the layer of switching material.

[0009] In accordance with another aspect, there is provided a sealed film comprising a first and second substrate, a first and second electrode disposed on the surface of at least one of the substrates, a switching material disposed between the first and second substrates, and a first seal and a second seal; the first seal disposed along an edge of the switching material, separating the switching material from the second seal.

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[0010] In accordance with another aspect, there is provided a system for sealing a switchable film comprising a bead of a first seal along an exposed edge of a switching material, and a second seal encapsulating the first seal.

[0011] In accordance with another aspect, there is provided a method for sealing a switchable film comprising: a) providing a switchable film comprising a first and a second substrate with a first and second electrode disposed on the surface of at least one of the substrates, and a switching material disposed between the first and second substrates; b) disposing a first seal in contact with an electrode and adjacent to the switching material; c) disposing a second seal adjacent to the first seal.

[0012] The method may further comprise a step b1) affixing a transparent liner to the first and second substrates.

[0013] In accordance with another aspect, there is provided an encapsulated switchable film comprising: a) a layer of switching material between a pair of parallel substrates; a first seal surrounding the layer of switching material; b) first and second encapsulating layers affixed to a second surface of the substrate; and c) a second seal disposed between the first and second encapsulating layers, and separated from the switching material by the first seal.

[0014] In accordance with another aspect, there is provided a method for encapsulating a switchable film comprising: a) providing a switchable film comprising a first and a second substrate with a first and second electrode disposed on the surface of at least one of the substrates, and a switching material disposed between the first and second substrates; b) disposing a first seal in contact with an electrode and adjacent to the switching material; c) affixing a transparent layer to the first and second substrates; and d) disposing a second seal adjacent to the first seal, the second seal separated from the switching material by the first seal.

[0015] In accordance with another aspect, there is provided a method for encapsulating a switchable film comprising: a) providing a switchable film comprising a first and a second substrate with a first and second electrode disposed on the surface of at least one of the substrates, and a switching material disposed between the first and second substrates; b) affixing a transparent layer to the first and second substrates; and c) disposing a first seal in a

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space defined at least in part by an edge of the switching material and the transparent layers affixed to the first and second substrates.

[0016] In accordance with another aspect, there is provided a laminated glass comprising: a) a first substrate and a second substrate; b) a first electrode and a second electrode disposed upon the first, the second or the first and the second substrate; c) a layer of switching material disposed between the first and the second substrates; d) an electrical connector for electrically connecting the first and the second electrodes to a power source; and e) a first seal contacting an edge of the layer of switching material.

[0017] In accordance with another aspect, there is provided a method of cutting a switchable film, comprising the steps of providing a switchable film, directing laser radiation at the film to cut a weed portion comprising a portion of a first substrate, but not a second substrate of the switchable film, leaving the conductive layer of the second substrate intact.

[0018] In some aspects, the switching material is in contact with the first and the second electrodes.

[0019] In some aspects, the first seal encapsulates an electrical connector.

[0020] In some aspects, the first substrate is offset along at least two adjacent edges relative to the second substrate. The offset edges provide for a busbar mounting platform. In some aspects, the first substrate may be offset along a substantive portion of the periphery, relative to the second substrate. In some aspects, one or more overhanging tabs may extend from a first substrate, beyond a periphery of a second substrate, to provide a busbar mounting platform.

[0021] In some aspects, the first and second electrodes comprise a conductive metal oxide.

[0022] In some aspects, the first seal contacts the conductive metal oxide.

[0023] In some aspects, the first seal is adherent to the conductive metal oxide.

[0024] In some aspects, the laminated glass further comprises a second seal, encapsulating the first seal and electrical connectors.

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[0025] In some aspects, the first seal, second seal, or first seal and second seal is selected from a group comprising silicones, natural rubbers, synthetic rubbers or elastomeric materials.

[0026] In some aspects, the first seal is installed in a gap between the edge of the switching material and the electrical connector.

[0027] In some aspects, the first seal is non-reactive with the switching material.

[0028] In some aspects, the first seal is gas-impermeable.

[0029] In some aspects, the first seal is water-impermeable.

[0030] In some aspects, the first seal and/or second seal is electrically insulating.

[0031] In some aspects, the first seal has low amount of electrical conductivity

[0032] In some aspects, the first seal is non-absorbing, or substantially non-absorbing of a solvent or plasticizer component of the layer of switching material.

[0033] In some aspects, the first seal comprises a polymer matrix comprising thermoplastic, thermosetting, or thermoplastic and thermosetting polymers.

[0034] In some aspects, the first seal is a thermoset material.

[0035] In some aspects, the first seal does not release water when curing.

[0036] In some aspects, the first, the second or the first and the second substrates each have a thickness of from about 1.0 to about 5 mm.

[0037] In some aspects, the second seal is non-reactive with the first seal.

[0038] The present disclosure also relates to a seal system for a switchable film. The seal system may further comprise a detection system for detecting a compromised seal component.

[0039] In accordance with another aspect, there is provided a seal system for a switchable film, the seal system comprising a first seal and a second seal, the first seal disposed along an

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edge of a switching material, separating the switching material from the second seal; the first seal, second seal, or first seal and second seal comprising an indicator material.

[0040] In some aspects, the seal system further comprises a trigger material.

[0041] In some aspects, the switching material comprises an indicator material or a trigger material, or both an indicator material and a trigger material.

[0042] In some aspects, the first seal comprises an indicator material and a trigger material.

[0043] In some aspects, the second seal comprises an indicator material and a trigger material.

[0044] In some aspects, the indicator material, trigger material or indicator material and trigger material may be encapsulated with an encapsulating material. The indicator material, trigger material or indicator material and trigger material may be encapsulated in layers.

[0045] This summary does not necessarily describe the entire scope of all aspects. Other aspects, features and advantages will become apparent to those of ordinary skill in the art upon review of the following description of specific embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0046] These and other features will become more apparent from the following description in which reference is made to the appended drawings wherein:

[0047] **Figure 1** shows a schematic diagram of a switchable film with opposing, offset edges, according to one embodiment.

[0048] **Figure 2** shows a section view along line A-A of the switchable film of Figure 1.

[0049] **Figure 3** shows a schematic diagram of the cut edges, busbar and electrical connectors for a film with offset edges, according to another embodiment.

[0050] **Figure 4** shows a schematic diagram of cut edges, bus bars and electrical connectors for a film with offset edges according to another embodiment.

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[0051] **Figures 5A, B** show schematic diagrams of a switchable film with offset edges cut to a shape, according to another embodiment.

[0052] **Figure 6** shows a sectional diagram of the cut edges, busbar and electrical connectors for an encapsulated film with offset edges according to another embodiment.

[0053] **Figure 7** shows a sectional diagram of the cut edges, busbar and electrical connectors for an encapsulated film with offset edges, according to another embodiment.

[0054] **Figure 8** shows a sectional diagram of a portion of a switchable film comprising an active layer and first and second seal materials, according to another embodiment.

[0055] **Figure 9** shows a sectional diagram of a portion of a switchable film comprising an active layer and indicator layers, according to another embodiment.

DETAILED DESCRIPTION

[0056] In the description that follows, a number of terms are used extensively, the following definitions are provided to facilitate understanding of various aspects of the invention. Use of examples in the specification, including examples of terms, is for illustrative purposes only and is not intended to limit the scope and meaning of the embodiments of the invention herein.

[0057] This disclosure provides, in part, a sealed film comprising a first and a second substrate, a first and a second electrode disposed on the surface of at least one of the substrates; a switching material disposed between the first and second substrates and in contact with the first and second electrodes; and a first seal and a second seal, the first seal disposed along an edge of the switching material, separating the switching material from the second seal.

[0058] This disclosure further provides, in part, a system for sealing a switchable film comprising a first seal along an exposed edge of a switching material, and a second seal encapsulating the first seal.

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[0059] The disclosure provides, in part, a seal for a switchable laminated glass comprising a first seal, adherent to a conductive metal oxide electrode and compatible with a switching material of the switchable laminated glass.

[0060] A seal, or a seal system, may be useful for an apparatus comprising a switching material which may be sensitive to oxygen, water or environmental contaminants. A seal may separate sections of switching materials in the same film or device. A seal may provide a border or barrier between cells or units of switching material, permitting their independent operation and switching. A switching material may be layered between first and second substrates, an edge seal may be provided along all, or substantially all edges. A portion of one or both substrates may be removed before installation of the seal. In some embodiments, sections of seal may subsequently be removed to allow for application of electrical connectors, or to facilitate installation of other components or refine the shape of the switching material. A seal may be useful to contain the switching material, or prevent egress of the switching material or component of the switching material from the device. A seal may be useful to isolate the switching material from an external environment.

[0061] When making a through-cut on a switchable film (comprising first and second substrates, transparent conductive layers, switching material and optionally other layers or components) with a mechanical cutter (scissors, knife or the like), the pressure applied to initiate the cut may compress a portion of the switchable film, distorting or displacing a layer of switchable film and enabling contact between the transparent conductive layers on the interior sides of the substrates. For some films, the layer of switching material is thin, and the transparent conductive layers brittle when cut – microscopic shards of conductive material created or released with use of a mechanical cutter may span across the cut edge of the switching material, enabling contact across the edge of the switching material. This contact, whether from compression of the switching material, spanning of the switching material by conductive shards, or other undesired contact may allow for electrical flow (when electricity is applied) bypassing the switchable film (creating an electrical short in the film) and the film may not switch uniformly, or at all. Use of a laser cutter avoids the application of force to the film when cutting, and reduces the pressure-contact of the transparent conductive layers. In some embodiments, cutting the first and second substrates to form offset edges, and removing a portion of the switching material provide a platform for mounting busbars separated from

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the cut edge of the switching material and directly on the transparent conductive layer on the interior side. The busbar may be positioned on the uncut substrate to provide a gap to receive a seal material along the cut edge of the switching material, thereby sealing the switching material, and physically separating the busbar from the switching material. Forming the busbar mounting platforms from the film itself allows for the manufacture of a switchable apparatus to be performed separately from preparation of the switchable film. The switchable film may be manufactured using roll to roll or other continuous or semi-continuous coating method. The final shape of the switchable device does not have to be considered when preparing the switchable film in bulk, as it can be cut to shape as needed, as described herein. This feature may be particularly useful when the switchable apparatus necessitates use of a non-regular shaped film, for example custom-sized glazings for buildings or vehicles, or custom shaped lenses or lens inserts for opthalmic devices.

[0062] A supporting liner that may absorb or deflect the laser is not required – in some embodiments, the switchable material itself may be suitably absorbing of the laser to allow laser cutting of a first substrate and transparent conductive layer, but prevent through-cutting of the laser to the second substrate and transparent conductive layer, the conductive layers may be only a few angstroms thick, to facilitate the desired transparency.

[0063] Referring to Figures 1 and 2, an apparatus according to another embodiment is shown generally at 58. Film 58 includes a layer of switching material 52 between first substrate 54 and second substrate 56 is electrically connected to electrical connectors 42, 44 via busbars 58a and 58b applied to a conductive coating (not shown) on substrates 54, 56; the conductive coating is in contact with switching material 52. A portion of substrates 54, 56 has been removed to expose the conductive coating where the busbars may be applied. First seal 64 is applied in a space 62 between busbar and switching material, adjacent to the cut edge of the switching material. First seal 64 may be in contact with switching material 52. First substrate 54 and second substrate 56 are offset along opposing sides 60a and 60b – this provides for access to the conductive surfaces to apply busbars and electrical connectors. For this embodiment - a generally rectangular-cut film – two sides have aligned edges 57a, 57b.

[0064] A seal may be applied along one or more edges of the switching material. A seal may be applied to a perimeter of the switchable layer before or after cutting to a desired size

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or shape. A seal may be applied by dispersing a bead, or applying a strip or die-cut section, of a sealing material along the periphery of the switching material. Other methods of dispersing or applying a sealing material such as extrusion, injection, spraying may also be used. The seal may isolate the switching material from other components of the laminated glass or optical filter, or from the ambient environment (e.g. air and/or moisture). The die-cut section may be a straight or curved strip, or a continuous shape (polygon, rounded, oval or irregular) to provide a continuous bound to the edge of the switching material.

[0065] Referring to Figure 3, an apparatus according to another embodiment is shown generally at 87. First substrate 54 is offset along one edge 90 relative to second substrate 56; second substrate 56 of film 87 is inset along three edges 91, 92, 93, relative to first substrate 54. Offsetting of some or all edges of the substrate and conductive layer surrounding the switching material in a film, or a portion of the edges, and removal of the switching material along the cut edges provides a busbar mounting platform. This offset area may prevent inadvertent electrical contact between the conductive coatings of the first and second substrates which may short out the device, and may provide a larger surface area for the first, second or first and second sealing material to adhere to. Without an offset cut to form a busbar mounting platform, adhesion of a sealing material may be substantively dependent on the through-cut edge of the film - a substantially reduced surface area.

[0066] Figure 4 shows an apparatus according to another embodiment. Film 89 has second substrate 56 inset along three edges, relative to substrate 54, with busbar 58a positioned on an offset edge adjacent to that of busbar 58b. Electrical connections 42, 44 lead to power source and/or control apparatus from the same corner of film 89. Electrical connections 42, 44 may be further embedded in an electrically insulating material (e.g. a seal) to prevent their inadvertent contact with a conductive coating of an opposing substrate. A first seal may be placed along the cut edge of the switching material, along the offset.

[0067] Other film shapes are contemplated, including curved, polygon or a combination thereof. In some embodiments, the shape of the film may be cut to resemble or match the shape of the switchable glazing or lens. For example, a triangular switchable glazing may comprise a triangular film, with two adjacent edges having opposing offsets, with busbars

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and positioned along the opposing offsets and electrical connectors leading from a common corner of the triangular film.

[0068] In some embodiments, a film may be cut to a shape suitable for use in an opthalmic device. Referring to Figure 5A, an apparatus according to another embodiment is shown generally at 100. Film 100 is cut to a general shape suitable for use as, or with, a goggle lens or similar opthalmic device. The lens 100 has an arc-shaped upper edge 106 and a lower edge with a cutout section 108 of height X for accommodating a user's nose, between lobed sections to cover the eyes of a user. The lens 100 may have a nose bridge section 109 of height Y, with an overall depth of the switchable area (from an upper edge to a bottom edge of the lens, inside the circumferential offset edges) of X +Y. The lens may be of unitary construction. Film 100 comprises a layer of switching material (not shown) is disposed between first substrate 102 and second substrate 104. First and second substrates have interior sides facing each other, and exterior sides facing away. The interior side of one or both substrates has a transparent conductive layer in contact with the layer of switching material. First substrate 102 is cut to have a smaller perimeter relative to substrate 104, providing a recessed section along a portion of the perimeter. An overhanging tab 110 provides a platform for mounting a busbar 112 on the interior side of substrate 102, in contact with the transparent conductive layer. Substrate 104 has a recessed section corresponding overhanging tab 110. Busbar 114 is mounted on the interior side of substrate 104, along a portion of an edge of substrate 104, and in contact with a conductive transparent layer on the interior side of substrate 104. Gap 116 separates the cut sections of substrates 102 and 104, providing non-overlapping mounting points for busbars 112, 114. Electrical connectors (not shown) may be mounted to busbars 112, 114 to connect the lens to a source of power to facilitate electrochromic switching of the lens. The offset edges of lens 100 may be sealed using a first, or a first and a second sealing material.

[0069] Lens 100 may be shaped to a cylindrical, spherical or frusto-conical configuration, and affixed to a frame using attachment points along a portion of the edge (not shown) or in a frame surrounding the periphery of the lens. Lens 100 may be thermoformed to conform to a spherical, or partially spherical lens shape. Lens 100, once shaped, may be laminated to a static plastic or glass opthalmic device using heat (melt lamination), or a heat or pressure activated adhesive, or combination thereof. In some embodiments, substrates 102, 104 may

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be rigid, or partially flexible plastic that may be formed into a suitable cylindrical, frusto-conical, spherical or partially spherical lens shape, and used in an opthalmic device without a second static glass or plastic lens.

[0070] Decreasing the depth of the nose bridge may generally increase the depth of the cutout section, making the first and second lobes of the lens more pronounced. By altering the height of the nose bridge and cutoff relative to each other (shifting the ratio X:Y), a lens with more or less flexibility about the nose bridge, a flatter profile, or more prominent profile may be formed.

[0071] The ratio of X:Y may be from about 1:10 to about 10:1 or any ratio therebetween, and may be selected according to the desired profile and shape of the lens. For example Y may be any percentage of the depth of the lens X+Y; Y may be from about 5% of X+Y to about 95% of X+Y, or any amount therebetween, for example about 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85 or 90%, or any amount or range therebetween.

[0072] For example, a lens for a ski goggle may have an X:Y ratio of from about 1:5 to about 1:1, whereas a unitary lens for sunglasses may have a smaller nose bridge, with an X:Y ratio of about 1:1 to about 5:1. It is appreciated however, that any suitable X:Y ratio may be used for ski goggles, sunglasses or any other type of unitary lens, without limitation.

[0073] To electrochemically switch a lens according to some embodiments, an electrical potential is applied to the electrodes of the film 100 via busbars 112, 114, and the switching material switches. The relationship between the height of the nose bridge Y, and the area of the lens may, in part, impact the speed of the switch of the lens. Without wishing to be bound by theory, resistivity of the electrode may increase as the nose bridge decreases (Y is reduced and X increased). In some embodiments, a second pair of busbars 120, 122 may be included (Figure 5B), with the electrical potential being applied to both pairs of busbars simultaneously. For large area lenses or lenses with a smaller nose bridge (e.g. where X:Y is from about 1:1, 2:1, 3:1, 4:1,or the like) , inclusion of first and second pairs of busbars may allow for a faster switch.

[0074] The disclosure further provides, in part, a method for sealing a switchable film, comprising providing a switchable film comprising a first and a second substrate with a first

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and second electrode disposed on the surface of at least one of the substrates, and a switching material disposed between the first and second substrates and in contact with the first and second electrodes; disposing a first seal in contact with an electrode and adjacent to the switching material; and disposing a second seal adjacent to the first seal.

[0075] The disclosure further provides, in part, a method of cutting a switchable film, comprising the steps of providing a switchable film, directing laser radiation at the film to sever a weed portion comprising a portion of a first substrate, but not a second substrate of the switchable film, leaving the conductive layer of the second substrate intact.

[0076] To provide the offset edges, the film comprising a switchable layer may be kiss-cut with a laser. The laser is configured to cut only through the upper most substrate and conductive coating, without cutting through or damaging the conductive coating of the lower substrate – the switching material separates the two substrates. The penetrative power of the laser when cutting through the upper substrate may be absorbed or dissipated to below a threshold level, and may be further absorbed or dissipated by the layer of switching material. The penetrative power of the laser may be a product of the laser power (wattage), the type or source of the laser, whether the laser is a continuous or a pulsed beam, duration of the pulses, and the rate at which the laser is moved across the surface to be cut. In some embodiments, the laser may be a CO_2 laser; in some embodiments, the laser power may be from about 0.1 to about 5 W or any amount or range therebetween, or from about 0.5 to about 2 W, or any amount or range therebetween; in some embodiments, the laser may be pulsed at an interval of from 500 to about 2000 pulses per inch (PPI) or any amount or range therebetween, or from about 1200 to about 1800 PPI or any amount or range therebetween or from about 1400 to about 1600 PPI or any amount or range therebetween; in some embodiments the laser radiation may have a frequency of from about 9 to about 11 microns or any amount or range therebetween. Laser cutting may be performed under a nitrogen blanket. Pulsing the laser allows application of a substantially consistent amount of energy along a cutline; if insufficient energy is applied to make the cut, the weed portion may not separate cleanly and shorting may result. Guidance of the laser may be manual, or may be computer controlled, automated or semi-automated (e.g. CNC automation).

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[0077] Kiss-cutting of the film with a laser may be advantageous over cutting with a knife or die – as the active layer of a switchable film may be very thin, any slivers or shards of conductive coating left along the edge after removal of the weed portion of the upper substrate and conductive coating may contact the lower conductive coating and cause an electrical short in the apparatus, and the active layer may fail to switch, or may switch unevenly or slowly.

[0078] The film may be cut in stages. In a first stage, the overall size and shape of the switchable area is defined, and an area of film slightly larger overall cut with flush edges (no offset). To cut a film as shown in Figure 3, a first kiss-cut on substrate 54 is made, to provide edge 90. Additional kiss-cuts on substrate 56 may be made to provide edges 91, 92, 93. The cuts on substrate 56 may be continuous or separate, and depending on equipment configuration, the film may be turned over afte the first kiss-cut, or a laser cutting head positioned underneath the film may be used. After the film is cut, weed portions are removed, and any switching material remaining on the uncut substrate is removed. The one or more cuts may be straight or curved. Where the substrate is a spun, cast, extruded or woven web, cuts may be at any angle relative to the direction of the web, including parallel, perpendicular or any angle therebetween Electrical connectors 58a, 58b may be placed on the conductive coating, for connection of the film to a power source; in the embodiment shown, electrical connectors 42, 44 are also provided.

[0079] Thus, the disclosure further provides, in part, a switchable film where the first and the second substrates are in an offset relationship along at least one edge, or along at least two edges. The at least two offset edges may be on different substrates, or on the same substrates. Where the at least two offset edges are on the same substrate, they may be adjacent (share a common corner or vertex).

[0080] A portion of a first seal is applied adjacent to the switching material along cut edges 90, 91, 92, 93 the first seal contacts the cut edge of the switching material and the conductive coating of the uncut substrate. Contact with the uncut surface may aid in maintaining the position of the first seal, to ensure a suitable seal for the switching material.

[0081] In some embodiments, support and separation of the substrates and their respective conductive coatings is provided by the switching material itself – a spacer, or the like, is not

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required to keep the conductive coatings from contacting and shorting. As the switching material may be cast or extruded as one or more layers on a first substrate, followed by application of the second substrate on top, there is no chamber defined in advance by the substrates and an edge configuration, which may be subsequently filled. Instead, the switching material may be set, cooled or cured to a suitable strength to maintain the separation of the conductive coatings and prevent shorting of the device, even following lamination with heat and pressure. Spacers, beads or other physical devices to maintain separation of the substrates and conductive coating are not needed. Additionally, the film may be produced in advance of knowing the final shape or configuration of the device in which it will be used, and until needed. Suitable shapes – flat or curved (e.g. lenses for helmets, visors, windows of any desired shape) – may later be cut from the film as needed.

[0082] The disclosure further provides, in part, an encapsulated switchable film comprising a layer of switching material between a pair of parallel substrates, and a first and a second conductive coating or layer (first and second electrode) disposed on a first surface of one or both substrates; a first seal surrounding the layer of switching material; first and second transparent layers affixed to a second surface of the substrate; a second seal disposed between the first and second transparent layers, and separated from the switching material by the first seal. In some embodiments, the switching material may be in contact with both the first and the second electrode.

[0083] The disclosure further provides, in part, a switchable film comprising: a layer of switching material between a pair of parallel substrates, the switching material in contact with a first and a second electrode disposed on a first surface of a substrate; a first seal surrounding the layer of switching material; first and second transparent layers affixed to a second surface of the substrate; a second seal disposed between the first and second transparent layers, and separated from the switching material by the first seal; with the proviso that no spacer is needed to prevent contact of the electrodes. The switchable film may be described as a "spacerless" switchable film.

[0084] The disclosure further provides, in part, a method for encapsulating a switchable film comprising: providing a switchable film; comprising a first and a second substrate with a first and second electrode disposed on the surface of at least one of the substrates, and a

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switching material disposed between the first and second substrates and in contact with the first and second electrodes; disposing a first seal in contact with an electrode and adjacent to the switching material; affixing a transparent layer to the first and second substrates; and disposing a second seal adjacent to the first seal, the second seal separated from the switching material by the first seal.

[0085] Referring to Figure 6 an apparatus of an embodiment is shown generally at 50. A layer of switching material 52 between first 54 and second 56 substrates is electrically connected to electrical connectors 42, 44 via busbars 58a, 58b in contact with a conductive coating (not shown) on substrates 54, 56; the conductive coating is in contact with the switching material 52. A portion of substrates 54, 56 has been removed to expose the conductive coating where the busbars may be applied. The first seal 64 is applied in a space 62 between the busbar and switching material, adjacent to the cut edge of the switching material. First seal may be in contact with the switching material. A second seal 78 may be disposed in a space defined in part by the first and second transparent layers 66, 68 and first seal 64, encapsulating the first seal, busbar and electrical connector. The second seal is not contacted by the switching material; this is prevented by the first seal. Transparent layers 66, 68 may be affixed to substrates 54, 56 by an adhesive 70. The adhesive 70 may be a layer of pressure-sensitive adhesive or a sheet material. The adhesive 70 may be pre-cut (die cut, laser cut or other suitable cutting method) to a suitable shape for the switchable film and offset edges, before incorporation into the apparatus. The second seal may be a separate application of the same material as the first seal, or may be a different seal.

[0086] The disclosure further provides, in part, a method for encapsulating a switchable film comprising: providing a switchable film; comprising a first and a second substrate with a first and second electrode disposed on the surface of at least one of the substrates, and a switching material disposed between the first and second substrates and in contact with the first and second electrodes; affixing a transparent layer to the first and second substrates; and disposing a first seal in a space defined at least in part by a kiss-cut edge of the switchable film and the transparent layers affixed to the first and second substrates.

[0087] Referring to Figure 7, an apparatus according to another embodiment is shown generally at 80. A seal 82 is applied in a space defined in part by the first and second

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transparent layers 66, 68, and an edge of the switching material 52, filling the space 62 and encapsulating the busbars 58 a, 58b and electrical connectors 42, 44. In this embodiment, there is no first seal preventing contact of the switching material by the seal 82.

[0088] In another embodiment, the second seal may comprise a component that interacts with a component in a switching material, creating a detectable change that identifies a deficiency in the first seal – a leak, gap or the like. Where the first seal is intact and prevents contact of the switching material by the second seal, the second seal cures to isolate the switching material from the external environment. The first seal may absorb a portion of the switching material, but prevent contact of one or more components of the active layer and second seal long enough for the second seal to complete curing or hardening. Where there is a deficiency in the first seal, the uncured or partially cured second seal may contact the switching material. When this occurs, an observable alteration such as a color change may result. This observable alteration may be due to an indicator in the switching material, the second seal or both. Detection of a faulty seal early in the manufacture process may allow for defective films or devices to be identified and if appropriate, removed from the production process, to reduce the number of defective devices in the final product lot. In other embodiments, the indicator of the cured second seal may be activated if the first seal is breached – for example, if the switchable film, or a device comprising the switchable film is twisted or physically damaged. A change in color or other visible indicator draws attention to the damaged device.

[0089] In another embodiment, the seal system may comprise one or more indicators for indicating a deficiency in the first seal, the second seal, or both the first seal and the second seal. A breach or other deficiency in a seal may result in a product comprising a material that is less durable, or potentially adversely affected by the external environment. Examples of such materials include switchable materials, active layers, suspended particle layers, liquid crystal, photovoltaic materials or the like. In some of the embodiments that follow, a switchable material or active layer is exemplified, however any other material adversely affected by a breach in the seal – by ingress of a seal system component or environment interaction (e.g. water, air, oxygen, etc), or by egress of a component of the material (e.g. loss, disruption or inactivation of a component of the material) may benefit from a seal system and/or an indicator system as described herein.

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[0090] Referring to Figure 8, a schematic diagram of a switchable film with first and second seals is shown generally at 130. Active layer 131 is disposed between substrates 132. Substrate 132 may include a conductive layer (not shown). In one embodiment, active layer 131 comprises an indicator material and second seal 134 comprises a trigger material. In another embodiment, active layer 131 comprises a trigger material and second seal 134 comprises an indicator material. Where first seal 136 fails, interaction of the indicator material and trigger material may be permitted, and a detectable change occurs.

[0091] In another embodiment, first seal 136 comprises an indicator material, and a trigger material is a component of the external environment. Where the second seal 134 fails, interaction of the indicator material and trigger material is permitted, and a detectable change occurs.

[0092] Referring to Figure 9, a schematic diagram of a switchable film with first and second seals is shown generally at 140. Active layer 131 is disposed between substrates 132 and layer 138. Substrate 132 may include a conductive layer (not shown). In one embodiment, active layer 131 comprises an indicator material and substrate 132 comprises a trigger material. In another embodiment, active layer 131 comprises a trigger material, and substrate 132 comprises an indicator. Active layer 131 and substrate 132 are separated by layer 138 – where the integrity of layer 138 fails or otherwise allows contact of substrate 132 with active layer 131, interaction of the indicator material and trigger material is permitted, and a detectable change occurs.

[0093] In another embodiment, substrate 132 comprises an indicator material and a trigger material is a component of the external environment. Where substrate 132 fails, or otherwise allows contact of layer 138 with the external environment, interaction of the indicator material and trigger material is permitted and a detectable change occurs.

[0094] For clarity, the embodiments of Figures 8 and 9 are shown as separate diagrams; it is contemplated that a switchable film or switchable device may incorporate both the seal configuration like that of Figure 8, and the layer configuration like that of Figure 9. In an embodiment comprising both, active layer 131 may comprise an indicator, and substrate 132 and second seal 134 each comprise a trigger material; the trigger material may be the same or different. In another embodiment, active layer 131 may comprise a trigger, ad substrate 132

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and second seal 134 each comprise an indicator material; the indicator material may be the same or different. In another embodiment, the first seal 136 and layer 138 may each comprise an indicator material, the indicator material may be the same or different, and the trigger may be a component of the external environment.

[0095] An indicator material or a trigger material may be mixed in, coated on, or dispersed through a seal, substrate, layer or active layer. The indicator material or trigger material may be soluble in the seal, substrate, layer or active layer; the indicator material or trigger material may be encapsulated. In one embodiment, the indicator material is encapsulated and the trigger material disrupts the encapsulating material to release the indicator. Reaction of the indicator material with a component of the seal, substrate, layer or active layer may effect a detectable change. In some embodiments, the seal, substrate, layer or active layer may comprise a second trigger material to interact with the indicator material to effect the detectable change.

[0096] A detectable change may be a colour change. An example of an indicator material may be a dye molecule or dye molecule precursor. A dye molecule may undergo a permanent or temporary change from a first colored state to a second colored state. A dye molecule precursor may interact with a trigger material and be cleaved, or undergo a chemical reaction (reversible or irreversible) with the trigger material, and change from a first colored state to a second colored state. A first colored state and a second colored state may each independently be any color, or may be fluorescent, or may be colourless or substantially colourless.

[0097] In some embodiments, the detectable change may be a change in solubility of an indicator material, where contact of the indicator material and trigger material induces precipitation of the indicator material, changing the optical clarity, or light transmittance of the indicator material, or device component (e.g. substrate, layer, seal or active layer)comprising the indicator material.

[0098] In another embodiment, the indicator material and trigger material may be encapsulated in layered microcapsules, where the material used for encapsulation maintains the indicator and trigger in separate compartments. The material for encapsulation may be solubilized or otherwise disrupted by a component of the active layer e.g. a solvent or

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plasticizer. The encapsulated indicator and trigger materials may be incorporated into the second seal material – when the first seal is compromised, the indicator and trigger are released by interaction with the component of the active layer and a detectable change may be observed. Such an embodiment may be advantageous in that no additional materials are added to the active layer, minimizing the complexity of the active layer formulation.

[0099] Where the active layer is switchable between light and dark states with a reduction or oxidation event, inclusion of a redox indicator, or an oxidant or reductant as an indicator material in a first or a second seal material may be useful. In another embodiment, the redox indicator or oxidant or reductant may be incorporated into the second seal material – when the first seal is compromised, the indicator undergoes oxidation or reduction and a detectable change may be observed. The indicator material may be encapsulated, and the material used for encapsulation may be solubilized or otherwise disrupted by a component of the active layer. The indicator material, trigger material, or both indicator and trigger material may be dispersed in one or more carrier fluids, as a dispersion, suspension or emulsion, or dissolved in a carrier fluid. Where the indicator and/or trigger material is encapsulated, the carrier fluid may be compatible (non-disruptive) of the encapsulating material.

[00100] Examples of dyes or dye precursors include redox indicators, halochromic indicators, inorganic oxidants or reductants. Examples of inorganic oxidants or reductants include potassium permanganate and potassium dichromate. Redox indicators may be pH dependent, or pH independent. Examples of redox indicators are set out in Table 1:

[00101] Table 1: Redox indicators

Indicator (pH independent)	**E^0, V**	**E^0, V at pH=0**	**E^0, V at ph=7**
2,2'-bipyridine (Ru complex)	+1.33 V		
Nitrophenanthroline (Fe complex)	+1.25 V		
N-Phenylanthranilic acid	+1.08 V		
1,10-Phenanthroline iron(II) sulfate complex	+1.06 V		
N-Ethoxychrysoidine	+1.00 V		
2,2`-Bipyridine (Fe complex)	+0.97 V		
5,6-Dimethylphenanthroline (Fe complex)	+0.97 V		
o-Dianisidine	+0.85 V		
Sodium diphenylamine sulfonate	+0.84 V		

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Diphenylbenzidine	+0.76 V		
Diphenylamine	+0.76 V		
Viologen	-0.43 V		
(pH dependent)			
Sodium 2,6-dibromophenol-indophenol		+0.64 V	+0.22 V
Sodium o-Cresol indophenol		+0.62 V	+0.19 V
Thionine		+0.56 V	+0.06 V
Methylene blue		+0.53 V	+0.01 V
Indigotetrasulfonic acid		+0.37 V	-0.05 V
Indigotrisulfonic acid		+0.33 V	-0.08 V
Indigo carmine		+0.29 V	-0.13 V
Indigomono sulfonic acid		+0.26 V	-0.16 V
Phenosafranin		+0.28 V	-0.25 V
Safranin T		+0.24 V	-0.29 V
Neutral red		+0.24 V	-0.33 V

[00102] Examples of halochromic indicators include leuco dyes; some examples of halochromic indicators may include gentian violet (methyl violet 10b) (transition pH range 0.0–2.0), malachite green (first transition pH 0.0–2.0),malachite green (second transition pH 11.6–14),thymol blue (first transition pH1.2–2.8),thymol blue (second transition pH 8.0–9.6),methyl yellow (pH 2.9–4.0),bromophenol blue (pH 3.0–4.6),congo red (pH 3.0–5.0),methyl orange (pH 3.1–4.4),screened methyl orange (first transition pH 0.0–3.2),screened methyl orange (second transition pH 3.2–4.2),bromocresol green (pH 3.8–5.4),methyl red (pH 4.4–6.2),azolitmin (pH 4.5–8.3),bromocresol purple (pH 5.2–6.8),bromothymol blue (pH 6.0–7.6),phenol red (pH 6.4–8.0),neutral red (pH 6.8–8.0),naphtholphthalein (pH 7.3–8.7),cresol red (pH 7.2–8.8),cresolphthalein (pH 8.2–9.8),phenolphthalein (pH 8.3–10.0),thymolphthalein (pH 9.3–10.5),alizarine yellow R (pH10.2–12.0).

[00103] Examples of trigger materials include those that may effect a pH change in a local environment (e.g. acids or bases); a pH change may trigger a color change in a halochromic indicator. Examples of trigger materials include propionic acid, butyric acid, valeric acid, caproic acid, caprylic acid, capric acid, lauric acid, myristic acid, palmitic acid, stearic acid, cyclohexanoic acid, phenylacetic acid, benzoic acid, toluic acid, chlorobenzoic acid, bromobenzoic acid, nitrobenzoic acid, phthalic acid, isophthalic acid, terephthalic acid, salicylic acid, hydroxybenzoic acid and aminobenzoic acid, or the like.

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[00104] Examples of materials that may be used to encapsulate indicator materials or trigger materials include Acrylonitrile-Butadiene-Styrene Copolymer , Acrylonitrile-Methyl acrylate copolymer, acylonitrile-styrene-acrylate copolymer, amorphous nylon, arabinogalacatan, beeswax, carboxymethylcellulose, carnauba, cellulose, cellulose acetate phthalate, cellulose nitrate, cyclic olefin copolymer, epoxy resin, ethylcellulose, ethylene , ethylene-chlorotrifluoroethylene copolymer , ethylene-tetrafluoroethylene copolymer, ethylene-vinyl acetate copolymer, ethylene-vinyl alcohol copolymer, fluorinated ethylene-propylene copolymer, stearyl alcohol, gelatin, glyceryl stearate, glycol modified polycyclohexylenedimethylene terephthalate, gum arabic, hexafluoropropylene,, hydroxyethylcellulose, ionomer, liquid crystal polymer, methylcellulose, nylon, polyvinylpyfrrolidone, paraffin, paraffin wax, perfluoroalkoxy resin , poly(lactide-co-glycolide), polyacrylic acid, polyamide, polyamide, polyamide-imide, polyarlysulfone, polyaryletheretherketone, polyaryletherketone, polybutylene, polybutylene terephthalate, polycarbonate, polychlorotrifluoroethylene, polycyclohexylenedimethylene ethylene terephthalate, polyester, polyethelyene vinyl acetate, polyetherimide, polyethersuflone, polyethylene, polyethylene naphthalate, polyethylene terephthalate , polyethylene/polystyrene alloy , polyethylene-acrylic acid copolymer , polyimide, polymethacrylate, polyolefin plastomers , polyoxymethylene , polyparaxylylene, polyphenylene sulfide, polyphthalamide, polypropylene , polystyrene , polysulfone, polytetrafluoroethylene, polyurea, polyurethane, polyvinyl alcohol , polyvinyl chloride , polyvinyl fluoride, polyvinylidene chloride, shellac, starch, stearic acid, styrene-acrylate, styrene-acrylonitile copolymer , styrene-butadiene block copolymer , styrene-methacrylate, tetrafluoroethylene, urea-formaldehyde resin, vinylidene fluoride terpolymer, zein, latexes, polyacetal, polyacrylate, polyacrylic, polyacrylonitrile, polyamide, polyaryletherketone, polybutadiene, polybutylene, polybutylene terephthalate, polychloroprene, poly ethylene, polyethylene terephthalate, polycyclohexylene dimethylene terephthalate, polycarbonate, polychloroprene, polyhydroxyalkanoate, polyketone, polyester, polyethylene, polyetherimide, polyethersulfone, polyethylenechlorinates, polyimide, polyisoprene, polylactic acid, polymethylpentene, polyphenylene oxide, polyphenylene sulfide, polyphthalamide, polypropylene, polystyrene, polysulfone, polyvinyl acetate, polyvinyl chloride, as well as polymers or copolymers based on acrylonitrile-butadiene, cellulose acetate, ethylene-vinyl

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acetate, ethylene vinyl alcohol, styrene-butadiene, vinyl acetate-ethylene, and mixtures thereof, or the like.

[00105] A trigger material of an external environment may include a material that 'poisons' the switching action of the active material. For switching materials that involve a reduction or oxidation event (e.g. diarylethenes, viologens, phenazines) a material that injects or scavenges electrons may disrupt the reductive or oxidative switch – slowing it down or stopping it altogether. For switching materials that involve migration of an ionic species across, or into or out of, a layer, disruption of the movement of the ionic species may disrupt the switch – slowing it down or stopping it altogether. In other embodiments, the poison may disrupt polymerization of a switching material – preventing it from completing, or inducing undesirable polymerization. In some embodiments, the trigger material from the external environment may include ambient air, or a gas, or a component thereof, e.g. carbon dioxide, oxygen, H_2S, water, or other material in the environment external to the active layer. Examples of indicator materials that undergo a detectable change with exposure to water include cobalt (II) chloride, copper (II) sulfate. In some embodiments, the indicator material may be incorporated in a first seal, when the second seal is compromised, water, water vapor or air from the external environment may interact with the indicator material to induce a detectable colour change.

[00106] In some embodiments, the indicator material may be responsive to oxygen, and oxygen may be a trigger material. The indicator material may be included in the first seal, and if the second seal is compromised, oxygen in the external environment may interact with the indicator material to provide a detectable change. US 8647876 (incorporated herein by reference) discloses several indicator materials that may undergo a colour change, or become chemiluminescent, when exposed to oxygen.

[00107] In some embodiments, a first seal may comprise an indicator material and a trigger material may be encapsulated in a layered microcapsule, and the encapsulating material may be water soluble. When the second seal is compromised, water or water vapor from the external environment may disrupt the encapsulation, allowing interaction of the indicator and trigger, providing a detectable change. Examples of water soluble encapsulating materials may include gelatin, gum arabic, starch, polyvinylpyrrolidone, carboxymethylcellulose,

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hydroxyethylcellulose, methylcellulose, arabinogalacan, polyvinyl alcohol, polyacrylic acid, or a combination thereof, or the like.

[00108] In an embodiment, the switching material may include an indicator material; the indicator material may be a diarylethene, and the second seal may include a trigger material; the second seal may be a two-part epoxy, such as that described in US 6248204 (incorporated by reference herein), and the trigger material may be an epoxy resin an epoxy resin hardener or both an epoxy resin and an epoxy resin hardener.

[00109] **Lamination:** A switchable film may be further laminated with heat and pressure between layers of glass, to provide a switchable, laminated glazing. The disclosure further provides, in part, a laminated glass comprising: a switchable film; an electrical connector for electrically connecting the first and the second electrodes to a power source; and a first seal contacting an edge of the layer of switching material. The switchable film may be an encapsulated switchable film.

[00110] The switchable film may be layered between layers of PVB, and this between first and second layers of glass. For lamination, the glass-PVB-switchable film-PVB-glass sandwich may be passed through a press roll, pressed between plates at an elevated temperature (about 90°C to about 140°C – pressure and temperature may be increased and decreased over several steps), or may be placed in a vacuum bag (rubber), with an initial bonding at a temperature of about 70°C-110°C, while applying a vacuum to remove air between the layers. A second bonding step may then be performed at a temperature of about 120°C-150°C, with pressure (e.g. about 0.95 MPa to about 1.5 MPa in an autoclave). The overall thickness of the laminated glass is dependent, in part on the thickness of the various layers. Laminated glass may have advantages for strength, safety, impact resistance, reduction in noise or the like), and inclusion of a switchable compound provides additional, advantageous features over conventional laminated glass. A switchable film is "laminatable" if it retains the ability to fade and darken after lamination.

[00111] A seal for a switchable film or used in a device comprising a switchable film prevents ingress of matter that may affect performance of the switching material. Where a switching material is self-supporting, support or separation devices such as spacers, beads, dividers or the like are not needed in the seal. Where the switching material is part of a film

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that is to be laminated between rigid substrates (e.g. using heat and pressure such as for a laminated glass), it may be advantageous to use seals that are compressible, to prevent breakage of the glass during lamination.

[00112] Seals may be a thermoplastic, a thermoset, a rubber, a polymer or metal, a metallized tape, or combinations thereof. A seal may be selected to provide good adhesion to contacted surfaces (substrate, conductive layer, electrode, switching material, electrical connectors or the like, and to provide sufficient flexibility, barrier properties, mechanical durability and adhesion at the operating temperature of the switchable layer to maintain the isolation of the switching material – for example, a seal may be selected that does not crack or crumble, break down, or lose adhesion as the temperature changes. A seal may not interact with the switching material, or "poison" or interfere with the photochemistry and electrochemical performance of the switching material. A seal may be electrically insulating. A seal may be gas-impermeable. A seal may be resistant to water, or may be water impermeable. A seal may comprise a dessicant to scavenge any residual water that may be present. Examples of dessicants include zeolites, activated alumina, silica gel, calcium sulfate, calcium chloride, calcium bromide and lithium chloride, alkaline earth oxide, potassium carbonate, copper sulfate, zinc chloride or zinc bromide. A dessicant may be dispersed in a seal, or applied to a surface of a seal.

[00113] Thermoset materials include polymers, rubbers and plastics. Examples of thermoset seals include polymers with reactive groups. Examples of polymers may include silicones and siloxanes. Examples of reactive groups include vinyl groups, hydride groups, silanol groups, alkoxy or alkoxide groups, amine groups, epoxy groups, carbinol (polyester or polyurethane groups), methacrylate or acrylate groups, mercapto (thiol, polythiol groups), acetoxy, chlorine or dimethylamine groups. Curing or hardening of such materials may be chemical, radiation, temperature or moisture dependent. Examples of radiation curing may include exposure to light (UV light or visible light); examples of temperature curing may include resting the material at an elevated temperature; examples of chemical curing may include a condensation reaction, an addition reaction, vulcanization, or the like. The chemical curing may include a catalyst, or addition of a reactive group to facilitate crosslinking of a polymer. The chemical cure may further be heated to accelerate the curing reaction, or may be cooled to retard the curing reaction.

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[00114] For example, vinyl functional polymers may be employed in an addition cure system (e.g. Pt catalyzed); hydride functional polymers may be employed in an addition cure system; siloxane functional polymers may be employed in a condensation cure system (e.g. silicones with one part or two part room temperature vulcanization (RTV)), or an acetoxy, enoxy, oxime, alkoxy or amine moisture-cure system.

[00115] Thermoplastic materials may include polymers, rubbers and plastics that melt or flow at elevated temperatures, and reversibly set to a non-flowing state at a reduced temperature. Examples of thermoplastic materials include poly(vinyl alcohol), poly(vinylidene chloride), polyvinylidene fluoride, ethylene vinyl acetate (EVA), and polyvinyl butyral (PVB), Examples of rubbers include polyisoprene, polyisobutylene (PIB), poly(isobutylene-co-isoprene), block, copolymer and graft polymer of butadiene-styrene, poly(chlorobutadiene), poly(butadiene-co-acrylonitrile), poly(isobutylene-co-butadiene), acrylate-ethylene containing copolymer rubber, poly(ethylene-co-propylene), poly(ethylene-co-butene), ethylene-propylene-styrene copolymer rubber, poly(styrene-co-isoprene), poly(styrene-co-butylene), styrene-ethylene-propylene copolymer rubber, perfluorinated rubber, fluorinated rubber, chloroprene rubber, silicone rubber, ethylene-propylene-nonconjugated diene copolymer rubber, thiol rubber, polysulfide rubber, polyurethane rubber, polyether rubber (such as polypropylene oxide), epichlorohydrin rubber, polyester elastomer, alpha olefin polymer, and polyamide elastomer.

[00116] A seal overlaid with a metal layer or metal foil or tape may be a useful edge seal system.

[00117] Examples of epoxy seal materials include DP100, DP105, DP110, DP125 from 3M; 1C, E-30-CL, M-31 CL from Hysol; EP415S-1HT from MasterBond, Delo LP655. Examples of silicone seal materials include Sylgard182, RTV3165, RTV791, RTV9-1363, RTV948 from Dow; or SWS, SCS2000, RTV102, RTV6700 or RTV11 from Momentive, RGS7730, HM2500, CAF520 (Blustar); PV8303, RTV791, RTV730, RTV795 from Dow; SCS2000 from Momentive. Examples of polyurethane seal materials include Titebond MP75 HiPURformer, 3M Scotch-Weld DP605 NS, Lord 6650, Hysol U09FL, Examples of acrylic seal materials include Tremflex 834, 3M 8211, 3M 8172PCL, Surlyn 1601, Surlyn 1703. Examples of ethyl vinyl acetate seal material include EVASAFE (Bridgestone), 3M Scotch-

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Weld 3764, 3M Scotch-Weld 3792. Examples of olefin polymer (polyolefin) seal materials include 3M Scotch-Weld 3748. ,. Examples of polysulfide seals include THIOKOL. Examples of polyethylene seal materials include silane-crosslinked polyethylene (Solvay). Examples of isobutylene rubber seal materials include OppanolB15, OppanolB50, OppanolB12, OppanolB10 from BASF, Tremco 440, HL-5140 (HB Fuller), Poly(isobutylene-co-isoprene) from Scientific Polymer.

[00118] Some isobutylene seal materials comprise polyisobutene (polyisobutylene).

[00119] Some ethyl vinyl acetate seal materials may comprise ethylene-vinyl acctatc polymer (55-75$ by weight and hydrocarbon resin (25-45 % by weight). Some ethyl vinyl acetate seal materials may comprise ethylene-vinyl acetate polymcr (50-65% by weight), hydrocarbon resin (25-35 % by weight), polyethylene polymer (5-10 % by weight), polyolefin wax 91-5% by weight) and an antioxidant (0.5-1.5 % by weight).

[00120] Some polyolefin polymer scal materials may comprise polypropylene (15-40 % by weight), hydrocarbon resin (10-30 % by weight), styrene-butadiene polymer (10-30 % by weight), cthylene-propylene polymer (5-25 % by weight), polyethylene (5-20% by weight) and polyolcfin wax (7-13% by weight).

[00121] In some embodiments, the seal may swell; swelling may occur during curing (for seals that arc cured), or may swell after installation by absorption of a component of the switching material. For some embodiments, this may be advantageous in instilling the sealing material into small gaps or separations.

[00122] Sealing materials may be tested by immersion of a sample in a solvent and observed pcriodically for swelling, loss of mass, degradation, crumbling or other indicator of interaction with the solvent or components dissolved in the solvent. In some embodiments, some degree of swelling may be advantageous in a sealing material, in that the sealing material may expand to fill any gaps or spaces after installation. Sealing materials may also be tested by sealing a layer of switching material between substrates in a device. Devices with a single seal may be weighed (determine initial mass) and placed in an oven, and periodically weighed to assess any loss in mass – a loss in mass may be indicative of a sealing material that is not impermeable to the solvent or plasticizer or other component of

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the switching material. Devices may be further examined for the initial and ability to photochemically and/or electrochemically transition the switching material from a dark state to a faded state, or from a faded state to a dark state. During and after switching, the devices may be inspected for visual defects – uneven switching, development of spots, bubbles or other defects, or the like.

[00123] Where the plasticizer comprises triglyme, some examples of first seals may include: silicones (e.g. Sylgard182, RTV3165, RTV791, RTV9-1363, RTV948 from Dow; or SWS, SCS2000, RTV102 or RTV11 from Momentive), or isobutylene rubbers (e.g. polyisobutylene).

[00124] Where the plasticizer comprises 2,2,4-trimethyl-1,3-pentanediol monoisobutyrate, some examples of first seals may include: silicones (e.g. RGS7730, HM2500, CAF520 (Blustar); PV8303, RTV791, RTV730, RTV795 from Dow; SCS2000 from Momentive), some epoxies (e.g. DP110 from 3M), polyisobutylene rubbers (e.g. OppanolB15, OppanolB50, OppanolB12, OppanolB10 from BASF), or polysulfides.

[00125] Where the plasticizer comprises dimethyl-2-methyl glutarate, some examples of first seals may include: silicones (e.g. Sylgard 182, RTV791 from Dow; RTV102, RTV106, RTV6700, SCS2000 from Momentive; SCS9000, RTV100); polyisobutylene rubbers (e.g. OppanolB15, OppanolB50, OppanolB12, OppanolB10 from BASF); poly(isobutylene-co-isoprene rubber).

[00126] Where the plasticizer comprises diethyl succinate, some examples of first seals may include: silicones (e.g. Sylgard 182, RTV791 from Dow; RTV102, RTV106, RTV6700, SCS2000 from Momentive), polyisobutylene rubbers (e.g. OppanolB15, OppanolB50, OppanolB12, OppanolB10 from BASF).

[00127] Where the plasticizer comprises 2-(2-butyoxyethoxy) ethyl acetate, some examples of first seals may include: epoxies, silicones (e.g. Sylgard 182, RTV791, RTV730 from Dow; SCS2000, RTV6700 from Momentive), or polyisobutylene rubbers (e.g. OppanolB15 from BASF).

[00128] In some embodiments, the first seal may be a temporary barrier, separating the switching material from a second seal. The first seal may swell or absorb plasticizer or other

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component from the switching material (in a sufficiently small amount so as to not detrimentally affect the operation of the switching material). For such embodiments, the first seal may also be unreactive with the second seal. The second seal may be reactive with the switching material in an uncured, but not a cured state. The second seal may be sufficiently fast curing so as to complete the curing process before components of the switching material swell and migrate through the first seal. Selection of such a combination of first and second seal materials may be counter-intuitive based on initial testing results, but when combined, provide an improved seal system. Examples of such seal systems may include a PIB first seal material, and an epoxy or EVA second seal material.

[00129] In some embodiments, the first seal material may be substantially non-reactive with the switching material and the second seal material; the second seal material may be reactive with the switching material (e.g. swelling, softening or the like). The second seal material may, on the other hand be preferable for resistance to environmental aspects – it may be particularly durable, or resistant to oxygen or water, for example. Selection of such a second seal material may be counter-intuitive based on initial testing results, but when combined with a suitable first seal material, an improved seal system is realized.

[00130] **Active layer** ("switchable layer"): an active layer comprises a switching material. An active layer as referenced herein may include any solid, semi-solid, gel or liquid material that alters light transmittance in response to a stimulus. An alteration in light transmittance may be a change in one or more of transparency, opacity, color, haze; the reduction in light transmittance may be selective – the a portion of UV, visible or IR light that is transmitted by the active layer may change, or selective wavelengths be blocked, at least in part. The stimulus may include one or more than one of electricity (an electrochromic active layer), temperature or temperature change (a thermochromic active layer), electromagnetic radiation in a range of from about 300 nm to about 750 nm or any amount or range therebetween (UV or visible light) (a photochromic active layer). Some active layers may be responsive to both light and electricity (a photochromic-electrochromic active layer).

[00131] Some active layers comprise a polymer or polymer matrix and one or more compounds or compositions that undergo a structural change or orientation in response to the stimulus. For example, a liquid crystal or suspended particle display electrochromic active

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layer comprises discrete particles suspended in a liquid or semi-solid polymer matrix, and the alignment of the crystals or particles is controlled by application of electricity. Other examples of electrochromic active layers comprise two or more compounds that behave as a redox pair – when electricity is applied, one compound is electrochemically oxidized to a coloured state, and the other is electrochemically reduced to a coloured state. When electricity is removed, the compounds revert to their uncoloured state. Some photochromic materials, when exposed to UV light, change color – darken or fade. Some photochromic materials may have 'memory' in that they remain in the UV-exposed state until a second stimulus is applied; others do not exhibit memory, and will gradually revert to their unexposed state.

[00132] Some active layers comprise materials that are both photochromic and electrochromic. When exposed to selected wavelengths of light (e.g. UV light), the materials darken. When exposed to electricity, the materials fade. Examples of compounds (chromophores) that may be useful in a photochromic-electrochromic active layer include some switchable compounds such as photochromic-electrochromic diarylethenes (see, for example US 7777055, WO2010/142019 and WO2013/044371). An active layer comprising one or more of these compounds may be transitionable from a faded state to a dark state with exposure to UV light, and from a dark state to a faded state with application of electricity, or light in the visible range.

[00133] **Switching material:** a switching material may comprise a polymer and a switchable compound, and optionally, one or more of a plasticizer, dye, UV light stabilizer, antioxidant, supporting electrolyte, surfactant, adhesion promoter or adhesion control agent or the like. The switching material may comprise part of an active layer. The switching material may be a single layer of material (cast or extruded), or maybe two or more layers, cast or extruded sequentially or simultaneously one on top of the other. Generally, the switching material is substantially optically clear, or with minimal (e.g. less than 3%) haze. The switching material may comprise adhesive properties. A switching material may be described as "laminatable" if it retains the ability to fade and darken after lamination (e.g. after elevated temperature and/or pressures used during a glass lamination process). Haze may be measured using methods known in the art, for example use of an XL-211 Hazemeter from BYK-Gardner.

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[00134] Components of the switching material may further provide, in part, one or more than one secondary functions. For example, any of a switchable compound, polymer, plasticizer, supporting electrolyte, charge carrier or the like may provide a secondary function as one or more than one of a plasticizer (solvent), polymer, supporting electrolyte, or the like. In another embodiment, where a polymer comprises a switching compound, the polymer may provide multiple functionalities, including a combination of polymer and switchable compound, and in some embodiments, a charge carrier function, a plasticizer function and/or a supporting electrolyte function. Inclusion of different switchable compounds and/or different polymer backbone moieties may alter the function of the polymer.

[00135] Examples of solvents (which may function as plasticizers in the switching material) include dimethyl adipate, diethyl adipate, 2-(2-butyoxyethoxy) ethyl acetate, triglyme, diethyl succinate, 2,2,4-trimethyl-1,3-pentanediol monoisobutyrate, dimethyl-2-methyl glutarate, butylene carbonate, dibutyl itaconate, tetraethylene glycol di-heptanoate, triethylene glycol di-2-ethylhexanoate, triethylene glycol di-2-ethyl butyrate, triethylene glycol di-n-heptanoate, benzyl octyl adipate, di-n-hexyl adipate, triethylene glycol, combinations thereof, or the like.

[00136] Examples of supporting electrolytes include tetrabutylammonium tetrafluoroborate ($TBABF_4$), tetrabutylammonium bis((trifluoromethyl)sulfonyl)imide (TBATFSI).

[00137] Examples of polymers include ethylene copolymers (e.g. ethylene-vinyl acetate,), apolyurethane, a polyalcohol, an ionomer, PVDF, or the like. Examples of polyalcohols include ethylene vinyl alcohol copolymer, polyvinyl alcohol, polyvinyl acetals (e.g. polyvinyl butyral - PVB), poly(ethylene oxide), or the like. Examples of ionomers include poly(ethylene-co-methacrylic acid, PV5300 (DuPont) or the like. In some embodiments the switching material may comprise a mixture of polymers. Other polymers having a suitable glass transition temperature may also be used. Where ranges, values and/or methods are described with reference to PVB, such ranges, values and/or methods may also apply, where applicable, to other polymers or polymer blends disclosed herein as useful components of switching materials. A polymer may be crosslinked. A crosslinking agent may comprise two or more reactive groups; reactive groups may independently be, for example, aldehyde, epoxide, isocyanate, silane or the like. Examples of aldehyde crosslinkers include terephthalaldehyde and the like. Examples of epoxides include diglycidyl ethers of

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polypropylene glycol (e.g. DER736, DER732, both from Dow Chemical), bisphenol A diglycidyl ether (BADGE), 1,4-butanediol diglycidyl ether, 1,4-cyclohexanedimethanol diglycidyl ether, and the like. Examples of isocyanate crosslinking agents include hexamethylene diisocyanate (HMDI), dimers, trimmers, or multimers of HMDI (e.g. DESMODUR™ N100, N3300A, N3600 from Bayer) and the like.

[00138] The one or more supporting electrolytes may be absent, or present in an amount of from about 0.1% to about 20% (by weight) or any amount or range therebetween, for example 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18 or 19%. The one or more plasticizers (solvents) may be absent, or may be present in a switching material in an amount ranging from about 5 wt% to about 90 wt% or any amount or range therebetween. The one or more switchable compounds may be present in a switching material in an amount (% weight) of from about 0.05% to about 80%, or any amount or range therebetween, for example about 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70 or 75%. The polymer may be present in an amount of from about 10 wt% to about 95 wt%, or any amount or range therebetween, for example 15, 20, 30, 40, 50, 60, 70, 80 or 90 wt%.

[00139] **Substrates:** The one or more transparent, or substantially transparent, substrates may be glass - float glass, tempered glass, toughened, or chemically -strengthened glass, an organic glass or the like. The substrate may be flexible (e.g. plastic film, glass film, or glass microsheet). An organic glass is an amorphous, solid glasslike material made of transparent plastic. Organic glass may provide advantages such as toughness, reduced weight, improved thermal insulation, ease of colour modification (incorporation of colorants in the plastic when molding) or the like. Examples of organic glasses or plastics include polycarbonate, acrylonitrile butadiene styrene, polyesters (polyethylene terephthalate (PET), modified PET), acrylics (polymethyl methacrylate) or modified acrylics (e.g. imidized, rubber toughened, stretched or the like), polyester carbonate, allyl diglycol carbonate, polyether imide, polyether sulfone (polysulfone, PSU), cellulose acetate, cellulose butyrate, cellulose propionate, polymethyl pentene, polyolefins, nylon, polyphenylsulfone, polyarylate, polystyrene, polycarbonate, polysulfone, polyurethane, polyvinyl chloride, styrene acrylonitrile , ethylene vinyl acetates, or the like. Where the one or more glass is an organic glass, one or more of the components of the switching material may be selected to be immiscible, or insoluble, with one or more of the components of the organic glass, to prevent diffusion into the glass. For

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example, a solvent or plasticizer used in some embodiments described herein may be immiscible, or insoluble, with a plasticizer used in an organic glass. Combinations of organic glass and switching material materials with one or more immiscible components may be selected in this way. In some embodiments, a layer of plastic (e.g. PET film) may be included between the organic glass and the switching material, to prevent diffusion of plasticizers or other components into the organic glass. Substrates may independently be of any suitable thickness. Substrates may independently be coated with, or comprise anti-scratch layers, security films, heat or infrared reflecting or absorbing materials, or UV reflecting or absorbing materials or the like. Glass layers may independently be tinted; examples of tinted glass include grey, bronze or green glass, or may comprise coatings or additives to block some wavelengths of light (e.g. portions of UV, VIS, IR incident light or the like).

[00140] Glass layers may be tinted. Color and depth of coloration of tinted glass may be selected to achieve certain levels of light transmission (visible, UV or IR), or to harmonize with the site of installation e.g. exterior automotive paint, building envelope, or to harmonize with other components of a laminated glass. Glass color may be described with reference to colour values L*a* and b*, and/or light transmittance (LT_A). As examples, US 5308805 describes a neutral low transmittance glass and US 7932198 describes examples of grey glass.

[00141] In some embodiments, a substrate may be clear, or may be grey, with an LT_A of about 25-35% or any amount or range therebetween. A second substrate may be clear, or may be colored (e.g. grey), with an LT_A of about 75-85% or any amount or range therebetween. A substrate may be glass or plastic (an "organic glass"). A substrate may be flexible or rigid. A substrate may be coloured to harmonize with the exterior paint of the vehicle or building where the laminated glass is installed, or to mask the inherent color of one or more layers in the laminated glass (e.g. the active layer, the static filter or the incident light filter, for embodiments where one or more of these layers has a colour that does not harmonize with the surrounding surface or paint). Alternately, a substrate may be substantially clear to allow as much light as possible reach the active layer.

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[00142] Where the glass is an organic glass, it may be advantageous to include a layer of plastic (e.g. PET film) between the organic glass and an adhesive layer or sound insulating layer comprising PVB, to prevent diffusion of plasticizers or other components of the adhesive layer into the organic glass.

[00143] The substrate may be of uniform or varying thickness, and of any suitable dimension. For example, the substrate may have a thickness from about 0.01 mm to about 10 mm, or any amount or range therebetween, for example 0.05, 0.1, 0.5, 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10 mm, or from about 0.012 mm to about 10 mm, or from about 0.5 mm to 10 mm, or from about 1 mm to 5 mm, or from about 0.024 mm to about 0.6 mm, or from about 0.051 mm (2 mil) to about 0.178 mm (7 mil). In some embodiments, the thickness and/or material of a first substrate differs from the thickness and/or material of a second substrate.

[00144] **Conductive coatings** may be transparent. A conductive coating may include a transparent conducting oxide (TCO) such as indium tin oxide (ITO), fluorine tin oxide (FTO) or the like, metal or metal oxide coatings (e.g. silver, gold or the like), transparent conducting polymers, or other substantially transparent conductive coatings. Examples of transparent substrates with conductive coatings include ITO-coated glass, or FTO-coated glass (e.g. TEC glass from Pilkington). For embodiments comprising co-planar electrodes, the electrode pattern (e.g. interdigitated electrodes such as that illustrated in Figure 3c) may be etched into a conductive coating on the substrate, or printed on a substrate. In some embodiments, a substrate with a conductive layer may be ITO-coated glass, or ITO-coated PET. A conductive coating may be an electrode of a switchable film.

[00145] Some methods of manufacture of conductive coatings may necessitate use of selected substrates that tolerate the coating methods. For example, FTO coatings may be less expensive, and thus an attractive substrate and conductive coating, but require a substrate that tolerates the high temperatures (>400°C) used in some coating methods. Glass may be suitable for this application, however some plastics or films may not. Having a switchable switching material that may be laminated between FTO-coated substrate may provide a less expensive laminated glass.

[00146] In some embodiments, both first and second electrodes may be disposed on one substrate. First and second coplanar electrodes may be etched into the conductive coating or

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printed on the surface of the substrate in a suitable pattern e.g., a discontinuous conductive coating providing first and second electrodes on the same substrate. In such embodiments, a second substrate may lack a conductive coating, and first and second busbars and electrical connectors may be disposed on the first and second electrodes of the first substrate. in such embodiments, the second substrate (lacking a conductive coating) may be a plastic or glass, or a film or release liner. PCT publication WO2012/079159 describes coplanar electrode configurations that may be useful in some embodiments.

[00147] **Making a switchable film:**

[00148] In some embodiments, components of the switching material may be combined in subcombinations ('parts'), with the parts combined at a later step. Preparation of a switching material in one or more parts may be advantageous to solubilize one or more components of a switching material, prevent side reactions, or to prevent initiation of crosslinking ('curing') before the formulation is complete or ready for casting or coating. In some embodiments, a switching material may be prepared according to the following steps: providing a first part comprising a polymer, a switching compound, a salt and a first portion of a solvent; providing a second part comprising one or more crosslinking reagents and a second portion of the solvent; providing an accelerant and an optional co-solvent; combining the first part and the second part; and combining the third part with the combined first and second parts.

[00149] The switching material may be coatable. A coatable switching material is one that is of suitable viscosity to be applied to a substrate in a suitable thickness and substantially uniform manner. Viscosity of a switching material may be altered by increasing or decreasing the quantity of sacrificial solvent, altering the polymer (different quantity and/or molecular mass), increasing or decreasing temperature of the switching material, inclusion of a rheology modifier or the like. In some embodiments, the switching material does not include a sacrificial solvent, and viscosity is manipulated by heating the switching material and/or using a heated die for coating. Partial curing of the switching material in advance of, or during the process of coating, may also increase the viscosity of the switching material applied to a moving web, or extruded or injected into a mold or extruded or applied onto a substrate. Curing may be slowed or stopped by decreasing temperature, and/or diluting the

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partially cured material with a co-solvent. Increasing temperature and/or removal of the co-solvent may subsequently allow curing to proceed to completion.

[00150] A switching material, or one or more parts thereof may be treated to remove dissolved gas (oxygen, air, or the like), and/or treated to remove water, or prepared in an environment with reduced oxygen and/or reduced humidity. In some embodiments, one or more of the steps of making a switchable formulation, coating a substrate, and/or curing the film may be performed in an inert atmosphere (e.g. nitrogen, with less than 100 ppm oxygen, less than 100 ppm water, or both); a reduced humidity atmosphere (e.g. about 5-15% relative humidity), or in an open atmosphere. In some embodiments, a method of making a coatable formulation, coating of substrates and/or curing of a switching material may be performed in a reduced humidity and/or reduced oxygen environment, for example less than 100 ppm relative humidity, and/or less than 100 ppm oxygen.

[00151] A switching material may be coated at a suitable thickness onto a conductive coating of a substrate using a slot die, knife coater, roll-to-roll coating method, extrusion, dipping, spraying, spin coating, gravure coating method, hand-drawing or the like. A suitable coating thickness may be selected such that the switching material is of the desired thickness once the co-solvent is evaporated (if a co-solvent is present), or the final layer is of the desired thickness following cooling and/or crosslinking of the coated switching material. For example, to obtain a final thickness of about 50 microns, a switching material with co-solvent may be applied to the substrate in a layer of about 100 to about 120 microns. A second layer of substrate is laminated on top of the coated switching material (conductive side in contact with the switching material) to form a sandwich structure. The 'sandwich' may be cured, or allowed to continue to cure (if curing is initiated during the coating or laminating process) and if desired, cut to a suitable size. Busbars or other electrical contacts may be added if desired.

[00152] A second substrate may be applied on top of the disposed switching material; the second substrate may comprise a conductive layer, positioned so as to be in contact with the switching material. The resulting film may be cut to a desired size or shape. Electrical contacts (e.g. busbars, wires or the like) may be added, to facilitate application of a voltage to the switching material.

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[00153] The switching material may be cured or crosslinked before, or after application of the second substrate. The step of curing may comprise heating the switching material to a temperature suitable for crosslinking (e.g. about 20°C to about 90°C, or any amount or range therebetween. The step of disposing may be preceded by a step of filtration of the switching material.

[00154] In other methods, a switching material, or one or more components of a the switching material, may be formed into pellets, chips or flakes and mixed with other components(e.g. in a screw mixer) and extruded through a die to form one or more layers or films. The mixer, die and/or extruder may be heated. Alternately, the extruded material may itself be pelletized, for subsequent blending with other materials and extruded in a second extruder to produce a switchable film, or molded to produce a switchable article. One or more additional components may be imbibed or soaked into the cast layer. If the switching material is to be crosslinked, this may be done before or after removal of sacrificial solvent (if used). The switching material may be configured to include spaced projections defining a surface irregularity (a "rough texture") – if such a switching material is laminated with heat and pressure between rigid substrates, the surface irregularity may facilitate removal of air from during the lamination process, and/or to facilitate handling of the unlaminated switching material.

[00155] In some embodiments, two or more layers of switching material may be co-extruded, or a first layer (e.g. comprising the switchable compound as a monomer, or as part of a switchable polymer) may be applied (coated) onto the second layer. A release liner may be used for support in handling, and/or separation of layers when rolled for storage and handling. Following application, the first layer, or a component thereof may remain as a discrete layer, or may diffuse into the second layer to create a gradient, or may be imbibed into the second layer to provide a substantially uniform distribution, or a gradient distribution, of switchable compound within the second layer. Where a gradient is formed, the gradient may comprise a region of higher concentration along one surface of the second layer, and a region of lower concentration extending through the plane of the second layer. In other embodiments, the gradient may be established so as to extend along the plane of the second layer. In other embodiments comprising a composite switching material, a first layer may be applied to a first substrate, and a second layer applied to a second substrate (e.g.

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disposed on a conductive coating on the surface), and the substrates arranged to place the first and second layers adjacent, and the substrate-switching material-substrate sandwich laminated. The first layer may be applied to the second layer, or to a substrate by any of several methods, for example electrodeposition, vapor deposition, chemical deposition, chemical plating, brushing, spraying, extruding, slot-die coating, dipping or the like, or a combination thereof. If a co-solvent is used, it may be removed by evaporation. Where it is desired to vary the color or color density of the switching material, the switching compound may be applied using printing methods that deposit droplets of varying size and/or spacing – for example, smaller, and/or more widely spaced dots yield regions of lesser switching material, while larger, and/or more closely spaced dots yield regions of greater switching material.

[00156] A layer of switchable compound may be imbibed into a surface of the polymer, or may be applied as a layer of liquid and dried to a solid or semi-solid, or may be a solid or semi-solid of any suitable thickness; a suitable thickness may be selected dependent on the concentration of the switchable compound and the desired deposition amount. In some embodiments, the layer of switchable compound is of uniform, or substantially uniform, thickness. In some embodiments, the layer of switchable compound is of non-uniform thickness. The switchable compound may be in a crystallized form, or may be amorphous, or a combination thereof.

[00157] Busbars, Controls and applied potentials: Busbars may be applied to a portion of the conductive layer or electrodes so that a voltage differential is created across the layer (s) comprising the switchable material to effect the switch. The busbars may be of any suitable material to provide a low-profile conductive area suitable for attachment of an electrical connector thereto. Examples of suitable materials include conductive adhesive, conductive ink, conductive epoxy, conductive tape, metal mesh or film or the like, comprising at least one type of conducting material for example a metal, such as aluminum, gold, silver, copper or the like. The conductive material may be applied to the conductive surface by any of several methods known in the art, including printing, painting, screenprinting ('silkscreening'), stenciling (stencil printing) or the like. Electrical connectors or leads may be of any suitable material and may be affixed to the busbar by any suitable methods, including adhesion (conductive adhesive or conductive epoxy), soldering, clips,

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rivets or the like. Suitable material for electrical connectors may include conductive tape, wire, copper tape, copper-clad polyimide film (e.g. Kapton) or the like. The electrical connector may be doubled-sided.

[00158] A control circuit can be used to switch the electrical voltage on or off, based on input from an automated or semi-automated device (e.g. an irradiance meter, thermometer), a building or vehicle environmental control system, a user or some other input, and can also be used to modulate the voltage to a predetermined level. A power source may include an AC line voltage in a house or other building, a DC power source (e.g. a battery of a vehicle, or in a separate battery or power pack), an energy harvesting power source (e.g. solar panel) or the like. The control circuit may comprise one or more switches (transistor, relay, or electromechanical switch) for opening and closing a circuit between the voltage regulators and conductive layers of a substrate, an AC-DC and/or a DC-DC converter for converting the voltage from the power source to an appropriate voltage; the control circuit may comprise a DC-DC regulator for regulation of the voltage. The control circuit can also comprise a timer and/or other circuitry elements for applying electric voltage for a fixed period of time following the receipt of input.

[00159] Embodiments include switches that can be activated manually or automatically in response to predetermined conditions, or with a timer. For example, control electronics may process information such as time of day, ambient light levels detected using a light sensor, user input, stored user preferences, occupancy levels detected using a motion sensor, or the like, or a combination thereof, the control electronics configured to activate switches for applying voltage in response to processed information in accordance with predetermined rules or conditions. In one embodiment, the power control electronics comprises a user-activated switch. A user-activated switch may be a 'normally-open', or 'normally-closed' switch, for example a push-button switch. A switch may be configured to remain closed for a predetermined amount of time following actuation, thereby facilitating application of voltage for sufficient time to effect a state transition. Where the multilayer composition according to various embodiments is part of an automotive glazing (window or sunroof, or the like), the glazing may be installed in the vehicle and electrically connected to the vehicle's electrical system, through wiring in the frame, dash or roof, or connected to rails or guide tracks as may be used for some automotive roof applications.

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[00160] In one embodiment, the control electronics comprises a user-activated switch that passes the DC voltage from the power source substantially directly to a conductive layer on a substrate. The user activated switch can be a normally-open push button, or another type of switch. A switch may be configured to remain closed for a predetermined amount of time following actuation, thereby facilitating application of voltage for sufficient time to effect a state transition.

[00161] The voltage to be applied for transitioning the switching material may be from about 0.1 V to about 20 V, or any amount or range therebetween. In some embodiments, the amount of voltage applied is from about 0.1V to about 5V, or from about 1V to about 10 V, or from about 1.0 V to about 2.2 V, or from about 0.5V to about 3V, or from about 1.2V to about 2.5 V, or from about 1.8 V to about 2.1 V, or any amount or range therebetween. In some embodiments, the voltage applied is less than about 12 V, or less than about 6 V, or less than about 3 V or less than about 2.5 V, or about 2 V.

[00162] The polarity of the voltage applied to a switching material may be switched or alternated over a plurality of cycles to transition the assembly from a dark state to a faded state. Such polarity switching may decrease the fading time. A voltage of a first polarity may be applied across the optical filter for a first interval; followed by applying a voltage of a second, opposite polarity across optical filter for a second interval. The cycle of first and second intervals may be repeated until the optical filter is transitioned to a faded state. The first and second polarity may be of equivalent but opposite magnitude. The first and second intervals may be of equivalent magnitudes. The first and second intervals may be from about 0.5 seconds to about 60 seconds, or any amount therebetween.

[00163] Control circuits and systems that may be used with an apparatus comprising a switching material, or layered compositions according to various embodiments are described in, for example, PCT publication WO2010/142019.

[00164] Other layers that may be incorporated into a laminated glass may include:

[00165] IR-blocking: One or more layers may comprise an infra-red (IR)-blocking component. A solar control film may be included in the multi-layer composition or laminated glass. Alternately IR blocking materials may be incorporated into a layer of glass,

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or an adhesive layer. An IR blocking layer may reflect or absorb IR light. Reflection of IR may reduce the solar heat gain of the interior space, whereas absorption of IR may increase the temperature of the laminated glass, which may be advantageous in increasing the switching speed of the switching material. In some embodiments, one or IR blocking compounds or materials may be incorporated into the switching material.

[00166] UV-blocking: One or more layers may comprise a UV blocking component. Adhesive layers such as PVB may have additives that block UV; some transparent layers, or some substrates may be made of a material that has been treated with a UV blocking material (e.g. UV-blocking PET), or have a UV blocking layer applied thereto. It may be cost effective to incorporate into an optical filter or device comprising an switching material according to various embodiments, a substrate that blocks UV – this may be advantageous in reducing the amount, or controlling the wavelength, of UV light incident on the switching material, while preserving the ability to switch. In some embodiments, one or more UV blocking compounds or materials may be incorporated into the switching material. Examples of UV blocking compounds may include benzotriazole compounds (e.g. Tinuvin 328, Tinuvin 326, Tinuvin 234 (Ciba-Geigy)), benzophenone compounds, malonic ester compounds (e.g. Hostavin PR-25 Hostavin B-CAP (Clariant)), triazine compounds, (e.g. Tinuvin 400, Tinuvin 405, Tinuvin 460, Tinuvin 1577 (Ciba-Geigy); LA-46 (Adeka)), oxanilide compounds (e.g. Sanduvor VSU (Clariant)), titanium dioxide, or the like. Other compounds that may inhibit photodegradation may include hindered amine light stabilizers (HALS; e.g. LA-63P (Adeka), Tinuvin 144 (Ciba-Geigy)).

[00167] Sound insulation: Sound insulation may be provided by an acoustic layer. Acoustic PVB may be known by trade names such as SAFLEX™ or VANCEVA™. US 5190826 describes composition comprising two or more layers of resins of differing polyvinyl acetals; the acoustic layer may be in the range of 0.2 to 1.6 mm. Some acoustic PVB may comprise an acrylic polymer layer and polyester film layer. Acoustic layers comprising PVC, modified PVC, polyurethane or the like may also be used.

[00168] Self-cleaning coating: a self-cleaning coating may be applied to an outboard surface of the laminated glass. Several examples of such coatings, and methods of applying

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them are known – examples include hydrophilic coatings based on TiO_2 (e.g. Pilkington ACTIV™) and hydrophobic coatings (e.g. AQUACLEAN™ or BIOCLEAN™)

[00169] **Security coating:** A security coating may be applied to the laminated glass to prevent release of glass particles from laminated glass failure (breakage). Examples of such materials include PVB/PET composites or hard-coated PET films (e.g. SPALLSHIELD™ (DuPont).

[00170] **Anti-scratch:** an abrasion-resistant coating may be applied to the laminated glass to prevent distortion or surface damage, and preserve optical clarity; anti-scratch coatings may be particularly beneficial for use with organic glass.

[00171] In some embodiments, inclusion of an IR blocking layer, a UV blocking layer, or both an IR blocking layer and a UV blocking layer in a laminated glass comprising an switching material according to various embodiments may improve durability of the switching material. Without wishing to be bound by theory, a UV blocking layer positioned between a light source and the switching material may limit the energy, and/or overall quantity of UV light reaching the switchable switching material to effect the switch (e.g. it may act as a cutoff filter), and an IR blocking layer positioned between a light source and the switching material may reduce the heat gain of the switching material. Maintaining a lower temperature and/or reducing or blocking higher energy UV light incident on the switching material may prolong the life of the switching material and thus the laminated glass.

[00172] Coatings or treatments applied to the inboard or outboard surfaces of laminated glass are generally optically clear. Other examples of coatings or treatments may include anti-glare or anti-reflective coatings.

[00173] The term "mil" as used herein, refers to the unit of length for 1/1000 of an inch (.001). One (1) mil is about 25 microns; such dimensions may be used to describe the thickness of layer, according to some embodiments of the invention. One of skill in the art is able to interconvert a dimension in 'mil' to microns, and vice versa.

[00174] "About" as used herein when referring to a measurable value such as an amount, a temporal duration, and the like, is meant to encompass variations of ±20% or ±10%, more

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preferably ±5%, even more preferably ±1%, and still more preferably ±0.1% from the specified value, as such variations are appropriate to perform the disclosed methods

[00175] Laminated glass may be assessed with reference to light stability, humidity, temperature impact tests or the like (e.g. ANSI Z26.1; ECE R43 or other standards). A laminated glass may further comprise one or more additional layers that may be passive (not switchable). A passive layer may provide a chemical, atmospheric or moisture barrier, or may provide for scratch resistance. A passive layer may comprise UV or IR blocking agents. A passive layer may form part of a seal.

[00176] In some embodiments, the laminated glass may be integrated into an insulating glass unit (IGU). An IGU comprises two or more glass panes, often with an insulating layer between, and held in a frame, or held together as a unit. Spacers may maintain the separation between the glass layers, and the insulating layer between may be gas (e.g. argon, nitrogen, air or the like). A seal or gasket around the perimeter of the panes within the frame holds the panes in place, and mitigates ingress or egress of gas from the IGU space. The seal may further include a dessicant to absorb any moisture that may be present. An IGU comprising a switchable laminated glass may be assembled in a manner similar to conventional IGU, with the addition of electrical connectors to provide power to the switching material; the electrical connectors may extend through the seal and/or frame. The insulating capabilities of an IGU may lead to higher temperature exposure of the switching material, and to reduce or mitigate solar heat gain, one or more layers of glass in the IGU may comprise an IR blocking material.

[00177] The following non-limiting examples provide illustrations of some embodiments.

[00178] Methods

[00179] Seal and switching material compatibility testing: A 100-300 mg sample of a sealing material, record initial mass and immerse in a plasticizer or solvent used with a switching material or switching material for 48 hours at 90°C. Remove the sample, remove surface liquid (with a kimwipe) and record mass, and inspect for change in size, texture or condition. Crumbling or dissolution may indicate a sealing material is incompatible with the plasticizer or solvent; a mass increase of 10% or less may indicate that a sealing material is compatible with the plasticizer or solvent.

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Making a switchable film: a layer of switching material of about 0.5 to about 2.5 mil thickness is disposed between first and second substrates, each substrate comprising a transparent conductive coating (e.g. Melinex ST504, DuPont-Teijin Films 5 mil PET film with 50-100 ohm/square ITO coating). Kiss-cutting and encapsulating of a switchable film: A switchable film is cut to a desired size, and offset edges kiss-cut using a GCC Spirit GLS laser cutter (30W Synrad CO_2 laser), under a nitrogen blanket. Laser power was set to 4%, with 1500 pulses per inch. Weed portions are removed and the surface exposed by removal of the weed portion cleaned gently with isopropanol Silver ink (Fujikura Kasei Dotite 301) bus bars may be screenprinted onto the first and second conductive surfaces, or silver epoxy may be applied onto the first and second conductive surfaces. Kapton leads (copper-clad polyimide, DuPont Pyralux AC352500R) may be applied to the busbars. A first seal is applied along the cut edge of the switching material, and the first-sealed film is sandwiched between layers of transparent PET film (external PET layers), held by an adhesive layer (3M 8211). A second seal material is applied adjacent the first seal and between the external PET layers.

[00180] **Example 1:** Devices with a range of switching materials (Table 2) were constructed, and the seal integrity compared. PIB as a first seal material demonstrated some swelling when exposed to the switching material, likely absorbing some of the solvent phase from the crosslinked film. While the rate of absorption was slow, it was indicative that PIB alone may not provide a suitable seal material for longer term, unless it were paired with a second seal material.

[00181] Table 2: Switching materials. Quantities provided in wt%. Abbreviations: "Texanol", 2,2,4-trimethyl-1,3-pentanediol monoisobutyrate; "RI", dimethyl-2-methyl glutarate; "BC" butylene carbonate; "DES", diethyl succinate. PVB resins employed in the switching materials demonstrated a range of MW, PVOH and PVA contents. PVB-4 (MW 95-105k, PVOH content 18-21%, PVA content 0-4%); PVB-5 (MW 50-60k, PVOH content 12-16%, PVA content 1-4%); PVB-6 (MW 250-350k, PVOH content 12-16%, PVA content 6-10%): PVB-8 (MW 170-250k, PVOH content 17.5-20%, PVA content 0-2.5%).

Component	6	8.1a	8.2	8.4j
Chromophore	10	15	15	15
ZnOctoate	0.01	0.01	0.01	0.01

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N3600	0.2			0.21
HMDI		0.37	3.75	
TBA-TFSI		1	1	1
TBABF4	2			
PVB-8	7		3	5
PVB-5		10	10	
PVB-4		3		
PVB-6				10
BC		7	6.7	
RI		63.6		68.8
Texanol	80.79			
DES			60.5	

[00182] Table 3: switching material and seal combinations

Switching material #	Switching material Solvent	First seal	Second seal	Indicator/trigger Interaction
6	TX	PIB (Tremco 440)	Epoxy (E-30CL)	Y
8.1a	RI/BC	PIB (Tremco 440, Oppanol B1, B15) EVA (3M 3764)	Epoxy (E-30CL)	Y
8.2	DES/BC	PIB (Tremco 440, Oppanol B10, B15) EVA (3M 3764)	Epoxy (E-30CL)	Y
8.4j	RI	PIB (Oppanol B10, B15)	Epoxy (E-30CL)	Y

[00183] For test switching materials sealed with a single seal material, bleed-in of some seal materials (e.g. epoxy) occurs before the seal is cured. PIB did not exhibit any bleed-in, however it has absorbed solvent and exhibits flow at elevated temperature (e.g. when laminating the film). A PIB first seal, and an epoxy second seal combined the characteristics of each to provide a flexible, durable seal that did not fail with handling and lamination. The PIB was a temporary seal, preventing the switching material from contacting the epoxy while curing. Once cured, the epoxy constrains the PIB so it does not flow during elevated temperatures.

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[00184] **Example 2**: Films comprising a switching material, sealed with a PIB first seal, and an epoxy second seal as set out in Table 3 were tested for indicator/trigger interaction (signifying a compromised first seal). The indicator in the active layer was a diarylethene chromophore, and the trigger the epoxy material. Sealed films were subjected to mechanical stress, or were assembled with an incomplete first seal (first seal was laid down without covering the complete circumference of the switching material), and observed during and after epoxy cure. Films that were manipulated (bent or flexed during cure), or with an incomplete seal demonstrated a blue stain at the region of the breached first seal. The epoxy is a two part curable thermosetting epoxy resin comprising an epoxy resin, and an epoxy resin hardener.

[00185] **Other Embodiments**

[00186] It is contemplated that any embodiment discussed in this specification can be implemented or combined with respect to any other embodiment, method, composition or aspect, and vice versa. Figures are not drawn to scale unless otherwise indicated.

[00187] The present invention has been described with regard to one or more embodiments. However, it will be apparent to persons skilled in the art that a number of variations and modifications can be made without departing from the scope of the invention as defined in the claims. Therefore, although various embodiments of the invention are disclosed herein, many adaptations and modifications may be made within the scope of the invention in accordance with the common general knowledge of those skilled in this art. Such modifications include the substitution of known equivalents for any aspect of the invention in order to achieve the same result in substantially the same way. Numeric ranges are inclusive of the numbers defining the range. In the specification, the word "comprising" is used as an open-ended term, substantially equivalent to the phrase "including, but not limited to," and the word "comprises" has a corresponding meaning. As used herein, the singular forms "a", "an" and "the" include plural referents unless the context clearly dictates otherwise. Citation of references herein shall not be construed as an admission that such references are prior art to the present invention, nor as any admission as to the contents or date of the references. All publications are incorporated herein by reference as if each individual publication was specifically and individually indicated to be incorporated by reference herein and as though

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fully set forth herein. The invention includes all embodiments and variations substantially as hereinbefore described and with reference to the examples and drawings.

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WHAT IS CLAIMED IS:

1. A sealed film comprising

a first and a second substrate;

a first and a second electrode disposed on the surface of at least one of the substrates;

a switching material disposed between the first and second substrates;

a first seal and a second seal; the first seal disposed along an edge of the switching material, separating the switching material from the second seal.

2. The sealed film of claim 1 wherein the switching material is in contact with the first and second electrodes.

3. The sealed film according to claim 1 wherein the first and the second substrates are in an offset relationship.

4. The sealed film according to claim 2 wherein the first seal is disposed upon an offset area along the edge of the switching material.

5. The sealed film according to any one of claims 1 to 4 wherein the first seal separates the switching material from the second seal.

6. The sealed film according to any one of claims1 to 5 wherein the first substrate is offset along at least two adjacent edges relative to the second substrate.

7. The sealed film according to any one of claims 1 to 6 wherein the first and second electrodes comprise a transparent conductive metal oxide.

8. The sealed film according to any one of claims 1 to 7 wherein the first seal contacts the first, the second, or the first and the second electrode.

9. The sealed film of any one of claims 1 to 8 wherein the first seal is adherent to the first, the second or the first and the second electrode.

10. The sealed film according to any one of claims 1 to 9 further comprising a first pair of electrical connectors.

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11. The sealed film according to claim 10 further comprising a second pair of electrical connectors.

12. The sealed film according to claim 10 or claim 11 wherein the electrical connectors are encapsulated with the second seal.

13. The sealed film according to any one of claims1 to 12 wherein the first seal, the second seal or the first and second seal independently comprise an elastomeric material.

14. The sealed film according to claim 13 wherein the elastomeric material is silicone rubber, natural rubber or synthetic rubber.

15. The sealed film according to any one of claims 1 to 12 wherein the first seal, the second seal or the first and the second seal independently comprise a thermoplastic polymer, a thermoset polymer or a thermoplastic polymer and a thermoset polymer.

16. The sealed film according to any one of claims 1 to 15 wherein the first seal is non-reactive with the switching material.

17. The sealed film according to any one of claims 1 to 15 wherein the first seal is non-absorbing, or substantially non-absorbing of the switching material, or a component of the switching material.

18. The sealed film according to any one of claims 1 to 15 wherein the first seal, the second seal or the first and the second seal is gas-impermeable.

19. The sealed film according to any one of claims 1 to 15 wherein the first seal, the second seal or the first and the second seal is water-impermeable.

20. The sealed film according to any one of claims 1 to 15 wherein the first seal, the second seal or the first and the second seal is electrically insulating.

21. The sealed film according to any one of claims 1 to 20 wherein the sealed film is a spacerless switchable film.

22. The sealed film according to any one of claims 1 to 20 wherein the switching material is self-supporting.

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23. The sealed film according to any one of claims 1 to 22 wherein the film is a lens-shaped film, comprising a cutout section and a nose bridge section.

24. The sealed film according to claim 23 wherein the lens-shaped film has a cutout section of height X and nose bridge of height Y.

25. The sealed film according to claim 24 wherein the ratio of X:Y is from about 5:1 to about 1:1.

26. The sealed film according to claim 24 wherein the ratio of X:Y is from about 1:5 to about 1:1.

27. A method for sealing a switchable film comprising:

a. providing a switchable film comprising a first and a second substrate with a first and a second electrode disposed on the surface of at least one of the substrates, and a switching material disposed between the first and second substrates;

b. disposing a first seal in contact with an electrode and adjacent to the switching material;

c. disposing a second seal adjacent to the first seal.

28. The method of claim 27 wherein the switching material is in contact with the first and the second electrodes.

29. An encapsulated switchable film comprising:

a. a layer of switching material between a pair of parallel substrates, the switching material in contact with a first and a second electrode disposed on a first surface of a substrate; a first seal surrounding the layer of switching material;

b. first and second encapsulating layers affixed to a second surface of the substrate;

c. a second seal disposed between the first and second encapsulating layers, and separated from the switching material by the first seal.

30. A method for encapsulating a switchable film comprising:

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a. providing a switchable film comprising a first and a second substrate with a first and a second electrode disposed on the surface of at least one of the substrates, and a switching material disposed between the first and second substrates and in contact with the first and second electrodes;

b. disposing a first seal in contact with an electrode and adjacent to the switching material;

c. affixing a transparent layer to the first and second substrates; and

d. disposing a second seal adjacent to the first seal, the second seal separated from the switching material by the first seal.

31. A laminated glass comprising:

a first substrate and a second substrate;

a first electrode and a second electrode disposed upon the first, the second or the first and the second substrate;

a layer of switching material disposed between the first and the second substrates and in contact with the first and the second electrodes;

an electrical connector for electrically connecting the first and the second electrodes to a power source; and

a first seal contacting an edge of the layer of switching material.

32. A laminated glass comprising an encapsulated switchable film according to claim 31.

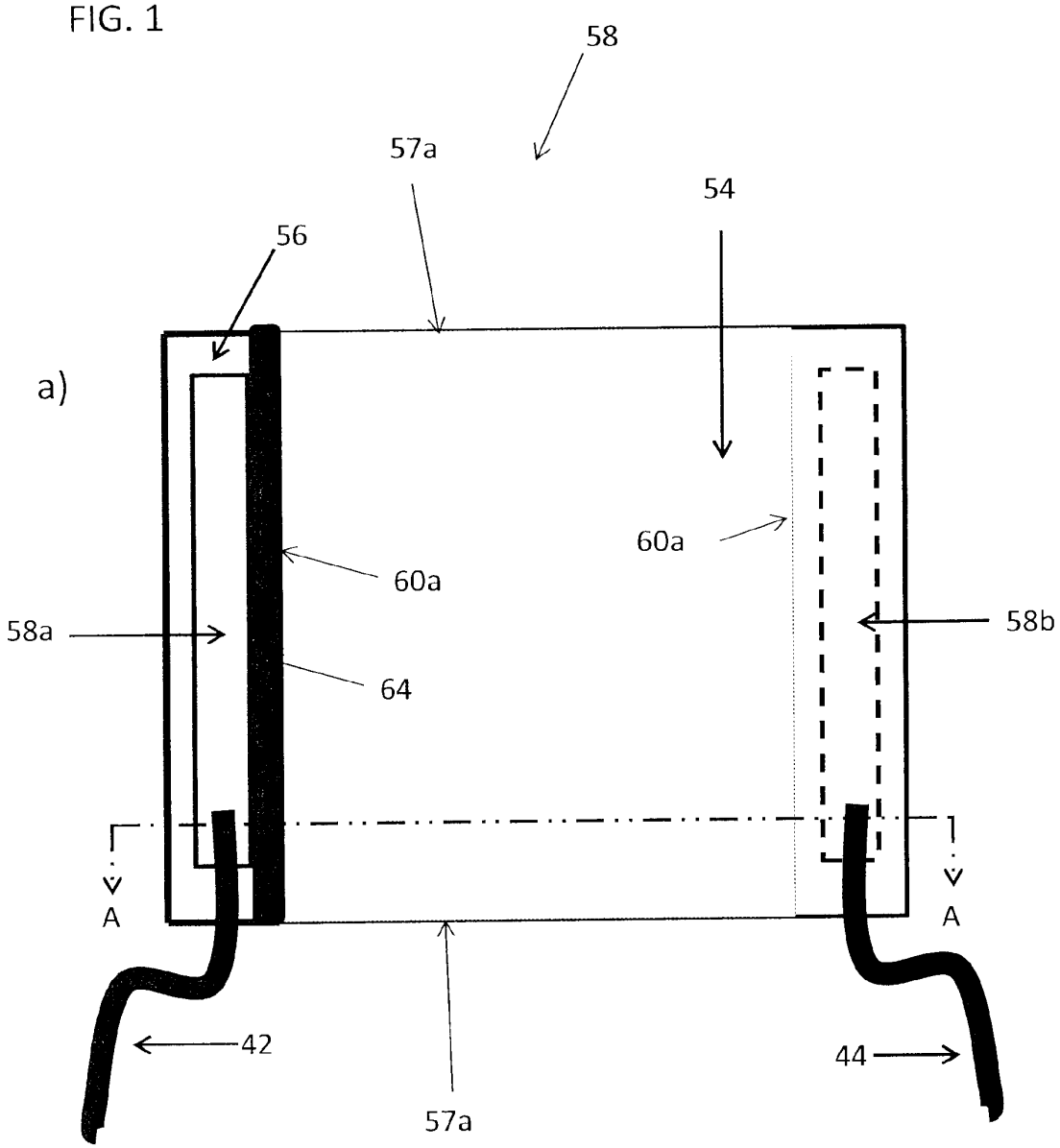
33. A method of cutting a switchable film, comprising the steps of:

a. providing a switchable film; and

b. directing laser radiation at the film to cut a weed portion comprising a portion of a first substrate, but not a second substrate of the switchable film; leaving the conductive layer of the second substrate intact.

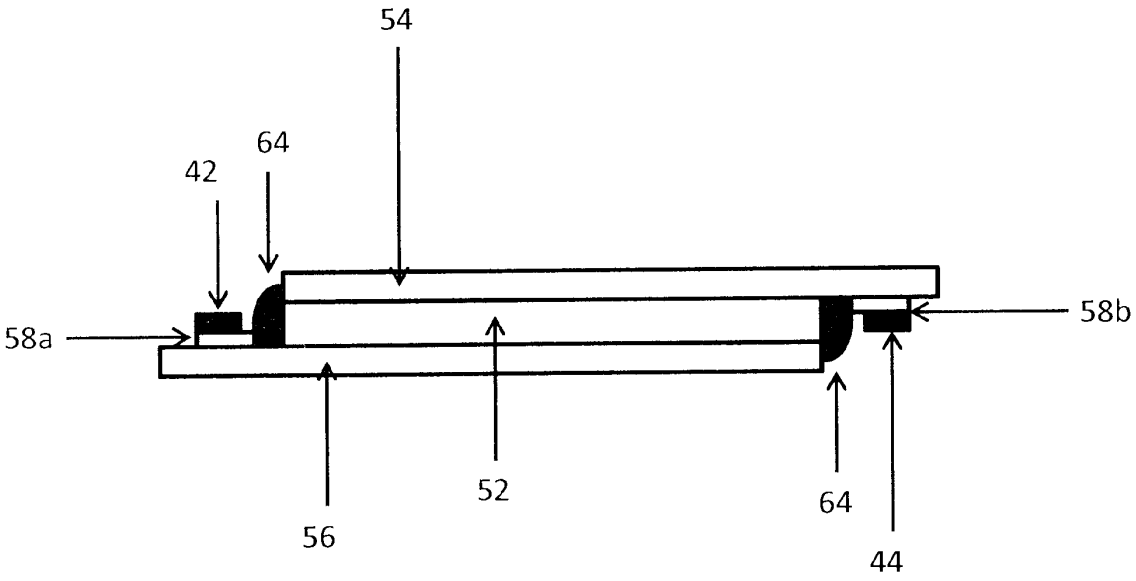
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FIG. 1



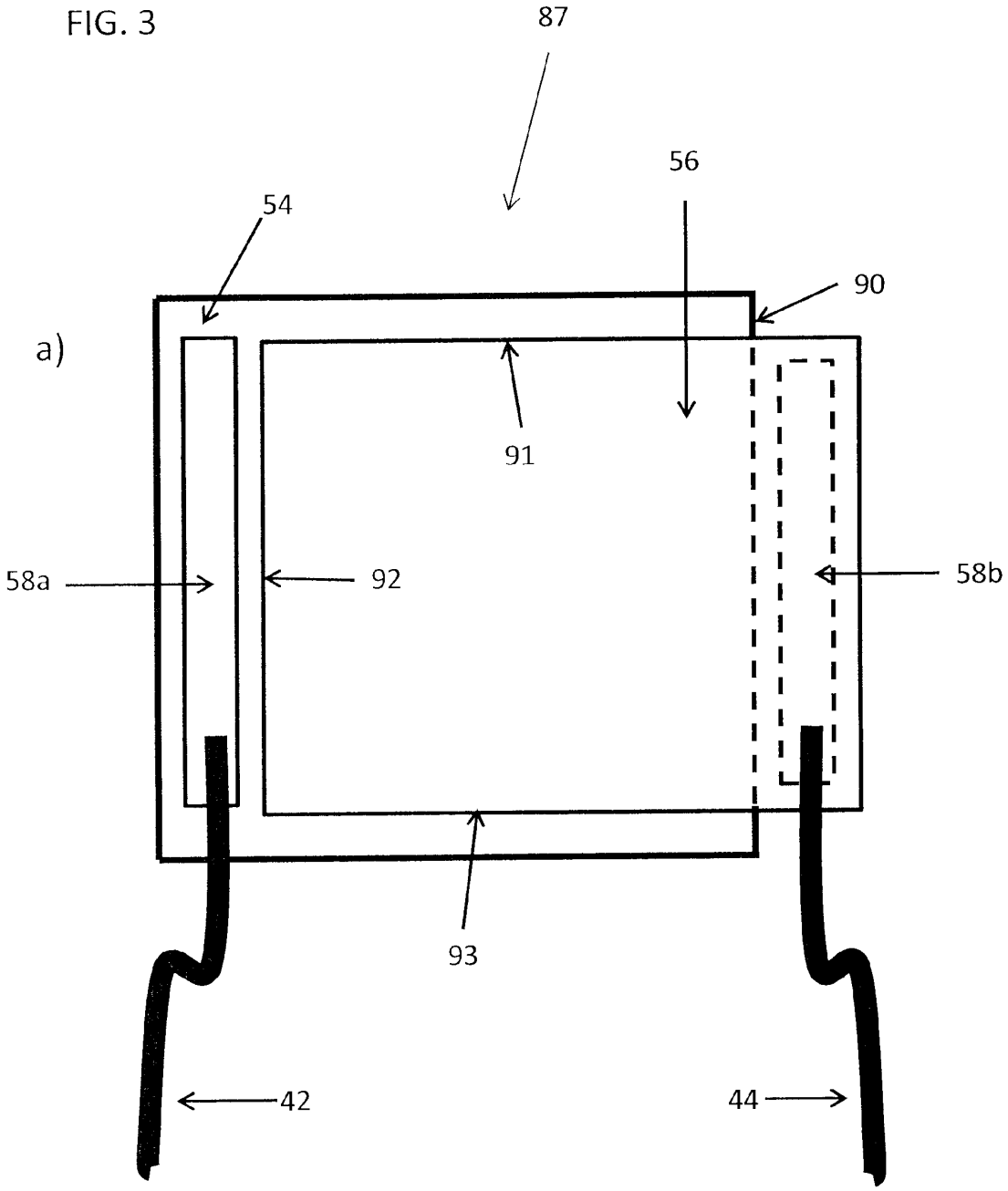
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FIG. 2



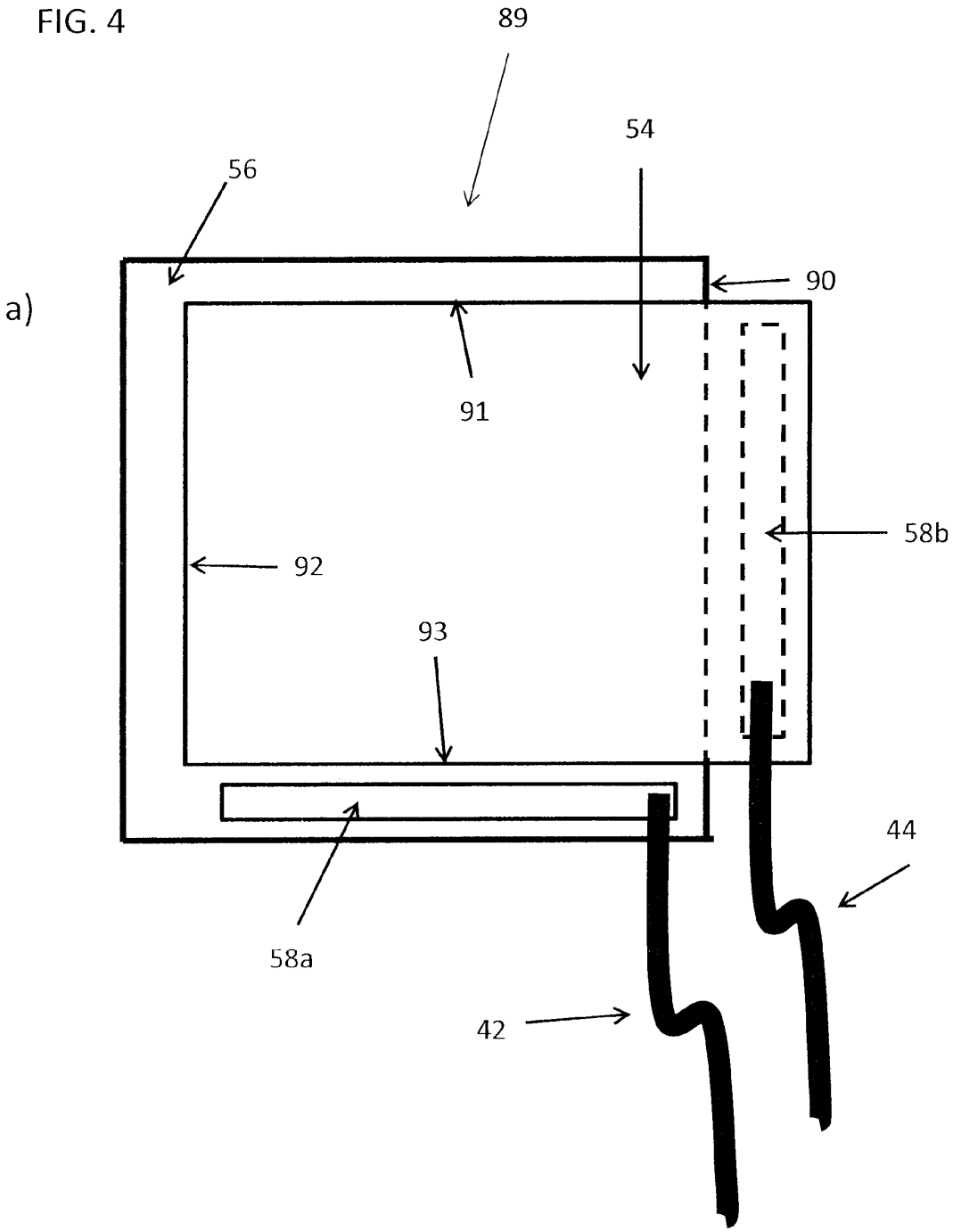
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FIG. 3



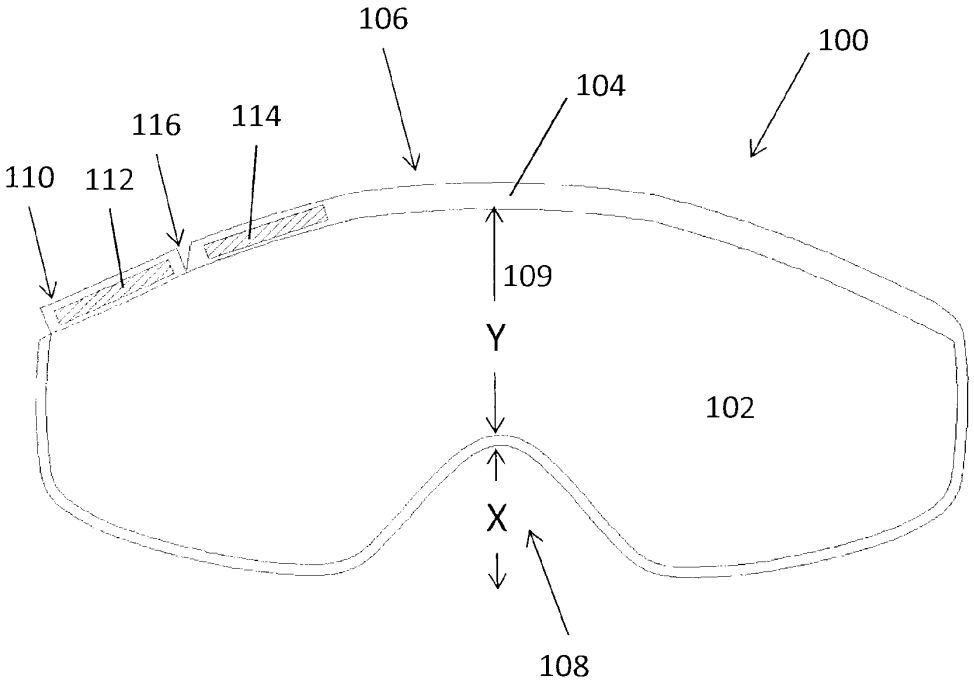
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FIG. 4



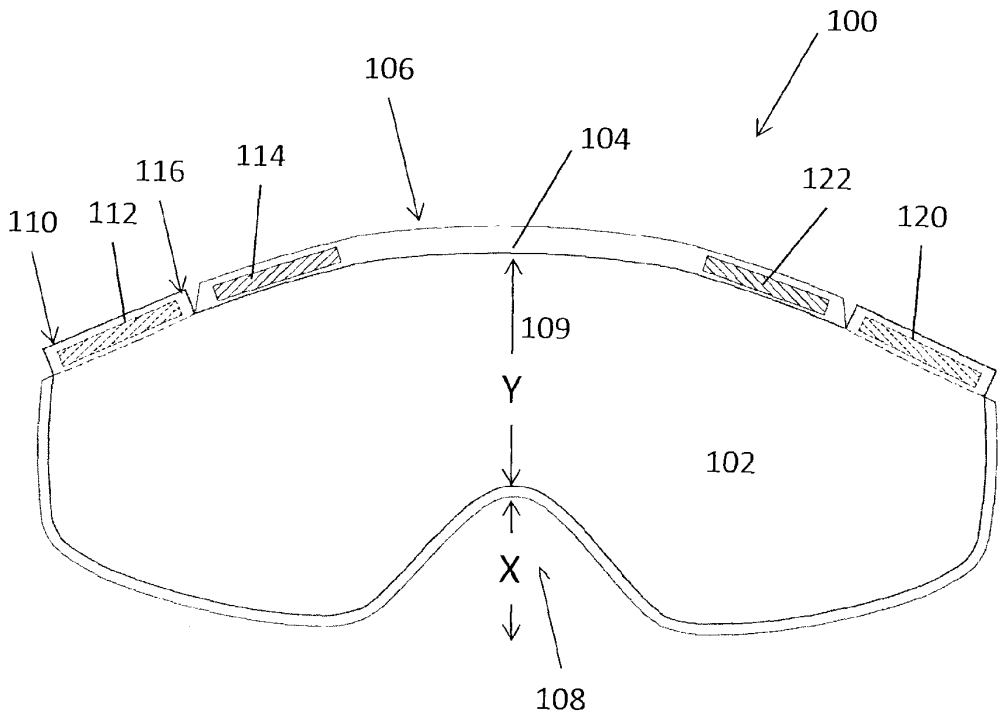
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FIG. 5A



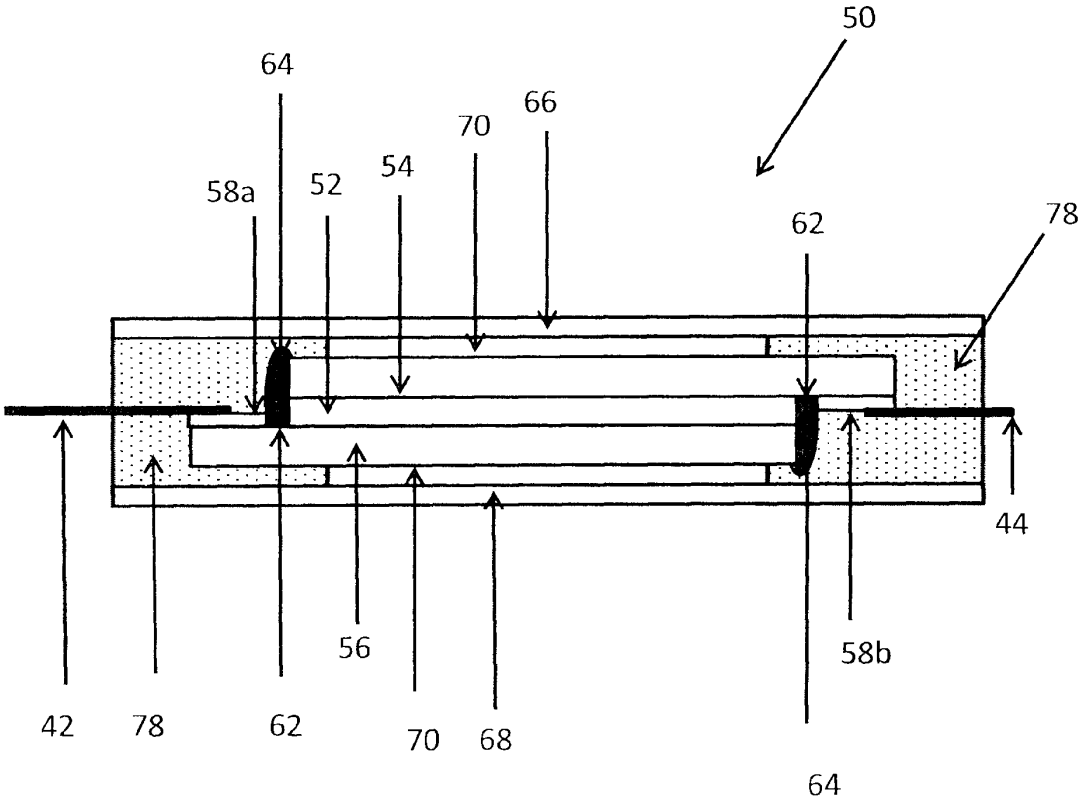
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FIG. 5B



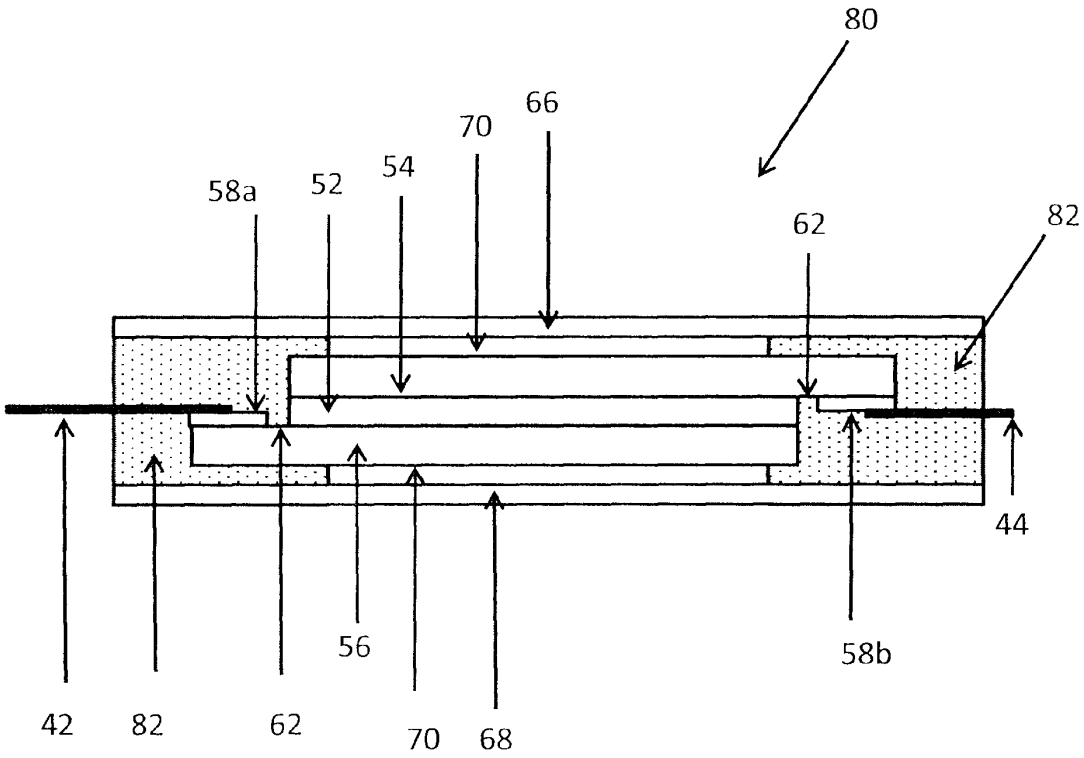
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FIG. 6



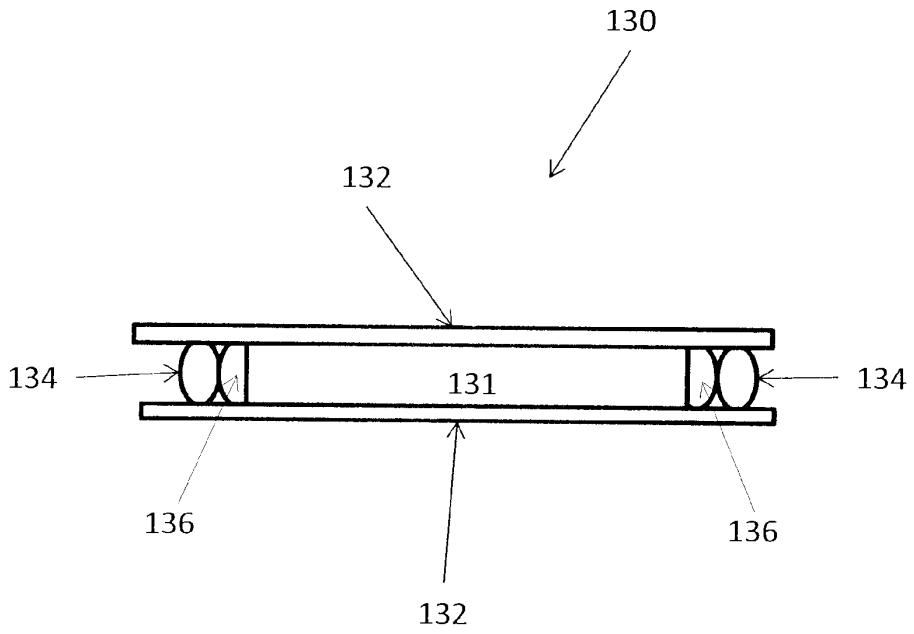
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FIG. 7



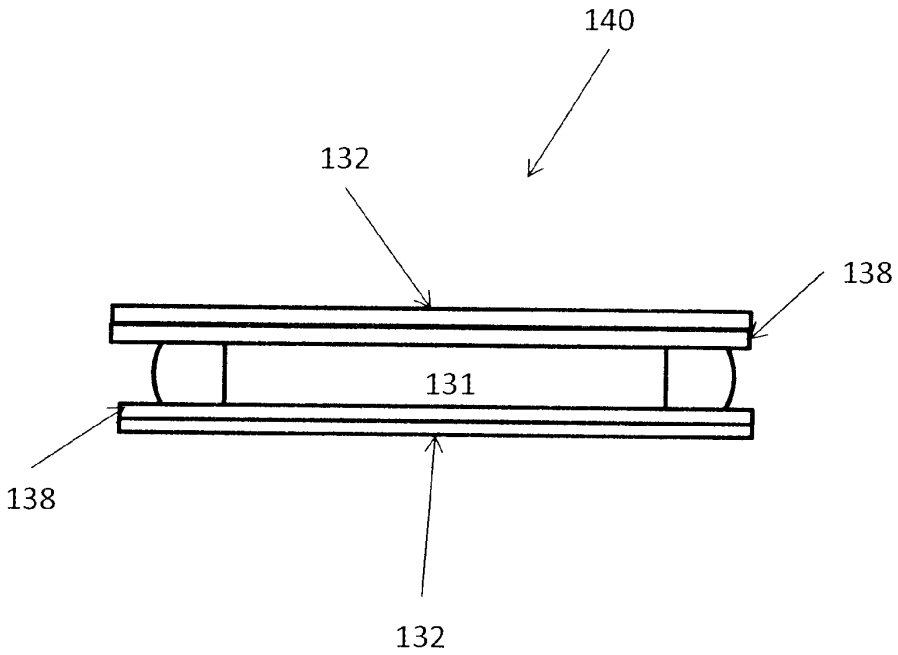
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FIG. 8



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FIG. 9



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Espacenet

Bibliographic data: JP2011095406 (A) — 2011-05-12

ELECTROCHROMIC MIRROR

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Classification: **- international:** ***G02F1/157***
- cooperative:

Application number: JP20090247912 20091028 Global Dossier

Priority number(s): JP20090247912 20091028

Abstract of JP2011095406 (A)

PROBLEM TO BE SOLVED: To obtain an electrochromic mirror wherein discoloration of an electrochromic film is suppressed even when silver is used in a reflective film. ;SOLUTION: The electrochromic mirror 10 includes an electrochromic film 16, a conductive reflective film 18 containing silver, and a protection film 36 made of a metal of which the work function is equal to or lower than that of silver, so that diffusion of silver to the electrochromic film 16 is suppressed to suppress yellowing of the electrochromic film 16. ;COPYRIGHT: (C)2011,JPO&INPIT

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Electrochromic mirror

Abstract

<P>PROBLEM TO BE SOLVED: To obtain an electrochromic mirror wherein discoloration of an electrochromic film is suppressed even when silver is used in a reflective film. <P>SOLUTION: The electrochromic mirror 10 includes an electrochromic film 16, a conductive reflective film 18 containing silver, and a protection film 36 made of a metal of which the work function is equal to or lower than that of silver, so that diffusion of silver to the electrochromic film 16 is suppressed to suppress yellowing of the electrochromic film 16. <P>COPYRIGHT: (C)2011,JPO&INPIT

Images (1)



JP2011095406A

Japan

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Other languages: Japanese

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Current Assignee : Nagoya University NUC , Tokai Rika Co Ltd

Worldwide applications

2009 JP

Application JP2009247912A events

2009-10-28	Application filed by Nagoya University NUC, Tokai Rika Co Ltd
2009-10-28	Priority to JP2009247912A
2011-05-12	Publication of JP2011095406A
Status	Pending

Info: Cited by (2), Similar documents, Priority and Related Applications

External links: Espacenet, Global Dossier, Discuss

Claims (3)

Hide Dependent translated from Japanese

An electrochromic film colored by a reduction reaction;
A conductive reflective film formed on one side in the thickness direction of the electrochromic film, reflecting light transmitted through the electrochromic film and having conductivity, and formed of silver or an alloy containing silver;
A protective film that is provided on one side in the thickness direction of the conductive reflective film on the side opposite to the electrochromic film and that includes a metal having a work function of silver or less;
A conductive film having conductivity provided on one side in the thickness direction of the protective film on the side opposite to the conductive reflective film;
A carbon film having conductivity formed including activated carbon on the conductive reflective film side of the conductive film;
Lithium ions are included and enclosed between the protective film and the conductive film, the conductive film is positive, and the conductive reflective film or the protective film is negative and voltage is applied to apply the voltage. An electrolytic solution in which lithium ions move to the electrochromic film side and subjected to a reduction reaction of the electrochromic film;
Electrochromic mirror equipped with. The electrochromic mirror according to claim 1, wherein the metal having a work function smaller than silver has a Mohs hardness of 4 or less. The electrochromic mirror according to claim 1 or 2, wherein the metal having a work function smaller than silver is bismuth or tin.

Description

translated from Japanese

The present invention relates to an electrochromic mirror that can be used for an outer mirror or an inner mirror for confirming the rear of a vehicle, and whose reflectance can be varied by applying a voltage.

In the electrochromic mirror disclosed in Patent Document 1 below, a transparent lithium ion permeable film is provided between the electrochromic film and the reflective film. Thereby, silver contained in the reflective film can be prevented from diffusing into the electrochromic film, and coloring of the electrochromic film can be suppressed.

JP 2009-8747 A

However, although coloring of the electrochromic film can be suppressed, a transparent lithium ion permeable film generally has low conductivity, and it may be difficult to obtain sufficient coloring and decoloring properties.
In view of the above facts, an object of the present invention is to obtain an electrochromic mirror in which discoloration of an electrochromic film is suppressed while maintaining good color decoloring properties.

The electrochromic mirror according to the first aspect of the present invention is formed on one side in the thickness direction of the electrochromic film that is colored by a reduction reaction and is transmitted through the electrochromic film. Provided on the opposite side of the electrochromic film on one side in the thickness direction

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of the conductive reflective film, and having a conductive reflective film that reflects light and has conductivity and is formed of silver or an alloy containing silver A protective film formed of a metal having a work function equal to or lower than silver, and a conductive film provided on one side of the protective film in the thickness direction opposite to the conductive reflective film. A conductive carbon film including activated carbon on the conductive reflective film side of the conductive film, and the protective film and the conductive film including lithium ions. The lithium ion is moved to the electrochromic film side by applying a voltage with the conductive film being positive and the conductive reflective film or the protective film being negative. And an electrolytic solution used for the reduction reaction of the membrane.

In the electrochromic mirror according to the first aspect of the present invention, diffusion of silver ions to the electrochromic film is suppressed by the protective film formed including a metal having a work function of silver or less, and the electrochromic film Discoloration is suppressed.

The electrochromic mirror according to the second aspect of the present invention is the electrochromic mirror according to the first aspect of the present invention, wherein the metal having a work function smaller than the silver has a Mohs hardness of 4 or less.

In the electrochromic mirror according to the second aspect of the present invention, the durability of the conductive reflective film is improved by the protective film formed by including a metal having a Mohs hardness of 4 or less. Is suppressed.

The electrochromic mirror according to the third aspect of the present invention is characterized in that, in the invention according to the first or second aspect, the metal having a work function smaller than that of silver is bismuth or tin.

In the electrochromic mirror according to the third aspect of the present invention, the protective film formed by containing bismuth or tin further improves the durability of the conductive reflective film, and the whitening of the conductive reflective film is more effective. To be suppressed.

As described above, in the electrochromic mirror according to the present invention, discoloration of the electrochromic film is suppressed.

It is sectional drawing which shows the outline of the structural example of the electrochromic mirror of this invention.

FIG. 1 is a schematic sectional view showing an example of the configuration of an electrochromic mirror according to the present invention.
As shown in FIG. 1, the electrochromic mirror 10 includes a surface side substrate 12. The front-side substrate 12 includes a transparent substrate body 14 made of glass or the like. The material constituting the substrate body 14 is not particularly limited as long as it has transparency (translucency) suitable for constituting the surface of the mirror. For example, glass (inorganic glass) and resin can be mentioned.

An electrochromic film 16 is formed on the surface of the substrate body 14 on one side in the thickness direction (the direction of arrow W in FIG. 1). The electrochromic film 16 is formed of, for example, tungsten trioxide (WO_3), molybdenum trioxide (MoO_3), or a mixture containing such an oxide. It is preferable that the electrochromic film 16 is formed of tungsten.
Moreover, there is no restriction | limiting in particular in the thickness of the electrochromic film | membrane 16 along the thickness direction of the substrate main body 14, For example, it can set in the range of 300 nm or more and 1000 nm or less. In the present invention, the thickness of the electrochromic film 16 is preferably 400 nm or more and 600 nm or less from the viewpoint of a decrease in reflectance.

As a method of forming an electrochromic film on the substrate body, a method that is usually used can be applied without any particular limitation. For example, a vapor deposition method, a sputtering method, etc. can be mentioned.

A conductive reflective film 18 is formed on the surface of the electrochromic film 16 opposite to the substrate body 14. The conductive reflective film 18 is a reflective film having conductivity and gloss capable of transmitting lithium ions, and is formed of silver or an alloy containing silver. The alloy containing silver is mainly composed of silver and other metals (preferably, a metal material having high cation permeability). Examples of the metal other than silver constituting the silver-containing alloy include rhodium (Rh), ruthenium (Ru), palladium (Pd), nickel (Ni), and the like. Among them, palladium (Pd) is included. An alloy is preferred. With such an embodiment, the cation permeability of the conductive reflective film is improved, and the response speed is improved.
Moreover, there is no restriction | limiting in particular in the thickness of the electroconductive reflection film 18 along the thickness direction of the substrate main body 14, For example, it can set in the range of 30 nm or more and 200 nm or less. In the present invention, the thickness of the conductive reflective film 18 is preferably 40 nm or more and 60 nm or less from the viewpoint of conductivity and reflectance.

The conductive reflective film can be produced (deposited) by various physical or chemical vapor deposition methods. For example, a conductive reflective film containing silver can be formed on the electrochromic film by preparing a target material containing silver and performing various sputtering using the target material.

A protective film 36 is formed on the surface of the conductive reflective film 18 opposite to the electrochromic film 16. The protective film 36 includes a metal having a work function of silver or less, but is preferably made of only a metal having a work function of silver or less. Here, the work function means the minimum energy required to extract one electron from the surface to infinity at the material surface.
By forming the protective film 36 including a metal having a work function equal to or lower than silver, diffusion into the silver electrochromic film 16 included in the conductive protective film 18 is suppressed, and the electrochromic film 16 made of silver is suppressed. Discoloration can be suppressed.

This can be considered as follows, for example. Since the electrochromic film 16 is made of a material having a work function larger than that of silver (for example, tungsten trioxide), the silver contained in the conductive reflective film 18 at the boundary between the electrochromic film 16 and the conductive reflective film 18. Atomic electrons are trapped by the material constituting the electrochromic film 16, and silver atoms are easily converted into silver ions. Since silver ions can move more easily than silver atoms, discoloration of the electrochromic film is likely to occur due to silver ions diffused into the electrochromic film 16.
On the other hand, in the present invention, the protective film 36 containing a metal having a work function of silver or less is formed on the surface of the conductive reflective film 18 opposite to the electrochromic film 16. Electrons are supplied from the metal atoms contained in the silver ions generated at the boundary between the electrochromic film 16 and the conductive reflective film 18 to suppress the ionization of silver contained in the conductive reflective film 18.

Compared with the silver work function (4.63 eV) contained in the protective film 36, the metal having a work function equal to or lower than silver is bismuth (Bi, 4.34 eV), tin (Sn, 4.42 eV), molybdenum. (Mo, 4.57 eV), antimony (Sb, 4.63 eV), gallium (Ga, 4.32 eV), zinc (Zn, 4.27 eV), chromium (Cr, 4.50 eV), niobium (Nb, 4. 33), vanadium (V, 4.30 eV), titanium (Ti, 4.33 eV), tungsten (W, 4.63 eV), cesium (Cs, 4.50 eV), boron (B, 4.45 eV), tantalum (Ta, 4.30) and the like.
Among these, bismuth (Bi), tin (Sn), and chromium (Cr) are preferable from the viewpoint of suppressing discoloration of the electrochromic film 16.

In addition, the metal having a work function of silver or less contained in the protective film 36 in the present invention preferably has a Mohs hardness of 4 or less. By configuring the protective film 36 to include a metal having a Mohs hardness of 4 or less, white turbidity of the conductive reflective film 18 can be suppressed. This is because, for example, the protective film 36 includes a soft metal having a Mohs hardness of 4 or less, so that the conductive reflective film 18 is formed in contact with the protective film 36 by repeated use of the electrochromic mirror of the present invention. It can be considered that generation of fine cracks (cracks) can be suppressed.
Examples of metals having a work function of silver or less and a Mohs hardness of 4 or less include bismuth (Bi), tin (Sn), antimony (Sb), gallium (Ga), zinc (Zn), and cesium (Cs). Among them, bismuth (Bi) and tin (Sn) are preferable.

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The thickness of the protective film 36 is not particularly limited, and can be set, for example, in the range of 10 nm to 200 nm. In the present invention, from the viewpoint of suppressing discoloration of the electrochromic film 16 and suppressing turbidity of the conductive reflective film 18, the thickness of the protective film 36 is preferably 20 nm or more and 80 nm or less.

The protective film 36 can be formed (deposited) by various physical or chemical vapor deposition methods, similarly to the conductive reflective film 18. For example, by preparing a target material containing a metal having a work function of silver or less (preferably a metal having a Mohs hardness of 4 or less) and performing various sputtering using the target material, the work function is less than silver. A protective film 36 containing a certain metal can be formed on the conductive reflective film 18.

The back side substrate 24 is provided on one side in the thickness direction of the front side substrate 12 having the above configuration so as to face the front side substrate 12. The back surface side substrate 24 includes a transparent substrate body 26 made of glass or the like. A conductive film 28 is formed on the other side in the thickness direction of the substrate body 26, that is, on the surface on the surface-side substrate 12 side. The conductive film 28 is made of a metal such as chromium (Cr) or nickel (Ni), indium tin oxide (In_2O_3 : Sn, so-called "ITO"), tin oxide (SnO_2), fluorine-doped tin oxide (SnO_2 : F), zinc oxide (ZnO_2), and the like, and a mixture of these is preferable.
The conductive film 28 can be formed (deposited) by various physical or chemical vapor deposition methods, similarly to the conductive reflective film 18.

A conductive carbon film 30 is formed on the surface of the conductive film 28 on the surface side substrate 12 side. The carbon film 30 is formed including at least one selected from graphite, carbon black, and activated carbon, and preferably includes 50% by weight or more of activated carbon. By including activated carbon as the carbon material, the surface area of the electrode increases, the flow of electrons (current) becomes smoother, and the voltage loss is reduced. The activated carbon surface also serves as a suitable place for a catalyst that can easily generate hydrogen ions.
Furthermore, by including a carbon material such as graphite, the hydrogen ion absorption ability in the electrode layer can be improved, and the transfer of hydrogen ions from the electrochromic film to the electrolyte can be promoted when the application of voltage is released. . Furthermore, by including carbon black together with activated carbon and graphite, the degree of electrical contact between the main components (activated carbon, graphite, etc.) constituting the carbon electrode can be improved.
The carbon film 30 preferably further includes at least one synthetic resin material such as a phenol resin, a polyimide resin, and an acrylic resin as a binder.

The thickness dimension of the carbon film 30 along the thickness direction of the substrate body 26 is preferably 50 μm or more.
As the method for forming the carbon film 30, for example, several types of carbon materials (for example, activated carbon, graphite, and carbon black described above) are used as appropriate binders (for example, cellulose binders such as carboxymethyl cellulose, phenol resins, polyimides). Mixed with a resin, a synthetic resin binder such as an acrylic resin), and applied onto the back side substrate 26 on which the conductive film 28 is formed by a known method such as a doctor blade method, and an appropriate temperature (for example, 150 to The film can be formed by heating at 200 ° C.).

A predetermined gap is formed between the front surface side substrate 12 and the back surface side substrate 24 having the above configuration, and a sealing material is provided between the outer peripheral portion of the front surface side substrate 12 and the outer peripheral portion of the back surface side substrate 24. 32 is sealed. An electrolytic solution 34 is sealed in a space surrounded by the front surface side substrate 12, the back surface side substrate 24, and the sealing material 32. The electrolytic solution 34 has a solvent formed of propylene carbonate, ethylene carbonate, butylene carbonate, diethyl carbonate, γ-butyrolactone, dimethylformamide, or the like, or a mixture thereof. In particular, in the present invention, propylene carbonate is a solvent. It is preferable to be used as

In addition to the solvent, the electrolyte 34 is composed of lithium perchlorate ($LiClO_4$), lithium hexafluorophosphate ($LiPF_6$), lithium tetrafluoroborate ($LiBF_4$), lithium bis (trifluoromethanesulfonyl) imide. ($LiN(SO_2CF_3)_2$), lithium bis (pentafluoroethanesulfonyl) imide ($LiN(SO_2C_2F_5)_2$), lithium trifluoromethanesulfonate ($LiCF_3SO_3$), etc., and mixtures thereof In particular, in the present invention, lithium perchlorate is preferably used as the electrolyte.

Furthermore, the conductive film 28 of the electrochromic mirror 10 having the above configuration is connected to a switch 42 that constitutes the circuit 40. The switch 42 is connected to a terminal connected in the ON state by a battery or the like mounted on the vehicle, and is connected to the positive electrode of a DC power supply 44 having a rated voltage of about 1.3V. The negative electrode of the DC power supply 44 is connected to the conductive reflective film 18. The terminal connected when the switch 42 is in the OFF state is connected to the conductive reflective film 18 without passing through the DC power supply 44, and in the OFF state, the conductive reflective film 18 and the conductive film 28 are short-circuited. Is done.
Although not shown, the negative electrode of the DC power supply 44 is connected to the protective film 36, and the terminal to which the switch 42 is connected in the OFF state is connected to the protective film 36 without passing through the DC power supply 44. In a state, the protective film 36 and the conductive film 28 may be short-circuited.

In the electrochromic mirror 10 having the above configuration, the electrochromic film 16 is substantially transparent when the switch 42 is in an OFF state. Therefore, light incident from the opposite side of the substrate body 14 from the electrochromic film 16 is The light passes through the substrate body 14 and the electrochromic film 16 and is reflected by the conductive reflective film 18. Further, the light reflected by the conductive reflective film 18 passes through the electrochromic film 16 and the substrate body 14. In the electrochromic mirror according to the present invention, the light reflectance is not particularly limited, and can be, for example, about 55%.

On the other hand, when the switch 42 is switched to the ON state, the electrons (e^-) that have moved through the circuit 40 toward the conductive reflective film 18 enter the electrochromic film 16, and at the same time, the lithium ions (Li^+) penetrates the protective film 36 and the conductive reflective film 18 and enters the electrochromic film 16. As a result, a reduction reaction of the following formula 1 occurs in the electrochromic film 16, and blue Li_xWO_3 called so-called tungsten bronze is formed in the electrochromic film 16.

$Li^+ + e^- + WO_3 \rightarrow Li_xWO_3$ (Formula 1)

As a result of the electrochromic film 16 being colored in blue in this way, the reflectivity, which was about 55 percent before the electrochromic film 16 was colored, is reduced to, for example, about 7 percent.

Furthermore, when the above reduction reaction occurs, electrons (e^-) move from the carbon constituting the carbon film 30 to the DC power supply 44 side, whereby negative ions derived from the salt constituting the electrolyte, for example, Then, negative ions (ClO_4^-) of lithium perchlorate move to the carbon film 30 side. As a result, a compensation reaction like the following formula 2 occurs with respect to the above reduction reaction.

$ClO_4^- + C - e^- \rightarrow C^+ \cdot ClO_4^-$ (Formula 2)

Further, the carbon film 30 contains not only activated carbon but also graphite and carbon ink, whereby the carbon film 30 is imparted with sufficient conductivity and the reaction in the carbon film 30 can be accelerated.
Furthermore, the provision of the carbon film 30 can reduce the voltage applied when coloring the electrochromic film 16. For this reason, when the switch 42 is turned off and the conductive reflective film 18 and the conductive film 28 are short-circuited, a reaction opposite to the above formulas 1 and 2 occurs, and the electrochromic film 16 is quickly discolored. The

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When the electrochromic mirror 10 as described above is used for a mirror body such as an inner mirror (room mirror) or an outer mirror (door mirror or fender mirror) for rear confirmation in a vehicle, for example, the switch 42 is maintained in an OFF state during the daytime. When the vehicle behind is turning on the headlight at night or the like, the switch 42 is turned on to color the electrochromic film 16 and reduce the reflectance. Thereby, the reflected light of a headlight can be reduced and dazzling falls.

EXAMPLES The present invention will be specifically described below with reference to examples, but the present invention is not limited to these examples.

<Example 1>
An electrochromic film was formed on an 85 × 114 mm glass substrate as follows. That is, using a commercially available vacuum deposition apparatus, tungsten trioxide (WO_3) was deposited, and an electrochromic film made of tungsten trioxide having a thickness of 500 nm was formed on a glass substrate.

Next, a conductive light reflecting film was formed in contact with the obtained electrochromic film. That is, in the formation of the electrochromic film, a conductive reflective film having a thickness of 50 nm was formed on the electrochromic film using silver (Ag) instead of tungsten trioxide (WO_3).

Next, a protective film was formed in contact with the obtained conductive reflective film. That is, in the formation of the conductive reflective film, a protective film made of tin having a thickness of 50 nm was formed on the conductive reflective film using tin (Sn) instead of silver.

On the other hand, the same glass substrate as the front surface side substrate was also adopted as the back side substrate, and a conductive film made of chromium (Cr) having a thickness of 200 nm was formed on the surface by vapor deposition in the same manner as described above.
Next, a carbon electrode film was formed on the conductive film made of chromium. That is, a carbon material composed of 10% by mass of graphite, 10% by mass of carbon black, 70% by mass of activated carbon and 10% by mass of polyimide binder is mixed with an appropriate amount of water, and the obtained mixed material is applied to the substrate surface by a doctor blade method. did. Then, it heated at 180 degreeC for 1 hour, and formed the carbon electrode film about 50 micrometers thick.

A sealing material made of an epoxy resin was applied to the peripheral portion of the surface of the carbon electrode film thus obtained, and an electrolytic solution was applied to the inside to a thickness of about 0.2 mm. As the electrolytic solution according to this example, a solution obtained by adding lithium perchlorate to propylene carbonate, which is an aprotic solvent, to a concentration of 100 mM was used.
Subsequently, the front side surface board | substrate provided with an electrochromic film | membrane, an electroconductive reflection film, and a protective film was piled up, and the electrochromic mirror which has a structure shown in FIG. 1 was obtained by sealing with the said sealing material.

<Examples 2-7, Comparative Examples 1-2>
In Example 1, an electrochromic mirror was obtained in the same manner as in Example 1 except that the metal constituting the conductive reflective film and the metal constituting the protective film were changed as shown in Table 1 below.

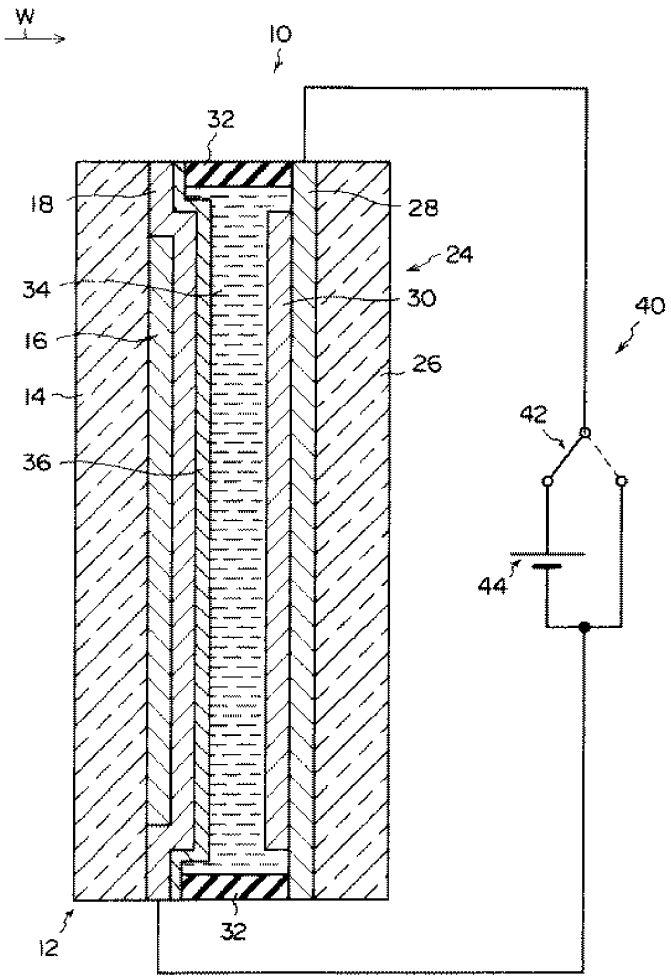
<Example 8>
In Example 1, a conductive reflective film is formed by sputtering using Ag37 (manufactured by Mitsubishi Materials Corporation, silver alloy No37) as a metal constituting the conductive reflective film, and a protective film is formed using chromium (Cr). Except that, an electrochromic mirror was obtained in the same manner as in Example 1.

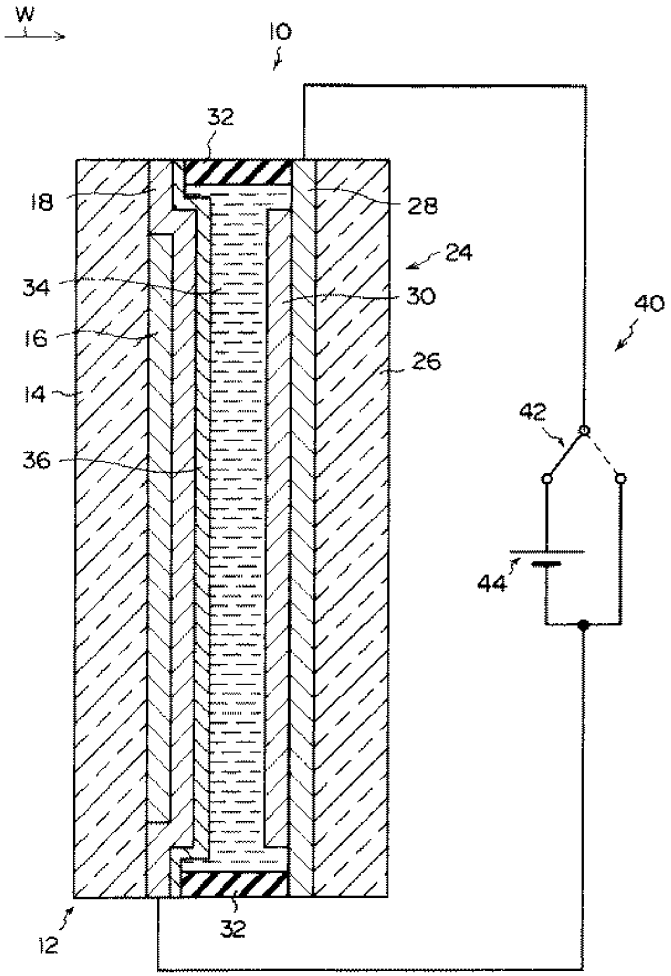
<Comparative Example 3>
In Example 1, the conductive reflective film was formed by sputtering using AgBi (Bi-added silver alloy) as a metal constituting the conductive reflective film, and the protective film was not formed. Thus, an electrochromic mirror was obtained.

<Evaluation>
(Discoloration and cloudiness)
About the obtained electrochromic mirror, discoloration and white turbidity of the electrochromic film were evaluated as follows. The results are shown in Table 1.
Connect the 1.3V DC power supply so that the electroreflective film of the obtained electrochromic mirror is the negative electrode and the conductive film is the positive electrode, and repeat the switch ON / OFF 100 times. The film and the conductive reflective film were observed and evaluated according to the following evaluation criteria.
~Evaluation criteria~
○: Discoloration of the electrochromic film was not observed, and white turbidity of the conductive reflective film was not observed after 24 hours.
Δ: Discoloration of the electrochromic film was not observed, but white turbidity of the conductive reflective film was observed after 24 hours.
X: Discoloration of the electrochromic film was observed, and white turbidity of the conductive reflective film was also observed.

(Reflectance)
The reflectance of the obtained electrochromic mirror when no voltage was applied (DAY reflectance (%)) and the reflectance when voltage was applied (NIGHT reflectance (%)) were measured using a spectral reflectometer. The results are shown in Table 1.

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W
10
32
18
28
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34
30
40
16
26
14
42
36
44
12
32



It can be seen from Table 1 that discoloration can be suppressed by forming a protective film using a metal having a work function of silver or less. Furthermore, it turns out that the cloudiness of a mirror can also be suppressed by comprising a protective film using the metal whose Mohs hardness is less than 4.

DESCRIPTION OF SYMBOLS 10 Electrochromic mirror 16 Electrochromic film 18 Conductive reflective film 28 Conductive film 30 Carbon film 34 Electrolyte solution 36 Protective film

Cited By (2)

Publication number	Priority date	Publication date	Assignee	Title
JP2013024727A *	2011-07-21	2013-02-04	Toyota Motor Corp	Decorative film
CN111399300A *	2018-11-14	2020-07-10	非尔齐费尔公司	Electrochromic film with edge protection
Family To Family Citations				

* Cited by examiner, † Cited by third party, ‡ Family to family citation

Similar Documents

Publication	Publication Date	Title
JP2005031628A	2005-02-03	Electrochromic mirror
JP2009008751A	2009-01-15	Electrochromic mirror
Shet et al.	2008	Carrier concentration tuning of bandgap-reduced p-type ZnO films by codoping of Cu and Ga for improving photoelectrochemical response

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JP5234237B2	2013-07-10	Transparent conductive film and method for producing the same, transparent electrode, infrared absorption reflection film, antifogging film, and electromagnetic shielding film
KR20010033200A	2001-04-25	Electrodeposition cell with high light transmission
KR20140076553A	2014-06-20	Reflective dimming electrochromic element inserted with non-water based hydrogen ion conductive electrolyte layer, and dimming element using said reflective dimming electrochromic element
DE602005000457T2	2007-05-03	Electrochromic mirror
CN104122730A	2014-10-29	Reflection type electrochromism device
JP2011095406A	2011-05-12	Electrochromic mirror
US7692843B2	2010-04-06	Electrochromic mirror
JP4948287B2	2012-06-06	Electrochromic mirror
JP2005031627A	2005-02-03	Electrochromic mirror
JP4949136B2	2012-06-06	Electrochromic mirror
JP2022176332A	2022-11-25	Electrochromic lighting control member, light-transmissive conductive glass film, and electrochromic lighting control element
CN101498868B	2011-06-15	Electrochromic mirror
JP5014893B2	2012-08-29	Electrochromic mirror
JP2012150184A	2012-08-09	Electrochromic mirror
WO2012173110A1	2012-12-20	Dye-sensitized solar cell, and method for preparing dye-sensitized solar cell
JP6265124B2	2018-01-24	Dye-sensitized solar cell paste, porous light reflecting insulating layer, and dye-sensitized solar cell
JP2012155099A	2012-08-16	Electrochromic mirror
JP2005099606A	2005-04-14	Electrochromic mirror
JP2009008750A	2009-01-15	Electrochromic mirror
KR101085268B1	2011-11-22	Electrode for electrochromic device having excellent water resistant property, and method for preparing the same
JP2014022569A	2014-02-03	Photoelectric conversion element and manufacturing method therefor
JP2011095483A	2011-05-12	Electrochromic mirror

Priority And Related Applications

Priority Applications (1)

Application	Priority date	Filing date	Title
JP2009247912A	2009-10-28	2009-10-28	Electrochromic mirror

Applications Claiming Priority (1)

Application	Filing date	Title
JP2009247912A	2009-10-28	Electrochromic mirror

Concepts

machine-extracted

Download Filter table

Name	Image	Sections	Count	Query match
silver		claims,abstract,description	47	0.000
silver		claims,abstract,description	47	0.000
metal		claims,abstract,description	31	0.000
metal		claims,abstract,description	31	0.000
carbon		claims,description	53	0.000

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protective	claims,description	38	0.000
carbon	claims,description	20	0.000
tin	claims,description	9	0.000
tin hydride	claims,description	9	0.000
lithium ion	claims,description	8	0.000
bismuth	claims,description	7	0.000
bismuth	claims,description	7	0.000
electrolyte solution	claims,description	7	0.000
reduction reaction	claims,description	7	0.000
alloy	claims,description	6	0.000
alloy	claims,description	6	0.000
aluminium(3+)	claims,description	6	0.000
suppression	abstract,description	20	0.000
discoloration	abstract,description	14	0.000
diffusion process	abstract,description	3	0.000
yellowing	abstract	1	0.000

Show all concepts from the description section

Data provided by IFI CLAIMS Patent Services

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(19)日本国特許庁(JP)　(12)公開特許公報(A)　(11)特許出願公開番号
特開2011-95406
(P2011-95406A)
(43)公開日　平成23年5月12日(2011.5.12)

(51)Int.Cl.	F I	テーマコード（参考）
G02F 1/157 (2006.01)	G02F 1/157	2K101

審査請求 未請求　請求項の数 3　OL　（全 11 頁）

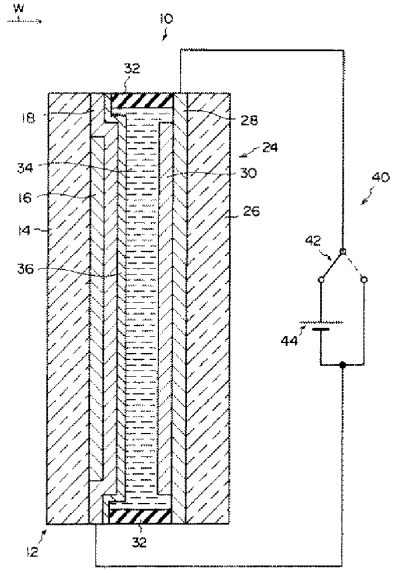
(21)出願番号　特願2009-247912 (P2009-247912)
(22)出願日　平成21年10月28日 (2009.10.28)

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最終頁に続く

(54)【発明の名称】エレクトロクロミックミラー

(57)【要約】
【課題】反射膜に銀を用いても、エレクトロクロミック膜の変色が抑制されたエレクトロクロミックミラーを得る。
【解決手段】本エレクトロクロミックミラー１０では、エレクトロクロミック膜１６と、銀を含む導電性反射膜１８と、仕事関数が銀以下である金属からなる保護膜３６とを設けているため、エレクトロクロミック膜１６への銀の拡散が抑制され、エレクトロクロミック膜１６の黄変を抑制することができる。
【選択図】図１



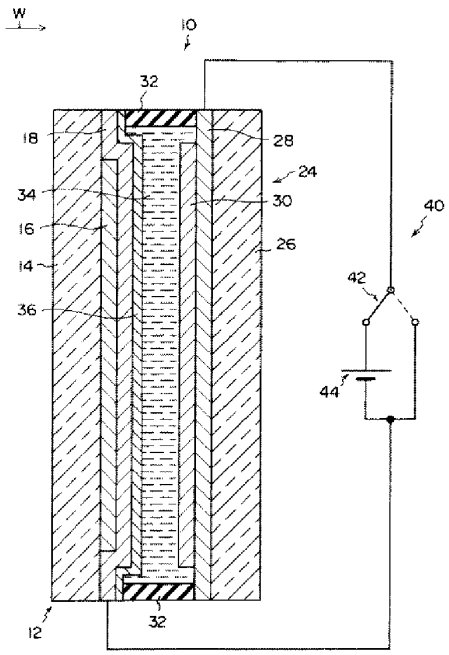
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【特許請求の範囲】
【請求項1】
還元反応することで着色されるエレクトロクロミック膜と、
前記エレクトロクロミック膜の厚さ方向一方の側に形成されて前記エレクトロクロミック膜を透過した光を反射すると共に導電性を有し、銀または銀を含む合金により形成された導電性反射膜と、
前記導電性反射膜の厚さ方向一方の側で前記エレクトロクロミック膜とは反対側に設けられ、仕事関数が銀以下である金属を含んで形成された保護膜と、
前記保護膜の厚さ方向一方の側で前記導電性反射膜とは反対側に設けられた導電性を有する導電性膜と、
前記導電性膜の前記導電性反射膜の側で活性炭を含めて形成された導電性を有するカーボン膜と、
リチウムイオンを含めて構成されて前記保護膜と前記導電性膜との間に封入され、前記導電性膜を正とし、前記導電性反射膜または前記保護膜を負として電圧を印加することで前記リチウムイオンが前記エレクトロクロミック膜の側へ移動して、前記エレクトロクロミック膜の還元反応に供される電解液と、
を備えるエレクトロクロミックミラー。
【請求項2】
前記銀よりも仕事関数が小さい金属は、モース硬度が４以下である請求項１に記載のエレクトロクロミックミラー。
【請求項3】
前記銀よりも仕事関数が小さい金属は、ビスマスまたはスズである請求項１または請求項２に記載のエレクトロクロミックミラー。

【発明の詳細な説明】
【技術分野】
【0001】
本発明は、例えば、車両の後方確認用としてアウタミラーやインナミラーに用いられて電圧を印加することにより反射率を可変できるエレクトロクロミックミラーに関する。
【背景技術】
【0002】
下記特許文献１に開示されたエレクトロクロミックミラーでは、エレクトロクロミック膜と反射膜の間に透明なリチウムイオン透過膜が設けられている。これにより反射膜に含まれる銀がエレクトロクロミック膜に拡散することを防止し、エレクトロクロミック膜が着色することを抑制することができる。
【図面の簡単な説明】
【0012】
【図1】本発明のエレクトロクロミックミラーの構成例の概略を示す断面図である。
【符号の説明】
【0046】
１０　エレクトロクロミックミラー
１６　エレクトロクロミック膜
１８　導電性反射膜
２８　導電性膜
３０　カーボン膜
３４　電解液
３６　保護膜

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【図1】



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Ｆターム(参考)　2K101　AA22　DC03　DC06　DC14　EA11　EB52　EC02　ED01　EE02　EE10
EG05　EG26　EG41　EG52　EG54　EH02　EJ11　EK07

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
18/606,980	03/15/2024		664	50WF-383698-US	20	2

CONFIRMATION NO. 9999

FILING RECEIPT

139780
Sheppard Mullin Richter & Hampton LLP
Weiguo Chen
650 Town Center Drive, 10th Floor
Costa Mesa, CA 92626

Date Mailed: 03/28/2024

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

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Inventor(s)

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Jian WANG, Fremont, CA;
Yan ZHOU, Fremont, CA;

Applicant(s)

Furcifer Inc., Fremont, CA;

Power of Attorney: The patent practitioners associated with Customer Number 139780

Domestic Priority data as claimed by applicant

This application is a CON of 18/152,033 01/09/2023
which is a CON of 16/190,723 11/14/2018 PAT 11,571,878

Foreign Applications for which priority is claimed (You may be eligible to benefit from the Patent Prosecution Highway program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

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The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 18/606,980**

Projected Publication Date: 07/04/2024

Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****
Title

ELECTROCHROMIC FILMS WITH EDGE PROTECTION

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

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Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 18/606,980

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	64		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	280		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	320		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	* 0	x =	0	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*	x =	0			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			0			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	664		TOTAL	

APPLICATION AS AMENDED - PART II

AMENDMENT A		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

AMENDMENT B		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
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Derrick Brent
Deputy Under Secretary of Commerce for Intellectual Property and
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APPLICATION NO./ CONTROL NO.	FILING DATE	FIRST NAMED INVENTOR/ PATENT IN REEXAMINATION	ATTORNEY DOCKET NO.
18/606,980	03/15/2024	CHEN et al.	50WF-383698-US

	EXAMINER	
Sheppard Mullin Richter & Hampton LLP Weiguo Chen 650 Town Center Drive, 10th Floor Costa Mesa, CA 92626	--	
	ART UNIT	PAPER
	--	20240428-1nDzDO

DATE MAILED: 28 April 2024

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner for Patents

PTO-90C (Rev.04-03)

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Henry "Jamie" Holcombe
Chief Information Officer
US Patent and Trademark Office
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Dated: April 27th, 2024

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/606,980	**05/28/2024 03:15:42 PM Z ET**	**50WF-383698-US**

Title of Invention

ELECTROCHROMIC FILMS WITH EDGE PROTECTION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9999	FILED BY	Chizu Sato
PATENT CENTER #	65697399	FILING DATE	03/15/2024
CUSTOMER #	139780	FIRST NAMED INVENTOR	Zhao CHEN
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	PJ Shang

Documents

TOTAL DOCUMENTS: 2

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
NPL_Furcifer12EPC1_OA.pdf	4	Non Patent Literature	121 KB
Furcifer12USC2_50WF-383698-US_IDS.pdf	4	Information Disclosure Statement (IDS) Form (SB08)	1010 KB

Digest

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Furcifer12USC2_50WF-383698-US_IDS.pdf	6EA3DCBAD5B93E497AA098243010B2AF9328679563EB203F810E415B21463E84510FF61C30BFF520A6FFBA5E88861268F23ADBA050B2ACF53A74802F4B7C23F0

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	
	Examiner Name	
	Attorney Docket Number	50WF-383698-US

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
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Signature	/Pengju Shang/	Date (YYYY-MM-DD)	2024-05-28
Name/Print	Pengju Shang	Registration Number	80050

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
18/606,980	03/15/2024	Zhao CHEN	50WF-383698-US

CONFIRMATION NO. 9999

139780
Sheppard Mullin Richter & Hampton LLP
Weiguo Chen
650 Town Center Drive, 10th Floor
Costa Mesa, CA 92626

PUBLICATION NOTICE

OC000000075164916

Date Mailed: 07/15/2024

Title:ELECTROCHROMIC FILMS WITH EDGE PROTECTION

Publication No.US-2024-0217214-A1
Publication Date:07/04/2024

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PTO/AIA/14 (01-22)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	50WF-383698-US
	Application Number	18/606,980
Title of Invention	ELECTROCHROMIC FILMS WITH EDGE PROTECTION	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
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Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Zhao		CHEN	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Camarillo	State/Province	CA	Country of Residence	US

Mailing Address of Inventor:

Address 1	4670 Del Rayo Ct.		
Address 2			
City	Camarillo	State/Province	CA
Postal Code	93012	Country i	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Jian		WANG	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Fremont	State/Province	CA	Country of Residence	US

Mailing Address of Inventor:

Address 1	38034 Village Cmn, Apt. 213		
Address 2			
City	Fremont	State/Province	CA
Postal Code	94536	Country i	US

Inventor 3 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Yan		ZHOU	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	50WF-383698-US
	Application Number	18/606,980
Title of Invention	ELECTROCHROMIC FILMS WITH EDGE PROTECTION	

City	Fremont	State/Province	CA	Country of Residence	US

Mailing Address of Inventor:

Address 1	38271 Paseo Padre Parkway		
Address 2			
City	Fremont	State/Province	CA
Postal Code	94536	Country i	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	139780		
Email Address	svpatents@sheppardmullin.com	Add Email	Remove Email

Application Information:

Title of the Invention	ELECTROCHROMIC FILMS WITH EDGE PROTECTION		
Attorney Docket Number	50WF-383698-US	Small Entity Status Claimed	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	9	Suggested Figure for Publication (if any)	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	50WF-383698-US
	Application Number	18/606,980
Title of Invention	ELECTROCHROMIC FILMS WITH EDGE PROTECTION	

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	(●) Customer Number	( ) US Patent Practitioner	( ) Limited Recognition (37 CFR 11.9)
Customer Number	139780		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	18152033	2023-01-09

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
18152033	Continuation of	16190723	2018-11-14	11571878	2023-02-07

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	50WF-383698-US
	Application Number	18/606,980
Title of Invention	ELECTROCHROMIC FILMS WITH EDGE PROTECTION	

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	50WF-383698-US
	Application Number	18/606,980
Title of Invention	ELECTROCHROMIC FILMS WITH EDGE PROTECTION	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	50WF-383698-US
	Application Number	18/606,980
Title of Invention	ELECTROCHROMIC FILMS WITH EDGE PROTECTION	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◉ Assignee	○ Legal Representative under 35 U.S.C. 117	○ Joint Inventor
○ Person to whom the inventor is obligated to assign.	○ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	~~Eurofer Inc.~~ LannRay Optoelectronics (Zhenjiang) Co. Ltd.		
Mailing Address Information For Applicant:			
Address 1	~~48417 Fremont Blvd.~~ No. 1, Xingye North Road, Youfang Town		
Address 2			
City	~~Fremont~~ Yangzhong City, Zhenjiang City	**State/Province**	~~CA~~
Country	~~US~~ CN	Postal Code	~~94538~~ 212218
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	50WF-383698-US
	Application Number	18/606,980
Title of Invention	ELECTROCHROMIC FILMS WITH EDGE PROTECTION	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

Signature:

Remove

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Pengju Shang/			Date (YYYY-MM-DD)	2024-03-15
First Name	Pengju	Last Name	Shang	Registration Number	80050

Additional Signature may be generated within this form by selecting the Add button. Add

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	50WF-383698-US
	Application Number	18/606,980
Title of Invention	ELECTROCHROMIC FILMS WITH EDGE PROTECTION	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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STATEMENT UNDER 37 CFR 3.73(c)

First Named Inventor/Patent Owner: Zhao CHEN

Application No./Patent No.: 18/606,980 Filed/Issue Date: March 15, 2024

Titled: ELECTROCHROMIC FILMS WITH EDGE PROTECTION

LannRay Optoelectronics (Zhenjiang) Co. Ltd., a corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached*.

B. ☑ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: Zhao CHEN, Jian WANG, and Yan ZHOU To: FURCIFER INC.

The document was recorded in the United States Patent and Trademark Office at

Reel 066806, Frame 0791, or for which a copy thereof is attached*.

2. From: FURCIFER INC. To: LannRay Optoelectronics (Zhenjiang) Co. Ltd.

The document was recorded in the United States Patent and Trademark Office at

Reel 068681, Frame 0150, or for which a copy thereof is attached*.

A Federal agency may not conduct or sponsor, and a person is not required to respond to, nor shall a person be subject to a penalty for failure to comply with an information collection subject to the requirements of the Paperwork Reduction Act of 1995, unless the information collection has a currently valid OMB Control Number. The OMB Control Number for this information collection is 0651-0031. Public burden for this form is estimated to average 12 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the information collection. Send comments regarding this burden estimate or any other aspect of this information collection, including suggestions for reducing this burden to the Chief Administrative Officer, United States Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450 or email InformationCollection@uspto.gov. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached*.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached*.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached*.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached*.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ *As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Weiguo Chen/	October 3, 2024
Signature	Date
Weiguo Chen	61878
Printed or Typed Name	Title or Registration Number

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Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. The United States Patent and Trademark Office (USPTO) collects the information in this record under authority of 35 U.S.C. 2. The USPTO's system of records is used to manage all applicant and owner information including name, citizenship, residence, post office address, and other information with respect to inventors and their legal representatives pertaining to the applicant's/owner's activities in connection with the invention for which a patent is sought or has been granted. The applicable Privacy Act System of Records Notice for the information collected in this form is COMMERCE/PAT-TM-7 Patent Application Files, available in the Federal Register at 78 FR 19243 (March 29, 2013). https://www.govinfo.gov/content/pkg/FR-2013-03-29/pdf/2013-07341.pdf

Routine uses of the information in this record may include disclosure to:

1) law enforcement, in the event that the system of records indicates a violation or potential violation of law;

2) a federal, state, local, or international agency, in response to its request;

3) a contractor of the USPTO having need for the information in order to perform a contract;

4) the Department of Justice for determination of whether the Freedom of Information Act (FOIA) requires disclosure of the record;

5) a Member of Congress submitting a request involving an individual to whom the record pertains, when the individual has requested the Member's assistance with respect to the subject matter of the record;

6) a court, magistrate, or administrative tribunal, in the course of presenting evidence, including disclosures to opposing counsel in the course of settlement negotiations;

7) the Administrator, General Services Administration (GSA), or their designee, during an inspection of records conducted by GSA under authority of 44 U.S.C. 2904 and 2906, in accordance with the GSA regulations and any other relevant (i.e., GSA or Commerce) directive, where such disclosure shall not be used to make determinations about individuals;

8) another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c));

9) the Office of Personnel Management (OPM) for personnel research purposes; and

10) the Office of Management and Budget (OMB) for legislative coordination and clearance.

If you do not furnish the information requested on this form, the USPTO may not be able to process and/or examine your submission, which may result in termination of proceedings, abandonment of the application, and/or expiration of the patent.

Doc Code: R46C.REQ
Document Description: Request under 37 CFR 1.46(c) to correct, update or change the applicant.

PTO/AIA/41 (04-15)
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U.S. Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE
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REQUEST TO CORRECT OR UPDATE THE NAME OF THE APPLICANT UNDER 37 CFR 1.46(c)(1), OR CHANGE THE APPLICANT UNDER 37 CFR 1.46(c)(2)

(FOR USE ONLY IN APPLICATIONS FILED ON OR AFTER SEPTEMBER 16, 2012)

Application Number	18/606,980
Filing Date	March 15, 2024
First Named Inventor	Zhao CHEN
Art Unit	Not yet assigned
Examiner Name	Not yet assigned
Practitioner Docket Number	50WF-383698-US

To: Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Applicant hereby **requests that the name of the applicant be corrected or updated under 37 CFR 1.46(c)(1), or that the applicant be changed under 37 CFR 1.46(c)(2),** in the above-identified application. **Requests under 37 CFR 1.46(c)(1) or (c)(2) cannot be submitted after payment of the issue fee or if the application has been patented.**

Please check the applicable box(es) below.

☐ 1. This request is to **correct or update the name of the applicant** (**under 37 CFR 1.46(c)(1)**) and includes:

☐ An application data sheet (ADS) in accordance with 37 CFR 1.76(c) with the corrected or updated information shown with markings (*e.g.*, underlining for insertions, strikethrough for deletions). A Corrected Web-based ADS may be used.

Note: Requests under 37 CFR 1.46(c)(1) may be filed to correct typographical errors in the name of the § 1.46 applicant, or for updating the name of the § 1.46 applicant (*i.e.*, where there is no change in the applicant itself but just in the applicant's name). See the Manual of Patent Examining Procedure (MPEP) section 605.01.

■ 2. This request is to **change the applicant** (**under 37 CFR 1.46(c)(2)**) and includes:

■ An application data sheet (ADS) in accordance with 37 CFR 1.76(c) that identifies the changes with proper markings (underlining for insertions and strikethrough for deletions). A Corrected Web-based ADS may be used.

■ A Statement Under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent). See MPEP 325.

I am the

☐ applicant* ■ attorney or agent of record Registration number 61878 ☐ attorney or agent acting under 37 CFR 1.34 Registration number _____

Signature /Weiguo Chen/

Typed or printed name Weiguo Chen

Date October 3, 2024

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. *Juristic entities must be represented by a patent practitioner (See 37 CFR 1.31, applicable to any paper filed on or after September 16, 2012 that is presented on behalf of a juristic entity, regardless of application filing date). Submit multiple forms if more than one signature is required, see below**.

☐ ** Total of _____ forms are submitted.

A Federal agency may not conduct or sponsor, and a person is not required to respond to, nor shall a person be subject to a penalty for failure to comply with an information collection subject to the requirements of the Paperwork Reduction Act of 1995, unless the information collection has a currently valid OMB Control Number. The OMB Control Number for this information collection is 0651-0031. Public burden for this form is estimated to average 12 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the information collection. Send comments regarding this burden estimate or any other aspect of this information collection, including suggestions for reducing this burden to the Chief Administrative Officer, United States Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450 or email InformationCollection@uspto.gov. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **If filing this completed form by mail, send to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. The United States Patent and Trademark Office (USPTO) collects the information in this record under authority of 35 U.S.C. 2. The USPTO's system of records is used to manage all applicant and owner information including name, citizenship, residence, post office address, and other information with respect to inventors and their legal representatives pertaining to the applicant's/owner's activities in connection with the invention for which a patent is sought or has been granted. The applicable Privacy Act System of Records Notice for the information collected in this form is COMMERCE/PAT-TM-7 Patent Application Files, available in the Federal Register at 78 FR 19243 (March 29, 2013). https://www.govinfo.gov/content/pkg/FR-2013-03-29/pdf/2013-07341.pdf

Routine uses of the information in this record may include disclosure to: 1) law enforcement, in the event that the system of records indicates a violation or potential violation of law; 2) a Federal, state, local, or international agency, in response to its request; 3) a contractor of the USPTO having need for the information in order to perform a contract; 4) the Department of Justice for determination of whether the Freedom of Information Act (FOIA) requires disclosure of the record; 5) a Member of Congress submitting a request involving an individual to whom the record pertains, when the individual has requested the Member's assistance with respect to the subject matter of the record; 6) a court, magistrate, or administrative tribunal, in the course of presenting evidence, including disclosures to opposing counsel in the course of settlement negotiations; 7) the Administrator, General Services Administration (GSA), or their designee, during an inspection of records conducted by GSA under authority of 44 U.S.C. 2904 and 2906, in accordance with the GSA regulations and any other relevant (i.e., GSA or Commerce) directive, where such disclosure shall not be used to make determinations about individuals; 8) another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)); 9) the Office of Personnel Management (OPM) for personnel research purposes; and 9) the Office of Management and Budget (OMB) for legislative coordination and clearance.

If you do not furnish the information requested on this form, the USPTO may not be able to process and/or examine your submission, which may result in termination of proceedings, abandonment of the application, and/or expiration of the patent.

Additional Uses

Additional USPTO uses of the information in this record may include disclosure to: 1) the International Bureau of the World Intellectual Property Organization, if the record is related to an international application filed under the Patent Cooperation Treaty; 2) the public i) after publication of the application pursuant to 35 U.S.C. 122(b), ii) after issuance of a patent pursuant to 35 U.S.C. 151, iii) if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections, or an issued patent, or iv) without publication of the application or patent under the specific circumstances provided for by 37 CFR 1.14(a)(1)(v)-(vii); and/or 3) the National Archives and Records Administration, for inspection of records.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82A (07-13)
Approved for use through 03/31/2021. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	18/606,980
Filing Date	March 15, 2024
First Named Inventor	Zhao CHEN
Title	ELECTROCHROMIC FILMS WITH EDGE PROTECTION
Art Unit	Not yet assigned
Examiner Name	Not yet assigned
Attorney Docket Number	50WF-383698-US

SIGNATURE of Applicant or Patent Practitioner

Signature	/Weiguo Chen/	Date (Optional)	October 3, 2024
Name	Weiguo Chen	Registration Number	61878
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82B (07-13)
Approved for use through 09/30/2025. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 139780

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☑ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

LannRay Optoelectronics (Zhenjiang) Co. Ltd.

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature		Date (Optional)	
Name	Jian Wang		
Title	COO of LannRay Optoelectronics (Zhenjiang) Co. Ltd.		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ Total of forms are submitted.

A Federal agency may not conduct or sponsor, and a person is not required to respond to, nor shall a person be subject to a penalty for failure to comply with an information collection subject to the requirements of the Paperwork Reduction Act of 1995, unless the information collection has a currently valid OMB Control Number. The OMB Control Number for this information collection is 0651-0035. Public burden for this form is estimated to average 3 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the information collection. Send comments regarding this burden estimate or any other aspect of this information collection, including suggestions for reducing this burden to the Chief Administrative Officer, United States Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450 or email InformationCollection@uspto.gov. **DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. If** filing this completed form by mail, send to: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/606,980	**10/03/2024 11:54:50 AM Z ET**	**50WF-383698-US**

Title of Invention

ELECTROCHROMIC FILMS WITH EDGE PROTECTION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9999	FILED BY	Chizu Sato
PATENT CENTER #	67422794	FILING DATE	03/15/2024
CUSTOMER #	139780	FIRST NAMED INVENTOR	Zhao CHEN
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Weiguo Chen

Documents

TOTAL DOCUMENTS: 4

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
50WF-383698-US_Request-Update-Applicant-Name-FINAL.pdf	2	Request under 37CFR1.46(c) to correct, update, change applicant	296 KB
50WF-383698-US_Statement373.pdf	3	Assignee showing of ownership per 37 CFR 3.73	306 KB
50WF-383698-US_POA.pdf	2	Power of Attorney	670 KB
50WF-383698-US_CorrectedADS_FINAL.pdf	9	Application Data Sheet	1105 KB

Warning: This is not a USPTO supplied ADS fillable form. Data in the form cannot be automatically loaded to other USPTO systems.

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
50WF-383698-US_Request-Update-Applicant-Name-FINAL.pdf	B9FE0205ED37648A407FDFA1D10FD35A4B2F3324219FD493A3CDF1BEB8DBDF25526FE5DC256E3EAC4B1E990E4A29148740E50F4122E3571E60BFCD113FD58DAA
50WF-383698-US_Statement373.pdf	0430A1A1DBB7231EA5298C0EBB1C5D8A9D1EFEF9698433E9CD6D82251D3E351901DF4F0A9D52D69245679A058239092ABBEB855F99AB458C4B3C70CB4DF9A697
50WF-383698-US_POA.pdf	BD960F5623926BE0481D2FBCD49B7CEDEE5FDF6A5963394ECAB9788C56DCD2E64B305BE6FBD17EEAA213CCC130B09B3BE8B6292B5C260747B1E03A08104BF46D
50WF-383698-US_CorrectedADS_FINAL.pdf	56BEC5A89B0E8F419F2E24BDB51024156CCE4A7F6D4F92DB1FB4148A55A622D9A2F1FF8F6A31FB9B6785F06BC758C7D8A4C2B490A15624B9B956847EAE4B9969

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
18/606,980	03/15/2024	Zhao CHEN	50WF-383698-US

CONFIRMATION NO. 9999

139780
Sheppard Mullin Richter & Hampton LLP
Weiguo Chen
650 Town Center Drive, 10th Floor
Costa Mesa, CA 92626

POA ACCEPTANCE LETTER

OC000000079040138

Date Mailed: 10/08/2024

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 10/03/2024.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/qnguyen/

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UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
18/606,980	03/15/2024	2872	664	50WF-383698-US	20	2

CONFIRMATION NO. 9999

REPLACEMENT FILING RECEIPT

139780
Sheppard Mullin Richter & Hampton LLP
Weiguo Chen
650 Town Center Drive, 10th Floor
Costa Mesa, CA 92626

OC000000079040143

Date Mailed: 10/08/2024

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Zhao CHEN, Camarillo, CA;
Jian WANG, Fremont, CA;
Yan ZHOU, Fremont, CA;

Applicant(s)

LannRay Optoelectronics (Zhenjiang) Co. Ltd., Yangzhong City, CHINA;

Power of Attorney: The patent practitioners associated with Customer Number 139780

Domestic Priority data as claimed by applicant

This application is a CON of 18/152,033 01/09/2023 PAT 11,969,970
which is a CON of 16/190,723 11/14/2018 PAT 11,571,878

Foreign Applications for which priority is claimed (You may be eligible to benefit from the Patent Prosecution Highway program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

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Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 03/26/2024

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 18/606,980**

Projected Publication Date: 07/04/2024

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

ELECTROCHROMIC FILMS WITH EDGE PROTECTION

Preliminary Class

359

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific

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countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

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This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

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Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/606,980	CHEN et al.
	Examiner	Art Unit
	JACK DINH	2872

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	12/17/2024								
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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/606,980	CHEN et al.
	Examiner	Art Unit
	JACK DINH	2872

CPC - Searched*		
Symbol	Date	Examiner

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Restrict claims.	12/17/2024	JD

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/JACK DINH/ Primary Examiner, Art Unit 2872	

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Ambilight v. Lannray PGR2026-00053

Bibliographic Data

Application No: 18/606,980

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /JACK DINH/ (Examiner's Signature) ____ (Initials)

Title: ELECTROCHROMIC FILMS WITH EDGE PROTECTION

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
03/15/2024	359	2872	50WF-383698-US
RULE			

APPLICANTS

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INVENTORS

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CONTINUING DATA

This application is a CON of 18152033 01/09/2023 PAT 11969970

18152033 is a CON of 16190723 11/14/2018 PAT 11571878

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

03/26/2024

** **SMALL ENTITY** **

STATE OR COUNTRY

UNITED STATES

ADDRESS

Sheppard Mullin Richter & Hampton LLP
Weiguo Chen
650 Town Center Drive, 10th Floor
Costa Mesa, CA 92626
UNITED STATES

FILING FEE RECEIVED

$664

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/606,980	03/15/2024	Zhao CHEN	50WF-383698-US	9999

139780 7590 12/20/2024

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EXAMINER
DINH, JACK

ART UNIT	PAPER NUMBER
2872	

NOTIFICATION DATE	DELIVERY MODE
12/20/2024	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

SheppardMullin_Pair@firsttofile.com
svpatents@sheppardmullin.com
wchen@sheppardmullin.com

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Office Action Summary	**Application No.** 18/606,980	**Applicant(s)** CHEN et al.	
	Examiner JACK DINH	**Art Unit** 2872	**AIA (FITF) Status** Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 2 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 10/3/24.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-20 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☐ Claim(s) _____ is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☑ Claim(s) 1-20 are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

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DETAILED ACTION

Election/Restriction

This application contains claims directed to the following patentably distinct species:

Group I, claims 1-12, is directed to an electrochromic device wherein a first edge of the first electrode layer is cut such that a portion of an inner surface of the second electrode layer is exposed, and a second edge of the second electrochromic file is cut such that a portion of an inner surface of the first electrode layer is exposed, the first edge and the second edge are opposing edges, a first edge protection material sealing the exposed portion of the inner surface of the second electrode layer, and a second edge protection material sealing the exposed portion of the inner surface of the first electrode layer.

Group II, claims 13-20, is directed to an electrochromic device wherein a first edge and a second edge of the second electrode layer are cut such a first portion and a second portion of an inner surface of the first electrode layer respectively at the first edge and the second edge are exposed; and a first edge protection material sealing the first portion of the inner surface of the first electrode layer; and a second edge protection material sealing the second portion of the inner surface of the first electrode layer.

The species are independent or distinct because they recite mutually exclusive characteristics. In addition, these species are not obvious variants of each other based on the current record.

Applicant is required under 35 U.S.C. 121 to elect a single disclosed species, or a single grouping of patentably indistinct species, for prosecution on the merits to which the claims shall be restricted if no generic claim is finally held to be allowable. Currently, no claim is generic.

There is a serious search and/or examination burden for the patentably distinct species as set forth above because at least the following reason(s) apply: the rejection used to reject one group of

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claims may not be used to reject another group of claims. Therefore, there is a serious search and/or examination burden.

Applicant is advised that the reply to this requirement to be complete must include (i) an election of a species to be examined even though the requirement may be traversed (37 CFR 1.143) **and (ii) identification of the claims encompassing the elected species or grouping of patentably indistinct species**, including any claims subsequently added. An argument that a claim is allowable or that all claims are generic is considered nonresponsive unless accompanied by an election.

The election may be made with or without traverse. To preserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point out supposed errors in the election of species requirement, the election shall be treated as an election without traverse. Traversal must be presented at the time of election in order to be considered timely. Failure to timely traverse the requirement will result in the loss of right to petition under 37 CFR 1.144. If claims are added after the election, applicant must indicate which of these claims are readable on the elected species or grouping of patentably indistinct species.

Should applicant traverse on the ground that the species, or groupings of patentably indistinct species from which election is required, are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing them to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the species unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103 or pre-AIA 35 U.S.C. 103(a) of the other species.

Upon the allowance of a generic claim, applicant will be entitled to consideration of claims to additional species which depend from or otherwise require all the limitations of an allowable generic claim as provided by 37 CFR 1.141.

No telephone call was made to request an oral election to the above restriction requirement.

Applicant is reminded that upon the cancelation of claims to a non-elected invention, the inventorship must be corrected in compliance with 37 CFR 1.48(a) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. A request to correct inventorship under 37 CFR 1.48(a) must be accompanied by an application data sheet in accordance with 37 CFR 1.76 that identifies each inventor by his or her legal name and by the processing fee required under 37 CFR 1.17(i).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JACK DINH whose telephone number is (571)272-2327. The examiner can normally be reached Monday - Friday 9am-5pm.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wyatt Stoffa can be reached on 571-270-1782. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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/JACK DINH/
Primary Examiner, Art Unit 2872
12/17/24

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/606,980	**01/03/2025 04:26:06 PM Z ET**	**50WF-383698-US**

Title of Invention

ELECTROCHROMIC FILMS WITH EDGE PROTECTION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9999	FILED BY	Chizu Sato
PATENT CENTER #	68600627	FILING DATE	03/15/2024
CUSTOMER #	139780	FIRST NAMED INVENTOR	Zhao CHEN
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	PJ Shang

Documents

TOTAL DOCUMENTS: 1

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
50WF-383698-US_ResponseRR.pdf	2	Response to Election / Restriction Filed	29 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
50WF-383698-US_ResponseRR.pdf	BF72B0340201DA778E3F0BE9B90A779C332B192E1FBDDE7D1239725098960663F2FAF5930462E2AF69E195D74728408998 31A2548055D199D546FCA6AF92E8E

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

INVENTORS :	Zhao CHEN *et al.*	CONFIRMATION NO. :	9999
SERIAL NUMBER:	18/606,980	EXAMINER :	JACK DINH
FILING DATE :	March 15, 2024	ART UNIT :	2872
FOR :	ELECTROCHROMIC FILMS WITH EDGE PROTECTION		

RESPONSE TO RESTRICTION REQUIREMENT

MAIL STOP RESTRICTION
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the Restriction Requirement mailed **December 20, 2024**, the Examiner requires a restriction under 35 U.S.C. § 121 among the following groups:

Group I: Claims 1-12; and

Group II: Claim 13-20.

In response, Applicant elects to prosecute Group I, claims 1-12, without traverse.

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CONCLUSION

In view of the foregoing remarks, Applicant respectfully requests reconsideration of this application and the timely allowance of the pending claims.

If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided. Applicant believes no fee is due. However, please charge any fees due in connection with this filing to Deposit Account No. 50-4561. If an extension of time is required for this filing, such an extension is hereby requested.

Respectfully submitted,

SHEPPARD MULLIN RICHTER & HAMPTON LLP

Dated: January 3, 2025

By: /Pengju Shang/
Pengju Shang
Reg. No. 80,050
(650)352-1971

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Espacenet

Bibliographic data: CN108463912 (A) — 2018-08-28

POLYMER ELECTROLYTE AND ELECTROCHROMIC DEVICES INCLUDING POLYMER ELECTROLYTE

Inventor(s): WANG CHAO; ZHOU YAN ± (王朝, ; 周焱)

Applicant(s): FURCIFER INC ± (菲尔齐费尔公司)

Classification: - international: *G02F1/15; H01M10/052; H01M10/0565; H01M4/66*
- cooperative: C08K3/10 (EP, US); C08K5/06 (US); C08K5/43 (US); C08L27/08 (EP); G02F1/13439 (US); G02F1/15 (EP, US); G02F1/155 (US); C08K2201/001 (US); C08L2201/10 (EP); G02F2001/164 (EP, US); Y02E60/10 (EP) more

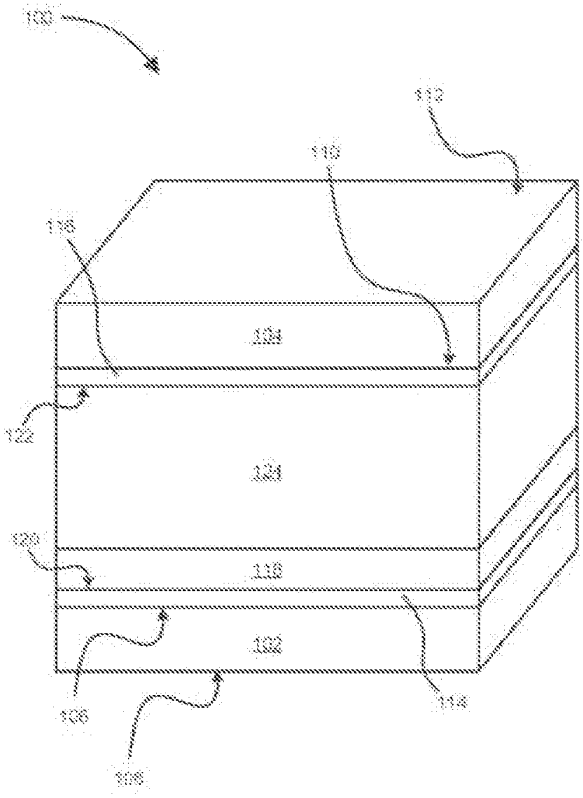
Application number: CN20178005574 20171010 Global Dossier

Priority number(s): US201662406778P 20161011 ; WO2017US55896 20171010

Also published as: CN108463912 (B) EP3526847 (A1) EP3526847 (A4) US10703881 (B2) US2018100056 (A1) WO2018071393 (A1) less

Abstract of CN108463912 (A)

The disclosure relates generally to a solid polymer electrolyte for use in electrochromic devices. The solid polymer electrolyte may include a framework of one or more polar crystalline polymers, oneor more polar amorphous polymers, and one or more electrolyte salts. The solid polymer electrolyte can be formed using a physical microphase separation approach.


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Notice

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DESCRIPTION CN108463912A

(10)Polymer electrolyte and electrochromic device including the same

[0001]

(14)CROSS-REFERENCE TO RELATED APPLICATIONS

[0002]

(18)This application is based on and claims priority to U.S. Provisional Application No. 62/406,778, filed on October 11, 2016, entitled "Polymer Electrolyte and Electrochromic Device Including Polymer Electrolyte".

(21)The entire contents of the above-mentioned application are incorporated herein by reference.

[0003]

(25)Technical Field

[0004]

(29)The present disclosure relates generally to solid polymer electrolytes, for example for use in electrochromic devices.

[0005]

(34)Background Art

[0006]

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Electrochromism generally refers to the reversible change in the optical properties of a material when an electric potential is applied.

Specifically, electrochromic materials exhibit a reversible color change due to an electrochemical reduction-oxidation (redox) reaction induced by the application of an electric field.

Electrochromic materials can include organic and inorganic materials.

[0007]

Electrochromic materials are often used in electrochromic devices.

A typical electrochromic device includes a four-layer assembly: (i) a first transparent conductive film, (ii) an electrochromic material (organic or inorganic) deposited on the first conductive film, (iii) a second transparent conductive film spaced apart from the first conductive film, and (iv) an ionically conductive medium (electrolyte) disposed between the electrochromic material and the second conductive film.

It has been found that the inclusion of only one electrochromic film can result in a shortened lifespan of the electrochromic device.

Therefore, a second electrochromic material film may be deposited between the ion-conductive medium and the second conductive film to facilitate the completion of the redox process in the device and reduce or eliminate degradation reactions in the electrolyte. This five-layer assembly can be used to obtain two mixed coloration states, or two materials with complementary optical properties can be used to enhance the contrast between previously determined states.

[0008]

Currently, forming the electrolyte layer with suitable materials remains a huge challenge.

The development of electrochromic devices has been greatly limited by the development of highly stable and transparent electrolytes. Previous electrochromic devices may use liquid/gel electrolytes or inorganic solid ion conductors. Liquid/gel electrolytes, most of which are based on organic solvents (e.g., carbonates, acetonitrile, etc.), have liquid electrolyte leakage, organic solvent evaporation and consumption, and potential safety issues. Inorganic solid electrolytes (eg, LiPON, etc.) require high vacuum pressure for evaporation/sputtering and therefore often have high costs. In addition, inorganic solid electrolytes have poor mechanical flexibility.

[0009]

There are several problems associated with known electrochromic devices and/or components thereof.

U.S. Patent No. 6,667,825 (the '825 patent) discloses an electrochromic device that uses two conjugated polymer-coated ITO-coated glass electrodes and an ionic liquid such as [BMIM][BF₄] as an electrolyte. The [BMIM][BF₄] liquid electrolyte of the '825 patent does not contain Lewis acids, thereby improving the stability and lifetime of the electrochromic device. Furthermore, the electrochromic device of the '825 patent can at least partially avoid problems caused by residual images after quenching and electrolyte decomposition, which typically occur in devices using organic solvent-based liquid electrolytes and ionic liquid electrolytes containing Lewis acids. However, the electrochromic device of the '825 patent still suffers from problems associated with leakage of the liquid electrolyte and the inability to form

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thin film and membrane shaped products.

[0010]

To compensate for these shortcomings of liquid electrolytes, solid polymer electrolytes have recently emerged. S.A.Agnihotry disclosed a polymer electrolyte having a high ionic conductivity of 10⁻³S/cm at room temperature, which is formed by adding a small amount of PMMA (polymethyl methacrylate) polymer and fumed silica to an electrolyte formed from propylene carbonate containing 1M LiClO₄ (see Electrochimica Acta, 2004, 49: 2343 – 2349). However, since the above-mentioned polymer electrolytes still use organic solvents as electrolytes, the devices still have several disadvantages, such as low quenching rate, residual images after quenching, decomposition and exhaustion of organic solvent-based electrolytes, etc. Furthermore, due to the swollen state of the above polymers, the interface and phase of the above polymers are relatively unstable. Over time, the interfaces of the above polymers may be susceptible to change, leading to failure of the electrochromic device.

[0011]

Therefore, there is a need in the art for an improved solid polymer electrolyte suitable for use in electrochromic devices.

[0012]

Summary of the invention

[0013]

One aspect of the present disclosure relates to a solid polymer electrolyte.

In some embodiments, the solid polymer electrolyte may include a backbone of one or more polar crystalline polymers, one or more polar amorphous polymers, and one or more electrolyte salts.

[0014]

Another aspect of the present disclosure relates to an electrochromic device.

In some embodiments, an electrochromic device includes a first electrode, a second electrode, an electrochromic material deposited on at least the first electrode, and a solid polymer electrolyte disposed between the electrochromic material and the second electrode.

The solid polymer electrolyte may comprise a backbone of one or more polar crystalline polymers, one or more polar amorphous polymers, and one or more electrolyte salts.

[0015]

Another aspect of the present disclosure relates to a method of making a solid polymer electrolyte.

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130 In some embodiments, the method includes forming a solid polymer electrolyte by microphase separation of a plurality of materials.

130 The plurality of materials may include one or more than one polar crystalline polymer, one or more than one polar amorphous polymer, and one or more than one electrolyte salt. One or more polar crystalline polymers, one or more polar amorphous polymers, and one or more electrolyte salts are mixed together into a transparent film by using a solution process or extrusion.

[0016]

139 Other objects, features and advantages of the described embodiments will become apparent to those skilled in the art from the following detailed description.

141 It should be understood, however, that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only and not by way of limitation. Many changes and modifications may be made within the scope of the present invention without departing from the spirit thereof, and the invention includes all such modifications.

[0017]

148 BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

152 Preferred and non-limiting embodiments of the present invention may be more readily understood by reference to the accompanying drawings, in which:

[0019]

157 1 is a cross-sectional view of a simplified schematic diagram of an electrochromic device including a solid polymer electrolyte therein according to an exemplary embodiment.

[0020]

162 2 is a graph showing resistance characteristics of an exemplary battery having a solid polymer electrolyte consistent with exemplary embodiments of the present disclosure.

[0021]

167 3 is a graph showing resistance characteristics of an exemplary electrochemical device having a solid polymer electrolyte consistent with exemplary embodiments of the present disclosure.

[0022]

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172 4 is a graphical representation showing cyclic voltammogram measurement results of an exemplary electrochemical device having a solid polymer electrolyte consistent with exemplary embodiments of the present disclosure.

[0023]

178 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0024]

182 Specific non-limiting embodiments of the present invention will now be described with reference to the accompanying drawings.

184 It should be understood that specific features and aspects of any embodiment disclosed herein may be used and/or combined with specific features and aspects of any other embodiment disclosed herein.

186 It should also be understood that such embodiments are exemplary and are merely illustrative of a few embodiments within the scope of the present invention.

188 Various changes and modifications apparent to one skilled in the art to which the present invention pertains are deemed to be within the spirit, scope and contemplation of the present invention as further defined in the appended claims.

[0025]

191 Unless the context requires otherwise, throughout this specification and claims, the word "comprising" is to be construed in an open, inclusive sense, ie, "including, but not limited to."

195 Numerical ranges also include the numbers defining the range.

197 In addition, an element without a quantifier includes a plurality of elements unless the context clearly dictates otherwise.

[0026]

202 Reference throughout this specification to "one embodiment" or "an embodiment" means that a particular feature, structure or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention.

205 Thus, appearances of the phrases "in one embodiment" or "in an embodiment" in various places throughout this specification are not necessarily all referring to the same embodiment, but may in some instances.

207 Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more than one embodiment.

[0027]

212 "Optional" or "optionally" means that the subsequently described event or circumstance can or cannot occur, and that the description includes instances where said event or circumstance occurs and instances where it

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does not.

216 For example, "optional second layer" means that the second layer may or may not be included.

[0028]

221 Embodiments disclosed herein are directed to solving problems associated with existing electrochromic devices using conventional liquid or polymer electrolytes.

223 For example, embodiments disclosed herein relate to novel transparent solid polymer electrolytes for electrochromic devices, wherein the solid polymer electrolyte comprises two or more chemically compatible polymer components.

226 One or more than one component is crystalline, and one or more than one component is amorphous.

227 At least one component is ionically conductive.

[0029]

231 In some embodiments, physical microphase separation methods may be used to form the solid polymer electrolytes of the present disclosure.

233 Microphase separation is an effective method to obtain polymer electrolytes with both excellent ionic conductivity and high stability.

235 For example, previous phase-separated designs of polymer electrolytes are mainly based on chemically linking crystalline polymer blocks to amorphous polymer blocks, resulting in semitransparent electrolytes. The present disclosure relates to microphase separation of multiple materials including one or more than one polar crystalline polymers, one or more than one polar amorphous polymers, and one or more than one electrolyte salts. The disclosed solid polymer electrolyte formed by microphase separation is stable and transparent, which can be obtained by designing the polymer structure and adjusting the ratio and processing conditions as described in the disclosed embodiments. In some embodiments, the solid polymer electrolytes of the present disclosure allow for stable operation of electrochromic devices. Embodiments of the disclosed electrochromic devices avoid problems associated with prior art electrochromic devices, such as electrolyte leakage, low ionic conductivity, inability to form thin films or film-shaped products, low adhesion, and the like.

[0030]

249 The following description discloses several preferred embodiments of solid polymer electrolytes and methods and apparatus for making and using the solid polymer electrolytes.

[0031]

254 Solid polymer electrolyte

[0032]

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The present disclosure generally relates to solid polymer electrolytes that are transparent and have sufficient ionic conductivity to facilitate ion transport in electrochromic devices.

[0033]

In one embodiment, the solid polymer electrolyte comprises a backbone of one or more polar crystalline polymers, one or more polar amorphous polymers, and one or more electrolyte salts.

In some embodiments, one or more of the one or more polar crystalline polymers or one or more polar amorphous polymers are ionically conductive.

In some embodiments, the solid polymer electrolyte is formed by microphase separation of the components.

[0034]

The one or more polar crystalline polymers disclosed herein may contain one or more of C, N, F, O, H, P, and the like.

In some embodiments, the one or more polar crystalline polymers have an average molecular weight of about 10,000 Daltons or greater.

Suitable polar crystalline polymers may include, but are not limited to, nylon, polyethylene terephthalate, polymethyl methacrylate (PMMA), polyacrylamide, polyimide, polyvinyl chloride (PVC), polybutylene terephthalate (PBT), polyetheretherketone (PEEK), polytetrafluoroethylene (PTFE), polyvinylidene fluoride (PVDF), poly(vinylidene fluoride-co-hexafluoropropylene) (PVDF-HFP), high molecular weight polyethylene oxide, polyphenylene sulfide, polyetherimide, polyethersulfone, combinations thereof, and the like.

In embodiments where multiple polar crystalline polymers are present, the polar crystalline polymers may be cross-linked to form a network having enhanced mechanical properties. In some embodiments, the total amount of the polar crystalline polymer may be from about 0wt % to about 60wt % based on the total weight of the solid polymer electrolyte.

[0035]

The one or more polar amorphous polymers disclosed herein may contain one or more of C, N, O, F, H, P, Si, and the like.

In some embodiments, the one or more than one polar amorphous polymers have a low degree of crystallinity. The one or more polar amorphous polymers may have a glass transition temperature (Tg) of -20° C or less. Suitable polar amorphous polymers may include, but are not limited to, polyurethanes, polysiloxanes, polyethylene oxides, branched polymers, combinations thereof, and the like. In some embodiments, the one or more polar amorphous polymers may have sufficient amorphousness to achieve sufficient ionic conductivity. In some embodiments, the total amount of the polar amorphous polymer may be from about 20wt % to about 70wt % based on the total weight of the solid polymer electrolyte.

[0036]

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As mentioned above, the solid polymer electrolyte of the present disclosure may include one or more than one electrolyte salt.

In some embodiments, the one or more electrolyte salts may include one or more organic salts. In some embodiments, the one or more electrolyte salts may include one or more inorganic salts (eg, metal salts). Suitable electrolyte salts may include, but are not limited to, LiTFSI, LiPF₆, LiBF₄, LiClO₄, LiCF₃SO₃, LiN(CF₃SO₂)₂, LiSbFg, LiAsF₆, LiN(CF₃CF₂SO₂)₂, (C₂H₅)₄NBF₄, (C₂H₅)₃CH₃NBF₄, LiI, combinations thereof, and the like. In some embodiments, the total amount of the electrolyte salt may be from about 10wt % to about 50wt % based on the total weight of the solid polymer electrolyte.

[0037]

In some embodiments, the one or more polar amorphous polymers and the one or more electrolyte salts of the present disclosure are substantially miscible with the backbone of the one or more polar crystalline polymers.

Preferably, the components of the solid polymer electrolyte of the present disclosure are compatible with each other and can be blended (eg, by solution processing or extrusion) into a transparent film without any observable particles.

[0038]

Solid polymer electrolytes are distinguishable from conventional liquid electrolytes and gel polymer electrolytes containing ionic liquids therein.

In other words, the solid polymer electrolyte of the present disclosure may be an all-solid polymer electrolyte and does not include any liquid or gel component therein. The solid polymer electrolytes of the present disclosure may also be transparent in some aspects. For example, the solid polymer electrolyte of the present disclosure may have a transparency of 80% or more. Furthermore, the solid polymer electrolyte may have an ionic conductivity of about 10⁻⁶S/cm to about 10⁻⁴S/cm.

[0039]

Methods of preparing the solid polymer electrolytes of the present disclosure may include synthesis, polymerization, solvation, and/or other processes known in the art.

In at least one embodiment, the disclosed methods can result in microphase separation of the various materials used to prepare the disclosed solid polymer electrolytes. In some embodiments, the solid polymer electrolyte of the present disclosure may be obtained by polymerizing monomers of polar polymers (eg, polar crystalline polymers and polar amorphous polymers). In a specific non-limiting embodiment, a method for preparing a solid polymer electrolyte of the present disclosure may comprise: (a) dissolving a backbone of one or more polar crystalline polymers, one or more polar amorphous polymers, and one or more electrolyte

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salts in a suitable solvent; and (b) removing (e.g., by evaporation) the solvent to obtain a solid polymer electrolyte. Exemplary solvents may include, but are not limited to, acetone, methanol, tetrahydrofuran, and the like. In some embodiments, one or more experimental parameters may be optimized to facilitate dissolution of the polar crystalline polymer backbone, the polar amorphous polymer, and the electrolyte salt in the solvent. These experimental parameters may include components remaining in the solvent, agitation/stirring of the solvent, etc.

[0040]

357 Electrochromic device

[0041]

361 An exemplary non-limiting schematic diagram of an electrochromic device 100 including a solid polymer electrolyte is shown in FIG. 1, according to one embodiment.

363 The electrochromic device 100 of FIG. 1 may be used in combination with other devices/features/components described herein, such as those described with reference to other embodiments/aspects.

366 Electrochromic device 100 may be used in a variety of applications and/or arrangements that may or may not be mentioned in the illustrative embodiments/aspects described herein. For example, in some embodiments, electrochromic device 100 may include more or fewer features/components than shown in FIG. 1. Furthermore, unless otherwise noted, one or more components of electrochromic device 100 may be of conventional materials, designs, and/or manufactured using known techniques (e.g., lamination, sputtering, chemical vapor deposition (CVD), spraying, spin coating, printing, etc.), as would be appreciated by one of ordinary skill in the art upon reading this disclosure.

[0042]

376 As shown in FIG. 1, the electrochromic device 100 includes a first transparent substrate 102 and a second transparent substrate 104 that are spaced apart and parallel to each other.

378 The first substrate 102 includes an inner surface 106 and an outer surface 108. Similarly, the second substrate 104 includes an inner surface 110 and an outer surface 112, wherein the inner surface 110 of the second substrate 104 faces the inner surface 106 of the first substrate 102. The first substrate 102 and the second substrate 104 may have the same or different sizes, include the same or different materials, etc. Suitable materials for the first substrate 102 and/or the second substrate 104 may include, but are not limited to, glass, polymer materials, plastic materials, and/or other materials that are transparent in at least a portion of the visible region of the electromagnetic spectrum. In some embodiments, the first substrate 102 and the second substrate 104 can include glass.

[0043]

389 Still as shown in FIG. 1, the first transparent conductive film 114 is deposited on the inner surface 106 of the

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first substrate 102 to act as an electrode.

[0043] A second transparent conductive film 116 is also deposited on the inner surface 110 of the second substrate 104 to act as an electrode. The first conductive film 114 and the second conductive film 116 may have the same or different sizes, include the same or different materials, and the like. The first conductive film 114 and the second conductive film 116 may each independently have a single-layer or multi-layer structure. Suitable materials for the first conductive film 114 and the second conductive film 116 may include, but are not limited to, tin-doped indium oxide (ITO), fluorine-doped indium oxide, antimony-doped indium oxide, zinc-doped indium oxide, aluminum-doped zinc oxide, silver nanowires, carbon nanotube films, patterned metals on glass or plastic substrates, combinations thereof, and/or other such transparent materials that exhibit sufficient electrical conductivity. In a preferred aspect, the first conductive film 114 and the second conductive film 116 may include ITO.

[0044]

[0045] The electrochromic device 100 may further include a power source (not shown) configured to provide a voltage between the first conductive film 114 and the second conductive film 116.

[0045]

[0045] As also shown in FIG. 1, a first layer 118 of electrochromic material is deposited on the inner surface 120 of the first conductive film 114.

[0045] The electrochromic material is configured to produce a reversible color change upon reduction (gain of electrons) or oxidation (loss of electrons) caused by exposure to an electric current.

[0045] In some embodiments, the electrochromic material of first layer 118 can be configured to change from a transparent state to a colored state, or from one colored state to another, upon oxidation or reduction. In some embodiments, the electrochromic material of the first layer 118 may be a multi-electrochromic material in which more than two redox states may exist, and thus may exhibit multiple colors. The electrochromic material of the first layer 118 may also be a reduction-colored material (ie, a material that becomes colored when it gains electrons) or an oxidation-colored material (ie, a material that becomes colored when it loses electrons).

[0046]

[0046] Suitable electrochromic materials for the first layer 118 may include, but are not limited to, inorganic materials, conjugated polymers, small organic molecules, metal salts, combinations thereof, and the like.

[0046] In some embodiments, the electrochromic material of the first layer 118 may include metal oxides such as MoO₃, V₂O₅, Nb₂O₅, WO₃, TiO₂, Ir(OH)_x, SrTiO₃, ZrO₂, La₂O₃, CaTiO₃, sodium titanate, potassium niobate, combinations thereof, and the like. In some embodiments, the electrochromic material of first layer 118 may include a metal salt (eg, FeCl₃, etc.). In some embodiments, the electrochromic material may include a conductive polymer such as poly-3,4-ethylenedioxythiophene (PEDOT), poly-2,2-bithiophene,

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polypyrrole, polyaniline (PANI), polythiophene, polyisothiophene, poly-o-aminophenol, polypyridine, polyindole, polycarbazole, polyquinone, octacyanophthalocyanine, combinations thereof, and the like. Additionally, the electrochromic material of the first layer 118 may include materials such as viologen, anthraquinone, phenocyazine, combinations thereof, and the like.

[0047]

Although not shown in the embodiment of FIG. 1, an optional second layer of electrochromic material may be deposited on the inner surface 122 of the second conductive film 116.

The optional second layer of electrochromic material may be the same or different size, comprise the same or different material/composition, etc. as the first layer 118 of electrochromic material. Optionally, a charge storage layer may be deposited on the inner surface 122 of the second conductive film 116. The optional charge storage layer may serve as ion storage and may preferably have electrochromic properties that are complementary to the electrochromic material of the first layer 118.

[0048]

As also shown in FIG. 1, a solid polymer electrolyte 124, as disclosed herein, is positioned between the first layer 118 of electrochromic material and the second conductive film 116.

In embodiments where electrochromic device 100 includes a first layer 118 of electrochromic material and an optional second layer of electrochromic material, solid polymer electrolyte 124 may be located between the two layers.

[0049]

In some embodiments, the electrochromic device 100 of the present disclosure includes a solid polymer electrolyte, such as the solid polymer electrolyte 124 described above, and does not include any liquid or gel electrolyte.

[0050]

The use of solid polymer electrolyte 124 in electrochromic device 100 provides several advantages.

For example, the solid polymer electrolytes disclosed herein (i) have sufficient mechanical strength and are shaped in a variety of shapes so as to be easily formed into thin films and thin-film-shaped products; (ii) avoid problems associated with adhesion and printing processing that affect conventional electrolytes; (iii) provide stable contact between electrolyte/electrode interfaces (interfaces with and without electrochromic material coatings thereon); (iv) avoid leakage problems typically associated with liquid electrolytes; (v) have desirable non-toxic and non-flammable properties; (vi) avoid problems associated with evaporation due to their insufficient vapor pressure; (vii) exhibit improved ionic conductivity compared to conventional polymer electrolytes; and the like.

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[0051]

Example

[0052]

An exemplary solid polymer electrolyte according to the present disclosure was prepared as follows.

[0053]

10grams of PVDF-HFP polymer was combined with a certain amount (eg. 2grams, 5grams, or 10grams) of PEO oligomer.

PVDF-HFP is used as the polar crystalline polymer backbone, while PEO oligomers are used as polar amorphous components as well as ion conductors.

The above combined components are further combined with an amount of lithium salt (eg, about 30wt % LiTFSI based on the weight of the PEO oligomer).

The combined components were mixed in acetone solvent and stirred overnight to obtain a solution.

The solution is processed and deposited on the electrochromic layer or substrate by, for example, slot die coating or spin coating. After drying the solvent, the resulting solid electrolyte was found to be a uniform transparent film with an ionic conductivity of about 10⁻⁵S/cm. The obtained solid electrolyte membrane can be used to assemble an electrochromic device. When the proportion of PEO in the solid electrolyte increases, the ionic conductivity increases, but the mechanical strength decreases and the transparency of the membrane changes.

[0054]

A battery can be formed using the solid polymer electrolyte prepared according to the foregoing procedure.

To form a battery, a solid polymer electrolyte can be sandwiched between two polyethylene terephthalate (PET) films coated with electronically conductive indium-doped tin oxide (ITO). The resistance characteristics of an exemplary battery are shown in FIG. 2. The surface resistance of this PET/ITO film is 100 ohms/square. The electrochemical AC impedance was measured by connecting the two PET/ITO films to a frequency analyzer. A typical impedance spectrum of a cell containing a polymer electrolyte (25um) has a total resistance of about 500ohms. The lithium conductivity of the membrane was calculated to be 10⁻⁵S/cm.

[0055]

An electrochemical device may be fabricated using the aforementioned solid polymer electrolyte, and poly((2,2-bis(2-ethylhexyloxymethyl)-propylene-1,3-dioxy)-3,4-thiophene-2,5-diyl) may be used as an electrochromic (EC) layer.

The EC layer can be coated on the ITO/PET substrate by slot die coating method with a dry film thickness of 550nm. ITO/PET coated with MoO_3 can be used as an ion storage layer (or called a counter electrode). Electrochromic devices can be evaluated using a frequency analyzer paired with a potentiostat. As

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shown in FIG 3, the internal resistance of the device was found to be about 200 ohms. As shown in FIG 4, the cyclic voltammogram shows a pair of high reversible redox peaks (0.25 V for reduction and 1.0 V for oxidation) at a scan rate of 10 mV/s. The device can quickly switch its color within a voltage window of -1.2 V to 1.2 V.

[0056]

531 Application/Use

[0057]

538 Embodiments of the disclosed solid polymer electrolytes may be used in a variety of applications, devices, industries, and the like.

540 A particular application of the solid polymer electrolytes disclosed herein relates to use in electrochromic devices.

542 Electrochromic devices are often associated with smart window and display technologies, such as anti-glare automotive mirrors; smart windows configured to regulate the transmission or reflection of solar radiation in automobiles, aircraft, buildings, etc.; protective eyewear; camouflage and/or color-changing materials; and the like.

[0058]

549 The invention described and claimed herein is not to be limited in scope by the specific preferred embodiments herein disclosed, since these embodiments are intended as illustrations of several aspects of the invention.

552 Indeed, various modifications of the invention in addition to those shown and described herein will become apparent to those skilled in the art from the foregoing description. Such modifications are also intended to fall within the scope of the appended claims.

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(19)中华人民共和国国家知识产权局

(12)发明专利申请

(10)申请公布号 CN 108463912 A
(43)申请公布日 2018.08.28

(21)申请号 201780005574.X

(22)申请日 2017.10.10

(30)优先权数据
62/406,778 2016.10.11 US

(85)PCT国际申请进入国家阶段日
2018.07.03

(86)PCT国际申请的申请数据
PCT/US2017/055896 2017.10.10

(87)PCT国际申请的公布数据
WO2018/071393 EN 2018.04.19

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(51)Int.Cl.
H01M 4/66(2006.01)
G02F 1/15(2006.01)
H01M 10/0565(2006.01)
H01M 10/052(2006.01)

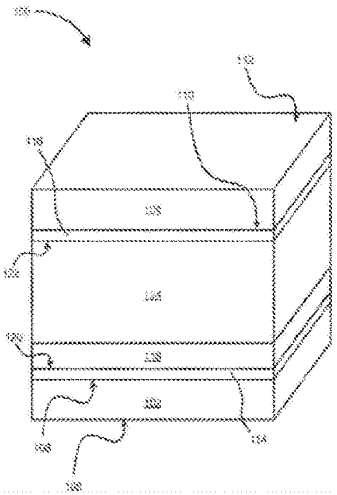
权利要求书2页 说明书7页 附图4页

(54)发明名称

聚合物电解质和包括聚合物电解质的电致变色装置

(57)摘要

本公开内容一般地涉及用于电致变色装置中的固体聚合物电解质。该固体聚合物电解质可以包含一种或多于一种极性结晶聚合物的骨架、一种或多于一种极性非晶聚合物和一种或多于一种电解质盐。该固体聚合物电解质可以使用物理微相分离法形成。



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1.一种固体聚合物电解质,其包含:

一种或多于一种极性结晶聚合物的骨架;

一种或多于一种极性非晶聚合物;和

一种或多于一种电解质盐。

2.根据权利要求1所述的固体聚合物电解质,其中所述一种或多于一种极性结晶聚合物或者一种或多于一种极性非晶聚合物中的一种或多于一种是离子导电的。

3.根据权利要求2所述的固体聚合物电解质,其中所述一种或多于一种极性结晶聚合物具有约10000道尔顿或更大的平均分子量。

4.根据权利要求2所述的固体聚合物电解质,其中所述一种或多于一种极性结晶聚合物包含C、N、F、O、H和P中的一种或多于一种。

5.根据权利要求2所述的固体聚合物电解质,其中所述一种或多于一种极性结晶聚合物选自:尼龙、聚对苯二甲酸乙二醇酯、聚甲基丙烯酸甲酯(PMMA)、聚丙烯酰胺、聚酰亚胺、聚氯乙烯(PVC)、聚对苯二甲酸丁二醇酯(PBT)、聚醚醚酮(PEEK)、聚四氟乙烯(PTFE)、聚偏氟乙烯(PVDF)、聚(偏氟乙烯-co-六氟丙烯)(PVDF-HFP)、高分子量聚环氧乙烷、聚苯硫醚、聚醚酰亚胺、聚醚砜及其组合。

6.根据权利要求2所述的固体聚合物电解质,其中所述一种或多于一种极性非晶聚合物包含C、N、O、F、H、P和Si中的一种或多于一种。

7.根据权利要求2所述的固体聚合物电解质,其中所述一种或多于一种极性非晶聚合物具有-20℃或更低的玻璃化转变温度(Tg)。

8.根据权利要求2所述的固体聚合物电解质,其中所述一种或多于一种极性非晶聚合物选自:聚氨酯、聚硅氧烷、聚环氧乙烷、支化聚合物及其组合。

9.根据权利要求1所述的固体聚合物电解质,其中所述一种或多于一种电解质盐包括一种或多于一种有机盐。

10.根据权利要求1所述的固体聚合物电解质,其中所述一种或多于一种电解质盐包括一种或多于一种金属盐。

11.根据权利要求1所述的固体聚合物电解质,其中所述一种或多于一种极性非晶聚合物和一种或多于一种电解质盐基本上与一种或多于一种极性结晶聚合物的骨架混溶。

12.根据权利要求1所述的固体聚合物电解质,其中所述固体聚合物电解质具有80%或更高的透明度。

13.一种电致变色装置,其包括:

第一电极;

第二电极;

沉积在至少所述第一电极上的电致变色材料;和

设置在所述电致变色材料与第二电极之间的固体聚合物电解质,其中所述固体聚合物电解质包含:

一种或多于一种极性结晶聚合物的骨架;

一种或多于一种极性非晶聚合物;和

一种或多于一种电解质盐。

14.根据权利要求13所述的电致变色装置,其还包括沉积在所述固体聚合物电解质与

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所述第二电极之间的另一种电致变色材料。

15.根据权利要求13所述的电致变色装置，其中所述一种或多于一种极性非晶聚合物和一种或多于一种电解质盐基本上与一种或多于一种极性结晶聚合物的骨架混溶。

16.根据权利要求13所述的电致变色装置，其中所述第一电极或第二电极由薄膜透明导体制成，所述薄膜透明导体选自：ITO、银纳米线、碳纳米管膜、玻璃或塑料基板上的图案化金属及其组合。

17.根据权利要求13所述的电致变色装置，其中所述电致变色材料选自：无机材料、共轭聚合物、小有机分子、金属盐及其组合。

18.根据权利要求13所述的电致变色装置，其还包括沉积在所述固体聚合物电解质与第二电极之间的电荷存储层。

19.一种制备固体聚合物电解质的方法，其包括：

通过多种材料的微相分离形成所述固体聚合物电解质，所述多种材料包含：

一种或多于一种极性结晶聚合物；

一种或多于一种极性非晶聚合物；和

一种或多于一种电解质盐；其中通过使用溶液工艺或挤出使所述一种或多于一种极性结晶聚合物、一种或多于一种极性非晶聚合物和一种或多于一种电解质盐一起混合到透明膜中。

20.根据权利要求19所述的方法，其还包括：

将所述一种或多于一种极性结晶聚合物、一种或多于一种极性非晶聚合物和一种或多于一种电解质盐溶解在至少一种溶剂中；和

通过蒸发所述至少一种溶剂而除去至少一种溶剂。

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聚合物电解质和包括聚合物电解质的电致变色装置

[0001] 相关申请的交叉引用

[0002] 本申请基于2016年10月11日提交的标题为"聚合物电解质和包括聚合物电解质的电致变色装置"的第62/406778号美国临时申请，并要求其优先权。上述申请的全部内容通过引用并入本文。

技术领域

[0003] 本公开内容一般地涉及例如用于电致变色装置的固体聚合物电解质。

背景技术

[0004] 电致变色一般是指施加电势时材料的光学性质的可逆变化。具体而言，电致变色材料由于施加电场所引起的电化学还原-氧化(氧化还原)反应而呈现出可逆的颜色变化。电致变色材料可以包括有机和无机材料。

[0005] 电致变色材料通常用于电致变色装置中。典型的电致变色装置包括四层组合件：(i)第一透明导电膜，(ii)沉积在第一导电膜上的电致变色材料(有机或无机的)，(iii)与第一导电膜间隔开的第二透明导电膜，和(iv)设置在电致变色材料与第二导电膜之间的离子导电介质(电解质)。已经发现，仅包含一种电致变色膜可以导致电致变色装置的寿命缩短。因此，可以将第二电致变色材料膜沉积在上述离子导电介质与第二导电膜之间，以促进在装置中完成上述氧化还原过程并减少或消除电解质中的降解反应。该五层组合件可以用于获得两种混合的着色状态，或者可以使用具有互补光学特性的两种材料以增强先前确定的状态之间的对比度。

[0006] 目前，用合适的材料形成电解质层仍然是巨大的挑战。电致变色装置的发展受到高度稳定和透明的电解质发展的极大限制。先前的电致变色装置可以使用液体/凝胶电解质或无机固体离子导体。液体/凝胶电解质(其中大部分是基于有机溶剂(例如碳酸酯、乙腈等)的电解质)具有液体电解质泄漏、有机溶剂蒸发和消耗以及潜在的安全问题。无机固体电解质(例如LiPON等)需要高真空压力来蒸发/溅射，因此常具有高成本。此外，无机固体电解质具有差的机械柔韧性。

[0007] 存在与已知的电致变色装置和/或其部件相关的若干问题。美国专利第6667825号('825专利)公开了一种电致变色装置，其使用两种共轭聚合物涂覆的ITO涂覆玻璃电极和离子液体如[BMIM][BF_4]作为电解质。'825专利的[BMIM][BF_4]液体电解质不包含路易斯酸，从而使电致变色装置的稳定性和寿命得到改善。此外，'825专利的电致变色装置可以至少部分地避免由淬火后的残留图像和电解质分解而引起的问题，该问题典型地出现于使用含有路易斯酸的基于有机溶剂的液体电解质和离子液体电解质的装置中。然而，'825专利的电致变色装置仍然存在与液体电解质泄漏以及无法形成薄膜和膜形状产品相关的问题。

[0008] 为了弥补液体电解质的这些缺点，最近出现了固体聚合物电解质。S.A.Agnihotry公开了一种在室温下具有10^{-3}S/cm的高离子电导率的聚合物电解质，该聚合物电解质通过向含有1M $LiClO_4$的由碳酸丙烯酯形成的电解质中添加少量PMMA(聚甲基丙烯酸甲酯)聚合

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物和煅制二氧化硅而形成(参见Electrochimica Acta,2004,49:2343-2349)。然而,由于上述聚合物电解质仍使用有机溶剂作为电解质,因此该装置仍然具有若干缺点,例如淬火率低、淬火后的残留图像、基于有机溶剂的电解质的分解和耗尽等。此外,由于上述聚合物的溶胀状态,上述聚合物的界面和相位相对不稳定。随着时间的推移,上述聚合物的界面可能容易改变,从而导致电致变色装置失效。

[0009] 因此,本领域需要一种适用于电致变色装置的改进的固体聚合物电解质。

发明内容

[0010] 本公开内容的一个方面涉及固体聚合物电解质。在一些实施方案中,固体聚合物电解质可以包含一种或多于一种极性结晶聚合物的骨架、一种或多于一种极性非晶聚合物和一种或多于一种电解质盐。

[0011] 本公开内容的另一方面涉及电致变色装置。在一些实施方案中,电致变色装置包括第一电极、第二电极、沉积在至少第一电极上的电致变色材料和设置在电致变色材料与第二电极之间的固体聚合物电解质。固体聚合物电解质可以包含一种或多于一种极性结晶聚合物的骨架、一种或多于一种极性非晶聚合物和一种或多于一种电解质盐。

[0012] 本公开内容的另一方面涉及制备固体聚合物电解质的方法。在一些实施方案中,该方法包括通过多种材料的微相分离形成固体聚合物电解质。该多种材料可以包括一种或多于一种极性结晶聚合物、一种或多于一种极性非晶聚合物和一种或多于一种电解质盐。通过使用溶液工艺或挤出使一种或多于一种极性结晶聚合物、一种或多于一种极性非晶聚合物和一种或多于一种电解质盐一起混合到透明膜中。

[0013] 根据以下的详细说明,所描述的实施方案的其他目的、特征和优点对本领域技术人员将是显而易见的。然而,应当理解,虽然指出了本发明的优选实施方案,但是详细的描述和具体实施例作为说明给出,而非作为限制。在不脱离本发明的精神的情况下,可以在本发明的范围内作出许多改变和修改,并且本发明包括所有这些修改。

附图说明

[0014] 通过参照附图可以更容易地理解本发明的优选和非限制性实施方案,其中:

[0015] 图1是根据一个示例性实施方案的其中包括固体聚合物电解质的电致变色装置的简化示意图的剖视图。

[0016] 图2是示出与本公开内容中示例性实施方案一致的具有固体聚合物电解质的示例性电池的电阻特性图示。

[0017] 图3是示出与本公开内容中示例性实施方案一致的具有固体聚合物电解质的示例性电化学装置的电阻特性图示。

[0018] 图4是示出与本公开内容中示例性实施方案一致的具有固体聚合物电解质的示例性电化学装置的循环伏安图测量结果图示。

[0019] 优选实施方案的详细描述

[0020] 现在将参照附图描述本发明具体的非限制性实施方案。应当理解,本文公开的任何实施方案的特定特征和方面可以与本文公开的任何其他实施方案的特定特征和方面一起使用和/或组合。还应当理解,这样的实施方案是示例性的,并且仅是本发明范围内的少

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数实施方案的说明。对于本发明所属领域的技术人员显而易见的各种变化和修改被认为在所附权利要求中进一步限定的本发明的精神、范围和设想之内。

[0021] 除非上下文另有要求，否则在本说明书和权利要求全文中，词语“包括”被解释为开放式、包含的意义，即“包括但不限于”。数值范围也包含定义范围的数。此外，没有数量词修饰的要素包括多个要素的情况，除非上下文另有明确规定。

[0022] 本说明书全文中提及的“一个实施方案”或“实施方案”是指结合该实施方案所描述的特定特征、结构或特性包含在本发明的至少一个实施方案中。因此，本说明书全文各处出现的短语“在一个实施方案中”或“在实施方案中”不一定都指相同的实施方案，但在一些情况下可以指相同的实施方案。此外，特定特征、结构或特性可以以任何合适的方式在一个或多于一个实施方案中组合。

[0023] “任选的”或“任选地”是指随后描述的事件或情况可以发生或可以不发生，并且说明书包括了所述事件或情况发生的情况以及其没有发生的情况。例如，“任选的第二层”是指可以包括或可以不包括第二层。

[0024] 本文公开的实施方案旨在使用常规液体或聚合物电解质解决与现有电致变色装置相关的问题。例如，本文公开的实施方案涉及用于电致变色装置的新型透明固体聚合物电解质，其中固体聚合物电解质包含两种或多于两种化学相容的聚合物组分。一种或多于一种组分是结晶的，并且一种或多于一种组分是非晶的。至少一种组分是离子导电的。

[0025] 在一些实施方案中，可以使用物理微相分离法形成本公开的固体聚合物电解质。微相分离法是获得同时具有较优良的离子电导率和较高稳定性的聚合物电解质的有效方法。例如，先前的聚合物电解质的相分离设计主要基于结晶聚合物嵌段与非晶聚合物嵌段的化学连接，从而产生半透明电解质。本公开内容涉及包含一种或多于一种极性结晶聚合物、一种或多于一种极性非晶聚合物和一种或多于一种电解质盐的多种材料的微相分离。所公开的由微相分离形成的固体聚合物电解质是稳定且透明的，如所公开的实施方案中描述的，其可以通过设计聚合物结构并调节比例以及处理条件而获得。在一些实施方案中，本公开的固体聚合物电解质允许电致变色装置的稳定运行。所公开的电致变色装置的实施方案避免了与现有电致变色装置相关的问题，例如电解质泄漏、低离子电导率、不能形成薄膜或薄膜形状的产品、低黏附性等。

[0026] 以下描述公开了固体聚合物电解质的几个优选实施方案以及制备和使用该固体聚合物电解质的方法和装置。

[0027] 固体聚合物电解质

[0028] 本公开内容一般涉及呈透明且具有足够的离子电导率以促进电致变色装置中的离子传输的固体聚合物电解质。

[0029] 在一个实施方案中，固体聚合物电解质包含一种或多于一种极性结晶聚合物的骨架、一种或多于一种极性非晶聚合物和一种或多于一种电解质盐。在一些实施方案中，一种或多于一种极性结晶聚合物或者一种或多于一种极性非晶聚合物中的一种或多于一种是离子导电的。在一些实施方案中，固体聚合物电解质通过组分的微相分离而形成。

[0030] 本公开的一种或多于一种极性结晶聚合物可以包含C、N、F、O、H、P等中的一种或多于一种。在一些实施方案中，一种或多于一种极性结晶聚合物具有约10000道尔顿或更大的平均分子量。合适的极性结晶聚合物可以包括但不限于尼龙、聚对苯二甲酸乙二醇酯、聚甲

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基丙烯酸甲酯(PMMA)、聚丙烯酰胺、聚酰亚胺、聚氯乙烯(PVC)、聚对苯二甲酸丁二醇酯(PBT)、聚醚醚酮(PEEK)、聚四氟乙烯(PTFE)、聚偏氟乙烯(PVDF)、聚(偏氟乙烯-co-六氟丙烯)(PVDF-HFP)、高分子量聚环氧乙烷、聚苯硫醚、聚醚酰亚胺、聚醚砜、其组合等。在存在多种极性结晶聚合物的实施方案中,极性结晶聚合物可以交联以形成机械性能增强的网络。在一些实施方案中,基于固体聚合物电解质的总重量,极性结晶聚合物的总量可以为约0重量%至约60重量%。

[0031] 本公开的一种或多于一种极性非晶聚合物可以包含C、N、O、F、H、P、Si等中的一种或多于一种。在一些实施方案中,一种或多于一种极性非晶聚合物具有低结晶度。一种或多于一种极性非晶聚合物可以具有-20℃或更低的玻璃化转变温度(Tg)。合适的极性非晶聚合物可以包括但不限于聚氨酯、聚硅氧烷、聚环氧乙烷、支化聚合物、其组合等。在一些实施方案中,一种或多于一种极性非晶聚合物可以具有足够的非晶性以实现足够的离子电导率。在一些实施方案中,基于固体聚合物电解质的总重量,极性非晶聚合物的总量可以为约20重量%至约70重量%。

[0032] 如上所述,本公开的固体聚合物电解质可以包含一种或多于一种电解质盐。在一些实施方案中,一种或多于一种电解质盐可以包括一种或多于一种有机盐。在一些实施方案中,一种或多于一种电解质盐可以包括一种或多于一种无机盐(例如金属盐)。合适的电解质盐可以包括但不限于LiTFSI、$LiPF_6$、$LiBF_4$、$LiClO_4$、$LiCF_3SO_3$、$LiN(CF_3SO_2)_2$、LiSbFg、$LiAsF_6$、$LiN(CF_3CF_2SO_2)_2$、$(C_2H_5)_4NBF_4$、$(C_2H_5)_3CH_3NBF_4$、LiI、其组合等。在一些实施方案中,基于固体聚合物电解质的总重量,电解质盐的总量可以为约10重量%至约50重量%。

[0033] 在一些实施方案中,本公开的一种或多于一种极性非晶聚合物和一种或多于一种电解质盐基本上与一种或多于一种极性结晶聚合物的骨架混溶。优选地,本公开的固体聚合物电解质的组分彼此相容,并且可以共混(例如,通过溶液工艺或挤出)到透明膜中而没有任何可观察到的颗粒。

[0034] 固体聚合物电解质与常规液体电解质以及其中包含离子液体的凝胶聚合物电解质是可区分的。换句话说,本公开的固体聚合物电解质可以是全固体聚合物电解质,并且其中不包括任何液体或凝胶组分。本公开的固体聚合物电解质在一些方面还可以是透明的。例如,本公开的固体聚合物电解质可以具有80%或更高的透明度。此外,固体聚合物电解质可以具有约10^{-6}S/cm至约10^{-4}S/cm的离子电导率。

[0035] 制备本公开的固体聚合物电解质的方法可以包括合成、聚合、溶剂化和/或本领域已知的其他工艺。在至少一个实施方案中,所公开的方法可以导致用于制备所公开的固体聚合物电解质的多种材料的微相分离。在一些实施方案中,本公开的固体聚合物电解质可以通过聚合极性聚合物(例如极性结晶聚合物和极性非晶聚合物)的单体而获得。在一个特定的非限制性实施方案中,制备本公开的固体聚合物电解质的方法可以包括:(a)将一种或多于一种极性结晶聚合物的骨架、一种或多于一种极性非晶聚合物和一种或多于一种电解质盐溶解在合适的溶剂中;和(b)除去(例如通过蒸发)溶剂以获得固体聚合物电解质。示例性的溶剂可以包括但不限于丙酮、甲醇、四氢呋喃等。在一些实施方案中,可以优化一个或多于一个实验参数以促进极性结晶聚合物的骨架、极性非晶聚合物和电解质盐在溶剂中的溶解。这些实验参数可以包括残留在溶剂中的组分、溶剂的搅动/搅拌等。

[0036] 电致变色装置

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[0037] 根据一个实施方案，在图1中示出了包含固体聚合物电解质的电致变色装置100的示例的非限制性示意图。图1的电致变色装置100可以与本文描述的其他装置/特征/部件组合，例如参照其他实施方案/方面描述的那些组合应用。电致变色装置100可以用于各种应用和/或排列中，这些应用和/或排列可能或可能没有在本文所述的说明性实施方案/方面中被提及。例如，在一些实施方案中，电致变色装置100可以包括比图1所示的更多或更少的特征/部件。此外，除非另外说明，电致变色装置100的一个或多于一个部件可以是常规的材料、设计和/或使用已知技术（例如，层压、溅射、化学气相沉积（CVD）、喷涂、旋涂、印刷等）制造的，正如本领域技术人员在阅读本公开内容时所领会的。

[0038] 如图1所示，电致变色装置100包括彼此间隔且平行的第一透明基板102和第二透明基板104。第一基板102包括内表面106和外表面108。类似地，第二基板104包括内表面110和外表面112，其中第二基板104的内表面110面向第一基板102的内表面106。第一基板102和第二基板104可以具有相同或不同的尺寸，包含相同或不同的材料等。用于第一基板102和/或第二基板104的合适材料可以包括但不限于玻璃、聚合物材料、塑料材料和/或在电磁光谱的至少部分可见光区中呈透明的其他材料。在一些实施方案中，第一基板102和第二基板104可以包含玻璃。

[0039] 仍如图1所示，第一透明导电膜114沉积在第一基板102的内表面106上以充当电极。第二透明导电膜116也沉积在第二基板104的内表面110上以充当电极。第一导电膜114和第二导电膜116可以具有相同或不同的尺寸，包含相同或不同的材料等。第一导电膜114和第二导电膜116也可以各自独立地具有单层或多层结构。用于第一导电膜114和第二导电膜116的合适材料可以包括但不限于锡掺杂氧化铟（ITO）、氟掺杂氧化铟、锑掺杂氧化铟、锌掺杂氧化铟、铝掺杂氧化锌、银纳米线、碳纳米管膜、玻璃或塑料基板上的图案化金属、其组合和/或其他呈现足够电导率的这类透明材料。在优选的方面中，第一导电膜114和第二导电膜116可以包含ITO。

[0040] 电致变色装置100还可以包括被配置用于在第一导电膜114与第二导电膜116之间提供电压的电源（未示出）。

[0041] 还如图1所示，电致变色材料的第一层118沉积在第一导电膜114的内表面120上。该电致变色材料被配置为在由暴露于电流所引起的还原（获得电子）或氧化（失去电子）时产生可逆的颜色变化。在一些实施方案中，第一层118的电致变色材料可以被配置为在氧化或还原时从透明状态变成着色状态，或者从一种着色状态变成另一种着色状态。在一些实施方案中，第一层118的电致变色材料可以是其中可能存在多于两种氧化还原状态的多电致变色材料，并因此可以呈现多种颜色。第一层118的电致变色材料还可以是还原着色材料（即，在获得电子时变成着色的材料）或氧化着色材料（即，在失去电子时变成着色的材料）。

[0042] 用于第一层118的合适的电致变色材料可以包括但不限于无机材料、共轭聚合物、小有机分子、金属盐、其组合等。在一些实施方案中，第一层118的电致变色材料可以包括金属氧化物如MoO_3、V_2O_5、Nb_2O_5、WO_3、TiO_2、$Ir(OH)_x$、$SrTiO_3$、ZrO_2、La_2O_3、$CaTiO_3$、钛酸钠、铌酸钾、其组合等。在一些实施方案中，第一层118的电致变色材料可以包括金属盐（例如，$FeCl_3$等）。在一些实施方案中，电致变色材料可以包括导电聚合物，例如聚-3,4-亚乙二氧基噻吩（PEDOT）、聚-2,2'-联噻吩、聚吡咯、聚苯胺（PANI）、聚噻吩、聚异硫茚、聚邻氨基苯酚、聚吡啶、聚吲哚、聚咔唑、聚靛、八氰基酞菁、其组合等。此外，第一层118的电致变色材料可以包

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括如紫精、蒽醌、phenocyazinc、其组合等的材料。

[0043] 虽然在图1的实施方案中未示出，但任选的电致变色材料的第二层可以沉积在第二导电膜116的内表面122上。任选的电致变色材料的第二层可以与电致变色材料的第一层118具有相同或不同的尺寸，包含相同或不同的材料/组成等。任选地，可以将电荷存储层沉积在第二导电膜116的内表面122上。任选的电荷存储层可以用作离子储存并且可以优选具有与第一层118的电致变色材料互补的电致变色特性。

[0044] 还如图1所示，如本文公开的固体聚合物电解质124，位于电致变色材料的第一层118与第二导电膜116之间。在电致变色装置100包括电致变色材料的第一层118和任选的电致变色材料的第二层的实施方案中，固体聚合物电解质124可以位于两层之间。

[0045] 在一些实施方案中，本公开内容的电致变色装置100包括固体聚合物电解质，如上述固体聚合物电解质124，并且不包括任何液体或凝胶电解质。

[0046] 在电致变色装置100中使用固体聚合物电解质124提供了数个优点。例如，本文公开的固体聚合物电解质(i)具有足够的机械强度且形状多样，以便容易形成薄膜和薄膜形状的产品；(ii)避免影响常规电解质的与黏附和印刷加工相关的问题；(iii)在电解质/电极界面(其上具有和不具有电致变色材料涂层的界面)之间提供稳定的接触；(iv)避免通常与液体电解质相关的泄漏问题；(v)具有期望的无毒和不易燃特性；(vi)避免由于其蒸气压力不足而引起的与蒸发相关的问题；(vii)与常规聚合物电解质相比呈现出改善的离子电导率；等等。

实施例

[0047] 如下制备根据本公开内容的示例性固体聚合物电解质。

[0048] 将10克PVDF-HFP聚合物与一定量(例如2克、5克或10克)的PEO低聚物合并。PVDF-HFP用作极性结晶聚合物骨架，而PEO低聚物用作极性非晶组分以及离子导体。将上述合并的组分进一步与一定量的锂盐(例如，约30重量%LiTFSI，基于PEO低聚物重量)合并。将合并的组分混合于丙酮溶剂中并搅拌过夜以得到溶液。对溶液进行处理并通过例如狭缝式挤压涂布或旋涂将其沉积在电致变色层或基板上。在干燥溶剂后，发现所得固体电解质是具有约10^{-5}S/cm的离子电导率的均匀透明膜。所得固体电解质膜可以用于组装电致变色装置。当固体电解质中PEO的比例增加时，离子电导率增加，但机械强度下降且膜的透明度发生变化。

[0049] 可以使用根据前述程序制备的固体聚合物电解质来形成电池。为了形成电池，可以将固体聚合物电解质夹在涂有电子导电锡掺杂氧化锡(ITO)的两个聚对苯二甲酸乙二醇酯(PET)膜之间。示例性电池的电阻特性在图2中示出。这种PET/ITO膜的表面电阻为100欧姆/平方。通过将两个PET/ITO膜连接到频率分析仪来测量电化学AC阻抗。含有聚合物电解质(25um)的电池的典型阻抗谱具有约500欧姆的总电阻。计算出膜的锂电导率为10^{-5}S/cm。

[0050] 可以用前述固体聚合物电解质制造电化学装置，并且聚((2,2-双(2-乙基己氧基甲基)-亚丙基-1,3-二氧)-3,4-噻吩-2,5-二基)可以用作电致变色(EC)层。可以通过狭缝式挤压涂布方法将EC层涂布在ITO/PET基板之上，并且干膜厚度为550nm。涂覆MoO_3的ITO/PET可以用作离子存储层(或称为对电极)。可以使用与恒电位仪配对的频率分析仪来评估电致变色装置。如图3所示，发现装置的内阻为约200欧姆。如图4所示，循环伏安图显示了

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10mV/s扫描速率下的一对高的可逆氧化还原峰(还原时为0.25V,氧化时为1.0V)。装置可以在-1.2V至1.2V的电压窗口内快速切换其颜色。

[0051] 应用/用途

[0052] 本公开的固体聚合物电解质的实施方案可以用于各种应用、装置、行业等。本公开的固体聚合物电解质的特定应用涉及用于电致变色装置。电致变色装置通常与智能窗和显示技术相关联,例如防眩汽车镜;被配置用于汽车、飞行器、建筑物等中的调节传输或反射太阳辐射的智能窗;防护眼镜;迷彩和/或变色材料;等等。

[0053] 本文描述和要求保护的发明不限于本文公开的具体优选实施方案的范围,因为这些实施方案旨在作为本发明的若干方面的说明。实际上,根据前面的描述,除本文所显示和描述的之外,本发明的各种修改对本领域技术人员将是显而易见的。这些修改也旨在落入所附权利要求的范围内。

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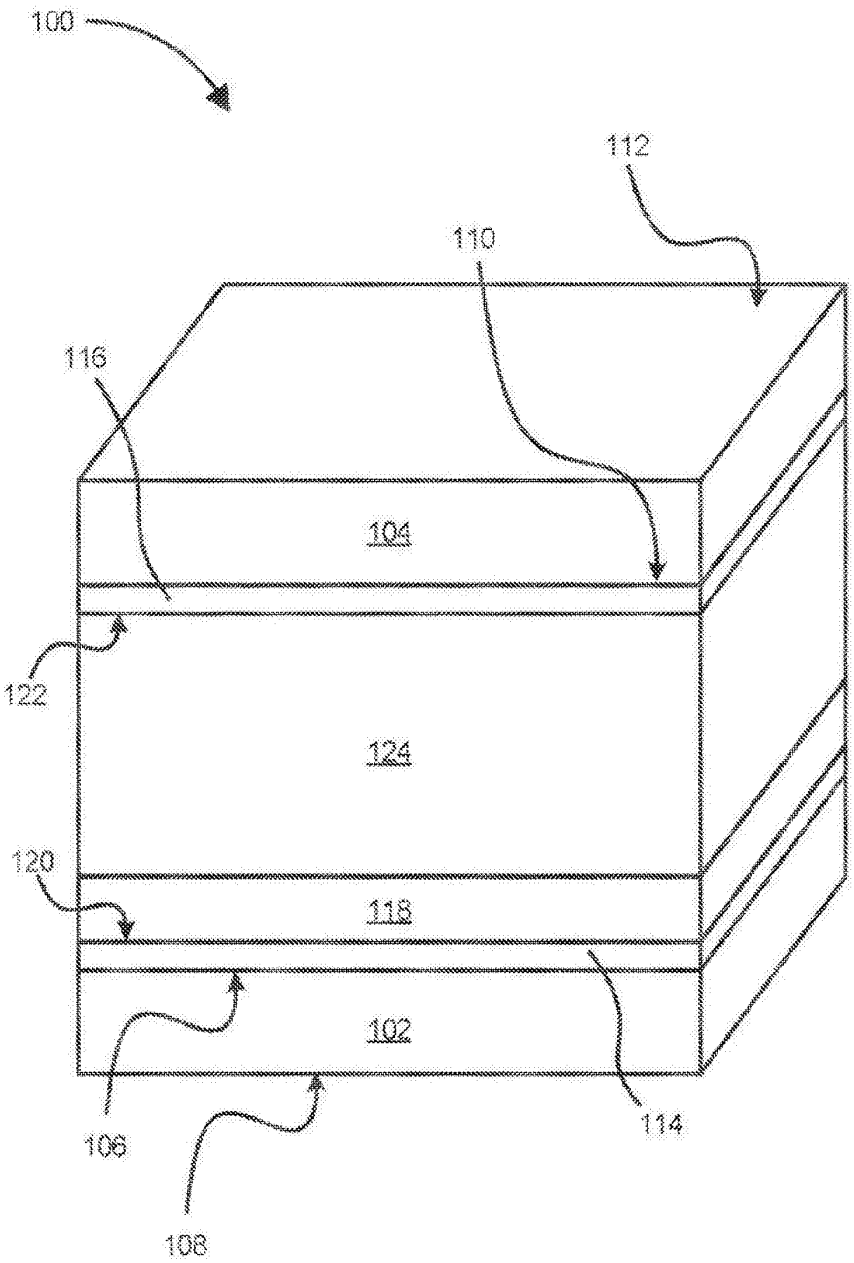


图1

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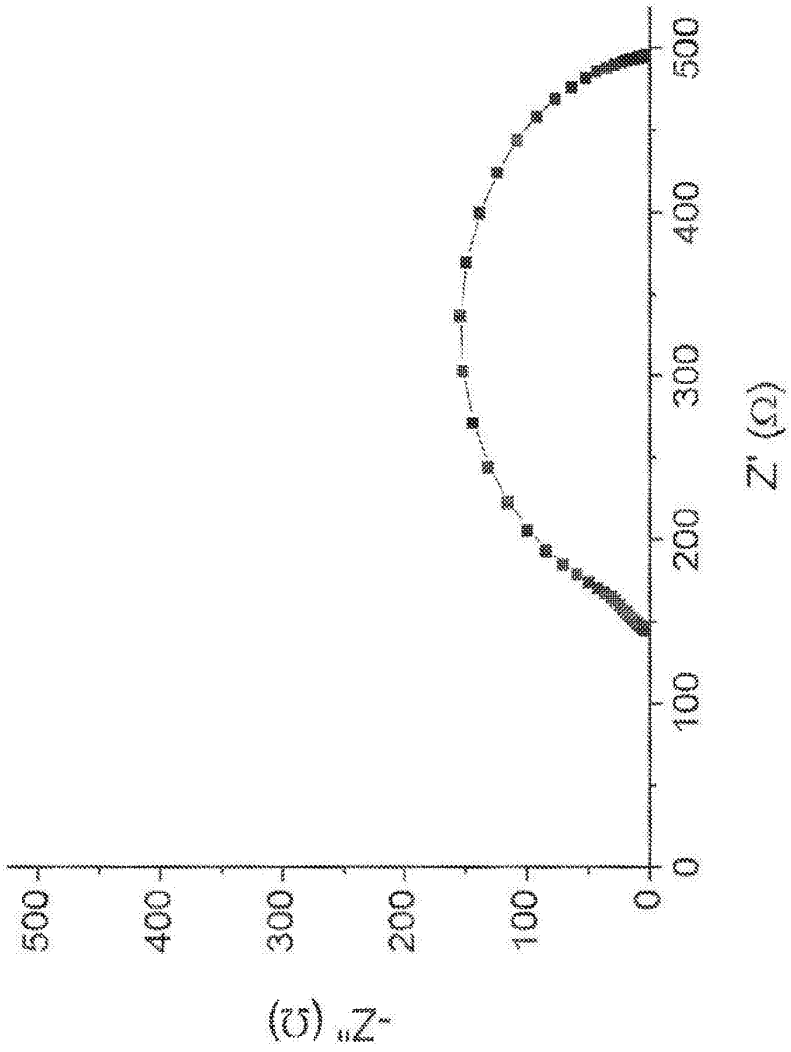


图2

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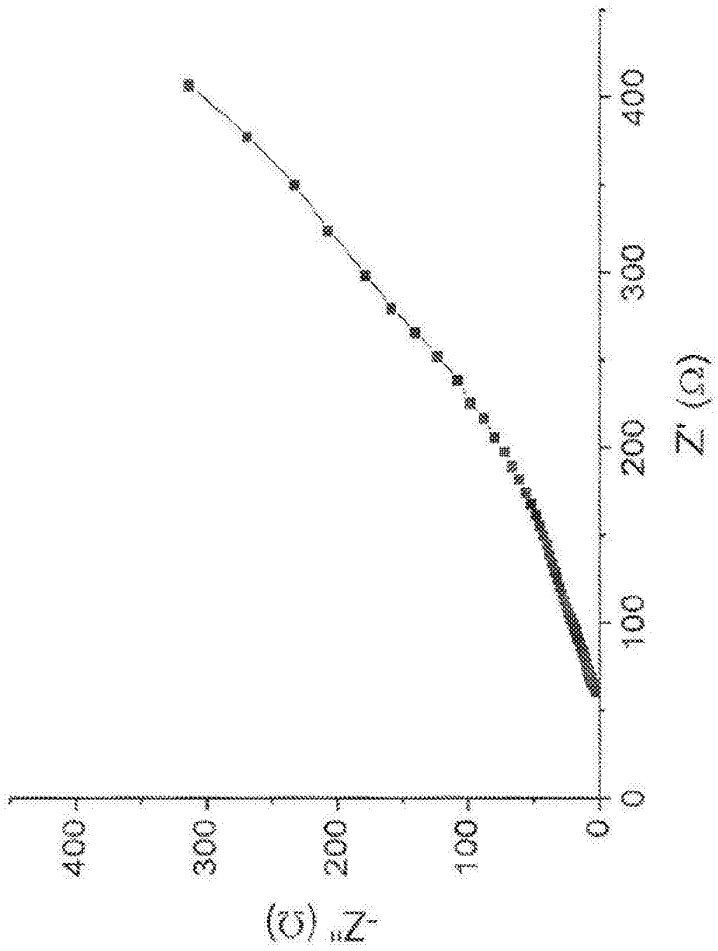


图3

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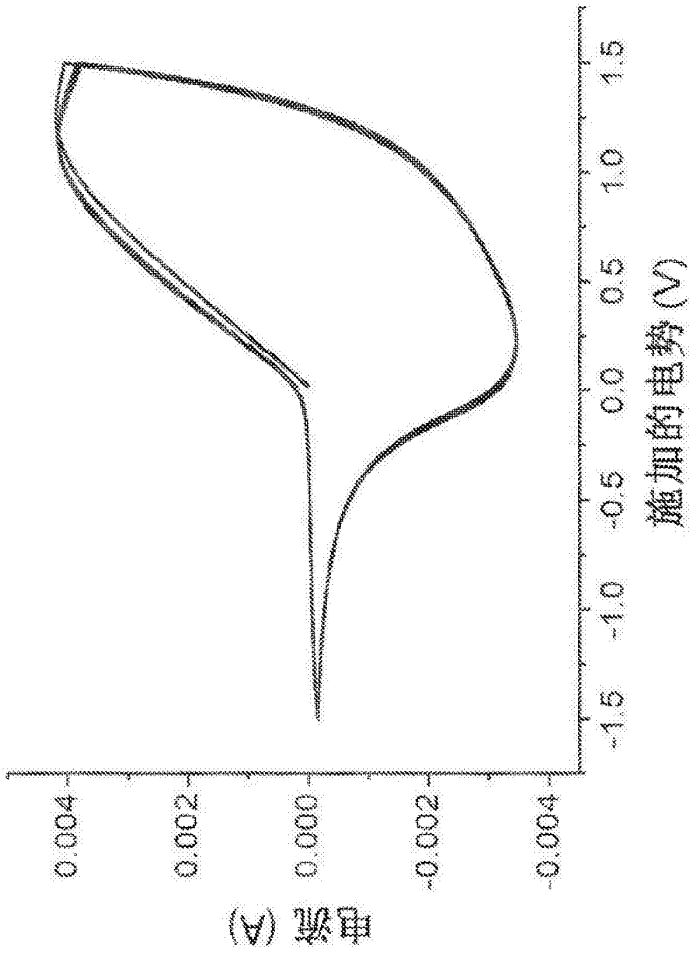


图4

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Espacenet

Bibliographic data: CN107709003 (A) — 2018-02-16

Laminated glazings with improved moisture protection

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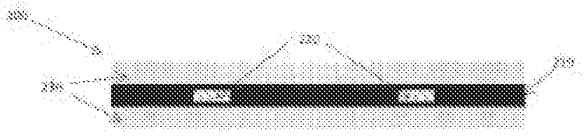
Classification: - international: *B32B17/06; B32B17/10*
- cooperative: B32B17/06 (KR); B32B17/10036 (EP, US); B32B17/10302 (EP, US); B32B17/10532 (EP, US); B32B17/10761 (EP, KR, US); B32B17/1077 (KR); B32B17/10788 (EP, KR, US); B32B2307/7246 (KR); B32B2307/73 (KR)

Application number: CN20168018390 20160321 Global Dossier

Priority number(s): US201562138711P 20150326 ; US201615073824 20160318 ; WO2016US23361 20160321

Also published as: CN107709003 (B) AU2016235455 (A1) AU2016235455 (B2) CA2980921 (A1) CA2980921 (C) EP3274165 (A1) EP3274165 (A4) JP2018516775 (A) JP6491351 (B2) KR101970323 (B1) KR20170131637 (A) US10137668 (B2) US2016282645 (A1) WO2016154089 (A1) less

Abstract of CN107709003 (A)



A laminated glazing including a moisture-sensitive functional insert included within the glazing, the laminated glazing comprising a stack comprised of a plurality of glass or plastic plies, the pliesbeing joined together by interlayers located between the plies, wherein a central area of the stack comprises at least one optically clear interlayer; the stack further including a moisture-sensitivefunctional insert; wherein an inner perimeter of the laminated glazing is formed with a frame comprised of a hydrophobic moisture-resistant material, the frame having a thickness substantially corresponding to a combined thickness of the interlayers within the glazing plus the insert. In addition, a method of reducing or eliminating exposure of a moisture-sensitive insert within a laminated glazing constructed as above is also described herein.

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DESCRIPTION CN107709003A

10 Laminated glass window with improved moisture protection

[0001]

14 Citation of Related Applications

[0002]

18 This patent application is a non-provisional application and claims the benefit of U.S. Provisional Patent Application No. 62/138,711, filed on March 26, 2015, entitled "LAMINATED GLAZING WINDOW HAVING IMPROVED OPTICAL PERFORMANCES," the entire contents of which are incorporated herein by reference.

[0003]

25 Field of the Invention

[0004]

29 The present invention relates to laminated glazings including moisture sensitive decorative or functional inserts.

31 Such laminated glazing may comprise an insert of a film such as used in a light valve comprising a particle suspension, generally referred to herein as a suspended particle device or SPD light valve, or simply SPD.

33 Such laminated glazing may also include other types of light valves, such as polymer dispersed liquid crystal (LC), electrochromic, thermochromic or electrophoretic light control materials.

35 The laminated glazing comprises a combination of interlayers wherein a central region of the stack comprises at least one optically transparent interlayer and the perimeter of the stack is formed by a border of hydrophobic, moisture resistant material having a similar thickness to the interlayer(s) plus inserts in the stack.

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[0005]

Background of the Invention

[0006]

Laminated glass is a type of safety glass that stays together when it shatters.

If damage occurs, it is secured by an interlayer between its two or more layers of glass, usually polyvinyl butyral (PVB), polyurethane (PU) or ethylene vinyl acetate (EVA).

This interlayer keeps the layers of glass together even if broken, and its high strength prevents the glass from forming large, sharp fragments. This creates a distinctive "spider web" shattering pattern when the impact is not strong enough to completely puncture the glass. In the case of thermosetting EVA, cross-linked EVA and glass bonding is achieved. All of the above interlayers can be used with non-glass substrates such as polycarbonate, polyacrylic, PET or other types of plastics to achieve similar bonding benefits.

[0007]

Laminated glass is often used when there is a possibility of human impact or where the glass would fall if broken, and for architectural applications.

Sunroof windows and car windshields often use laminated glass. Laminated glass is often used in storefront exteriors, curtain walls, and windows in geographic areas where hurricane-resistant facilities are required.

[0008]

Laminated glass is also used to increase the sound insulation rating of windows, significantly improving sound attenuation compared to non-laminated window panes of the same thickness.

For this purpose, special "acoustic PVB" compounds are used for the interlayer. In the case of EVA material, no additional acoustic material is required because the EVA provides the sound insulation. An additional property of laminated glass for windows is that the PVB and EVA interlayers can contain ultraviolet (UV) absorbers, which are able to block most UV radiation. For example, thermoset EVA can block up to 99.9% of UV rays.

[0009]

Laminated glazing typically has an insert laminated between a glass or plastic substrate and a transparent interlayer to make a decorative or functional laminated glazing.

Examples of decorative inserts would be colored plastic, fabric, or pictures on paper or silk. Functional inserts include smart technologies such as SPDs, as well as LC, photochromic, electrochromic and thermochromic materials.

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[0010]

80 Light valves have been known for more than eighty years for the modulation of light.

82 During that time such light valves have been used in a wide variety of applications including, but not limited to, for example, alphanumeric displays and television displays; filters for lamps, cameras, displays, and optical fibers; and windows, skylights, toys, sunshades, glasses, goggles, mirrors, rearview mirrors, light pipes, and the like, to control the amount of light passing therethrough or reflected therefrom, as appropriate. Examples of windows include, but are not limited to, architectural windows for commercial buildings, greenhouses, and residences; windows, visors, and skylights for motor vehicles, ships, trains, airplanes, and spacecraft; windows on doors including peepholes; and windows for household appliances such as ovens and refrigerators including their compartments.

[0011]

93 As used herein, the term "light valve" describes a cell formed by two walls separated by a small distance, having at least one transparent wall.

95 The walls have electrodes on them, usually in the form of a transparent, conductive coating. Optionally, the electrodes on the walls may have thin transparent dielectric overcoatings on them. The chamber includes a light-modulating element (which is sometimes referred to herein as an activatable material) which can be, but is not limited to, a liquid suspension of particles or alternatively, all or a portion of the entire element can include a plastic film in which droplets of the liquid suspension of particles are distributed.

[0012]

103 The liquid suspension (which is sometimes referred to herein as a light valve suspension or liquid light valve suspension) includes small particles suspended in a liquid suspending medium.

105 In the absence of an applied electric field, particles in the liquid suspension of an SPD light valve may assume random positions due to Brownian motion. Thus, a light beam entering the chamber is reflected, transmitted or absorbed, depending on the structure of the chamber, the nature and concentration of the particles and the energy content of the light. Therefore, SPD light valves utilizing this type of particle motion are typically relatively dim in the OFF state. However, when an electric field is applied across the liquid light valve suspension in the light valve, the particles become aligned and, for many suspensions, most of the light is able to pass through the chamber. Therefore, the SPD light valve is relatively transparent in the ON state.

[0013]

115 For many applications, it may be preferred that all or part of the activatable material (ie, the light modulating elements) be a plastic film rather than a liquid suspension.

117 For example, in a light valve used as a variable light transmittance window, the plastic film in which droplets of a liquid suspension are distributed is preferably only a liquid suspension due to the hydrostatic pressure effect, for example bulging associated with a high column of light suspension can be avoided by using a membrane and possible risks of leakage can also be avoided. Another advantage of using a plastic film is that in plastic films the particles are usually present only in very small droplets and therefore no significant accumulation

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occurs when the film is repeatedly activated by an electrical voltage.

[0014]

131 As used herein, light valve film (also sometimes referred to herein as SPD film) means a film or sheet, or more than one film or sheet, that includes a suspension of particles used or intended for use in a light valve.

133 Such light valve films typically contain a discontinuous, non-crosslinked phase of a liquid including dispersed particles, which is called a liquid light valve suspension, wherein such a discontinuous phase is distributed throughout a curable continuous phase, which is enclosed in one or more rigid or flexible solid films or sheets. The cured latex that may form part of the light valve film is sometimes referred to as a film or film layer. The light valve film and/or laminated glass stack including the light valve film may also include one or more additional layers, such as, but not limited to, films, coatings or sheets or combinations thereof, which may provide the light valve film with one or more of the following properties, for example, (1) scratch resistance, (2) protection against ultraviolet radiation, (3) reflection of infrared energy, (4) electrical conductivity for transmitting an applied electric or magnetic field to the activatable material, (5) a dielectric outer coating, (6) color tinting, (7) a heating element and/or (8) acoustic control. This additional layer may be adhered to the light valve film during the lamination procedure as discussed in the Summary section with a pressure sensitive adhesive (PSA) known to those skilled in the art or with an additional ply of an interlayer.

[0015]

148 A common (but not limited to) construction of an SPD film includes five layers, namely, in order from a first side to a second opposing side: (1) a first sheet of polyethylene terephthalate ("PET") plastic, conveniently 5-7 mils thick, (2) a very thin indium tin oxide ("ITO") conductive coating or an alternative conductive coating which acts or is capable of acting as an electrode on the first sheet of PET, (3) a layer of cured (i.e., cross-linked) SPD latex, typically 2-5 mils thick and (4) a second ITO coating (or an alternative conductive coating) which acts or is capable of acting as an electrode on (5) a second PET plastic substrate.

154 As previously mentioned, additional layers providing other functionality may optionally be added to the five-layer SPD film described above. Typically, copper foil, conductive fabric or the like is affixed to the electrode so that it extends beyond the perimeter of the SPD film to facilitate busbar connection to a suitable voltage source. Additionally, the SPD film can be laminated, for example, with a clear hot melt adhesive film and/or glass or a thicker clear plastic sheet, to provide strength and rigidity and protect the various parts of the combined unit from environmental conditions that would compromise its performance characteristics.

[0016]

163 US Patent No. 5,409,734 illustrates a non-crosslinked light valve film made by phase separation from a homogeneous solution.

165 Light valve films made by cross-linking (curing) of latex are also known. The process of the invention relates in particular to the use of films of the latter type, ie films comprising a layer formed by crosslinking a latex and in particular laminated films prepared. See, for example, US Pat. Nos. 5,463,491 and 5,463,492, and US Pat. No. 7,361,252, all of which are assigned to the assignee of the present invention. Various types of SPD latexes,

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and methods of curing the same, are described in US Pat. Nos. 6,301,040, 6,416,827, and 6,900,923B2, all of which are assigned to the assignee of the present invention. A non-limiting example of such a membrane of Example 5 of US Pat. No. 6,900,923B2 was prepared as follows: 0.002 g of Irgacure 819 (Ciba Specialty Chemicals) photoinitiator ("PI") was dissolved in 2 mL of chloroform and 1 g of the matrix polymer described in Example 1 was added. The PI solution was mixed thoroughly with the matrix polymer and the chloroform solvent was removed by placing the mixture in a vacuum oven at 60° C. To this was added 0.62 g of a polyiodide crystal paste containing a laurylmethacrylate/HEMA suspension polymer (0.56 g, synthesized as in Example 3 of the patent). The resulting mixture was mixed thoroughly and the obtained latex was applied to a conductive coated polyester substrate with a doctor blade as a 2 mil thick coating, paired with a blank conductive coated polyester substrate and cured with UV radiation (8000 mJ/cm²/min) for 2 minutes and 30 seconds. Such films and variations thereof can be cured by crosslinking produced by exposing the film to (1) ultraviolet radiation, (2) electron beams, or (3) heat.

[0017]

188 All patents and patent applications and other references cited in this application are incorporated herein by reference.

[0018]

193 Disadvantages of Prior Art SPD Laminates

[0019]

197 All of the laminated glazings discussed above must be protected against moisture penetration into the interior of the laminate, especially via the edges of the laminate.

199 For example, US 2002/0126249A1, "Transmissive or reflective liquid crystal display and novel process for its manufacture", paragraph [0004] states that "…both oxygen and moisture can chemically corrode liquid crystals.

202"

[0020]

205 The glass or thick plastic substrate of a laminated glazing prevents moisture from penetrating through the opposing surface of the laminated glazing, which represents the surface of the laminate that is most exposed to air.

209 However, moisture penetration through the PVB, EVA or PU interlayers can lead to a hazy appearance and delamination (separation of the glass or plastic substrate from the interlayer(s)) after prolonged exposure to moisture.

212 In the case of laminated glazings with inserts, moisture penetration can also damage the insert and functional inserts (eg SPDs) may become visually degraded and/or inoperable.

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[0021]

Prior art SPD films and stacks comprising such SPD film(s) are capable of developing a pattern at the perimeter of the SPD film where a light blue area or "light frame" is visible.

The light frame develops when the SPD film or stack of SPD films is exposed to elevated temperatures and/or moisture.

[0022]

As mentioned above, prolonged exposure of an SPD film or stack of SPD films to high humidity can cause light frames to appear.

U.S. Patent No. 7,361,252 (assigned to the assignee of the present invention) describes the use of tape to seal the edges of SPD film, thereby preventing hot melt bonding interlayer material from contacting the cured SPD latex, and the tape also acts as a physical barrier to prevent, for example, moisture from entering the interlayer material. However, such tapes have only moderate moisture resistance.

[0023]

Another drawback of prior art SPD films is that, over time, the cured latex tends to absorb moisture through the exposed edges of the SPD film if steps are not taken to isolate the SPD film from such sources of moisture.

Subsequent exposure of the SPD film or stack of SPD films to moisture can result in such defects as the above-mentioned loss of light frame and operation.

[0024]

US Patent No. 8,670,173 (assigned to the assignee of the present invention) specifically describes the use of a moisture barrier layer located across the outer edge portion of a glass or plastic substrate to prevent light framing along the perimeter of the SPD film of the laminated glazing.

However, the sealant and tape used in the '173 patent are applied to the outer edges of the laminated glass window, which limits the amount of sealant material that can be applied to the relatively small edge surface area and exposes the sealant to damage during handling that could create perforations or voids. Thus, while improved durability may be achieved using this approach, there remains a need for increased protection against moisture penetration through laminated glazing. As described above, these methods may also be applied to any laminated glazing that needs to remain optically clear and/or has an insert that needs to be protected from moisture.

[0025]

Accordingly, the inventors of the present application have endeavored to develop a method of manufacturing a laminated glazing comprising an insert, such as but not limited to a light valve of the type described herein, wherein the occurrence of moisture-related problems, such as undesirable light framing, loss of operation and/or the appearance of a cloudy, non-transparent interlayer, is eliminated or significantly reduced.

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[0026]

Summary of the invention

[0027]

Thus, in a first embodiment, by providing a moisture resistant shield layer around the perimeter of the SPD stack having the same or similar thickness to the total thickness of the optically transparent interlayer within the stack plus insert to form a border around the SPD film, the occurrence of such (multiple) light frames, turbid appearance and operational loss is eliminated or at least significantly reduced.

Lamination conditions and practices known to those skilled in the art, and various configurations of SPD films having multiple interlayer/glass or plastic substrate plies and including additional layers as described earlier may be used in any of the embodiments described herein.

A non-limiting summary of a method for laminating SPD films in U.S. Patent No. 7,361,252 (assigned to the assignee of the present invention) involves creating a "stack" comprising, in sequence: a first glass sheet, a first interlayer sheet, the SPD film (which comprises a cured SPD latex sandwiched between two ITO-coated PET substrate sheets having copper foil busbars attached to protruding from the ITO coating), a second interlayer sheet, and a second glass sheet, all of which are placed substantially congruent to each other.

The stack was placed in a vacuum bag located within a Carver Press and a strong vacuum (greater than 29 inches of mercury) was applied. The platens of the press are then arranged to contact the outside of the unlaminated stack and heat it up to affect melting of the interlayer within the stack. The platens are then cooled to solidify the interlayer used to adhere the stack into the SPD stack. The moisture barrier material frame of the first embodiment of the invention will be incorporated into the stack starting at the outer edge of the glass sheet and extending inwardly to the adjacent position of the SPD film or insert within the stack.

[0028]

In a second embodiment, where busbar wires or other suitable electrical leads are required to power a laminated insert (eg, SPD, LCD, etc.), two layers of the moisture barrier material are incorporated into the stack described above.

Each of the two layers has the same size and thickness. Additionally, the combined thickness of the two layers of moisture barrier material is approximately equal to the combined thickness of the optically clear interlayer and insert in the laminate stack. Suitable electrical leads will protrude out of the laminate from between the two plies of moisture barrier material to prevent moisture from entering the laminate at the connection point.

[0029]

In yet another embodiment, in which the insert is further laminated to one or more additional films, plies, etc. positioned outwardly from such film, additional steps are taken to maintain low moisture intrusion by incorporating a moisture resistant adhesive material into the laminate stack to form a border on the interior of the edges of the laminate so produced.

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In the above embodiment, although a specific brand of moisture-proof adhesive material is used in the following examples, it should be understood that any adhesive material including a hydrophobic material that repels water and moisture is suitable for use as a frame for the laminated moisture-proof material, including but not limited to epoxies, polyolefins, ionomers, and synthetic rubbers such as isobutylene polymers. It should be noted that other procedures for reducing or eliminating moisture from the laminate stack described in U.S. Patent No. 8,670,173 (assigned to the assignee of the present invention) that should also be implemented before or after the lamination step described herein include: (1) removing some or all of any trapped moisture from the SPD film; (2) providing a moisture barrier layer around the SPD film from the frame inward; and (3) using a moisture barrier layer located around the entire outer edge portion of the glass or plastic substrate forming the SPD stack described herein.

[0030]

BRIEF DESCRIPTION OF THE DRAWINGS

[0031]

FIG 1 is a plan view of an SPD stack according to the present invention, wherein a moisture barrier material having the same or similar thickness as an optically transparent interlayer within the stack is incorporated into the laminate stack to form a moisture barrier frame; and

[0032]

Figure 2 is a side view of an SPD stack according to the present invention showing the generatrix of the SPD film within the stack protruding out of the stack from between the moisture barrier materials.

[0033]

DETAILED DESCRIPTION

[0034]

Preliminary testing was conducted to determine the effectiveness of polyisobutylene (PIB) in blocking moisture vapor penetration.

The PIB used for this preliminary testing and the SPD stack in the present invention was HelioSeal PVS 101, obtained from ADCO of Michigan Center, MI.

The test consisted of applying a PIB material along the perimeter of the surface of a glass substrate and sandwiching a second glass substrate of the same size between the PIB material.

Before sandwiching the second glass substrate between the PIBs (Sample A), a moisture sensitive indicator strip (Cobalt Chloride Test Paper (3mm x 45mm strips), obtained from Avogadro Lab Supply, Miller Place, NY) was placed on the inside of the first glass substrate.

Two other samples were prepared in the same manner as described above, in one case a copper foil busbar was

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placed starting at the inside and extending outward so that it protruded beyond the second glass substrate before sandwiching the PIB applied to the first glass substrate (Sample B).

In the second case, the PIB layer applied to both the glass substrate and the copper foil busbar started at the interior and extended outward beyond the PIB to protrude beyond the second glass substrate before sandwiching the first PIB coated glass substrate between the first substrates (Sample C). All three samples contained moisture sensitive indicator strips as described above. The three samples were placed in the upper part of a dryer having a water storage tank in the lower part thereof. The perforated ceramic plate prevents direct contact of the sample with the water at the bottom of the desiccator. The desiccator was placed in an oven at 60° C to create a high temperature and high humidity environment.

[0035]

Sample A has been placed in a 60° C humidity chamber for 227 days, and no color change was observed on the high-sensitive indicator strip inside the sample.

This shows that no moisture has entered the interior of the sample.

[0036]

After 5 days in a 60° C humidity chamber, the color of the indicator strip in sample B changed from blue to white.

This shows that moisture has entered from the edge of the sample.

[0037]

Sample C has been placed in a 60° C humidity chamber for 209 days, and no color change was observed on the high-sensitive indicator strip inside the sample.

This shows that no moisture has entered the interior of the sample.

[0038]

Comparison of the results shows that the effective PIB moisture barrier of Sample A is compromised by the protruding busbar configuration in Sample B.

[0039]

Since both sides of the copper foil busbars of Sample B were not covered by PIB where they protruded outside the sample as in Sample C, it is believed that moisture was able to enter the edge of Sample B at the glass-copper foil interface at the perimeter of the sample.

Therefore, the positioning of the busbars between the two PIB plies in Sample C prevents moisture from entering the interior of Sample C.

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[0040]

In view of the above results, a series of SPD stacks incorporating SPD films as inserts were prepared using the lamination procedure described in US Pat. No. 7,361,252 (assigned to the assignee of the present invention). The EVA interlayer used as these laminates was an EVA layer obtained from Interlayer Solutions, Montreal, Canada. All SPD laminates produced incorporated a moisture sensitive indicator strip into the laminate stack, which was positioned adjacent to the SPD film in the laminate. The indicator strips used for these laminates were Humidity Detection strips, 20%-80%, Part # 33813-2080, available from Indigo Instruments, www.indigo.com.

[0041]

Therefore, to further investigate the effect of moisture in SPD films and SPD film stacks on light frame appearance, hazy appearance and operating loss, SPD stacks with different configurations were placed on top of a dryer with a water reservoir underneath, as described above. The perforated ceramic plate prevents the SPD stack from coming into direct contact with the water at the bottom of the dryer. The desiccator was placed in a 60° C oven to create a high temperature and high humidity environment to which the SPD film and SPD laminate would not normally be exposed. However, these extreme bars are created so that meaningful test results will be obtained within a reasonable period. The moisture-saturated dessicator containing the sample was placed in a 60° C oven and the sample was periodically evaluated for 1) the presence of moisture in the stack as detected by moisture indicator strips; 2) the formation of a light frame in the SPD film; 3) the change in appearance of the transparent interlayer in the stack from clear to cloudy/turbid; and 4) the OFF-state and ON-state transmittance of the SPD film in the stack.

[0042]

In the configuration where the tape was secured to the edge of the SPD film, the tape used was Teflon clear tape with silicone adhesive (McMaster Part #7562A11),

[0043]

As noted above, the SPD film and interlayer comprising the laminate stack should be dried as described in US Pat. No. 8,670,173, which is repeated here for the sake of completeness. The SPD film and interlayer were placed on top of a desiccant having a desiccant reservoir at its bottom. The sandwich was pre-stored in a humidity controlled area with a relative humidity of < 25%. The moisture barrier may be of any known type, including, but not limited to, silica gel, calcium oxide, calcium sulfate, and molecular sieves. The perforated ceramic plate prevents the SPD membrane and interlayer from coming into direct contact with the moisture barrier at the bottom of the desiccator. The desiccator containing the SPD film and interlayer was evacuated to a pressure of 0.001 Torr and maintained under vacuum for 3days.

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[0044]

427 The initial ΔT or visible light transmittance range (ON-state transmittance-OFF-state transmittance) of each SPD stack was measured with a Color Sphere Visible Spectrophotometer manufactured by Byk-Gardner by applying a 100V/60Hz electric field to the protruding busbars of the stack to obtain the ON-state transmittance.

432 These optical measurements were repeated periodically during the humidity test.

[0045]

436 After periodic re-lamination during humidity testing, digital photographs were taken of each SPD stack in both OFF and ON transmission states.

438 The photograph was used to record the start of the light frame in the SPD film and to monitor the moisture (indicator) strips in the stack to detect the presence of moisture in the stack.

[0046]

443 Results and discussion

[0047]

447 The following is a representation of the SPD stacks prepared with the glass substrates tested and Table 1 discloses the results of the 60° C humidity chamber testing.

[0048]

452 Test sample identification

[0049]

456 1.

457 EVA conventional laminate

[0050]

461 2.

462 EVA laminate with SPD film + GS22 glue sealant

[0051]

466 3.

467 EVA conventional laminate + PIB sealant

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[0052]

4. EVA+PIB frame laminate

[0053]

5. EVA + PIB frame laminate with SPD film attached,

[0054]

6. EVA + 2-layer PIB frame stack with SPD film, busbars between PIB layers

[0055]

Table 1

[0057]

The column labeled in Table 1, "Moisture as indicated by indicator strips," reveals the number of days of exposure of the sample to the 60° C humidity chamber before the moisture level in the laminate reached 20%.

The results showed that laminates with no sealant around the outside edges of the laminate (Laminate #1) or laminates using GS22 Glue (hot melt, manufactured by Bostik of Wauwatosa, WI) (Laminate #2) or PIB (Laminate #3) as a sealant around the outside edges of the laminate only prevented moisture from entering the laminate for 4 days.

[0058]

Conversely, laminates #4-6, incorporating PIB into the laminate stack to form the frame, prevented moisture from entering the laminate for 410 days, 410 days, and 418 days, respectively, and testing continued.

[0059]

The column labeled in Table 1, "Occurrence of Light Frames," reveals the number of days of sample exposure to the 60° C humidity chamber before degradation in the form of light frames was observed at the perimeter of the SPD film in the stack.

Again, the results show that the laminate with no sealant around the outside edge of the laminate (Laminate #1) or the laminate using GS22 Glue (Laminate #2) or PIB (Laminate #3) as a sealant around the outside edge of the laminate developed light frames in the SPD film within 26 days, 48 days, and 58 days, respectively.

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[0060]

In contrast, stacks #4-6, which incorporated PIB into the laminate stack to form the frame, had undeveloped light frames in the SPD film for 410 days, 410 days, and 418 days, respectively, as the test progressed.

[0061]

The column labeled in Table 1, "Haze Interlayer Appearance," reveals the number of days the sample was exposed to the 60° C humidity chamber before the clear EVA interlayer became hazy.

The results showed that stacks #1-3 developed a cloudy appearance after 66 days, 66 days, and 101 days, respectively.

The hazy appearance was most likely the result of continued moisture penetration into the laminates beginning after 4 days of sample exposure (see, Table 1 and discussion above).

[0062]

The interlayers of stacks #4-6 still showed no hazy appearance in the SPD film after 410 days, 410 days, and 418 days, respectively, and testing continued.

These results complement the moisture and light frame results in Table 1 for stacks #4-6.

[0063]

The column labeled "ΔT Change Days and Condition" in Table 1 lists the change in visible light transmittance of the SPD film in the stack from its initial ΔT value to its ΔT value after long term exposure to a 60° C humidity chamber.

These results show that the laminates with no sealant around the outside edge of the laminate (Laminate #1) or using GS22 Glue (Laminate #2) or PIB (Laminate #3) as a sealant around the outside edge of the laminate had a significant loss in ΔT.

Testing of stack #1 was discontinued after 101 days due to severe loss of ΔT.

Stack #2, which had lost 5.96 transmission points after 80 days of exposure, had to be discontinued due to SPD busbar failure, which prevented measurement of ON state transmission, probably due to moisture ingress into the stack.

However, it is expected that based on the poor results of moisture penetration into the laminate and light frame development in the SPD film, ΔT will continue to decrease if testing continues.

Similar to the poor results of stack #2 regarding moisture penetration into the stack and light frame development in the SPD film, stack #3 lost 19.81 transmission points after 122 days of exposure and the experiment was terminated due to a significant loss in ΔT, indicating that ΔT will continue to decrease.

[0064]

After 410 days of exposure, stack #4 lost 3.90 transmission points and testing continued.

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After 410 and 418 days of exposure respectively, stacks #5-6 had lost only 1.37 and 1.62 transmission points and testing continued.

Laminate #5 was similar to Sample B tested initially above with the copper foil busbar adjacent to the glass substrate, and Laminate #6 was similar to Sample C tested initially with the copper foil busbar sandwiched between two PIB plies.

Therefore, as testing continues, laminate #6 will be expected to maintain its moisture barrier properties longer than laminate #5.

[0065]

Thus, the 60° C humidity chamber results for stack #4-5 confirm the first embodiment of the present invention, in which a moisture barrier material border is incorporated into the stack starting at the outer edge of the glass sheet and continuing inwardly toward the location in the stack adjacent to the transparent interlayer or SPD film or insert.

[0066]

In addition, the results of the 60° C humidity cabinet test of stack #6 and the preliminary 60° C humidity cabinet test of sample C confirm the preferred second embodiment of the present invention, in which two layers of moisture barrier material are combined to form a frame of moisture barrier material, which is incorporated into the stack that starts at the outer edge of the glass sheet and continues inwardly toward the position of the transparent interlayer or SPD film or insert in the stack.

[0067]

Suitable electrical leads will protrude out of the laminate from between the two plies of moisture barrier material to prevent moisture from entering the laminate at the connection point.

[0068]

As mentioned above, epoxies, polyolefins, and ionomers are also suitable for use as the frame of the laminated moisture barrier.

For example, US Patent No. 8,303,436 B2 discloses a golf ball having a moisture barrier layer composed of a polyolefin-based composition (column 2, lines 3-4).

"The moisture vapor barrier encapsulates the core to protect it from the negative effects of moisture" (column 1, lines 10-11).

"...wherein the moisture barrier layer is preferably made of a non-ionomeric polyolefin composition".

US Patent No. 4,716,184 discloses epoxy-based encapsulation compositions having enhanced moisture resistance (column 1, lines 34-36). "... or utilizing an epoxy-based encapsulation composition having enhanced moisture resistance which remains intact...", (column 2, lines 67-68 to column 3, lines 1-2). "It is therefore a primary object of the present invention to provide an epoxy-based encapsulation composition having enhanced moisture resistance for semiconductor packaging...". Finally, US Pat. No. 8,399,098 B2

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discloses laminates comprising ionomer-based interlayers having low haze and high moisture resistance (col. 2, lines 14-17). "... to develop ionomer-based compositions for use in security laminates that maintain good optical properties and good moisture resistance...".

[0069]

607 The drawings included in this application are provided for the purpose of illustrating several possible configurations of SPD stacks produced in accordance with the present invention.

609 It should not be construed as limiting the invention, however, as numerous alternative arrangements, optionally utilizing a variety of different materials known to those familiar with the SPD art, will readily suggest themselves to those having at least an ordinary level of skill in the art.

[0070]

615 As noted above, Figure 1 provides a plan view, i.e., a top view of an SPD stack (100) constructed in one possible non-limiting embodiment, with an SPD film (140) having busbars (120) attached to and protruding outwardly from the SPD stack (100).

618 The SPD film (140) with busbars (120) is sandwiched between two or more transparent interlayers (130), which are each laminated between two sheets of glass or plastic substrates (not shown). A moisture barrier material (110) is also laminated between the two glass or plastic substrates (not shown) and adjacent to the transparent interlayer (130) to form a frame within the SPD stack (100).

[0071]

625 FIG. 2 provides a side view of an SPD stackup (200) including a moisture resistant bezel (210) sandwiched between two sheets of glass or plastic substrate (230).

627 Busbars (220) are shown protruding outwardly from between the moisture barrier material (210).

[0072]

631 Although the invention has been described in conjunction with specific embodiments thereof, many other variations and modifications and other applications will be apparent to those skilled in the art.

633 It is preferred, therefore, that the present invention be limited not by the specific disclosure herein, but only by the appended claims.

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(19)中华人民共和国国家知识产权局

(12)发明专利申请

(10)申请公布号 CN 107709003 A
(43)申请公布日 2018.02.16

(21)申请号 201680018390.2

(22)申请日 2016.03.21

(30)优先权数据
62/138,711 2015.03.26 US
15/073,824 2016.03.18 US

(85)PCT国际申请进入国家阶段日
2017.09.26

(86)PCT国际申请的申请数据
PCT/US2016/023361 2016.03.21

(87)PCT国际申请的公布数据
WO2016/154089 EN 2016.09.29

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(51)Int.Cl.
B32B 17/06(2006.01)
B32B 17/10(2006.01)

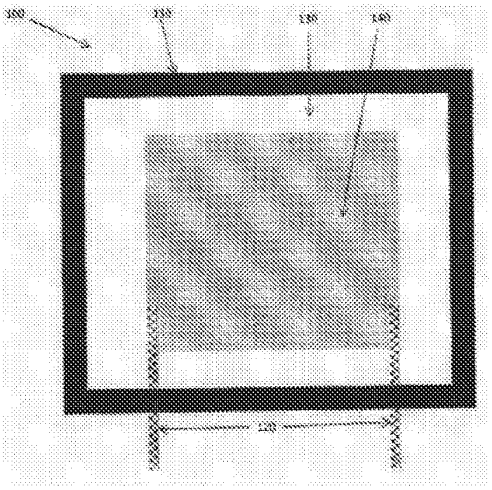
权利要求书2页 说明书8页 附图1页

(54)发明名称

具有改善的湿气保护的夹层玻璃窗

(57)摘要

一种包括湿敏功能嵌件的夹层玻璃窗，该湿敏功能嵌件包含在玻璃窗内，该夹层玻璃窗包括由多个玻璃或塑料层片组成的堆叠，该层片通过位于层片之间的夹层被拼合在一起，其中该堆叠的中心区域包含至少一个光学透明的夹层；该堆叠还包括湿敏功能嵌件；其中该夹层玻璃窗的内周界由边框形成，该边框的厚度大体上对应于玻璃窗内的夹层加嵌件的组合厚度。另外，本文还描述了减少或消除如上构造的夹层玻璃窗内的湿敏嵌件的暴露的方法。



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1.一种包括湿敏功能嵌件的夹层玻璃窗，所述湿敏功能嵌件包含在所述玻璃窗内，所述夹层玻璃窗包括：

包括多个玻璃或塑料层片的堆叠，所述层片通过位于所述层片之间的夹层被拼合在一起，其中所述堆叠的中心区域包括至少一个光学透明的夹层，

所述堆叠中还包括湿敏功能嵌件，

并且其中所述夹层玻璃窗的内周界由边框形成，所述边框包括疏水的防潮材料，所述边框的厚度大体上对应于所述玻璃窗内的夹层加所述嵌件的组合厚度。

2.根据权利要求1所述的夹层玻璃窗，其中，所述边框由选自由环氧树脂类、聚烯烃类、离聚物类和合成橡胶组成的组中的材料形成。

3.根据权利要求2所述的夹层玻璃窗，其中，所述边框由聚异丁烯形成。

4.根据权利要求1所述的夹层玻璃窗，其中，所述湿敏功能嵌件为光阀，所述光阀选自由悬浮颗粒器件、聚合物分散液晶的膜、电致变色光控材料、热致变色光控材料和电泳光控材料组成的组。

5.根据权利要求4所述的夹层玻璃窗，其中，所述湿敏嵌件为悬浮颗粒器件，并且其中所述悬浮颗粒器件包括由两个分隔开的壁形成的室，其中的一个所述壁是透明的，每个所述壁在其内表面上具有电极，并且光调制元件在所述室壁之间位于所述室内。

6.根据权利要求5所述的夹层玻璃窗，其中，所述光调制元件包括颗粒的液体悬浮物或液体悬浮物液滴分布于其中的塑料膜。

7.根据权利要求6所述的夹层玻璃窗，其中，所述膜包括至少一个包括包含分散颗粒的液体的不连续的非交联相的膜或片，这样的不连续相被分散在包覆在一个或多个刚性的或柔性的固态膜或片中的可固化连续相中。

8.根据权利要求7所述的夹层玻璃窗，其中，所述膜包括位于其外表面上的一个或多个附加层，其中所述一个或多个附加层包括能够为所述悬浮颗粒器件提供至少一种性质的膜、涂层、片或它们的组合，所述性质选自由耐刮擦性、防紫外线辐射、红外能量反射、用于将所施加的电场或磁场传输至所述光调制元件的电导率、介电外涂层、着色性、热和声学控制组成的组。

9.根据权利要求5所述的夹层玻璃窗，其中，将一个或多个导电元件附着于所述电极，以使得所述导电元件延伸超过所述膜的周界，从而允许其连接至适合的电压源。

10.根据权利要求5所述的夹层玻璃窗，其中，将所述悬浮颗粒器件与透明热熔胶黏剂膜和/或玻璃或较厚的透明塑料片层压在一起，从而为所述悬浮颗粒器件提供额外的强度和刚度，以及保护其免于破坏所述悬浮颗粒器件的性能特性的环境条件影响。

11.根据权利要求6所述的夹层玻璃窗，其中，所述膜通过交联而被固化，所述交联是通过将非交联的膜暴露于选自紫外线辐射、电子束和热的能量源获得的。

12.根据权利要求1所述的夹层玻璃窗，其中，所述夹层由选自由聚乙烯醇缩丁醛、聚氨酯和乙烯-醋酸乙烯酯组成的组中的材料形成。

13.根据权利要求12所述的夹层玻璃窗，其中，所述夹层由乙烯-醋酸乙烯酯(EVA)形成，并且其中所述EVA为热固性EVA。

14.根据权利要求12所述的夹层玻璃窗，其中，所述夹层由聚乙烯醇缩丁醛(PVB)形成，并且其中所述PVB为声学PVB。

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15.根据权利要求1所述的夹层玻璃窗，其中，至少一个所述层片为塑料层片。

16.根据权利要求1所述的夹层玻璃窗，其中，所述塑料为聚碳酸酯、聚丙烯酸或聚对苯二甲酸乙二醇酯。

17.根据权利要求5所述的夹层玻璃窗，进一步包括附着于所述电极的一个或多个导电元件，以使得所述一个或多个导电元件延伸超过所述膜的周界，从而允许所述膜连接至适合的电压源，并且其中所述边框由所述疏水的防潮材料的两个层片形成，所述两个层片的总厚度大体上等于所述堆叠中的光学透明层加嵌件的总厚度，其中所述导电元件在疏水的防潮材料的所述两个层片之间突出所述叠层之外。

18.用于消除或者至少减少位于夹层玻璃窗内的湿敏功能嵌件暴露于来自所述玻璃窗外侧的湿气的方法，所述方法包括沿着所述玻璃窗的内周界提供由疏水的防潮材料构成的边框，所述边框的厚度基本对应于位于所述夹层玻璃窗内的(多个)夹层和湿敏嵌件的组合厚度。

19.根据权利要求18所述的夹层玻璃窗，其中，所述边框由选自由环氧树脂类、聚烯烃类、离聚物类和合成橡胶组成的组中的材料形成。

20.根据权利要求19所述的夹层玻璃窗，其中，所述边框由聚异丁烯形成。

21.根据权利要求18所述的方法，其中，所述湿敏嵌件为光阀，所述光阀选自由悬浮颗粒器件、聚合物分散液晶的膜、电致变色光控材料、热致变色光控材料和电泳光控材料组成的组。

22.根据权利要求19所述的方法，其中，所述疏水的防潮材料为聚异丁烯。

23.根据权利要求18所述的方法，其中，所述湿敏嵌件为悬浮颗粒器件(SPD)且边框由所述疏水的防潮材料的两个层片组成，并且其中用于将所述悬浮颗粒器件连接至电压源的电引线在所述两个层片之间从所述悬浮颗粒器件延伸至夹层玻璃窗之外。

24.根据权利要求23所述的方法，其中，所述疏水的防潮材料的所述两个层片均由聚异丁烯形成。

25.根据权利要求18所述的方法，其中，所述湿敏嵌件为悬浮颗粒器件(SPD)，并且其还包括在所述SPD中的膜周围提供防潮屏蔽层，所述屏蔽层从所述边框向内定位。

26.根据权利要求25所述的方法，其中，所述防潮屏蔽层由至少一种隔绝水和湿气的疏水的材料组成。

27.根据权利要求26所述的方法，其中，所述防潮屏蔽层由选自由乙烯醋酸乙烯酯、聚乙烯醇缩丁醛和聚氨酯组成的组中的材料形成。

28.根据权利要求18所述的方法，其中，所述湿敏嵌件为悬浮颗粒器件(SPD)，并且其中所述方法进一步包括在层压所述玻璃窗之前，从所述SPD的膜中除去至少一些被捕获的湿气。

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具有改善的湿气保护的夹层玻璃窗

[0001] 相关申请的引用

[0002] 本专利申请是非临时申请并且要求于2015年3月26日提交的标题为“具有改善的光学性能的夹层玻璃窗”的美国临时专利申请第62/138,711号的权益，其全部内容以引用方式结合于此作为参考。

发明领域

[0003] 本发明涉及包括湿敏装饰性或功能嵌件的夹层玻璃窗(laminated glazings)。这样的夹层玻璃窗可以包含诸如在包含颗粒悬浮物的光阀中使用的膜的嵌件，在本文中该光阀通常是指悬浮颗粒器件或SPD光阀，或者简称为SPD。这样的夹层玻璃窗也可以包括其他类型的光阀，例如聚合物分散的液晶(LC)、电致变色、热致变色或电泳光控材料。该夹层玻璃窗包含夹层的组合，其中该叠层的中心区域包含至少一个光学透明的夹层，并且该叠层的周界由与叠层中的(多个)夹层加嵌件具有相似厚度的疏水的防潮材料的边框形成。

[0004] 发明背景

[0005] 夹层玻璃是一类安全玻璃，当其碎裂时会保持在一起。如果发生破坏的话，其会被位于其两层或多层玻璃之间的夹层固定，该夹层通常为聚乙烯醇缩丁醛(PVB)、聚氨酯(PU)或乙烯-醋酸乙烯酯(EVA)。即使被破坏，该夹层也能保持玻璃的层粘在一起，并且其高强度防止玻璃形成大的尖锐碎片。当撞击不足以完全刺穿玻璃时，这产生了独特的“蜘蛛网”碎裂图案。在热固性EVA的情况下，实现了交联的EVA与玻璃粘结。所有的上述夹层能够与非玻璃基材(例如聚碳酸酯、聚丙烯酸、PET或其他类型的塑料)一起使用，以实现类似的粘结效益。

[0006] 当存在人类冲击的可能性或者当破碎时玻璃会落下的情况下，以及用于建筑学应用时，通常会使用夹层玻璃。天窗玻璃窗和汽车挡风玻璃通常使用夹层玻璃。在需要抗飓风设施的地理区域内，通常在店面的外墙、幕墙和窗户中使用夹层玻璃。

[0007] 夹层玻璃也用于增加窗户的隔音等级，相比于相同厚度的非夹层玻璃窗玻璃，其显著改善了声衰减。出于此目的，对于该夹层使用特殊的“声学PVB”化合物。在EVA材料的情况下，不需要额外的声学材料，因为EVA提供了隔音。窗户的夹层玻璃的额外性能是，PVB和EVA夹层可以包含紫外线(UV)吸收体，其能够阻挡大多数紫外线辐射。例如，热固性EVA能够阻挡高达99.9％的UV射线。

[0008] 夹层玻璃窗通常具有被层压在玻璃或塑料基材和透明夹层之间的嵌件，以制成装饰性或功能性的夹层玻璃窗。装饰性嵌件的实例可以是彩色塑料、织物或者纸张或丝绸上的图片。功能嵌件包括智能技术，例如SPD，以及LC、光致变色、电致变色和热致变色材料。

[0009] 已知光阀用于光的调制超过八十年。在那期间这样的光阀已被用于大量应用中，包括但不限于，例如，字母数字显示器和电视显示器；灯具、照相机、显示器和光纤的滤光片；以及窗户、天窗、玩具、遮光板、眼镜、护目镜、镜子、后视镜、光导管(light pipes)等等，以根据情况控制通过其中的光或者从其反射的光量。窗户的实例包括，但不限于，商业建筑、温室和住宅的建筑物窗；机动车辆、船、火车、飞机和航天器的窗户、遮阳板和天窗；包括

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窥视孔的门上的窗;以及家用电器输诸如烤箱和冰箱包括其隔室的窗。

[0010] 如本文中使用的,术语"光阀"描述了由以小距离隔开的两个壁形成的室(cell),其具有至少一个透明的壁。壁上具有电极,通常是透明的、导电涂层的形式。可选地,壁上的该电极上可以具有薄的透明介电外涂层(overcoatings)。该室包括光调制元件(light-modulating element)(在本文中其有时是指代可活化材料),其可以是,但不限于,颗粒的液体悬浮物或者可替代地,整个元件的全部或一部分可以包括塑料膜,颗粒的液体悬浮物的液滴分布于其中。

[0011] 该液体悬浮物(在本文中其有时是指代光阀悬浮物或液体光阀悬浮物)包括悬浮于液体悬浮介质中的小颗粒。在不存在施加电场的情况下,SPD光阀的液体悬浮物中的颗粒可能由于布朗运动而呈现(assume)随机位置。因此,进入该室内的光束被反射、透射或吸收,这取决于室的结构、颗粒的性质和浓度以及光的能量含量。因此,利用这种类型的颗粒运动的SPD光阀通常在OFF状态下相对较暗。然而,当施加电场穿透光阀中的液体光阀悬浮物时,颗粒变得整齐排列,并且对于许多悬浮物而言,大多数的光能够穿过该室。因此,该SPD光阀在ON状态下是相对透明的。

[0012] 对于许多应用而言,优选所有或者部分的可活化材料(即,光调制元件)为塑料膜而不是液体悬浮物。例如,在用作可变透光窗的光阀中,由于静水压力效应,液体悬浮物的液滴分布于其中的塑料膜优选仅为液体悬浮物,例如,与高光悬浮柱(high column of light suspension)相关的膨胀(bulging),能够通过使用膜而避免并且可能的泄漏风险也能够被避免。利用塑料膜的另一个优点是,在塑料膜中,颗粒通常仅存在于非常小的液滴中,并且因此当膜被电压反复地活化该时,并不会发生明显的积聚。

[0013] 如本文中使用的光阀膜(在本文中有时也被称作SPD膜)意指膜或片,或者一个以上的膜或片,其包括所使用的或预期用于光阀中的颗粒的悬浮物。这样的光阀膜通常含有包括分散颗粒的液体的不连续的非交联(non-crosslinked)相,其被称为液体光阀悬浮物,这样的不连续相分布于整个可固化(curable)连续相,该可固化连续相被包覆(enclosed)在一个或多个刚性的(rigid)或柔性的(flexible)固态膜或片中。可以形成部分光阀膜的固化乳胶有时也被称作膜或膜层。该光阀膜和/或包括光阀膜的夹层玻璃堆叠也可以包括一个或多个附加层,例如但不限于,膜、涂层或片或者它们的组合,其可以提供具有如下性质中一种或多种的光阀膜,例如,(1)耐刮擦性(scratch resistance),(2)防紫外线辐射,(3)红外能量反射,(4)用于将所施加的电场或磁场传输至可活化材料的电导率,(5)介电外涂层,(6)着色性(color tinting),(7)加热元件和/或(8)声学控制。可以在如发明内容部分中所讨论的层压程序期间,用本领域技术人员已知的压敏胶黏剂(PSA)或者用夹层的额外层片将该额外的层粘附于所述光阀膜。

[0014] SPD膜的常见(但不限于此)构造包括5个层,即,以从第一侧至第二相对侧的顺序为:(1)聚对苯二甲酸乙二醇酯("PET")塑料的第一片,方便地其厚度为5-7mils,(2)非常薄的氧化铟锡("ITO")导电涂层或替代的导电涂层,其在PET的第一片上起到电极的作用或者能够起到电极的作用,(3)固化的(即,交联的)SPD乳胶的层,其厚度通常为2-5mils和(4)第二ITO涂层(或替代的导电涂层),其在(5)第二PET塑料基材上起到电极的作用或者能够起到电极的作用。如前文所述,提供其他功能的附加层可以任选地添加到上文所述的五层SPD膜。通常,将铜箔、导电织物等等粘贴至电极,以使得其延伸超过SPD膜的周界,以便于母线

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(busbar)连接至适合的电压源。此外，该SPD膜能够被层压，例如，与透明热熔胶黏剂膜和/或玻璃或较厚的透明塑料片层压在一起，以提供强度和刚度并且保护组合单元的各个部分免受使其性能特性受损的环境条件的影响。

[0015] 美国专利第5,409,734号例示了一种通过从均质溶液中相分离制成的非交联的光阀膜。通过乳胶交联(固化)制成的光阀膜也是已知的。本发明的方法具体地涉及使用后一种类型的膜，即，包括通过交联乳胶形成的层的膜以及尤其制备的层压膜。参见，例如，美国专利第5,463,491号和第5,463,492号，以及美国专利第7,361,252号，其全部受让于本发明的受让人。美国专利第6,301,040号、第6,416,827号和第6,900,923 B2号中描述了各种类型的SPD乳胶，以及其固化方法，其全部受让于本发明的受让人。美国专利第6,900,923 B2号的实施例5的这种膜的非限制性实例按如下制备：将0.002g的Irgacure 819(汽巴精化(Ciba Specialty Chemicals))光引发剂("PI")溶解于2mL的氯仿并加入1g实施例1中所述的母体(matrix)聚合物。将该PI溶液与母体聚合物充分混合并通过将该混合物置于60℃的真空烘箱中除去氯仿溶剂。向其中加入0.62g的含有甲基丙烯酸月桂酯/HEMA(lauryl methacrylate/HEMA)悬浮聚合物(0.56g，如在该专利的实施例3中合成的)的多碘化合物结晶糊(polyiodide crystal paste)。将所得混合物充分混合，并且用刮刀将所获得的乳胶施加至导电涂覆的聚酯基材成为2mil的厚涂层，与空白导电涂覆的聚酯基材配对并且用紫外线辐射(8600mJ/cm^2/min)固化2分30秒。这样的膜及其变体可以通过将膜暴露于(1)紫外线辐射、(2)电子束或(3)热而产生的交联来固化。

[0016] 本申请中引用的所有专利和专利申请以及其他参考文献通过引用并入本文。

[0017] 现有技术SPD叠层(laminates)的缺陷

[0018] 上文中所讨论的所有夹层玻璃窗必须被保护以免于湿气渗透进该叠层的内部，尤其是经由该叠层的边缘。例如，US 2002/0126249A1，"穿透式或反射式液晶显示器以及其新制造方法(Transmissive or reflective liquid crystal display and novel process for its manufacture)"第[0004]段记载了"……氧气和湿气均可以化学侵蚀液晶。"

[0019] 夹层玻璃窗的玻璃或厚塑料基材会防止湿气渗透通过该夹层玻璃窗的相对表面，该相对表面代表大多数暴露于空气的叠层的表面。然而，通过PVB、EVA或PU夹层的湿气渗透，长时间暴露于湿气后，会导致浑浊外观和分层(delamination)(玻璃或塑料基材与(多个)夹层分离)。在具有嵌件的夹层玻璃窗的情况下，湿气渗透也能够损坏嵌件且功能嵌件(例如SPD)会变得视觉上退化和/或不可操作。

[0020] 现有技术的SPD膜和包括(多个)这样的SPD膜的叠层能够在SPD膜的周界处显影(develop)图案，在该周界处浅蓝色区域或"光帧(light frame)"可见。当SPD膜或SPD膜的叠层暴露于高温和/或湿气时，该光帧显影。

[0021] 如上文所述，SPD膜或SPD膜的叠层长时间暴露于高湿度能够导致光帧出现。美国专利第7,361,252号(受让于本发明的受让人)描述了使用胶带来密封SPD膜的边，从而防止热熔粘结夹层材料与固化的SPD乳胶接触，并且该胶带还起到物理屏障的作用以防止例如，湿气进入到夹层材料中。然而，这样的胶带仅具有适中的防潮性能。

[0022] 现有技术的SPD膜的另一个缺陷为，如果不采取措施将SPD膜与这样的湿气的来源分离，则随着时间的变化，固化的乳胶倾向于通过该SPD膜的暴露边吸收湿气。SPD膜或SPD膜的叠层随后暴露于湿气能够导致诸如上述的光帧和操作丧失的这样的缺陷。

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[0023] 美国专利第8,670,173号(受让于本发明的受让人)特别描述了使用位于玻璃或塑料基材的整个外部边缘部分的防潮屏蔽层以防止沿着该夹层玻璃窗的SPD膜的周界形成光帧。然而,'173号专利中使用的密封剂和胶带被施加至夹层玻璃窗的外部边缘,其限制了能够施加至相对小的边缘表面区域的密封剂材料的量,并且将密封剂暴露至在处理期间可能产生穿孔或孔隙的损伤中。因此,尽管采用这种方法可获得改善的耐久性,但是仍需要增强防止湿气渗透通过夹层玻璃窗。如上文所述,这些方法也可被应用于需要保持光学透明的和/或具有需保护免受湿气影响的嵌件的任何夹层玻璃窗。

[0024] 因此,本申请的发明人致力于开发一种制造包含嵌件的夹层玻璃窗的方法,该嵌件例如但不限于本文中所述类型的光阀,其中与湿气相关问题的出现,例如不期望的光帧、操作损失和/或出现浑浊的非透明夹层,被消除或大幅地减少。

发明内容

[0025] 因此,在第一种实施方式中,通过围绕SPD叠层的周界提供与叠层加嵌件内的光学透明的夹层总厚度具有相同或相似厚度的防潮屏蔽层以围绕SPD膜形成边框,消除或条件至少大幅地减少了这样的(多个)光帧、混浊外观和操作损失的出现。本领域技术人员已知的层压条件和实践,以及具有多个夹层/玻璃或塑料基材的层片的SPD膜的各种构型以及包括早前所述的附加层的各种构型可用于本文所述的任意实施方式中。美国专利第7,361,252号(受让于本发明的受让人)中的用于层压SPD膜的方法的非限制性发明内容(summary)涉及创建"堆叠",该堆叠依次包括:第一玻璃片、第一夹层片、所述SPD膜(其包括夹在两个具有附接至从所述ITO涂层突出的铜箔母线的涂覆有ITO的PET基材片之间的固化的SPD乳胶)、第二夹层片以及第二玻璃片,其全部基本上彼此叠合(congruent)放置。将该堆叠放置在位于雕刻压机(Carver Press)内的真空袋中并且施加强真空(大于29英寸汞柱)。然后压机的压盘被布置以接触本层压的堆叠外侧并且将其升温以影响堆叠内的夹层的熔化。然后,将压盘冷却以固化用于将该堆叠粘附至SPD叠层中的夹层。本发明第一种实施方式中的防潮材料边框将从玻璃片外边缘处开始并入到堆叠中,并且向内延伸至叠层内的SPD膜或嵌件的相邻位置。

[0026] 在第二种实施方式中,其中需要母线电线或其他适合的电引线为层压的嵌件(例如,SPD、LCD等)供电,将两层所述防潮材料并入到上文所述的堆叠中。两个层中的每一层具有相同的尺寸和厚度。另外,两层防潮材料的总厚度大约等于层压堆叠中光学透明的夹层和嵌件的总厚度。适合的电引线将从防潮材料的两个层片之间突出至叠层之外,以防止湿气在连接点处进入叠层。

[0027] 在又一实施方式中,其中嵌件被进一步层压到一个或多个从这样的膜向外定位的附加膜、层片等上,通过将防潮粘接材料并入至层压堆叠中以在如此制成的叠层边缘的内部形成边框,附加地采取步骤来保持低湿气侵入。在上述实施方式中,尽管在如下实施例中使用了具体品牌的防潮粘接材料,但是应该理解,包括排斥水和湿气的疏水材料的任意粘接材料均适合用作叠层的防潮材料的边框,其包括但不限于,环氧树脂类(epoxies)、聚烯烃类(polyolefins)、离聚物类(ionomers)和合成橡胶(synthetic rubbers)如异丁烯聚合物(isobutylene polymers)。应该注意,在本文中所述的层压步骤之前或之后,还应该实施减少或者消除来自美国专利第8,670,173号(受让于本发明的受让人)中描述的层压堆叠的

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湿气的其他程序包括：(1)从SPD膜除去一些或全部任意捕获的湿气；(2)从边框向内提供围绕SPD膜的防潮屏蔽层；以及(3)使用位于形成本文中所述的SPD叠层的玻璃或塑料基材的整个外部边缘部分周围的防潮屏蔽层。

附图说明

[0028] 图1是根据本发明的SPD叠层的平面图，其中，与叠层内的光学透明的夹层具有相同或相似厚度的防潮材料被并入到层压堆叠中以形成防潮边框；以及

[0029] 图2是根据本发明的SPD叠层的侧视图，其示出了从防潮材料之间突出到叠层之外的叠层内的SPD膜的母线。

具体实施方式

[0030] 进行初步测试以确定聚异丁烯(PIB)在阻挡湿气渗透方面的有效性。用于该初步测试的PIB和本发明中的SPD叠层为HelioSeal PVS 101，获自Michigan Center,MI的ADCO。该测试由沿着玻璃基材的表面的周界施加PIB材料和将相同尺寸的第二玻璃基材夹在该PIB材料之间组成。在将第二玻璃基材夹在PIB之间(样品A)之前，将湿敏指示剂条(氯化钴试纸(3mm x 45mm的条)，获自Avogadro Lab Supply,Miller Place,NY)置于第一玻璃基材的内部上。以如上所述的相同方式制备两个其他样品，在一种情况下，在将施加至第一玻璃基材的PIB夹在其间(样品B)之前，将铜箔母线置于在内部处开始并且向外延伸以使得其突出至第二玻璃基材之外。在第二种情况下，在将第一PIB涂覆的玻璃基材夹在第一基材之间(样品C)之前，将施加至玻璃基材和铜箔母线二者的PIB层在内部处开始并且向外延伸超过PIB以突出超过第二玻璃基材。所有这三个样品都如上文所述含有湿敏指示剂条。将三个样品放置在干燥器的上部，干燥器在其下部具有贮水槽。带孔的陶瓷板防止样品与干燥器底部的水直接接触。将该干燥器置于60℃烘箱中以创造高温高湿环境。

[0031] 样品A已被放置于60℃湿度箱中227天，在样品内部的高敏感指示剂条未观察到颜色变化。这显示没有湿气进入到该样品内部。

[0032] 在60℃湿度箱中5天后，样品B中的指示剂条的颜色从蓝色变为白色。这显示湿气已经从该样品的边缘进入。

[0033] 样品C已被放置于60℃湿度箱中209天，在样品内部的高敏感指示剂条未观察到颜色变化。这显示没有湿气进入到该样品内部。

[0034] 结果的比较显示，样品A的有效PIB湿气屏障因样品B中的突出母线构造而受到损害。

[0035] 由于样品B的铜箔母线的两面不像样品C中那样在其突出至样品外部被PIB覆盖，因此认为湿气能够在样品周界的玻璃-铜箔界面处进入样品B的边缘。因此，样品C中的两个PIB层片之间的母线的定位防止了湿气进入样品C的内部。

[0036] 考虑到上述结果，利用美国专利第7,361,252号(受让于本发明的受让人)中所述的层压程序制备了一系列并入SPD膜作为嵌件的SPD叠层。用作这些叠层的EVA夹层为获自Interlayer Solutions,Montreal,Canada的EVA层。所有所制备的SPD叠层将湿敏指示剂条并入至层压堆叠中，其在叠层中定位于邻近SPD膜。用于这些叠层的指示剂条是湿度检测指示剂条(Humidity Detection strips)，20%-80%，Part#33813-2080，其获自Indigo

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Instruments,www.indigo.com。

[0037] 因此，如上文所述，为了进一步研究在SPD膜和SPD膜的叠层中湿气对于光帧的出现、混浊外观和操作损失的影响，将具有不同构造的SPD叠层置于其下部具有贮水槽的干燥器的上部。带孔的陶瓷板防止SPD叠层与干燥器底部的水直接接触。将该干燥器置于60℃烘箱中以创造SPD膜和SPD叠层不能正常暴露于该环境中的高温高湿环境。然而，创造这些极端条以使得将会在合理的期间获得有意义的测试结果。将该含有样品的湿气饱和的干燥器置于60℃烘箱中并且周期性评价该样品的1)通过湿气指示剂条检测的在叠层中存在湿气；2)SPD膜中光帧的形成；3)叠层中透明夹层的外观从透明变为浑浊/混浊的变化；以及4)叠层中的SPD膜的OFF状态和ON状态透射率。

[0038] 在其中将胶带固定至SPD膜边缘的构造中，所使用的胶带为具有硅酮(silicone)胶黏剂的Teflon透明胶带(McMaster Part#7562A11)。

[0039] 如上文所述，所述对包含叠层堆叠的SPD膜和夹层应该如美国专利第8,670,173号中所述进行干燥，出于完整性的目的在此重复。将SPD膜和夹层置于干燥器的上部，该干燥器在其底部具有防潮剂(desiccant)贮槽。将夹层预先储存在湿度受控区域中，该区域的相对湿度为<25%。防潮剂可以是任意已知类型，包括但不限于，硅胶、氧化钙、硫酸钙和分子筛。带孔的陶瓷板防止SPD膜和夹层与干燥器底部的防潮剂直接接触。将含有该SPD膜和夹层的干燥器抽真空至0.001托的压力并且在该真空下保持3天。

[0040] 用由Byk-Gardner制造的彩色球可见分光光度计(Color Sphere Visible Spectrophotometer)，通过向叠层的突出母线施加100V/60Hz的电场以获得ON-state透射率，来测量每个SPD叠层的初始ΔT或可见光透射率范围(ON状态透射率-OFF状态透射率)。在湿度测试期间周期性重复这些光学测量。

[0041] 在湿度测试期间周期性重复层压之后，拍摄每一个SPD叠层在OFF和ON透射状态的数字照片。该照片被用于记录SPD膜中光帧的开始并且监控叠层中湿气(指示剂)条以监测叠层中湿气的存在。

[0042] 结果和讨论

[0043] 以下是用所测试的玻璃基材制备的SPD叠层的表述并且表1披露了60℃湿度箱测试的结果。

[0044] 测试样品鉴定

[0045] 1.EVA常规叠层

[0046] 2.粘附有SPD膜的EVA叠层+GS22胶水密封剂

[0047] 3.EVA常规叠层+PIB密封剂

[0048] 4.EVA+PIB边框叠层

[0049] 5.EVA+粘附有SPD膜的PIB边框叠层，

[0050] 6.EVA+粘附有SPD膜的2层片PIB边框叠层，PIB层片之间的母线

[0051] 表1

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[0052]

叠层#	指示剂条指示的湿气	光帧的出现	浑浊夹层外观	ΔT 变化天数和状态
1	4 天	26 天	66 天	在 101 天时为-27.33，失效
2	4 天	48 天	66 天	在 80 天时为-5.96，故障
3	4 天	58 天	101 天	在 122 天时为-19.81，被中止
4	无	无	无	在 410 天时为-3.9，继续
5	无	无	无	在 141 天时为-1.37，继续
6	无	无	无	在 418 天时为-1.62，继续

[0053] 表1中做标记的栏，“指示剂条指示的湿气”揭示了叠层中的湿气水平达到20％之前经过的60℃湿度箱的样品暴露天数。结果显示，在叠层的外部边缘周围没有密封剂的叠层(叠层#1)或者在叠层的外部边缘周围使用GS22 Glue(热熔胶，由Bostik of Wauwatosa，WI制造)(叠层#2)或PIB(叠层#3)作为密封剂的叠层仅能防止湿气进入叠层4天。

[0054] 反之，将PIB并入到层压堆叠中以形成边框的叠层#4-6，分别使得湿气不能进入叠层410天、410天和418天，并且测试继续进行。

[0055] 表1中做标记的栏，“光帧的出现”揭示了叠层中的SPD膜的周界处观察到光帧形式的降解之前经过的60℃湿度箱的样品暴露天数。再次，结果显示，在叠层的外部边缘周围没有密封剂的叠层(叠层#1)或者在叠层的外部边缘周围使用GS22 Glue(叠层#2)或PIB(叠层#3)作为密封剂的叠层分别在26天、48天和58天内在SPD膜中出现光帧。

[0056] 相比之下，将PIB并入到层压堆叠中以形成边框的叠层#4-6随着测试的进行分别在SPD膜中未显影光帧410天、410天和418天。

[0057] 表1中做标记的栏，“浑浊夹层外观”揭示了透明的EVA夹层变得浑浊之前经过60℃湿度箱的样品暴露天数。结果显示，叠层#1-3分别在66天、66天和101天后出现浑浊外观。该浑浊外观最大可能是在样品暴露4天后开始由于持续湿气渗透进这些叠层的结果(参见，表1和上文讨论)。

[0058] 叠层#4-6的夹层分别在410天、410天和418天后在SPD膜中仍未出现浑浊外观，并且测试继续进行。这些结果与表1中针对叠层#4-6的湿气和光帧结果互补。

[0059] 表1中做标记的栏，″ΔT变化天数和状态″列出了在叠层中SPD膜的可见光透射率范围从其初始ΔT值至其ΔT值长期暴露于60℃湿度箱之后的变化。这些结果显示，在叠层的外部边缘周围没有密封剂的叠层(叠层#1)或者在叠层的外部边缘周围使用GS22 Glue(叠层#2)或PIB(叠层#3)作为密封剂的叠层具有ΔT的显著损失。由于ΔT的严重损失，叠层#1测试在101天之后不再继续进行。由于SPD母线故障，在暴露80天后已经损失了5.96透射率点数的叠层#2，不得不不再继续进行，其阻止了ON状态透射率的测量，这可能是由于湿气进入叠层而造成的。然而，应该认为基于湿气渗透进叠层的较差结果以及在SPD膜中光帧显影，如果测试继续进行，ΔT将会继续减小。类似于叠层#2的关于湿气渗透进叠层的较差结果以及在SPD膜中光帧显影，在暴露122天后，叠层#3损失了19.81透射率点数，并且由于ΔT的显著损失而中止实验，这表明ΔT将会继续减小。

[0060] 在暴露410天后，叠层#4损失了3.90透射率点数，并且测试继续进行。在分别暴露410天和418天之后，叠层#5-6仅损失了1.37和1.62透射率点数，且测试继续进行。叠层#5类似于前文中初步测试的样品B其中铜箔母线邻近于玻璃基材，并且叠层#6类似于初始测试

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的样品C其中铜箔母线夹在两个PIB层片之间。因此，随着测试继续，相比于叠层#5，叠层#6将有望保持更长时间的防潮特性。

[0061] 因此，叠层#4-5的60℃湿度箱结果证实了本发明第一种实施方式，其中防潮材料边框被并入到堆叠中，该堆叠在玻璃片的外部边缘处开始并且向该叠层中邻近于透明夹层或SPD膜或嵌件的位置向内延续。

[0062] 此外，叠层#6的60℃湿度箱和初步60℃湿度箱测试的样品C的结果证实了本发明的优选第二种实施方式，其中组合防潮材料的两个层片以形成防潮材料的边框，其被并入到堆叠中，该堆叠在玻璃片的外部边缘处开始并且向该叠层中邻近于透明夹层或SPD膜或嵌件的位置向内延续。

[0063] 适合的电引线会从防潮材料的两个层片之间突出到叠层之外，以防止湿气在连接点处进入该叠层。

[0064] 如上文所述，环氧树脂类、聚烯烃类和离聚物类也适合用作叠层的防潮材料的边框。例如，US专利8,303,436 B2披露了具有由聚烯烃类组合物组成的湿气屏蔽层的高尔夫球(第2栏，第3-4行)。“湿蒸汽屏蔽层包封核心以保护其免于湿气的负面影响”(第1栏，第10-11行)。“……其中该湿气屏蔽层优选地由非离聚物类聚烯烃类组合物制成”。美国专利第4,716,184披露了具有增强防潮性的环氧树脂类包封组合物(第1栏，第34-36行)。“……或利用仍保持完整的具有增强的防潮性的环氧树脂类包封组合物……”，(第2栏，第67-68行至第3栏，第1-2行)。“因此，本发明的主要目的是提供对于半导体封装具有增强的防潮性的环氧树脂类包封组合物……”。最后，美国专利第8,399,098 B2披露了包含离聚物类夹层的叠层，其具有低雾度和高防潮性(第2栏，第14-17行)。“……以开发在安全性叠层中使用的离聚物类组合物并且其能够保持良好的光学特性和良好的防潮性……”。

[0065] 本申请中包含的附图是为了举例说明根据本发明生产的SPD叠层的若干可能构造而提供。其不应被解释为限制本发明，然而，由于大量替代性的布置，即，可选地利用SPD领域熟悉的已知的各种不同材料，将容易地被那些至少具有本领域的通常水平的人员想起。

[0066] 如上文中所指出的，图1提供了平面图，即，在一种可能的非限制性实施方式中构造的SPD叠层(100)的俯视图，具有母线(120)的SPD膜(140)被附着至SPD叠层(100)并从SPD叠层(100)向外突出。具有母线(120)的SPD膜(140)被夹在两个或更多个透明夹层(130)之间，它们均被层压在两片玻璃或塑料基材(未示出)之中。防潮材料(110)也被层压在该两片玻璃或塑料基材(未示出)之中并且邻近于所述透明夹层(130)以在SPD叠层(100)内部形成边框。

[0067] 图2提供了包括夹在两片玻璃或塑料基材(230)之间的防潮边框(210)的SPD叠层(200)的侧视图。母线(220)被示出为从所述防潮材料(210)之间向外突出。

[0068] 尽管已经结合其特定实施方式描述了本发明，但是对于本领域技术人员而言，许多其他变体和修改以及其他应用是显而易见的。因此，优选的是，本发明不应被限于本文中具体披露的内容，而应仅由所附权利要求限定。

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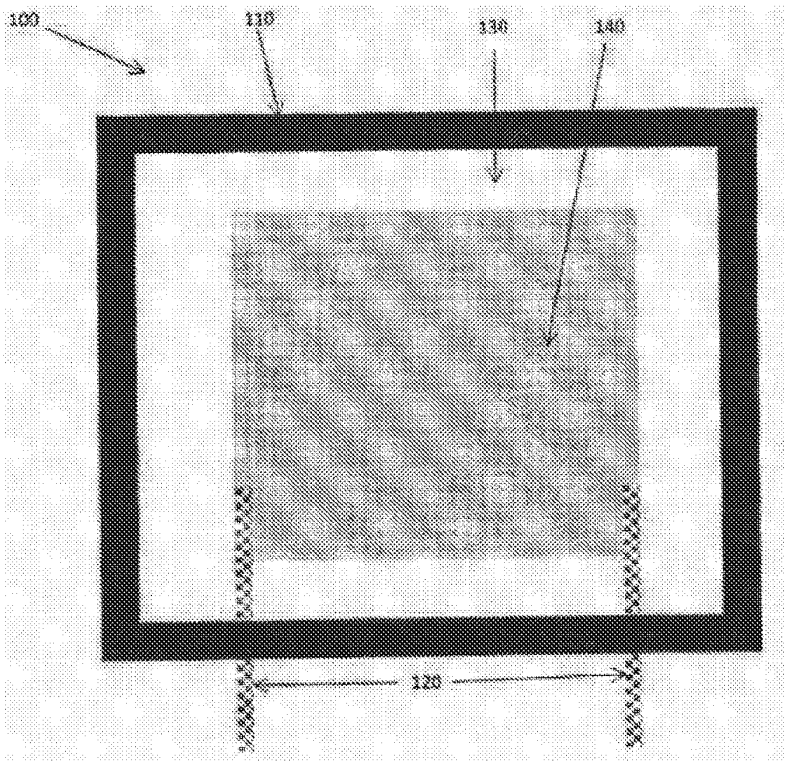


图1具有PIB边框的SPD叠层的俯视图

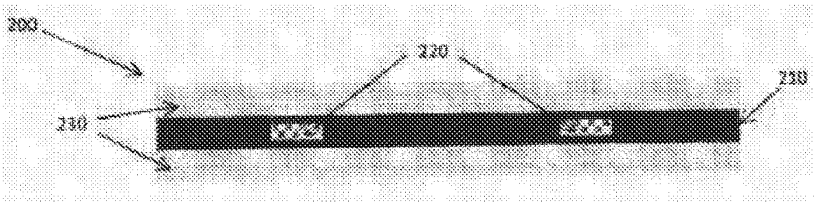


图2具有PIB边框的叠层的侧视图

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Espacenet

Bibliographic data: CN104375350 (A) — 2015-02-25

Multifunctional controllable electrochromic device and manufacturing method thereof

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Classification: **- international:** *G02F1/153*
- cooperative: G02F1/153 (CN)

Application number: CN201410606612 20141031 Global Dossier

Priority number(s): CN201410606612 20141031

Also published as: CN104375350 (B)

Abstract of CN104375350 (A)

The invention discloses a multifunctional controllable electrochromic device and a manufacturing method of the multifunctional controllable electrochromic device. The multifunctional controllable electrochromic device comprises a first substrate and a second substrate opposite to the first substrate. A first conductive material layer and a second conductive material layer are arranged on the inner side of the first substrate and the inner side of the second substrate respectively, an electroactive material layer is arranged on the inner side of the first conductive material layer, sealing adhesives are arranged on the periphery of the second conductive material layer and the periphery of the electroactive material layer, the sealing adhesives, the second conductive material layer and the electroactive material layer form a cavity in an encircling mode, and the cavity is filled with an electrochromic electrolyte solution. Compared with the prior art, the multifunctional controllable electrochromic device and the manufacturing method of the multifunctional controllable electrochromic device have the advantages that the semi-fixed and semi-free electrochromic device can solve the matching problem of a full-fixed electrochromic device and the layering problem caused by long-term voltage applying of a full-free electrochromic device and has good controllability, and the color and the optical properties of the whole device can be adjusted by adjusting the material of a free part.

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DESCRIPTION CN104375350A

10 A multifunctional controllable electrochromic device and its manufacturing method

[0001]

14 Technical Field

[0002]

18 The invention relates to the field of electrochemistry, and in particular to a multifunctional controllable electrochromic device.

[0003]

23 Background Art

[0004]

27 Electrochromic devices can change their own absorption or reflectivity under a certain voltage to achieve the purpose of adjusting light and temperature.

29 Electrochromic technology has been developed for many years and has a wide range of applications, including transportation, display, building energy conservation and other fields. With the continuous improvement and improvement of its technology, it will still have greater application prospects.

[0005]

35 Electrochromic devices can be roughly divided into two categories according to the existence of electrochromic materials: free type and fixed type.

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[0006]

Free-type devices have been studied to a very mature level. They are composed of cathode electrochromic materials and their matching anode electrochromic materials. These materials are dissolved in electrolytes. In addition, various stabilizers are added to the electrolyte, such as thermal stabilizers, UV stabilizers, etc.

This type of device usually has high stability, such as thermal stability and UV stability, because it has no interface problems. In addition, due to the simple structure of the device, its preparation process is simple.

Since all electrochromic materials are dissolved in the solution, if the substrate materials on both sides are the same, the device itself has no distinction between positive and negative electrodes, and applying positive and negative voltages can drive the material to color.

Since all electrochromic materials are dissolved in the electrolyte and the material itself has no storage capacity for ions or electrons, this type of device has a self-erasing function.

However, this type of device has a disadvantage. Since the coloring inside the device relies on the concentration diffusion and ion migration of the electrochromic material itself to the surface of the ITO electrode to participate in the process of gaining and losing electrons, due to the difference in electric field strength, once this type of device is subjected to voltage for a long time, obvious stratification will occur and it is difficult to recover in a short time, affecting the actual use effect.

[0007]

The fixed device structure usually includes a working electrode, an electrolyte, and a counter electrode.

The electrochromic materials are all prepared into thin films and attached to a conductive substrate. The color-changing materials of this type of device can be inorganic, organic polymers and organic small molecules. Since the materials of this type of device are attached to the substrate, ions can be stored inside the film (in the lattice or gaps) during the color change process, giving the device a certain memory function. However, since the materials need to be prepared into films, there are certain requirements for the matching between the two color-changing electrodes during the preparation of the device. In addition, the extra interface also increases the probability of device damage.

[0008]

Summary of the invention

[0009]

The purpose of the present invention is to overcome the deficiencies of the prior art and provide a multifunctional controllable electrochromic device.

[0010]

The present invention is achieved through the following technical scheme: a multifunctional controllable electrochromic device, comprising a first substrate and a second substrate arranged opposite to each other, a

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first conductive material layer and an electroactive material layer are arranged on the inner side of the first substrate, the first conductive material layer is located between the first substrate and the electroactive material layer, a second conductive material layer is arranged on the inner side of the second substrate, a sealant is arranged on the peripheral edges of the second conductive material layer and the electroactive material layer, the sealant, the second conductive material layer and the electroactive material layer surround a cavity, and the cavity is filled with an electrochromic electrolyte.

83 Compared with general electrochromic devices, this scheme reduces one layer of structure and combines the characteristics of both fixed and free devices, namely, fixed electrode film and electrochromic electrolyte.

91 This can avoid the easy stratification phenomenon of free-type electrochromic devices and the difficult charge matching problem of fixed-type electrochromic devices.

[0011]

96 The reason why free-type electrochromic devices produce stratification is that the two matching electrochromic materials are in a freely dissolved state. Due to the resistance distribution of the conductive substrate, the distribution of the electric field in the device becomes smaller and smaller from the edge of the applied voltage to the other side. Therefore, long-term electric field driving will cause the two materials to move to places where the positive and negative fields are strong respectively, and thus gather together near the positive and negative electrodes to form a more obvious stratification.

102 The difference between the semi-fixed and semi-free type device mentioned in the present invention and the free type electrochromic device is that a fixed type electrochromic film is introduced. The evenly distributed fixed type electrochromic film enables the matching free type electrochromic material to be evenly distributed on the opposite conductive substrate, thereby avoiding stratification.

[0012]

109 For fixed electrochromic devices, the electrochromic materials exist in the form of thin films, so there are certain difficulties in measuring the amount of electrochromic materials. The amount of material essentially determines the electrons required for the coloring and fading process of the electrochromic film.

112 At the same time, the stability of a device is affected by the charge matching of the thin film electrodes. Therefore, factors such as the thickness of the two matching thin film electrodes and the film growth density need to be considered during the device manufacturing process. This greatly increases the complexity and uncertainty of the production of electrochromic devices.

116 Here, we abandon the traditional fully fixed thin film electrodes and introduce free electrochromic materials. The advantage is not only that the concentration of the electrochromic material can be adjusted arbitrarily, but also that the redox balance of the device can be adjusted by introducing auxiliary redox pairs.

[0013]

122 As an improvement, the components of the electrochromic electrolyte include: a solvent, an electrolyte salt and an electrochromic preparation.

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[0014]

128 As an improvement, the electrolyte salt is composed of at least one salt component, and the salt components include: LiClO ₄ , LiPF ₆ , LiCl, LiBr, LiBF ₄ , ZnCl ₂ , LiAsF ₆ , LiCF ₃ SO ₃ , KNO ₃ , KBrO ₃ , KBF ₄ , KOH, KSCN, K ₂ Cr ₂ O ₇ , KCl, KCH ₃ CO ₂ , NH ₄ SCN.

[0015]

136 As an improvement, the solvent is composed of at least one solvent component, and the solvent components include: propylene carbonate, ethylene carbonate, dimethyl carbonate, ethyl methyl carbonate, diethyl carbonate, tetrahydrofuran, 2-methyltetrahydrofuran, 1,3-dioxolane, 4-methyl-1,3-dioxolane, dimethoxymethane, 1,2-dimethoxyethane, 1,2-dimethoxypropane, γ -butyrolactone, methyl formate, methyl acetate, and methyl propionate.

[0016]

141 As an improvement, the sealant is an ultraviolet light curing glue or a heat curing glue.

145 The sealant must have good adhesion to separate the two electrodes by a thin gap so that the electrochromic medium can be filled in and prevent the electrochromic medium from leaking or overflowing.

147 In addition to the above characteristics, these sealing materials must also have: 1) good stability, thermal stability, and ultraviolet climate stability; 2) no chemical corrosion with the materials on the electrode, and no chemical reaction with the electrochromic medium; 3) a certain degree of isolation from water and air.

150 The outer side surface of the first substrate or the outer side surface of the second substrate is plated with a high reflective layer. By plating one side with silver, the color-changing device can have the function of an adjustable reflective mirror surface, and can be used in a car rearview mirror to prevent the glare of the lights of the following vehicles.

[0017]

157 As an improvement, the electroactive material layer contains an electrochromic material.

158 Combined with the color change of electrochromic electrolyte, a variety of color change effects can be provided.

[0018]

163 The material of the electroactive material layer must have the following characteristics: 1) good optical properties, such as low light scattering rate in the visible light region, low refractive index, etc., and high transparency; 2) good adhesion to the first conductive material layer; 3) good stability and corrosion resistance in the air or in the device; 4) certain electrochemical activity.

167 These materials include: transition metals, such as WO ₃ , TiO ₂ , MoO <sub>

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3</sub> , NiO, V ₂ O ₅ , Fe ₂ O ₃ , Ta ₂ O ₅ , Cr ₂ O ₃ , MnO ₂ , FeO ₂ , CoO ₂ , RhO ₂ , IRO ₂ , Nb ₂ O ₅ , CuO, ZnO; lanthanides, such as CeO ₂ , Nd ₂ O ₃ , Dy3, Er3, ₂ O ₃ ; and binary or multi-doped substances of the above materials, such as WO ₃ -TiO ₂ , WO ₃ -TiO ₂ - Li, V ₂ O ₅ -TiO ₂ , V ₂ O ₅ - TiO ₂ -Li, NiO-V ₂ O ₅ , V ₂ O ₅ -MnO ₂ , etc.; or composites of the above materials with polymers and other materials; non-metallic oxides, such as Prussian blue, tungsten sulfide, tungsten phosphate, indium nitride, graphene, carbon nanotubes, polymer-doped metals; polymer films, polythiophene and its Derivatives, polyaniline and its derivatives, polypyrrole and its derivatives, polycarbazole and its derivatives.

[0019]

184 As an improvement, the first substrate and the second substrate are made of transparent glass or transparent plastic or a composite of the two.

186 The first substrate and the second substrate can use any transparent or visible light transparent material, such as quartz glass, soda-lime glass, borosilicate glass, lead silicate glass, aluminosilicate glass, phosphate glass, float glass, natural or synthetic polymer glass, plastic, and their composites.

189 The first substrate 1 is usually used with a thickness ranging from 0.5mm to 12mm, wherein the specific thickness depends on its application. If the device is used in a mirror or a display device, the composition of the first substrate and the second substrate will be different, and the composition of the front surface will be different from that of the rear surface.

[0020]

196 In the present invention, at least one of the electroactive material contained in the electrochromic electrolyte and the electroactive material contained in the electroactive material layer is an electrochromic material, and they must have a certain degree of matching, which includes: 1) whether the electrochemical performance is complementary, and 2) whether the color change voltage is matched.

200 In addition to having a certain degree of compatibility with the materials of the electroactive material layer, the electroactive materials in the electrochromic electrolyte also need to have the following characteristics: 1) be able to electrochromize in the solution; and 2) have good electrochemical stability. Such materials can be: viologen compounds, triphenylamine and its derivatives, carbazole and its derivatives, phenazines and their derivatives, thiophenes and their derivatives, thiazines and their derivatives, metallophtalocyanines (MPcs, M = Cu, Co, Mg and Zn), etc.

[0021]

209 As an improvement, the electroactive material layer is a V ₂ O ₅ -TiO ₂ thin film, and the electrochromic agent in the electrochromic electrolyte is a viologen compound.

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[0022]

214 As a further improvement, the structure of the viologen compound is shown in the figure, as shown in Figure 2, wherein R₁, R₂ can be the same or different alkyl chains with a carbon chain length between 1 and 10, phenyl, benzyl, phenethyl, phenylpropyl, phenylbutyl, etc., and the preferred viologen compound is 1,1-diethyl-4,4-bipyridyl dihexafluorophosphate.

[0023]

221 As an improvement, the electroactive material layer is a WO ₃ film, and the electrochromic agent in the electrochromic electrolyte is N-methylphenothiazine.

[0024]

226 Taking the WO ₃ -methylphenothiazine device as an example, the device consists of a first substrate, a first conductive material layer, a fixed electrochromic film WO ₃ , a free electrochromic electrolyte PC/LiClO ₄ /methylphenothiazine, a second conductive material layer and a second substrate.

[0025]

233 When the device is in the faded state, when a forward voltage is applied to the device, that is, the first substrate, the first conductive material layer and the fixed electrochromic film WO ₃ are partially at the negative pole, and the second conductive material layer and the second substrate are partially at the positive pole.

237 The WO ₃ film at the negative electrode gains electrons and converts to a blue state. At this time, the methyl phenothiazine material at the edge of the second conductive material layer of the positive substrate loses electrons to form red cationic radicals, which are distributed on the positive substrate under the action of the electric field.

241 The consumed methylphenothiazine forms a concentration gradient in the solution. Under the action of diffusion, the methylphenothiazine gradually diffuses to the second conductive material layer to participate in the electron loss reaction, forming a red electrochromic layer.

244 Here, LiClO ₄ salt mainly plays the role of balancing the charges in the solution.

245 At this time, the color of the entire device is caused by the superposition of blue WO ₃ and red methylphenothiazine.

[0026]

250 A device in a colored state can be restored to a faded state by two methods: one is to apply a reverse voltage; the other is to remove the applied voltage.

252 When reverse voltage is applied to the device, the WO ₃ film is at the positive electrode,

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obtains electrons, and returns to the faded state, while the methylphenothiazine cation radicals near the positive electrode undergo electron-gaining reactions at the negative electrode and return to the faded state; when the external voltage is removed from the device, the methylphenothiazine cation radicals near the positive electrode are not bound by the electric field and diffuse into the electrochromic solution. When they diffuse to the edge of the WO ₃ film, they undergo redox reactions with it, causing the WO ₃ and methylphenothiazine cation radicals in the colored state to return to the faded state respectively. Similar to the coloring, the concentration gradient formed drives the methylphenothiazine cation radicals to move to the edge of the WO ₃ film to participate in the reaction, and finally the device returns to the colorless state.

[0027]

266 The present invention also provides a method for manufacturing a multifunctional controllable electrochromic device, comprising the following steps:

[0028]

271 Step 1: preparing a first conductive material layer on the inner side of the first substrate, and preparing a second conductive material layer on the inner side of the second substrate;

[0029]

276 Step 2: Prepare an electroactive material layer coating solution, and apply the coating solution to the inner side of the first conductive material layer to form an electroactive material layer.

278 and performing annealing treatment on the prepared electroactive material layer;

[0030]

282 Step 3: Apply UV curing glue on the inner side of the second conductive material layer around the frame, and reserve a glue injection port;

[0031]

287 Step 4: Compounding the electroactive material layer together with the first conductive material layer and the first substrate onto the UV curing adhesive coated on the inner side of the second conductive material layer, curing under UV light, and forming a cavity between the electroactive material layer and the second conductive material layer;

[0032]

291 Step 5: Prepare the electrochromic electrolyte and inject it into the cavity formed in step 4through the injection port reserved in step 3

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[0033]

As an improvement, in step 2, the electroactive material layer is coated onto the first conductive material layer by spin coating, spraying or electrodeposition.

[0034]

Compared with the prior art, the present invention has the following advantages: the semi-fixed and semi-free electrochromic device proposed in the present invention can solve the matching problems existing in the fully fixed and fully free electrochromic devices respectively, as well as the stratification phenomenon existing when voltage is applied for a long time.

At the same time, it has good controllability, and the color and optical properties (ultraviolet, infrared and visible light) of the entire device can be adjusted by adjusting the free-type part material.

[0035]

For free-type electrochromic devices, the material can move under the action of an external electric field. Then, under long-term voltage drive, the cathode and anode electrochromic materials will gradually move to the positive and negative high field areas to undergo a color change reaction, showing blue and yellow polarization. The electrochromic device of this invention still shows uniform color under long-term voltage.

[0036]

For fixed electrochromic devices, taking the WO ₃ -V ₂ O ₅ device as an example, since the charge capacity of V ₂ O ₅ is low and the charge capacity of WO ₃ is high, it is difficult for the WO ₃ material to achieve complete color change in the device assembled by the two.

The transmittance difference of the currently manufactured fully fixed WO ₃ -V ₂ O ₅ devices is relatively low in the visible light range (500-800nm) to which the human eye is sensitive, not exceeding 60%. However, the transmittance difference of the WO ₃₋ methylphenothiazine device prepared in this invention can reach 70% in the range of 500-800nm, as shown in Figure 4.

[0037]

BRIEF DESCRIPTION OF THE DRAWINGS

[0038]

FIG. 1 is a schematic cross-sectional view of the present invention.

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[0039]

FIG. 2 is a general formula of the viologen compound used in the present invention.

[0040]

Figure 3 is a spectral characteristic curve of the V ₂ O ₅ /TiO ₂ - violet essence electrochromic device described in the present invention.

[0041]

FIG. 4 is a spectral characteristic curve of the WO ₃ -methylphenothiazine electrochromic device described in the present invention.

[0042]

DETAILED DESCRIPTION

[0043]

The following is a detailed description of an embodiment of the present invention. This embodiment is implemented based on the technical solution of the present invention, and provides a detailed implementation method and a specific operation process, but the protection scope of the present invention is not limited to the following embodiment.

[0044]

Embodiment 1:

[0045]

A multifunctional controllable electrochromic device comprises a first substrate 1 and a second substrate 2 which are arranged opposite to each other. The first substrate 1 and the second substrate 2 are made of transparent glass.

A first conductive material layer 3 and an electroactive material layer 5 are arranged on the inner side of the first substrate 1. The electroactive material layer 5 is a V ₂ O ₅ -TiO ₂ thin film layer. The first conductive material layer 3 is located between the first substrate 1 and the electroactive material layer 5. A second conductive material layer 4 is arranged on the inner side of the second substrate 2. A sealant 6 is arranged on the peripheral edges of the second conductive material layer 4 and the electroactive material layer 5. The sealant 6 is an ultraviolet light curing glue. The sealant 6, the second conductive material layer 4 and the electroactive material layer 5 surround a cavity 7, and the cavity 7 is filled with an electrochromic electrolyte.

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The components of the electrochromic electrolyte include: solvent propylene carbonate, electrolyte salt lithium perchlorate and electrochromic agent viologen compound, and the viologen compound is preferably 1,1-diethyl-4,4'-bipyridyl dihexafluorophosphate.

[0046]

The electrochromic device in this embodiment can switch between a colorless state and a faded state under the action of ±1.2V. There is a very high transmittance difference between these two states, as shown in FIG. 3, which can reach more than 60%.

It remains stable after 200,000 cycles at a high temperature of 60° C.

[0047]

Embodiment 2

[0048]

A multifunctional controllable electrochromic device comprises a first substrate 1 and a second substrate 2 which are arranged opposite to each other. The first substrate 1 and the second substrate 2 are made of transparent glass.

A first conductive material layer 3 and an electroactive material layer 5 are arranged on the inner side of the first substrate 1. The electroactive material layer 5 is a WO ₃ thin film layer. The first conductive material layer 3 is located between the first substrate 1 and the electroactive material layer 5. A second conductive material layer 4 is arranged on the inner side of the second substrate 2. A sealant 6 is arranged on the peripheral edges of the second conductive material layer 4 and the electroactive material layer 5. The sealant 6 is a thermosetting adhesive. The sealant 6, the second conductive material layer 4 and the electroactive material layer 5 surround a cavity 7, and the cavity 7 is filled with an electrochromic electrolyte.

The components of the electrochromic electrolyte include: solvent propylene carbonate (PC), electrolyte salt lithium perchlorate and electrochromic agent N-methylphenothiazine.

[0049]

The electrochromic device in this embodiment has a very high transmittance difference when it is colored at 1.2V, as shown in FIG 4, which can reach more than 70% in the visible light region, and the transmittance difference in the infrared region can reach 40%.

It remains stable after 50,000 cycles at high temperature of 60° C.

[0050]

Embodiment 3

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[0051]

423 A multifunctional controllable electrochromic device can be used in a car rearview mirror to prevent glare from the lights of vehicles behind.

426 It includes a first substrate 1 and a second substrate 2which are arranged opposite to each other, and the first substrate 1 and the second substrate 2are made of transparent glass.

428 The outer side surface of the first substrate 1 is plated with a high reflective material.

429 A first conductive material layer 3and an electroactive material layer 5are arranged on the inner side of the first substrate 1. The electroactive material layer 5is a WO ₃ thin film layer. The first conductive material layer 3is located between the first substrate 1 and the electroactive material layer 5. A second conductive material layer 4is arranged on the inner side of the second substrate 2. A sealant 6is arranged around the edges of the second conductive material layer 4and the electroactive material layer 5. The sealant 6is a thermosetting adhesive. The sealant 6, the second conductive material layer 4and the electroactive material layer 5surround a cavity 7, and the cavity 7is filled with an electrochromic electrolyte.

436 The components of the electrochromic electrolyte include: solvent propylene carbonate (PC), electrolyte salt lithium perchlorate and electrochromic agent N-methylphenothiazine.

[0052]

441 The electrochromic device in this embodiment has a very high transmittance difference when it is colored at 1.2V, as shown in FIG 4, which can reach more than 70% in the visible light region, and the transmittance difference in the infrared region can reach 40%.

444 It remains stable after 50,000cycles at high temperature of 60° C.

445 In this embodiment, coating the silver-plated surface on the outer side surface of the second substrate 2can achieve the same effect.

[0053]

450 Embodiment 4:

[0054]

454 A method for manufacturing a multifunctional controllable electrochromic device comprises the following steps:

[0055]

459 Step 1: preparing a first conductive material layer 3on the inner side of the first substrate 1, and preparing a second conductive material layer 4on the inner side of the second substrate 2;

[0056]

461 Step 2: Prepare the coating solution of the electroactive material layer 5. Dissolve vanadium triisopropoxide or

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titanium tetraisopropoxide in isopropanol. Different concentrations can be selected according to different preparation methods to prepare vanadium-titanium composite oxides of different proportions. Mix the two solutions in a volume ratio of 2:1 (vanadium: titanium) to prepare a mixed solution.

The vanadium pentoxide thin film electrode was prepared by a spraying method, wherein the concentration of vanadium triisopropoxide and titanium tetraisopropoxide was 0.08 mol/L.

The film was then annealed at 40° C for 30 minutes to 300° C, kept at 300° C for 0.5 h, and naturally cooled to room temperature.

[0057]

Step 3: Apply sealant 6 to the inner side of the second conductive material layer 4 around the frame, and reserve a sealant injection port;

[0058]

Step 4: Compounding the electroactive material layer 5 together with the first conductive material layer 3 and the first substrate 1 onto the sealant coated on the inner side of the second conductive material layer 4, and curing the sealant to form a cavity 7 between the electroactive material layer 5 and the second conductive material layer 4;

[0059]

Step 5: Prepare an electrochromic electrolyte: dissolve 1.512 g of 1,1-diethyl-4,4'-bipyridyl dihexafluorophosphate and 10.64 g of lithium perchlorate in 100 ml of propylene carbonate solution, bubble in N₂ to remove dissolved oxygen, and prepare a solution, which is then poured into the cavity 7 formed in step 4 through the injection port reserved in step 3.

[0060]

Embodiment 5:

[0061]

A method for manufacturing a multifunctional controllable electrochromic device comprises the following steps:

[0062]

Step 1: preparing a first conductive material layer 3 on the inner side of the first substrate 1, and preparing a second conductive material layer 4 on the inner side of the second substrate 2;

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[0063]

Step 2: Prepare the coating solution of the electroactive material layer 5. Dissolve vanadium triisopropoxide or titanium tetraisopropoxide in isopropanol. Different concentrations can be selected according to different preparation methods to prepare vanadium-titanium composite oxides of different proportions. Mix the two solutions in a volume ratio of 2:1 (vanadium: titanium) to prepare a mixed solution.

The vanadium pentoxide thin film electrode was prepared by spin coating, where the concentration of vanadium triisopropoxide and titanium tetraisopropoxide was 0.12 mol/L, and the spin coating parameters were 1000 rpm, 30 s.

The film was then annealed at 40° C for 30 minutes to 300° C, kept at 300° C for 0.5 h, and naturally cooled to room temperature.

[0064]

Step 3: Apply sealant 6 on the inner side of the second conductive material layer 4 around the frame, the sealant 6 is UV light curing glue, and reserve a glue injection port;

[0065]

Step 4: Compounding the electroactive material layer 5 together with the first conductive material layer 3 and the first substrate 1 onto the UV curing glue coated on the inner side of the second conductive material layer 4, curing under UV light 1, and forming a cavity 7 between the electroactive material layer 5 and the second conductive material layer 4;

[0066]

Step 5: Prepare an electrochromic electrolyte: dissolve 1.512 g of 1,1-diethyl-4,4'-bipyridyl dihexafluorophosphate and 1.064 g of lithium perchlorate in 100 ml of propylene carbonate solution, bubble in N₂ to remove dissolved oxygen, and prepare a solution, which is then poured into the cavity 7 formed in step 4 through the injection port reserved in step 3.

[0067]

Embodiment 6

[0068]

A method for manufacturing a multifunctional controllable electrochromic device comprises the following steps:

[0069]

Step 1: preparing a first conductive material layer 3 on the inner side of the first substrate 1, and preparing a

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second conductive material layer 4 on the inner side of the second substrate 2;

[0070]

555 Step 2: Prepare the coating solution of the electroactive material layer 5, select the electrodeposition method to prepare the WO ₃ film, the first conductive material layer 3 is used as the working electrode, the Pt sheet is used as the counter electrode, and the silver wire is used as the reference electrode. The three electrodes are placed in the polytungstic acid peroxide electrodeposition solution, and the chronoamperometry is selected. The voltage is set to 0.5V, and the electroplating is performed for 200-250s, and then it is soaked in ethanol for 2min and taken out.

562 The WO ₃ film obtained by the electrodeposition method was placed in a muffle furnace and baked at 300° C for 30 minutes, and the preparation of the WO ₃ film was completed.

[0071]

566 Step 3: Apply sealant 6 on the inner side of the second conductive material layer 4 around the frame, the sealant 6 is UV light curing glue, and reserve a glue injection port;

[0072]

571 Step 4: Compounding the electroactive material layer 5 together with the first conductive material layer 3 and the first substrate 1 onto the UV curing adhesive coated on the inner side of the second conductive material layer 4, curing under UV light, and forming a cavity 7 between the electroactive material layer 5 and the second conductive material layer 4;

[0073]

578 Step 5: prepare an electrochromic electrolyte, weigh 1.0665 g of N-methylphenothiazine (Mr = 213.30 g/mol, n = 0.05 mol) and 10.64 g of lithium perchlorate (Mr = 106.40 g/mol, n = 1 mol), respectively, dissolve them in propylene carbonate (PC) under the protection of N₂, stir for 1 hour to completely dissolve it to form a solution, obtain the solution, and inject it into the cavity 7 formed in step 4 through the injection port reserved in step 3.

[0074]

586 The above are only preferred embodiments of the present invention and are not intended to limit the present invention. Any modifications, equivalent substitutions and improvements made within the spirit and principles of the present invention should be included in the protection scope of the present invention.

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(19)中华人民共和国国家知识产权局

(12)发明专利申请

(10)申请公布号 CN 104375350 A
(43)申请公布日 2015.02.25

(21)申请号 201410606612.5

(22)申请日 2014.10.31

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(51)Int.Cl.
G02F 1/153(2006.01)

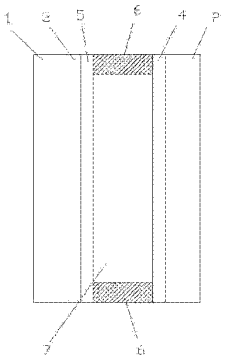
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(54)发明名称

一种多功能可控电致变色器件及其制作方法

(57)摘要

本发明公开了一种多功能可控电致变色器件及其制作方法，所述多功能可控电致变色器件包括相对设置的第一基板和第二基板，第一基板和第二基板的内侧设置第一导电材料层和第二导电材料层，第一导电材料层内侧设置电活性材料层，第二导电材料层与所述电活性材料层的周边缘设置有密封胶，密封胶、第二导电材料层和所述电活性材料层包围形成一个空腔，所述空腔内灌装电致变色电解液。本发明相比现有技术具有以下优点：本项发明中提出的半固定半自由型电致变色器件能够解决全固定型与全自由型电致变色器件中分别存在的匹配性以及长时加电压所存在的分层现象。同时具有很好的可控性，可以通过调节自由型部分材料而调节整个器件的颜色与光学性质。



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1. 一种多功能可控电致变色器件，其特征在于：所述新型多功能可控电致变色器件包括相对设置的第一基板和第二基板，所述第一基板的内侧设置有第一导电材料层和电活性材料层，所述第一导电材料层位于所述第一基板与所述电活性材料层之间，所述第二基板的内侧设置有第二导电材料层，所述第二导电材料层与所述电活性材料层的周边缘设置有密封胶，所述密封胶、所述第二导电材料层和所述电活性材料层包围形成一个空腔，所述空腔内灌装电致变色电解液。

2. 如权利要求 1 所述一种多功能可控电致变色器件，其特征在于：所述电致变色电解液的组分包括：溶剂、电解质盐和电致变色制剂。

3. 如权利要求 2 所述一种多功能可控电致变色器件，其特征在于：所述电解质盐由不少于一种盐组分组成，所述盐组分包括：$LiClO_4$、$LiPF_6$、LiCl、LiBr、$LiBF_4$、$ZnCl_2$、$LiAsF_6$、$LiCF_3SO_3$、KNO_3、KB_5O_8、KBF_4、KOH、KSCN、$K_2C_{12}O_7$、KCl、KCH_3CO_2、NH_4SCN。

4. 如权利要求 2 所述一种多功能可控电致变色器件，其特征在于：所述溶剂由不少于一种溶剂组分组成，所述溶剂组分包括：碳酸丙稀酯、碳酸乙烯酯、碳酸二甲酯、碳酸甲乙酯、碳酸二乙酯、四氢呋喃、2- 甲基四氢呋喃、1, 3- 二氧环戊烷、4- 甲基 -1, 3- 二氧环戊烷、二甲氧甲烷、1, 2- 二甲氧乙烷、1, 2- 二甲氧丙烷、γ - 丁内酯、甲酸甲酯、乙酸甲酯、丙酸甲酯。

5. 如权利要求 1 或 2 所述一种多功能可控电致变色器件，其特征在于：所述密封胶是紫外光固胶或热固胶。

6. 如权利要求 1 或 2 所述一种多功能可控电致变色器件，其特征在于：所述电活性材料层中包含电致变色材料。

7. 如权利要求 2 所述一种多功能可控电致变色器件，其特征在于：所述电活性材料层是 V_2O_5-TiO_2 薄膜，所述电致变色电解液中的电致变色制剂是紫精化合物。

8. 如权利要求 7 所述一种多功能可控电致变色器件，其特征在于：所述紫精化合物包括对称或不对称的 4, 4' 联吡啶盐。

9. 如权利要求 2 所述一种多功能可控电致变色器件，其特征在于：所述电活性材料层是 WO_3 薄膜，所述电致变色电解液中的电致变色制剂是 N- 甲基吩噻嗪。

10. 一种如权利要求 1 所述新型多功能可控电致变色器件的制作方法，其特征在于包括如下步骤：

步骤 1：在第一基板内侧制备第一导电材料层，在第二基板内侧制备第二导电材料层；

步骤 2：配制电活性材料层涂覆溶液，并将涂覆溶液涂覆到第一导电材料层内侧，制备形成电活性材料层。并对制备好的电活性材料层进行退火处理；

步骤 3：在第二导电材料层内侧四周边框处涂覆密封胶，并预留注胶口；

步骤 4：将电活性材料层连带第一导电材料层和第一基板复合到第二导电材料层内侧涂覆的密封胶上，固化，在电活性材料层和第二导电材料层之间形成空腔；

步骤 5：配制电致变色电解液，并通过步骤 3 预留的注胶口将其灌注进步骤 4 形成的空腔中。

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一种多功能可控电致变色器件及其制作方法

技术领域

[0001] 本发明涉及电化学领域，尤其涉及的是一种多功能可控电致变色器件。

背景技术

[0002] 电致变色器件能够在一定电压下改变其自身的吸收或反射率，达到调节光线、温度的作用。电致变色技术已发展多年，其应用也很广泛，涉及交通运输、显示、建筑节能等多个领域，随着其技术的不断完善及改进，仍会有更大的应用前景。

[0003] 电致变色器件按照电致变色材料的存在方式大致可分为自由型，固定型两大类。

[0004] 自由型器件目前已研究相当成熟，它是由阴极电致变色材料及其相匹配的阳极电致变色材料组成，这些材料均溶解于电解液中，另外电解液中还添加有各类稳定剂，如热稳定剂、紫外稳定剂等。这一类器件因没有界面等问题，通常会有很高的稳定性，如热稳定性、紫外稳定性等，另外由于器件结构简单，其制备工艺简单。因所有电致变色材料均溶解于溶液中，若两边基板材料相同，器件本身无正负电极之分，施加正负电压均可驱动材料着色。由于所有的电致变色材料均溶解于电解液中，材料本身对离子或电子没有存储能力，故该类器件有自擦写功能。但是，这类器件存在一个缺点，由于器件内部着色是靠电致变色材料本身的浓度扩散和离子迁移使其到 ITO 电极表面参与得失电子过程，由于电场强度的差异，这类器件一旦长时加电压，即会出现明显的分层现象，并且短时间内难以恢复，影响实际使用效果。

[0005] 固定型器件结构通常包括工作电极，电解液，对电极。其中电致变色材料均制备成薄膜状态附着在导电基板上。这类器件的变色材料可以采用无机类，有机高分子和有机小分子。这类器件由于材料均附着于基板上，变色过程中离子可以存储在薄膜内部（晶格或缝隙内），而使器件有一定的将记忆功能。但是由于材料需要制备成膜，在器件的制备过程中对两种变色电极间的匹配性则具有一定的要求，另外多出的界面也增加了器件损坏的几率。

发明内容

[0006] 本发明的目的在于克服现有技术的不足，提供了一种多功能可控电致变色器件。

[0007] 本发明是通过以下技术方案实现的：一种多功能可控电致变色器件，包括相对设置的第一基板和第二基板，第一基板的内侧设置有第一导电材料层和电活性材料层，第一导电材料层位于第一基板与电活性材料层之间，第二基板的内侧设置有第二导电材料层，第二导电材料层与电活性材料层的周边缘设置有密封胶，密封胶、第二导电材料层和电活性材料层包围形成一个空腔，空腔内灌装电致变色电解液。与一般的电致变色器件相比，本方案减少了一层结构，并结合了固定型和自由型两种器件的特点，既固定型电极薄膜和电致变色电解液。这样既能避免自由型电致变色器件的易分层现象，也能避免固定型电致变色器件的电荷匹配困难的问题。

[0008] 自由型电致变色器件之所以会产生分层现象，是由于两种相匹配的电致变色材料

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均处于自由溶解状态，由于导电基板的电阻分布，使得电场在器件的分布自施加电压边缘向另一边越来越小，于是长时间的电场驱动会使得两种材料分别移向正负场强大的地方，因而聚集起来在正负极附近形成较为明显的分层。本发明中提到的半固定半自由型器件与自由型电致变色器件的区别是引入了固定型电致变色薄膜，分布均匀的固定型电致变色薄膜使得与之相匹配的自由型电致变色材料同样均匀地分布在对面的导电基板上，因而避免了分层现象。

[0009] 对于固定型电致变色器件，电致变色材料均是以薄膜状态形式存在，那么在计量电致变色材料的量上就存在一定困难，而材料的量在本质上决定了电致变色薄膜着褪色过程中所需要的电子。与此同时，一个器件的稳定性受到薄膜电极的电荷匹配性影响，因此在器件制作过程中需要考虑两种相匹配的薄膜电极的厚度、薄膜生长密度等因素，这就大大增加了电致变色器件制作的繁复程度和不确定性。在这里，我们摒弃了传统的全固定型薄膜电极，引入了自由型电致变色材料，其优点不仅在于电致变色材料的浓度可以任意调节，另外还可通过引入辅助氧化还原对来调节器件的氧化还原平衡。

[0010] 作为改进，电致变色电解液的组分包括：溶剂、电解质盐和电致变色制剂。

[0011] 作为改进，电解质盐由不少于一种盐组分组成，盐组分包括：$LiClO_4$、$LiPF_6$、LiCl、LiBr、$LiBF_4$、$ZnCl_2$、$LiAsF_6$、$LiCF_3SO_3$、KNO_3、$KBrO_3$、KBF_4、KOH、KSCN、$K_2Cr_2O_7$、KCl、KCH_3CO_2、NH_4SCN。

[0012] 作为改进，溶剂由不少于一种溶剂组分组成，溶剂组分包括：碳酸丙稀酯、碳酸乙烯酯、碳酸二甲酯、碳酸甲乙酯、碳酸二乙酯、四氢呋喃、2- 甲基四氢呋喃、1,3- 二氧环戊烷、4- 甲基 -1,3- 二氧环戊烷、二甲氧甲烷、1,2- 二甲氧乙烷、1,2- 二甲氧丙烷、γ - 丁内酯、甲酸甲酯、乙酸甲酯、丙酸甲酯。

[0013] 作为改进，密封胶是紫外光固胶或热固胶。密封胶必须很好的粘附力，将两边电极隔开一个细缝，以使电致变色介质能够灌装入内，防止电致变色媒介漏出或溢出。除了以上特性，这些密封材料还需具备：1) 良好的稳定性，热稳定性，紫外气候稳定性；2) 不与电极上的材料有化学腐蚀作用，并且不能与电致变色介质间由化学反应；3) 对水，空气又一定的隔绝作用。第一基板的外侧面或第二基板的外侧面镀高反射层，通过一面镀银能够让该变色器件具有可调节反光镜面的功效，能够用于汽车后视镜，起到防后面车辆灯光炫目的作用。

[0014] 作为改进，电活性材料层中包含电致变色材料。结合电致变色电解液的变色，可以提供多种变色效果。

[0015] 电活性材料层材料需具备以下特征：1) 具有良好的光性能，如可见光区域下的低光散射率，低折射率等，高透明度；2) 与第一导电材料层有着很好的附着能力；3) 在空气或者器件中有着良好的稳定性和抗腐蚀能力；4) 具有一定的电化学活性。这下材料包括：过渡金属，如 WO_3，TiO_2，MoO_3，NiO，V_2O_5，Fe_2O_3，Ta_2O_5，Cr_2O_3，MnO_2，FeO_2，CoO_2，RhO_2，IRO_2，Nb_2O_5，CuO，ZnO；镧系元素，如 CeO_2，Nd_2O_3，Dy3，Er_2O_3；以及以上材料的二元或多元掺杂物质，如 WO_3-TiO_2，WO_3-TiO_2-Li，V_2O_5-TiO_2，V_2O_5-TiO_2-Li，NiO-V_2O_5，V_2O_5-MnO_2 等；或者以上诸多材料与高分子等材料的复合物；非金属氧化物，如普鲁士蓝，硫化钨，磷酸钨，氮化铟，石墨烯，碳纳米管，聚合物掺杂金属；高分子薄膜，聚噻吩及其衍生物，聚苯胺及其衍生物，聚吡咯及其衍生物，聚咔唑及其衍生物。

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[0016] 作为改进，第一基板和第二基板的材质为透明玻璃或透明塑料或二者的复合物。第一基板和第二基板可以使用任何透明或在可见光区域透明的材料，如石英玻璃，钠钙玻璃，硼硅酸玻璃，铅硅酸盐玻璃，铝硅酸盐玻璃，磷酸盐玻璃，浮法玻璃，天然或合成高分子玻璃，塑料，及其复合物。第一基板 1 通常采用厚度从 0.5mm 至 12mm 厚，其中具体厚度取决于其用途。如果器件用于镜子或是显示装置，第一基板和第二基板的组成将会有所不同，前表面于后表面的组成成分由差别。

[0017] 在本项发明中，在电致变色电解液中所包含的电活性材料与电活性材料层包含的电活性材料中至少有一个为电致变色材料，且必须有一定的匹配性，它包括：1) 电化学表现是否互补，2) 变色电压是否匹配。电致变色电解液中电活性材料除需要与电活性材料层的材料间具一定的匹配性外，还需要具备：1) 溶液中能够电致变色；2) 电化学稳定性良好。这类材料可以是：紫精化合物，三苯胺及其衍生物，咔唑及其衍生物，吩嗪类及其衍生物，噻吩类及其衍生物，噻嗪类及其衍生物，金属钛箐 (metallophtalocyanines，MPcs，M = Cu，Co，Mg and Zn) 等等。

[0018] 作为改进，电活性材料层是 V_2O_5-TiO_2 薄膜，电致变色电解液中的电致变色制剂是紫精化合物。

[0019] 作为进一步改进，紫精化合物结构如图所示，如附图 2 所示，其中 R_1，R_2 可以是相同或不相同的碳链长度在 1-10 之间的烷基链、苯基、苄基、苯乙基、苯丙基、苯丁基等，优选的紫精化合物是 1，1- 二乙基 -4，4’ 联吡啶二六氟磷酸盐。

[0020] 作为改进，电活性材料层是 WO_3 薄膜，电致变色电解液中的电致变色制剂是 N- 甲基吩噻嗪。

[0021] 以 WO_3- 甲基吩噻嗪的器件为例，该器件由第一基板，第一导电材料层，固定型电致变色薄膜 WO_3，自由型电致变色电解液 PC/$LiClO_4$/ 甲基吩噻嗪，以及第二导电材料层和第二基板组成。

[0022] 当器件处于褪色状态时，当给器件施加一个正向电压，也就是第一基板，第一导电材料层和固定型电致变色薄膜 WO_3 部分处于负极，第二导电材料层和第二基板部分处于正极。处于负极的 WO_3 薄膜得到电子转换为蓝色状态，而此时，处于正极基板第二导电材料层边缘的甲基吩噻嗪材料失去电子形成红色状态的阳离子自由基，这种阳离子自由基在电场的作用下分布在正极基板上。所消耗的甲基吩噻嗪在溶液中形成浓度梯度，在扩散作用下，甲基吩噻嗪逐渐扩散至第二导电材料层参与失电子反应，形成红色的电致变色层。在这里，$LiClO_4$ 盐主要起到平衡溶液中电荷的作用。此时，整个器件的颜色由蓝色的 WO_3 和红色的甲基吩噻嗪共同叠加所致。

[0023] 处于着色状态的器件可以通过两种方法使其恢复到褪色状态：一是施加反向电压；二是移去外加电压。当给器件施加反向电压时，WO_3 薄膜处于正极，得到电子，恢复至褪色态，而处于正极附近的甲基吩噻嗪阳离子自由基则在负极发生得电子反应恢复至褪色状态；当给器件移去外加电压后，处于正极附近的甲基吩噻嗪阳离子自由基没有电场束缚而扩散至电致变色溶液，当扩散至 WO_3 薄膜边缘时，与其发生氧化还原反应，使得处于着色状态的 WO_3 与甲基吩噻嗪阳离子自由基分别恢复至褪色状态，与着色类似，形成的浓度梯度驱使甲基吩噻嗪阳离子自由基移向 WO_3 薄膜边缘参与反应，最终器件恢复至无色状态。

[0024] 本发明还提供了一种多功能可控电致变色器件的制作方法，包括如下步骤：

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[0025] 步骤 1：在第一基板内侧制备第一导电材料层，在第二基板内侧制备第二导电材料层；

[0026] 步骤 2：配制电活性材料层涂覆溶液，并将涂覆溶液涂覆到第一导电材料层内侧，制备形成电活性材料层。并对制备好的电活性材料层进行退火处理；

[0027] 步骤 3：在第二导电材料层内侧四周边框处涂覆紫外光固胶，并预留注胶口；

[0028] 步骤 4：将电活性材料层连带第一导电材料层和第一基板复合到第二导电材料层内侧涂覆的紫外光固胶上，紫外光下 1 固化，在电活性材料层和第二导电材料层之间形成空腔；

[0029] 步骤 5：配制电致变色电解液，并通过步骤 3 预留的注胶口将其灌注进步骤 4 形成的空腔中。

[0030] 作为改进，步骤 2 中，电活性材料层是通过旋涂法或喷雾法或电沉积法涂覆到第一导电材料层上的。

[0031] 本发明相比现有技术具有以下优点：本项发明中提出的半固定半自由型电致变色器件能够解决全固定型与全自由型电致变色器件中分别存在的匹配性以及长时加电压所存在的分层现象。同时具有很好的可控性，可以通过调节自由型部分材料而调节整个器件的颜色与光学性质（紫外，红外以及可见光）。

[0032] 对于自由型电致变色器件，材料在外加电场的作用下可以发生移动，那么在长时间的电压驱动下，阴极与阳极电致变色材料则会逐渐移向正负极高场区发生变色反应，呈现出蓝色与黄色的两极分化，而本项发明所电致变色器件在长时间的电压下仍然表现出均匀的颜色。

[0033] 对于固定型电致变色器件，以 WO_3-V_2O_5 器件为例，由于 V_2O_5 的电荷容量较低，WO_3 的电荷容量较高，两者所组装的器件中 WO_3 材料难以实现完全变色。目前所制作的全固定型 WO_3-V_2O_5 器件其透过率差值于人眼敏感的可见光范围内（500-800nm）较低，不超过 60%，而本项发明中所制备的 WO_3- 甲基吩噻嗪器件在 500-800nm 范围内的透过率差值可达 70%，如图 4 所示。

附图说明

[0034] 图 1 是本发明的横截面示意图。

[0035] 图 2 是本发明中使用的紫精化合物通式。

[0036] 图 3 是本发明中所描述的 V_2O_5/TiO_2- 紫精电致变色器件的光谱特征曲线。

[0037] 图 4 是本发明中所描述的 WO_3- 甲基吩噻嗪电致变色器件的光谱特征曲线。

具体实施方式

[0038] 下面对本发明的实施例作详细说明，本实施例在以本发明技术方案为前提下进行实施，给出了详细的实施方式和具体的操作过程，但本发明的保护范围不限于下述的实施例。

[0039] 实施例 1：

[0040] 一种多功能可控电致变色器件，包括相对设置的第一基板 1 和第二基板 2，第一基板 1 和第二基板 2 的材质为透明玻璃。第一基板 1 的内侧设置有第一导电材料层 3 和电活

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性材料层 5，电活性材料层 5 是 V_2O_5-TiO_2 薄膜层，第一导电材料层 3 位于第一基板 1 与电活性材料层 5 之间，第二基板 2 的内侧设置有第二导电材料层 4，第二导电材料层 4 与电活性材料层 5 的周边缘设置有密封胶 6，密封胶 6 是紫外光固胶；密封胶 6、第二导电材料层 4 和电活性材料层 5 包围形成一个空腔 7，空腔 7 内灌装电致变色电解液。电致变色电解液的组分包括：溶剂碳酸丙稀酯、电解质盐高氯酸锂和电致变色制剂紫精化合物，紫精化合物优选为 1,1- 二乙基 -4,4' 联吡啶二六氟磷酸盐。

[0041] 本实施例中的电致变色器件在 ±1.2V 作用下，可在无色状态和褪色状态之间相互转换，这两种状态下有着很高的透过率差，如图 3 所示，可达 60% 以上。在高温 60℃下循环 20 万次仍然稳定。

[0042] 实施例 2：

[0043] 一种多功能可控电致变色器件，包括相对设置的第一基板 1 和第二基板 2，第一基板 1 和第二基板 2 的材质为透明玻璃。第一基板 1 的内侧设置有第一导电材料层 3 和电活性材料层 5，电活性材料层 5 是 WO_3 薄膜层，第一导电材料层 3 位于第一基板 1 与电活性材料层 5 之间，第二基板 2 的内侧设置有第二导电材料层 4，第二导电材料层 4 与电活性材料层 5 的周边缘设置有密封胶 6，密封胶 6 是热固胶；密封胶 6、第二导电材料层 4 和电活性材料层 5 包围形成一个空腔 7，空腔 7 内灌装电致变色电解液。电致变色电解液的组分包括：溶剂碳酸丙二醇酯 (PC)、电解质盐高氯酸锂和电致变色制剂 N- 甲基吩噻嗪。

[0044] 本实施例中的电致变色器件处于着色 1.2V 下，有着很高的透过率差，如图 4 所示，在可见光区域可达 70% 以上，同时于红外区域的透过率差值可达 40%。在高温 60℃下循环 5 万次仍然稳定。

[0045] 实施例 3：

[0046] 一种多功能可控电致变色器件，该器件能够用于汽车后视镜，起到防后面车辆灯光炫目的作用。包括相对设置的第一基板 1 和第二基板 2，第一基板 1 和第二基板 2 的材质为透明玻璃。第一基板 1 的外侧面镀高反射材料。第一基板 1 的内侧设置有第一导电材料层 3 和电活性材料层 5，电活性材料层 5 是 WO_3 薄膜层，第一导电材料层 3 位于第一基板 1 与电活性材料层 5 之间，第二基板 2 的内侧设置有第二导电材料层 4，第二导电材料层 4 与电活性材料层 5 的周边缘设置有密封胶 6，密封胶 6 是热固胶；密封胶 6、第二导电材料层 4 和电活性材料层 5 包围形成一个空腔 7，空腔 7 内灌装电致变色电解液。电致变色电解液的组分包括：溶剂碳酸丙二醇酯 (PC)、电解质盐高氯酸锂和电致变色制剂 N- 甲基吩噻嗪。

[0047] 本实施例中的电致变色器件处于着色 1.2V 下，有着很高的透过率差，如图 4 所示，在可见光区域可达 70% 以上，同时于红外区域的透过率差值可达 40%。在高温 60℃下循环 5 万次仍然稳定。本实施例中，将镀银面镀在第二基板 2 的外侧面能起到一样的效果。

[0048] 实施例 4：

[0049] 一种多功能可控电致变色器件的制作方法，包括如下步骤：

[0050] 步骤 1：在第一基板 1 内侧制备第一导电材料层 3，在第二基板 2 内侧制备第二导电材料层 4；

[0051] 步骤 2：配制电活性材料层 5 涂覆溶液，将三异丙醇氧钒或四异丙醇钛溶解在异丙醇中，根据制备的方法不同选择不同的浓度，可以制备不同比例的钒钛复合氧化物将两种溶液按 2:1（钒：钛）体积比混合制备成混合溶液。利用喷雾方法制备五氧化二钒薄膜电

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极，在这里三异丙醇氧钒和四异丙醇钛的浓度为浓度是0.08mol/L。然后将薄膜进行退火处理，其过程为40℃，30分钟到300℃，在300℃下保持0.5h，自然冷却到室温。

[0052] 步骤3：在第二导电材料层4内侧四周边框处涂覆密封胶6，并预留注胶口；

[0053] 步骤4：将电活性材料层5连带第一导电材料层3和第一基板1复合到第二导电材料层4内侧涂覆的密封胶上，固化，在电活性材料层5和第二导电材料层4之间形成空腔7；

[0054] 步骤5：配制电致变色电解液，将1.512克1,1-二乙基-4,4'联吡啶二六氟磷酸盐和10.64克高氯酸锂溶于100毫升碳酸丙烯酯溶液中，在N_2中鼓泡除去溶解氧，制得溶液，并通过步骤3预留的注胶口将其灌注进步骤4形成的空腔7中。

[0055] 实施例5：

[0056] 一种多功能可控电致变色器件的制作方法，包括如下步骤：

[0057] 步骤1：在第一基板1内侧制备第一导电材料层3，在第二基板2内侧制备第二导电材料层4；

[0058] 步骤2：配制电活性材料层5涂覆溶液，将三异丙醇氧钒或四异丙醇钛溶解在异丙醇中，根据制备的方法不同选择不同的浓度，可以制备不同比例的钒钛复合氧化物将两种溶液按2:1（钒：钛）体积比混合制备成混合溶液。利用旋涂方法制备五氧化二钒薄膜电极，在这里三异丙醇氧钒和四异丙醇钛的浓度为0.12mol/L，旋涂参数是1000rpm，30s。然后将薄膜进行退火处理，其过程为40℃，30分钟到300℃，在300℃下保持0.5h，自然冷却到室温。

[0059] 步骤3：在第二导电材料层4内侧四周边框处涂覆密封胶6，密封胶6是紫外光固胶紫外光固胶，并预留注胶口；

[0060] 步骤4：将电活性材料层5连带第一导电材料层3和第一基板1复合到第二导电材料层4内侧涂覆的紫外光固胶上，紫外光下1固化，在电活性材料层5和第二导电材料层4之间形成空腔7；

[0061] 步骤5：配制电致变色电解液，将1.512克1,1-二乙基-4,4'联吡啶二六氟磷酸盐和10.64克高氯酸锂溶于100毫升碳酸丙烯酯溶液中，在N_2中鼓泡除去溶解氧，制得溶液，并通过步骤3预留的注胶口将其灌注进步骤4形成的空腔7中。

[0062] 实施例6：

[0063] 一种多功能可控电致变色器件的制作方法，包括如下步骤：

[0064] 步骤1：在第一基板1内侧制备第一导电材料层3，在第二基板2内侧制备第二导电材料层4；

[0065] 步骤2：配制电活性材料层5涂覆溶液，选用电沉积方法制备WO_3薄膜，第一导电材料层3作为工作电极，Pt片作为对电极，银丝作为参比电极，将三电极置于聚过氧化钨酸电沉积溶液中，选择计时电流法，设置电压0.5V，电镀200-250s，再将其用乙醇浸泡2min取出。用电沉积法得到的WO_3薄膜置于马弗炉中300℃烘烤30min，WO_3薄膜制备完成。

[0066] 步骤3：在第二导电材料层4内侧四周边框处涂覆密封胶6，密封胶6是紫外光固胶紫外光固胶，并预留注胶口；

[0067] 步骤4：将电活性材料层5连带第一导电材料层3和第一基板1复合到第二导电材料层4内侧涂覆的紫外光固胶上，紫外光下固化，在电活性材料层5和第二导电材料层4

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之间形成空腔 7；

[0068] 步骤 5：配制电致变色电解液，分别称量 N- 甲基吩噻嗪 1.0665g(Mr = 213.30g/mol，n = 0.05mol)，高氯酸锂 10.64g(Mr = 106.40g/mol，n = 1mol) 在 N_2 保护下溶解于碳酸丙二醇酯 (PC)，搅拌 1 小时使其完全溶解制成溶液，获得溶液，并通过步骤 3 预留的注胶口将其灌注进步骤 4 形成的空腔 7 中。

[0069] 以上仅为本发明的较佳实施例而已，并不用以限制本发明，凡在本发明的精神和原则之内所作的任何修改、等同替换和改进等，均应包含在本发明的保护范围之内。

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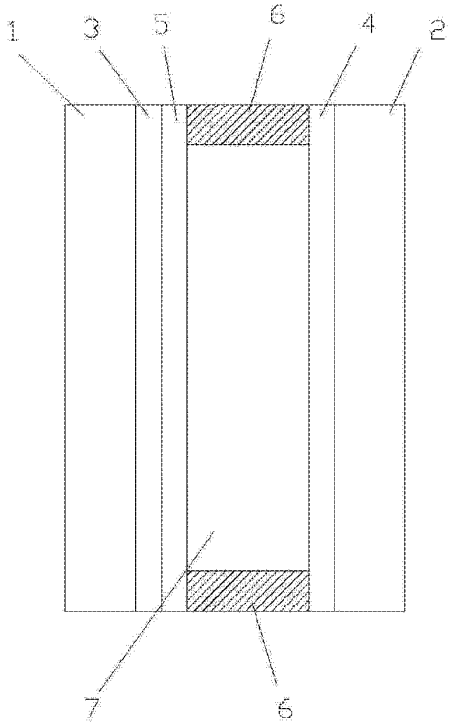


图 1

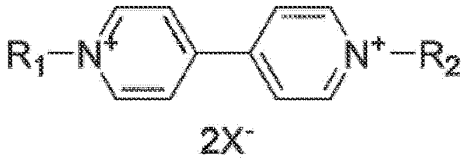


图 2

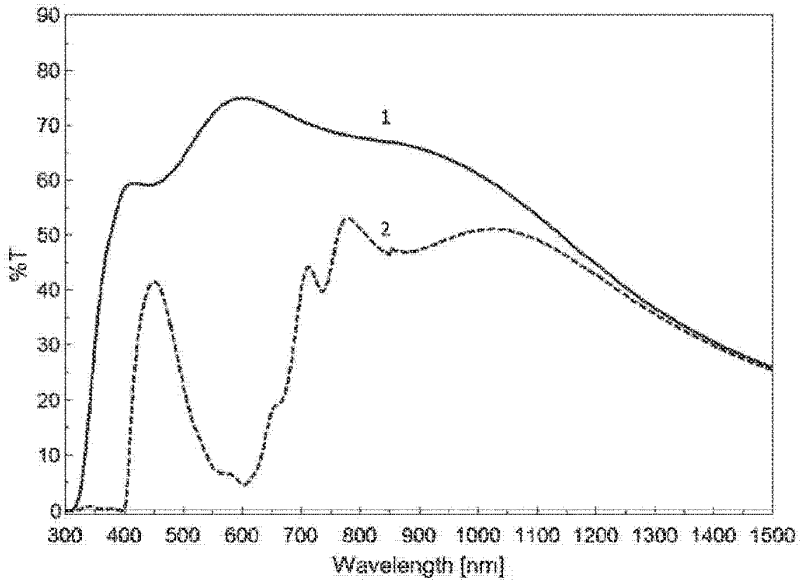


图 3

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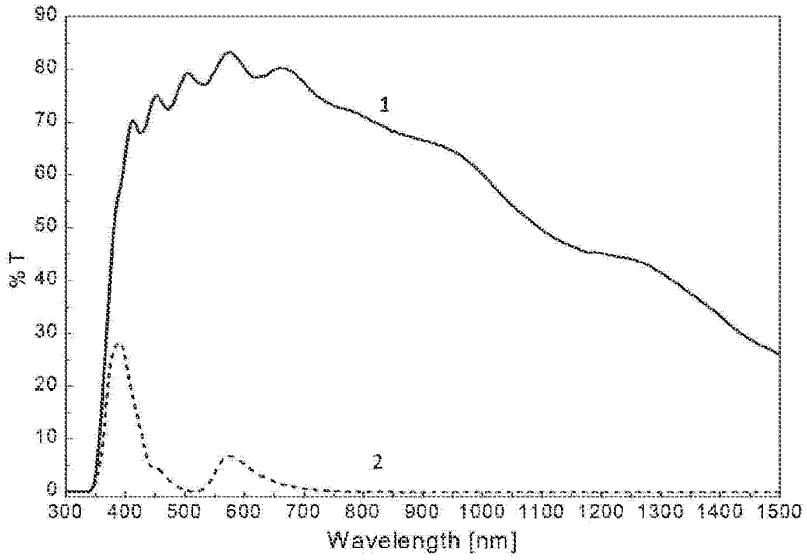


图 4

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Bibliographic data: CN107438793 (A) — 2017-12-05

ELECTROCHEMICAL DEVICES WITH PLASTIC SUBSTRATES

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Classification: - international: *G02F1/15; G02F1/153*
- cooperative: G02F1/15165 (KR); G02F1/1533 (EP, CN, KR, US); G02F1/15165 (EP, CN, US); G02F2001/1536 (EP, CN, KR, US); G02F2201/086 (EP, CN, KR, US); G02F2201/501 (EP, CN, KR, US)

Application number: CN20168021339 20160309 Global Dossier

Priority number(s): US201562130354P 20150309 ; US201562135003P 20150318 ; US201562184704P 20150625 ; US201562257950P 20151120 ; US201562258051P 20151120 ; WO2016US21619 20160309

Also published as: EP3268806 (A1) EP3268806 (A4) JP2018514799 (A) JP2019091053 (A) JP6514786 (B2) JP6824301 (B2) KR102029304 (B1) KR20170134472 (A) KR20180004311 (A) US10539853 (B2) US2016266460 (A1) US2017357136 (A1) US9766528 (B2) WO2016145120 (A1) less

Abstract of CN107438793 (A)

An electrochromic device includes a first flexible or rigid plastic substrate including a front surface, and a rear surface, wherein the rear surface comprises a first conductive material; and the front surface, the rear surface, or both the front surface and the rear surface of the first substrate comprises a gas diffusion barrier; and a second flexible or rigid plastic substrate including a front surface, and a rear surface, wherein the front surface comprises a second conductive material, wherein the first substrate is joined to the second substrate by a sealing member, where the rear surface of the first substrate and the front surface of the second substrate with the sealing member define a chamber therebetween.

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DESCRIPTION CN107438793A

10 Electrochemical device with plastic substrate

[0001]

14 CROSS-REFERENCE TO RELATED APPLICATIONS

[0002]

18 This application claims the benefit of U.S. Provisional Patent Application Nos. 62/130,354 (filed March 9, 2015); 62/135,003 (filed March 18, 2015); 62/184,704 (filed June 25, 2015); 62/257,950 (filed November 20, 2015); and 62/258,051 (filed November 20, 2015), the entire disclosures of which are incorporated herein by reference for any and all purposes.

[0003]

25 Technical Field

[0004]

29 The present technology generally relates to electrochromic devices.

30 More particularly, the present invention relates to electrochromic devices having at least one plastic substrate.

[0005]

34 Summary of the invention

[0006]

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In one aspect, an electrochromic device includes a first flexible or rigid plastic substrate and a second flexible or rigid plastic substrate.

The first flexible or rigid plastic substrate comprises a front surface and a back surface, wherein the back surface comprises a first conductive material, and the front surface, the back surface, or both the front surface and the back surface of the first substrate comprise a gas diffusion barrier.

The second flexible or rigid plastic substrate includes a front surface and a back surface, wherein the front surface includes a second conductive material.

In addition, in the device, the first substrate is connected to the second substrate through a sealing member, wherein a rear surface of the first substrate and a front surface of the second substrate and the sealing member define a cavity therebetween.

In some embodiments, the front surface, the back surface, or both the front surface and the back surface of the second substrate include a gas diffusion barrier. In any of the above embodiments, the chamber may include an electrochromic medium including a cathode material and an anode material. In any of the above embodiments, the first conductive material may include a conductive nanowire coating, a conductive metal mesh, an insulator/metal/insulator stack (IMI stack), a transparent polymer filled with nanoparticles (such as indium tin oxide particles), carbon nanotubes, graphene, or a conductive polymer. In any of the above embodiments, the second conductive material may include a conductive nanowire coating, a conductive metal mesh, or an IMI stack. In some embodiments, the additional conductive coating may overlie either or both of the first or second conductive metal mesh or conductive nanowire coating.

[0007]

In any of the above embodiments, the sealing component may include a heat curable seal, a UV curable seal, a hot melt using a third thermoplastic, a weld, a pressure sensitive adhesive (PSA), or a heat seal film that holds the first substrate to the second substrate.

[0008]

In any of the above embodiments, the chamber may include an electrochromic film based on a first polymer.

In any of the embodiments described herein, the polymer-based electrochromic film can be a cross-linked electrochromic film or a thermoplastic electrochromic film.

In any of the above embodiments, the first polymer-based electrochromic film may include a first electroactive material and a first thermoplastic polymer. In any of the above embodiments, the first electroactive material is a cathode material and an anode material, or a mixture of a cathode material and an anode material.

[0009]

In any of the above embodiments, the chamber may include an electrochromic film based on a second polymer.

The polymer-based electrochromic film may be a cross-linked electrochromic film or a thermoplastic electrochromic film. The polymer-based electrochromic film may include a second electroactive material and a second thermoplastic polymer. In any of the above embodiments, where the device includes first and second

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polymer-based electrochromic films (eg, thermoplastic electrochromic films), the films may be separated by an electrolyte layer. The electrolyte layer may incorporate a porous membrane or an ion exchange membrane capable of ion transport.

[0010]

In another aspect, an electrochromic device includes a first flexible or rigid plastic substrate having a first surface and a second surface, a second flexible or rigid plastic substrate having a first surface and a second surface; and a sealing member connecting the second surface of the first substrate to the first surface of the second substrate to form a chamber therebetween.

In the device, one surface or both surfaces of the first substrate are coated with an ultraviolet light absorbing layer or material, or the substrate is impregnated with an ultraviolet light absorbing layer or material, the second surface is coated with a conductive material and an electrochromic film based on a first polymer including an anode material, and the chamber includes a fluid medium containing a UV-curable or heat-curable gelling agent. In some embodiments, the fluid medium further comprises a cathode material. In any of the above embodiments, the fluid medium may further include an ultraviolet absorbing material. In some embodiments, the first surface of the second substrate is coated with a second polymer-based electrochromic film including a cathode material. In other embodiments, the first surface of the second substrate is coated with a conductive coating. The sealing member may include a UV curable resin, a heat curable resin, a hot melt plastic, a PSA, a heat sealing film, or a weld between the first substrate and the second substrate.

[0011]

In another aspect, an electrochromic device includes a first flexible or rigid plastic substrate and a second flexible or rigid substrate.

In the device, a first flexible or rigid substrate comprises a front surface and a back surface, wherein the back surface has a conductive nanowire coating, a conductive metal mesh, an IMI stack, a transparent polymer filled with nanoparticles (such as indium tin oxide particles), carbon nanotubes, graphene or a conductive polymer, wherein the front surface, the back surface, or both the front surface and the back surface of the first substrate have a gas diffusion barrier. The conductive wire mesh or conductive nanowire coating may be coated with another conductive coating. In the device, the second flexible or rigid plastic substrate includes a front surface and a back surface, the front surface having a conductive nanowire coating, a conductive metal mesh, an IMI stack, a transparent polymer filled with nanoparticles (such as indium tin oxide particles), carbon nanotubes, graphene or a conductive polymer, wherein the first substrate is connected to the second substrate by a sealing component, and the back surface of the first substrate and the front surface of the second substrate together with the sealing component define a chamber therebetween. In some embodiments, the second substrate is a plastic substrate and the front surface, the back surface, or both the front surface and the back surface of the second substrate include a gas diffusion barrier. The substrate may include an additional coating that absorbs UV light or the UV absorbing material may be incorporated into the base plate. In any of the above embodiments, the chamber includes an electrochromic medium including a cathode material and an anode material. In any of the above embodiments, the back surface of the first substrate includes a conductive nanowire coating, a conductive metal mesh, an IMI stack, a transparent

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polymer filled with nanoparticles (such as indium tin oxide particles), carbon nanotubes, graphene, or a conductive polymer; and the front surface of the second substrate includes a conductive nanowire coating, a conductive metal mesh, an IMI stack, a transparent polymer filled with nanoparticles (such as indium tin oxide particles), carbon nanotubes, graphene, or a conductive polymer. In any of the above embodiments, the back surface of the first substrate and the front surface of the second substrate each include a conductive coating disposed between the conductive material and the cavity. In any of the above embodiments, the first surface of the first substrate and/or the second surface of the second substrate includes an anti-scratch coating. Additional coatings applied to the surface may include, but are not limited to, anti-reflective coatings and/or anti-fouling or anti-fingerprint coatings.

[0012]

[0011] In another aspect, a method of forming a substrate for an electrochromic device is provided. The method includes coating a first polymer-based electrochromic film on a surface of a first flexible or rigid plastic substrate. The first polymer-based electrochromic film has at least one first electroactive material and a first thermoplastic polymer, the first surface further comprising a conductive nanowire coating, a conductive metal mesh, an IMI stack, a transparent polymer filled with nanoparticles (such as indium tin oxide particles), carbon nanotubes, graphene or a conductive polymer, and a gas barrier coating on the second surface of the first flexible or rigid plastic substrate. The conductive nanowire coating or the conductive metal mesh may be further coated with another conductive coating. In some embodiments of the method, the coating is applied using slot die coating, inkjet printing, screen printing, gravure coating, curtain coating, spray coating, dip coating, extrusion coating, or ramp coating. In any of the above embodiments, the method further includes connecting the first substrate surface including the first polymer-based electrochromic film to the first surface of the second substrate using a sealing member and forming a cavity therebetween. In any of the above embodiments, the method further includes coating a second polymer-based electrochromic film on the first surface of the second substrate, the second electrochromic film including at least a second electroactive material and a second thermoplastic polymer. In any of the above embodiments, the method may further include filling the chamber with a fluid or gel electrolyte medium. The fluid medium may then gel or solidify in situ.

[0013]

In another aspect, an electrochromic device comprises a flexible substrate comprising a front surface and a rear surface, wherein: the rear surface comprises a first conductive material, and the front surface, the rear surface, or both the front surface and the rear surface of the first substrate comprise a gas diffusion barrier; a rigid substrate comprising a front surface and a rear surface, wherein: the front surface comprises a second conductive material; wherein: the shape of the flexible substrate conforms to that of the rigid substrate; the flexible substrate is connected to the rigid substrate via a sealing component, wherein the rear surface of the flexible substrate and the front surface of the rigid substrate together with the sealing component define a chamber therebetween.

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[0014]

In another aspect, an electrochromic device comprises a rigid substrate comprising a front surface and a rear surface, wherein: the rear surface comprises a first conductive material, and the front surface, the rear surface, or both the front surface and the rear surface of the first substrate comprise a gas diffusion barrier; a flexible substrate comprising a front surface and a rear surface, wherein: the front surface comprises a second conductive material; wherein: the shape of the flexible substrate conforms to that of the rigid substrate; the flexible substrate is connected to the rigid substrate via a sealing component, wherein the rear surface of the flexible substrate and the front surface of the rigid substrate together with the sealing component define a chamber therebetween.

[0015]

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

1 is a schematic cross-sectional view of an electrochromic device according to some embodiments.

[0017]

FIG. 2 is a schematic diagram of a substrate having a conductive layer on a surface according to some embodiments.

[0018]

FIG. 3 is a schematic diagram of a conductive line and mesh pattern.

[0019]

FIG. 4 illustrates an increase in the absorbance of an electrochromic device according to a working example due to the ingress of oxygen into the device.

[0020]

DETAILED DESCRIPTION

[0021]

A number of embodiments are described below.

It should be noted that the specific embodiments are not intended to be an exhaustive description or to limit the broader aspects discussed herein.

An aspect described in connection with a particular embodiment is not necessarily limited to that

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embodiment and can be implemented with any other embodiments.

[0022]

As used herein, "about" will be understood by one of ordinary skill in the art and will vary to some extent depending on the context in which it is used.

If a term is used that is not clear to one of ordinary skill in the art, then "about" will mean up to plus or minus 10% of the particular term, given the context in which it is used.

[0023]

In the context of describing elements (especially in the context of the following claims), the use of the terms "a," "an," and "the" and similar referents are to be construed to cover both the singular and the plural unless otherwise indicated herein or clearly contradicted by context.

Recitation of ranges of values herein are merely intended to serve as a shorthand method of referring individually to each separate value falling within the range, unless otherwise indicated herein, and each separate value is incorporated into the specification as if it were individually recited herein.

All methods described herein can be performed in any suitable order unless otherwise indicated herein or otherwise contradicted by context.

The use of any and all examples, or exemplary language (eg, "such as") provided herein, is intended merely to better illustrate the embodiments and does not pose a limitation on the scope of the claims unless otherwise claimed.

No language in the specification should be construed as indicating any non-claimed element is essential.

[0024]

As used herein, the term "substantially transparent" will be understood by one of ordinary skill in the art and will vary to some extent depending on the context in which it is used.

If a term is used that is not clear to a person of ordinary skill in the art, given the context in which it is used, the term means that the material allows about 75% or more of a 400nm wavelength light beam directed at the material at a specular angle of 10° to pass through a 2mm thickness of the material.

[0025]

Electrochromic devices having plastic substrates have been desired for many years.

The inventors herein provide various solutions to the problems that have plagued the implementation of plastic substrate electrochromic devices.

Such issues include, but are not limited to, oxygen ingress, inability to obtain low resistance conductive coatings, ability to cure materials using ultraviolet (UV) light, flexing of the electrochromic film with the substrate, and methods of making such materials and devices.

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[0026]

The electrochromic device described herein includes at least one chamber defined by a first substrate having a first conductive surface, a second substrate having a second conductive surface, and a sealing component, wherein the sealing component connects the first substrate to the second substrate by causing the first and second conductive surfaces to contact at least a portion of the sealing component.

An electrochromic medium may be disposed within the chamber defined therein, which effects a color change in the device upon application of an electrical potential to one or both of the conductive surfaces.

As used herein, an electrochromic medium may contain at least a cathode material (ie, a reducible material), an anode material (ie, an oxidizable material), or a mixture of a cathode material and an anode material.

The electrochromic medium may be a solid state, solution phase, gel, or polymer based material such as a thermoplastic or a cross-linked material.

One or both of the cathode material and the anode material may be confined to one or both of the first and second substrates. In some embodiments, where one or both of the cathode material and the anode material are surface constrained, the anode material may be sequestered on either the first or second conductive surface, and the cathode material may be sequestered on either the second or first conductive surface. The electrochromic medium may also contain an electrolyte to facilitate the movement of charge from one electrode to the other. The first and second substrates may be offset from one another to allow electrical contact to be made to the first and second conductive surfaces.

[0027]

Because these devices are electrochromic devices, it is understood that when a sufficient electrical potential is applied to the device, the transmittance of the electrochromic medium or coating changes.

Changes in transmittance can be the result of changes in the color of the medium or coating, such that oxidation and reduction of the anodic and cathodic materials change the absorbance of the medium, resulting in a decrease in transmittance after application of a potential. The release potential can maintain a reduced transmittance state when the anode material and cathode material are confined with respect to movement through the chamber, or the release potential can cause an increase in transmittance if the anode material and cathode material are allowed to migrate through the chamber or if the reduced cathode and oxidized anode are not kept isolated in the chamber. Shorting the device after application of a potential can accelerate the time necessary for the transmissive state to return to the original transmittance before application of the potential. Instantaneous reversal of the applied potential can also accelerate the transmittance change from low transmittance to high transmittance.

[0028]

Referring generally to FIG. 1, an electrochromic device 100 is provided.

The device 100 has a first substrate 110 and a second substrate 120, each substrate having a front surface and a back surface. The first substrate 110 will be connected to the second substrate 120 through the sealing member 130 so as to form a chamber. The chamber is defined by a rear surface of the first substrate 110, a front surface of the second substrate 120, and an inner surface of the sealing member 130. As illustrated in FIG. 2, the rear surface of the first substrate 110 may include a first conductive material 112. The device may

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be a mirror, wherein the first substrate is substantially transparent and the second substrate is a specular substrate, wherein the front surface or the back surface is a specular surface. The device may also be a window, such as a building window, a car window or an aircraft window, wherein both substrates are substantially transparent. The device may also be an optical filter. The device may also be a pair of glasses. The device may also be a moderately transparent or substantially transparent mirror-type flexible or rigid electrochromic device for any other specific application.

[0029]

325 Gas Diffusion Barrier

[0030]

329 In the device, the front surface, the rear surface, or both the front surface and the rear surface of the first substrate include a gas diffusion barrier.

331 A gas diffusion barrier is a barrier that prevents gases, such as oxygen or water vapor, from entering a device.

332 Thus, the gas diffusion barrier prevents or at least limits the entry of gas into the device. In case the second substrate is made of a permeable material (see below), the front surface, the rear surface or both the front surface and the rear surface of the second substrate may also comprise a gas diffusion barrier. The gas barrier is preferably located on the surface of the substrate closest to the electrochromic medium. For example, the back surface of the first substrate and/or the front surface of the second substrate.

[0031]

340 In any case where a gas diffusion barrier is used in a device, the gas diffusion barrier can minimize or prevent gas from entering the device.

342 For example, where the gas to be excluded by the diffusion barrier is oxygen, the gas diffusion barrier prevents or at least minimizes the ingress of oxygen into the device. In the case where the gas to be removed is water vapor, the gas diffusion barrier prevents or at least minimizes the ingress of water into the device. In some embodiments, the gas diffusion barrier is a barrier to a single gas, while in other embodiments, the gas diffusion barrier is a barrier to multiple gases. This can be provided by a single layer gas diffusion barrier or a multilayer gas diffusion barrier. For electrochromic devices, the substrate and gas barrier should have an oxygen permeability of less than 10⁻²cm³/m²/atm per day. This may include less than 10⁻³cm³/m²/atm per day and less than 10⁻⁴cm³/m²/atm per day.

[0032]

354 Illustrative gas diffusion barriers may include polymer and/or inorganic films applied to a substrate, a layer applied to a substrate by physical vapor deposition (such as vacuum evaporation or sputtering), plasma enhanced chemical vapor deposition (PECVD); a layer applied by atomic layer deposition (ALD); or a layer applied to a substrate by neutral beam assisted sputtering (NBAS).

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338 Illustrative barrier films may include, but are not limited to, Al₂O₃, Si₃N₄, SN, TiN, SiO_xN_y, indium tin oxide (ITO) SiO₂, ZnO₂, or TiO₂ barrier films, where x and y are greater than 0 to 4. Where the gas diffusion layer is a polymer, illustrative polymers may include, but are not limited to, polyimides, polyesters such as polyethylene terephthalate (PET) and/or polyethylene naphthalate (PEN), cyclic olefin copolymers (COC), cyclic olefin polymers (COP), poly(ethylene-co-vinyl alcohol) (EVOH), acrylates, methacrylates, polyvinyl alcohol (PVOH), (PVDC), (HDPE, EVA and PVDC), epichlorohydrin, (an acrylonitrile copolymer).

358 Other illustrative barriers include films of self-assembled nanoparticles (SNAPs), multilayer hybrid organic and inorganic thin films such as (but not limited to) the barrier system, Fujifilm barriers, and 3M barriers. The Vitex system is a film with alternating layers of DC reactively sputtered aluminum oxide and UV-curable vapor deposited organic monomers. The Fujifilm and 3M systems are similar to Vitex in that they are films that alternate between inorganic and polymer films. Multilayer barrier films typically consist of alternating organic (usually acrylate) and inorganic (metal oxide or nitride) layers (dyads) on a polyethylene terephthalate or polyethylene naphthalate substrate. Commercially available barrier films typically have 2 to 3 duplexes and a protective topcoat. Another illustrative barrier system is alternating thin films of cationic and anionic polymers deposited by a layer-by-layer deposition technique as described in the following references: Yang, Y.H. et al. Macromol, 2011, 44, 1450-1459. Another illustrative barrier film includes a flexible thin glass film (less than 0.5 mm thick) applied to a plastic substrate. Thin glass can be adhered to plastic substrates using liquid optical coupling type adhesives or laminated using optically clear pressure sensitive adhesives. Suitable flexible thin glass films include, but are not limited to, those available from Corning Inc.) (Corning,NY) 's glass.

[0033]

359 Substrate

[0034]

363 In the device, at least the first substrate is a plastic substrate.

364 The plastic substrate can be a polymer substrate including but not limited to polyethylene (low density and high density), polyethylene terephthalate (PET), polyethylene naphthalate (PEN), polycarbonate (PC), polysulfone, acrylic polymers (including but not limited to polymethyl methacrylate (PMMA), polymethacrylates), polyamides (including but not limited to cycloaliphatic diamine dodecanedioic acid polymer (i.e., CX7323), epoxides, cycloolefin polymers (COP) (such as

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Zeonor 1420R), cycloolefin copolymers (COC) (such as Topas 6013S-04 or Mitsui Apel), polymethylpentene, cellulose ester-based plastics (such as cellulose triacetate) and polyacrylonitrile.

405 Regarding the second substrate, it may be a plastic substrate of the same or different polymer material as the first substrate. In case both the first and second substrates are plastic substrates, they may be flexible or rigid substrates, such that the electrochromic device formed therefrom is a flexible or rigid electrochromic device.

[0035]

414 A common problem with transparent conductive oxide (TCO) coatings on plastic substrates is the inability to achieve a low enough sheet resistance for electrochromic devices.

416 The back (or second) surface of the first substrate and the front (or first) surface of the second substrate include a conductive material. In case the second substrate is metal, the sheet resistance is sufficiently low, however for the first substrate being a substantially transparent substrate, the rear surface comprises a conductive material which provides a conductive surface on the substrate. For example, the conductive material may be a TCO such as indium tin oxide (ITO), indium zinc oxide (IZO), zinc oxide, and tin oxide. However, in the case where flexibility is desired to be exhibited by the first substrate, and in particular, in the case where both substrates are flexible or rigid, ITO is very brittle and may not withstand repeated bending. Thus, in the present technology, the conductive material may be a conductive nanowire coating or a conductive metal mesh material having a size such that it does not substantially affect reflection in the case of a mirror or does not substantially affect transmittance in the case of a window. For example, a mesh or nanowire coating may have a transmittance greater than 50%. In any of the above embodiments, the web can have a transmittance greater than 60%, greater than 70%, greater than 80%, or greater than 90%. The conductive material may also be an insulator/metal/insulator stack ("IMI stack"), such as those disclosed in US Pat. Nos. 7,830,583 and 8,368,992. The insulator may be a TCO, such as ITO, and the metal may be a conductive metal, such as silver. This type of structure is able to achieve a sheet resistance of 5 to 9 Ω/sq with a transmittance above 80% and a thickness below 110nm, which is much thinner than ITO coating on plastic which has a thickness of 5 Ω/sq at 880nm. Additionally, the mesh, nanowire coating, and or IMI stack may have a sheet resistance of less than 50 Ω/sq. This may include a sheet resistance of less than 10 Ω/sq, less than 1 Ω/sq, less than 0.5 Ω/sq, less than 0.2 Ω/sq, less than 0.1 Ω/sq, less than 0.05 Ω/sq, or less than 0.01 Ω/sq. In any of the above embodiments, the mesh may have a sheet resistance of about 0.0001 Ω/sq to about 50 Ω/sq. This can include meshes, nanowire coatings, and IMI stacks having a sheet resistance of about 0.0001 Ω/sq to about 10 Ω/sq, about 0.0001 Ω/sq to about 5 Ω/sq, about 0.0001 Ω/sq to about 1 Ω/sq, about 0.001 Ω/sq to about 10 Ω/sq, and about 0.001 Ω/sq to about 1 Ω/sq. A brittle TCO (such as ITO) can be coated (primed, overcoated, or both) with a more flexible conductive film, such as a conductive polymer filled with conductive nanoparticles (such as ITO nanoparticles) or a transparent polymer to make it more resistant to substrate bending. If a crack develops in the brittle TCO, the flexible conductive film will electrically bridge the gap and maintain conductivity in the damaged area.

[0036]

446 One problem with coatings on plastic substrates, particularly those with a tendency to be chemically inert such as COC or COP, is that without activating the adhesion promoting layer or the substrate surface prior to

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application of the gas diffusion barrier and conductive coating, the coating on the substrate will be susceptible to areas of delamination.

450 Debonding of the coating from the substrate provides a pathway for oxygen or water vapor to penetrate into the component cavity, especially when delamination occurs near the seal. Alternatively, delamination occurring near the center of the EC device may also create openings in the gas diffusion barrier through which oxygen or water vapor can enter and thus defeat its purpose. Thus, the adhesion promoting layer may be a semi-transparent layer of a metal coating, preferably applied using magnetron sputtering, such as aluminum, titanium, copper or chromium, preferably chromium, having a thickness below 20nm, preferably below 5nm and a transmittance greater than 50%. A polymer based adhesion promoting layer or primer may be used, such as a polyimide coating. The substrate may be surface activated prior to coating using a plasma jet at atmospheric pressure, such as a corona plasma using a gas mixture such as nitrogen, argon and oxygen. Another option is to use ion beam etching in a vacuum environment (also using gases such as oxygen and nitrogen), where the ion energy can be between 100and 5000keV and the ion dose is 1× 10¹⁴ to 1× 10¹⁸. Other options for surface activation are oxygen plasma etching and UV light in an ozone atmosphere. Yet another option for activating the surface is to use flame treatment and use SiO₂flame pyrolysis treatment.

[0037]

469 Illustrative nanowire coating or conductive metal mesh materials include, but are not limited to, silver, gold, stainless steel, aluminum, copper, nickel, molybdenum, tungsten, iridium, rhodium, ruthenium, platinum, cobalt, palladium, chromium, titanium, and alloys thereof.

472 Nanowire-based films can be formed by solution coating chemistry, printing methods, photography, roll-to-roll lithography, or self-assembly. Examples of membranes coated by solution coating chemistry include ClearOhm^{TM} (10-300 Ω/sq, >80% T) from Cambrios Technologies Corporation and Flexx^{TM} (10-100 Ω/sq, >80% T) from Carestream Advanced Materials. These films are based on PET. The nanowire-based membrane produced by self-assembly was Cima NanoTech's (10-100 Ω/sq, >80% T). Conductive metal mesh films are made using a variety of processing techniques including printing, roll-to-roll lithography and photography. Applied Nanotech's Exclucent^{TM}film (<0.1Ω/sq, 80% T) is made by printing method. Rolith Inc.'s NanoWeb^{TM}metal mesh (5Ω/sq, >80% T) is made by roll-to-roll lithography. Fujifilm provides Exclear^{TM}metal mesh (1-50Ω/sq, >80% T) made using the silver halide photography method.

[0038]

487 Nanowire-based films have the advantage of a random pattern, which minimizes moiré issues.

488 The repeating pattern of the metal mesh conductor is prone to moiré problems and requires the overlay film to have the correct orientation to minimize the effects.

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[0039]

A major problem with repeating patterns (such as in wire mesh conductors) is that when illuminated with a close point light source (such as a headlamp), street lamp or sunlight, a strong diffraction pattern can be seen when viewed through the transmissive and/or reflective conductor.

The patterning can be severe enough to make the conductor unusable in many commercial applications, such as windows for buildings and aerospace, and auto-dimming rearview mirrors. The visibility of the diffraction pattern can be minimized by changing the wire spacing in the mesh, changing the wire width in the mesh pattern, continuously changing the angle of the mesh wires relative to each other, thereby changing the relative distance between the mesh wires, or making the metal mesh feature dimensions (mesh spacing and wire width) large enough or small enough not to produce a diffraction pattern in the visible light range. Another way to reduce the visible intensity of these diffraction patterns is to make the metal surface black or non-reflective so that it absorbs light incident on it. This can be done in a variety of ways, such as printing black ink underneath the metal mesh, on top of the metal mesh, or both, or forming a black dendritic layer of nickel or chromium or other metal on the surface of the metal mesh. If a second continuous conductive coating is applied above or below the metal mesh layer, a light absorbing black patterned coating may be applied on top of or below the second continuous conductive coating. For electrochromic device applications, the black coating applied on top of the metal mesh is preferably conductive.

[0040]

In other embodiments, the mesh pattern on one substrate may be offset relative to the pattern on the second substrate.

For example, the web may be offset by 10 to 80 degrees. Alternatively, the pattern can be varied so that the wires in one direction have irregular spacing, thereby causing the conductive material to vary randomly across the surface of the substrate. FIG. 3 illustrates various deposition patterns and offsets of a conductive web or coating.

[0041]

Depending on the electrochromic device configuration, it may be preferred to have higher conductivity or lower resistance in one direction than in another.

Typically, the higher conductivity is oriented perpendicular to the high conductivity power busses, which are usually located at the periphery of the electrochromic device. This can be achieved by oriented more nanowires perpendicular to the busbars than parallel to the busbars, or by having more wires in the screen pattern perpendicular to the busbars, or wider wires perpendicular to the busbars, or thicker wires perpendicular to the busbars. In this way, the device will change color more quickly with no or minimal loss in transmittance. The ratio of the resistance perpendicular to the bus bar to the resistance parallel to the bus bar may be about 10% or more, or 20% or more, or 50% or more. For a flexible substrate that can be repeatedly bent, a mesh pattern other than straight lines intersecting at an angle of 90 degrees is preferred in order to impart flexibility and stretchability. Threads that intersect at angles less than 90 degrees and/or that incorporate a curved or wavy pattern that imparts stretchability to the web are preferred.

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[0042]

537 In another embodiment, the conductive layer may be a metal sheet applied to a very thin layer of the substrate.

538 For example, a copper, silver, or gold flake may be applied using inkjet technology, where the flake has a transmittance greater than 50% and a resistance of 0.1 Ω/sq or less. This includes cases where the flakes have a transmittance greater than 60%, 70% or 80%. This includes cases where the sheet has a transmittance of 50% to 90% or any range therebetween.

[0043]

545 It should be noted that applying the metal pattern by inkjet technology is called an additive process.

546 Other additive printing methods include gravure printing and screen printing. Subtractive methods can be used to form patterns using etching or laser ablation.

[0044]

551 Although the sheet resistance of the metal mesh conductor is extremely low, the density of the metal traces is not high enough to prevent selective coloring around the traces.

553 To further facilitate charge transfer from the substrate and conductive material to the chamber and the electrochromic medium confined therein, and to prevent the metal mesh from dissolving into the electrochromic medium during cycling, a conductive coating may be applied over the conductive nanowire coating or the conductive metal mesh. The coating may be applied only to the metal to protect it, or it may be applied to the metal and to a substrate not covered by the metal. The coating between the metals may have a sheet resistance of less than 10,000 Ω/sq. This may include less than 1,000 Ω/sq, less than 100 Ω/sq, or less than 10 Ω/sq. Illustrative conductive coating materials include, but are not limited to, thin metal coatings such as gold, transparent conductive metal oxides (e.g., indium tin oxide (ITO), indium zinc oxide (IZO), zinc oxide, and tin oxide), graphene, carbon nanotubes, or conductive polymers such as poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT-PSS), polythiophene, polyaniline, polyacetylene, polypyrrole, and polystyrene vinylene. For example, the material may be indium tin oxide, indium zinc oxide, graphene or carbon nanotubes.

[0045]

568 Another problem with TCO coatings is that typical TCOs (such as ITO) require heat treatment in order to achieve the highest conductivity of the material.

570 Due to the low glass transition temperature of the substrate (typically below 100° C), the temperature of heat treatment on plastics is greatly limited. Therefore, another disadvantage of TCO on plastic is that the material has suboptimal conductivity due to thermal limitations, 3 to 5 times lower than thermally processed ITO. To reduce the sheet resistance, the TCO thickness needs to be increased to compensate for the reduced conductivity. The problem with brittle films such as TCOs is that as the film becomes thicker, the coating becomes more sensitive to bending; in other words, a thick coating will fail sooner than a thinner coating with the same amount of bending, and therefore a thinner coating with the same sheet resistance as a thicker

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coating is preferred. The sheet resistance of a TCO such as ITO can be reduced without significant heating of the substrate by flash treating the TCO with high intensity light pulses from a xenon lamp or a laser. This treatment allows thinner TCO coatings to have the same sheet resistance as untreated thicker coatings.

[0046]

In another aspect, any of the above electrochromic devices is provided, further comprising an ultraviolet light absorbing film located on the first substrate.

Such a film may be included on the front surface or the back surface of the first substrate. It is also possible to incorporate the ultraviolet light absorbing material directly into the plastic substrate material itself as it is formed. As explained below, the electrochromic medium may include an ultraviolet light absorbing material to prevent or at least minimize degradation of the electrochromic medium and the plastic substrate due to ultraviolet light. For the purposes of this particular discussion regarding the application of UV light absorbing films, the first substrate is the substrate that faces the UV light source. For example, if the electrochromic device is a window, the first substrate is the substrate that is exposed to the exterior of a building and receives incident sunlight. Therefore, the first surface of the first substrate may include an ultraviolet light absorbing film. Alternatively or additionally, the second surface of the first substrate may include an ultraviolet light absorbing material. Each substrate may itself include ultraviolet light absorbing material. This provides two advantages.

[0047]

The first advantage relates to electrochromic medium preservation.

Electrochromic media may be sensitive to the degradative effects of ultraviolet light. Thus, the ultraviolet absorbing film can protect the electrochromic medium from being exposed to ultraviolet light through the first substrate. A second advantage is the ability to UV cure some or all of the electrochromic medium by exposing the second substrate, which has a higher UV transmittance, to UV light. The electrochromic medium may be gelled to prevent movement of the electrochromic medium within the device, to prevent leakage of the device in the event of a rupture, or to provide a unitary structure by bonding a first substrate to a second substrate. However, in many cases, the electrochromic medium includes dissolved UV light absorbing materials; therefore, gels that can be cured using UV light cannot be used. The use of a UV absorbing film on the first substrate allows the electrochromic medium to include a reduced amount of or no UV absorbing material, while allowing the electrochromic medium to be cured in the form of a UV curable gel because the electrochromic medium can be activated by irradiating UV light through the second substrate for a time sufficient to produce a gel in the chamber. The material used to seal the perimeter of the EC device can also be UV cured in this way.

[0048]

Any of the plastic substrates described herein may include an anti-scratch coating on the surface to prevent or at least minimize damage to the outer surface of the device.

In some embodiments, the device has an anti-scratch coating on an outer surface of the device and includes a

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gas diffusion barrier on an inner surface of the device so that the plastic substrate provides a first barrier to gas entering the device and the gas diffusion barrier provides a second barrier to gas passing through the plastic substrate.

[0049]

633 Other coatings on either device may include anti-fingerprint coatings, anti-fog coatings, as well as anti-smudge coatings and anti-reflective coatings.

[0050]

638 Electrochromic media

[0051]

642 Electrochromic media can take many different forms, such as thermoplastic polymer films, solution phases, or colloidal phases.

644 Illustrative electrochromic media are those described in U.S. Patent Nos. 4,902,108; 5,888,431; 5,940,201; 6,057,956; 6,268,950; 6,635,194 and 8,928,966 and U.S. Patent Application Publication No. 2002/0015214.

646 The anode and cathode electrochromic materials may also include coupling materials as described in US Pat. No. 6,249,369.

648 Also, the concentration of the electrochromic material may be selected as taught in US Pat. No. 6,137,620. Additionally, single layer, single phase media may include media in which the anode and cathode materials are incorporated into a polymer matrix, as described in International Patent Application Nos. PCT/EP98/03862 and PCT/US98/05570.

[0052]

655 The electrochromic medium may be a multi-layer or multi-phase electrochromic medium.

656 In a multilayer electrochromic medium, the medium may be composed of multiple layers and include an electroactive material that is directly attached to or constrained in close proximity to a conductive electrode so that the electroactive material remains attached or constrained when electrochemical oxidation or reduction occurs. In multiphase electrochromic media, one or more materials in the media undergo a phase change during device operation, such as when electrochemical oxidation or reduction occurs, where the material contained in an ionically conductive electrolyte solution forms a separate layer on a conductive electrode.

[0053]

666 The electrochromic medium may include materials such as (but not limited to) the following: anode materials, cathode materials, light absorbers, light stabilizers, heat stabilizers, antioxidants, thickeners, viscosity modifiers, colorants, redox buffers, and mixtures thereof.

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Suitable redox buffers include, among others, those disclosed in US Pat. No. 6,188,505. Suitable UV stabilizers may include: 2-ethyl-2-cyano-3,3-diphenyl acrylate, (2-ethylhexyl)-2-cyano-3,3-diphenyl acrylate, 2-(2-hydroxy-4'-methylphenyl)benzotriazole, 3-[3-(2H-benzotriazol-2-yl)-5-(1,1-dimethylethyl)-4-hydroxyphenyl]propanoic acid pentyl ester, 2,4-dihydroxybenzophenone, 2-hydroxy-4-methoxybenzophenone, 2-ethyl-2'-ethoxyaniline and the like.

[0054]

According to some embodiments, anode materials may include, but are not limited to, ferrocene, ferrocenium salts, phenazines, phenothiazines, and thianthrenes.

Illustrative examples of anode materials can include di-tert-butyl-diethylferrocene; 5,10-dimethyl-5,10-dihydrophenazine (DMP); 3,7,10-trimethylphenothiazine, 2,3,7,8-tetramethoxy-thienyl, 10-methylphenothiazine, tetramethylphenazine (TMP), and bis(butyltriethylammonium)-p-methoxyphendithiazine (TPDT). Anode materials may also include those materials incorporated into polymer membranes such as polyanilines, polythiophenes, polymer metallocenes, or solid transition metal oxides including, but not limited to, oxides of vanadium, nickel, iridium, and various heterocyclic compounds. Other anode materials may include those described in US Pat. Nos. 4,902,108; 6,188,505; and 6,710,906.

[0055]

In any of the above aspects, the anode material can be a phenazine, phenothiazine, triphenodithiazine, carbazole, indolocarbazole, biscarbazole or ferrocene enclosed in a second polymer matrix, the second polymer matrix being configured to prevent or minimize substantial diffusion of the anode material in an activated state.

Like the viologen, the anode material may be locked into the polymer matrix by being physically retained within the polymer matrix, or the anode material may be functionalized so that it can polymerize or react with the polymer, thereby covalently bonding to the polymer.

[0056]

In some embodiments, the anode material may be a compound represented by:

[0058]

In the above formula, E is S or NR¹⁰; R¹ and R¹⁰ are individually alkyl groups interrupted by at least one ammonium group; R² to R⁹ are individually H, F, Cl, Br, I, CN, OR¹¹, SR¹¹, NO₂, alkyl, aryl, amino, or any two adjacent groups of R²-R⁹ can be connected to form a monocyclic, polycyclic or heterocyclic group; each R¹¹ is individually H or alkyl; and R¹² is an alkylene group.

In some embodiments, E is NR¹⁰ and R²-R⁹ are H or

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OR¹¹.

712 In other embodiments, E is S and R⁷ and R⁸ are linked to form a heterocyclic group.

[0059]

718 The anode material may be a compound represented by:

[0061]

722 In the above formula, R¹⁴ is an alkyl group interrupted by at least one ammonium group.

723 In any of the above compounds, R¹, R¹⁴ and R¹³ can be represented by:

[0063]

728 wherein R¹⁵-R¹⁸ are individually H or alkyl; n is 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 or 12, n' is 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 or 12, and x is 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 or 12.

730 In some embodiments, n is 4, x is 2, and n' is 11.

[0064]

734 The cathode material may include, for example, a viologen, such as methyl viologen, octyl viologen, or benzyl viologen; a ferrocenium salt, such as (6-(tri-tert-butylferrocenyl)hexyl)triethylammonium.

736 It will be appreciated that all such species (referring only to the cationic portion of the molecule and the various anions) may be used as counterions.

738 While specific cathode materials are provided for illustrative purposes only, use of a variety of other conventional cathode materials is also contemplated, including, but not limited to, those disclosed in previously mentioned and incorporated U.S. Patent Nos. 4,902,108, 6,188,505, and 6,710,906.

741 Additionally, it is contemplated that the cathode material may include polymer films, such as various polythiophenes, polymer viologens, inorganic films, or solid transition metal oxides, including but not limited to tungsten oxide.

[0065]

747 Illustrative cathode materials for use in any of the devices described herein include viologens and metal oxides.

748 Illustrative metal oxides include those that are electrochromic, such as tungsten oxide.

749 Tungsten oxide can act as a cathode material as well as a conductive material.

[0066]

753 In any of the above aspects, the cathode material can be a viologen or a non-dimeric or oligomeric viologen.

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754 Illustrative viologens include, but are not limited to, methyl viologen, octyl viologen, benzyl viologen, polymeric viologens, and the viologens described in U.S. Pat. Nos. 7,372,609, 4,902,108, 6,188,505, and 6,710,906.

754 Other viologens may include viologens of formula (I), formula (III) or formula (IV):

[0068]

761 In formula I, R¹ and R² are individually alkyl, siloxyalkyl, hydroxyalkyl, alkenyl or aralkyl; R⁴, R⁶, R⁸ and R¹⁰ are individually H, OH, F, Cl, Br, I, CN, NO₂, alkyl or aryl; R³, R⁵, R⁷ and R⁹ are individually H, OH, F, Cl, Br, I, CN, NO₂, alkyl or aryl, and X is an anion.

766 However, formula (I) may satisfy the following condition: R³ and R⁵, or R⁷ and R⁹, or R³, R⁵, R⁷ and R⁹ are individually secondary alkyl groups, tertiary alkyl groups or aromatic groups.

769 Formula (III):

[0070]

773 In formula (III), R¹ and R² are individually alkyl, siloxyalkyl, hydroxyalkyl, alkenyl or aralkyl; R⁴, R⁶, R⁸, R¹⁰ are individually H, OH, F, Cl, Br, I, CN, NO₂, alkyl or aryl; R³, R⁵, R⁷ and R⁹ are individually H, OH, F, Cl, Br, I, CN, NO₂, alkyl or aryl; R¹⁹ is (CH₂)_{n'} or arylene, and n' is 1 to 12; X is an anion; and wherein R³ and R⁵, or R⁷ and R⁹ are individually secondary alkyl, tertiary alkyl or aryl.

780 Formula (IV)

[0072]

784 In formula (IV), R¹ and R¹' are individually alkyl, siloxyalkyl, hydroxyalkyl, alkenyl or aralkyl; R⁴, R⁶, R⁸, R¹⁰, R⁴', R⁶', R⁸' and R¹⁰' are individually H, OH, F, Cl, Br, I, CN, NO₂, alkyl or aryl; R⁷, R⁹, R⁷' and R⁹' are individually R111_' is individually H, OH, F, Cl, Br, I, CN, NO₂, alkyl or aryl; R¹⁹ is (CH₂)_{n'} or arylene, and n' is 1 to 12; X is an anion; and R³, R⁵, R³' and R⁵' are individually secondary alkyl, tertiary alkyl or aryl; R⁷, R⁹, R⁷' and R⁹' are individually secondary alkyl, tertiary alkyl or aryl.

793 In some embodiments, for the non-dimeric electrochromic compound represented by formula (IV), R¹⁹ is (CH₂)_{n'} or an arylene group, and n′ is 1 to 12.

795 With respect to any of the viologens, the counterion (anion) may be any of the following: a halide, borate,

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fluoroborate, tetraarylborate, hexafluorometal or metalloid, sulfate, sulfonate, sulfonamide, carboxylate, perchlorate, tetrachloroferrate or the like, or a mixture of any two or more thereof.

797 Illustrative counterions/anions include, but are not limited to: F⁻, Cl⁻, Br⁻, I⁻, BF₄⁻, PF₆⁻, SbF₆⁻, AsF₆⁻, ClO₄⁻, SO₃NER142_, CF⁻NER144_, 143_, N(CF₃SO₂)₂⁻, C(CF₃SO₂)₃⁻, trifluoromethanesulfonate (trifluoromethanesulfonate), N(SO₂C₂F₅)⁻ or BAr₄⁻, wherein Ar is aryl or fluorinated aryl or bis(trifluoromethyl)aryl. In some embodiments, X is tetrafluoroborate or a bis(trifluoromethylsulfonyl)imide anion.

[0073]

811 The cathode material can be a proton-soluble electrochromic material (e.g., soluble in protic solvents such as ethanol and/or water), or a single-component electrochromic material (i.e., an electrochromic material comprising a compound containing cathode and anode portions in the same molecule or cation/anion combination, as described in U.S. Provisional Application Nos. 62/257,950 (filed November 20, 2015) and 62/258,051 (filed November 20, 2015).

[0074]

819 Other examples of anode and cathode materials can be found in US Pat. Nos. 4,902,108, 5,294,376, 5,998,617, 6,193,912, and 8,228,590.

[0075]

824 For illustrative purposes only, the concentration of the anode material and/or cathode material in the electrochromic medium may be in the range of about 1 millimolar (mM) to about 500mM and more preferably in the range of about 2mM to about 100mM.

827 While specific concentrations of anode material and cathode material have been provided, it will be appreciated that the desired concentrations may vary widely depending upon the geometry of the chamber containing the electrochromic medium.

[0076]

833 For purposes of the present disclosure, the solvent of the electrochromic medium may comprise any number of common commercially available solvents, including 3-methylcyclobutane sulfone, dimethyl sulfoxide, dimethylformamide, tetraethylene glycol dimethyl ether, and other polyethers; alcohols, such as ethoxyethanol; nitriles, such as acetonitrile, glutaronitrile, 3-hydroxypropionitrile, and 2-methylglutaronitrile; ketones, including 2-acetylbutyrolactone and cyclopentanone; cyclic esters, including β-propiolactone, γ-butyrolactone, and γ-valerolactone; organic carbonates, including propylene

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carbonate (PC), ethylene carbonate, and ethyl methyl carbonate; and mixtures of any two or more thereof.

[0077]

849 The electrochromic medium may include a thermoplastic polymer in which the electrochromic material is enclosed ("electrochromic thermoplastic").

851 Such media are described in U.S. Provisional Application No. 62/184,704, filed May 25, 2015.

852 Such a medium may include a thermoplastic polymer, an electrochromic material, and a solvent or plasticizer, wherein the thermoplastic polymer is present in an amount sufficient to form a substantially formable gel matrix of the electrochromic material (ie, the matrix contains solvent but is self-supporting, formable and shapeable).

856 Such media are prepared by dissolving a thermoplastic polymer in a solvent under heating and also dissolving the electrochromic material in the solvent.

858 Upon cooling, the thermoplastic polymer sets up to form a formable gel material. The formable gel material may be shaped or cut to size.

[0078]

863 The formable gel material may contain a cathode material, an anode material, or both a cathode material and an anode material as the electrochromic material.

865 In the case where the electrochromic material is only the cathode material or only the anode material, the device can be prepared in a sandwich style so that a first substrate can be connected to a thermoplastic polymer material including the cathode material, and a second substrate is connected to an anode thermoplastic material, wherein the two substrates are connected with or without an electrolyte layer between the separate sides. In other words, the cathode material is confined in one half of the device and the anode material is confined in the other half of the device, with or without a separate electrolyte layer or ion exchange membrane or porous membrane in between. In some embodiments, the thermoplastic material may include only the anode material and be associated with a first substrate, while the second substrate contains a cathode coating, such as a metal oxide coating. Of course, the thermoplastic material may contain both anodic and cathodic materials.

[0079]

878 As mentioned above, the formable gel can be formed by dissolving the thermoplastic material in a solvent along with the electrochromic material and any other additives desired, such as electrolytes, UV absorbing materials, electrochromic buffers, and other stabilizers.

881 Once the solution of thermoplastic material is prepared, it can be poured into a mold and the layer drawn to the desired thickness with a paring knife, or placed between release layers so that it can be rolled to the desired thickness. The release liner may be molded or poured onto it so that after the material cools and forms a formable gel, the release liner can be released from the now electrochromic thermoplastic matrix. The resulting formable gel can be cut or trimmed into desired shapes.

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[0080]

The thermoplastic electrochromic film can be formed by dissolving a thermoplastic polymer and an electrochromic material and optionally other additives together in a solvent to form a film-forming composition.

The dissolution of the material can be carried out at elevated temperatures. For example, illustrative elevated temperatures may be about 30° C to about 150° C. The concentration of the thermoplastic polymer included in the solvent is such that, upon cooling, the thermoplastic polymer forms a self-supporting matrix containing the solvent, the electrochromic material and, if present, any optional additives. To form a film, the film-forming composition can be cast on a conductive substrate after dissolution but before a self-supporting matrix is established, or the film-forming composition can be cast on a release liner. After cooling, the thermoplastic polymer, electrochromic material and optional additives form a self-supporting film. Where a release liner is used, after the film-forming composition is applied to a release liner, an overlapping second release liner may be applied with the film-forming composition sandwiched therebetween and the entire assembly passed through an extruder or roller system to form a thermoplastic electrochromic film of uniform thickness. The release liner is then removed and the film is applied to the conductive surface of the first substrate, followed by the removal of the second release liner and the application of the conductive surface of the second substrate. After the edges are sealed, an electrochromic device is thus formed.

[0081]

In case the electrochromic device has been constructed using thermoplastic films, further post-processing can be envisaged in which the thermoplastic material is additionally crosslinked in order to enhance the long-term mechanical stability of the thermoplastic film, thereby producing a crosslinked electrochromic film.

This can be done by additional UV curing of the thermoplastic film.

[0082]

In cases where the electrochromic device includes more than one thermoplastic film and/or cross-linked electrochromic film (e.g., a first thermoplastic film contains a cathode material and a second thermoplastic film contains an anode material), the first and second thermoplastic membranes may be separated by an ion exchange membrane or a porous membrane or a third thermoplastic membrane separating the first and second membranes.

The third thermoplastic film may contain an electrolyte or salt that facilitates electrical conduction between the first film and the second film. Similarly, a first crosslinked membrane containing cathode material and a second crosslinked membrane containing anode material, the first crosslinked membrane and the second crosslinked membrane can be separated by an ion exchange or porous membrane or a third membrane that is thermoplastic or crosslinked to separate the first and second membranes. The third membrane may contain an electrolyte or salt that facilitates electrical conduction between the first membrane and the second membrane. Another example is a first thermoplastic membrane containing cathode material and a second cross-linked membrane containing anode material, the first and second membranes can be separated by an ion exchange membrane or a porous membrane or a third membrane that is thermoplastic or cross-linked to

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separate the first and second membranes. The third membrane may contain an electrolyte or salt that facilitates electrical conduction between the first membrane and the second membrane. Yet another example includes a first cross-linked membrane containing a cathode material and a second thermoplastic membrane containing an anode material, the first and second membranes may be separated by an ion exchange membrane or a porous membrane or a third membrane that is thermoplastic or cross-linked to separate the first and second membranes. The third membrane may contain an electrolyte or salt that facilitates electrical conduction between the first membrane and the second membrane.

[0083]

949 The electrochromic material included in the polymer-based electrochromic film may be a cathode material, an anode material, or an anode material and an anodic material.

951 Therefore, there are many possible combinations of different scenarios. Polymer-based electrochromic films can contain a variety of materials for various applications. As a non-limiting illustration, a polymer-based electrochromic film may contain all of the components necessary for an electrochromic device such that the film need only be placed between conductive substrates so that an electrical potential can be applied to the device to effect a color change.

[0084]

959 Illustrative thermoplastic polymers include, but are not limited to, acrylates, methacrylates, polyesters, polycarbonates, polylactides, polyvinyl esters, polyurethanes, cellulose esters, polyvinyl formal, polyvinyl butyral, polyethylene-co-vinyl acetate, and copolymers of any two or more thereof.

962 Crosslinked films can further be produced by crosslinking such thermoplastic polymers.

[0085]

966 Sealing parts

[0086]

970 The sealing member is used to connect the first substrate to the second substrate.

971 The sealing component may be an adhesive material applied to one substrate or the other, or a dual system adhesive in which a first component is applied to one substrate and a second component is applied to the other substrate and the two components are contacted and merged to bond the substrates together.

974 Illustrative adhesives include, but are not limited to, those containing epoxies, urethanes, cyanoacrylates, acrylics, polyimides, polyamides, polysulfides, phenoxys, polyolefins, and silicones. The sealing component may include a heat curing system such as a heat curing epoxy or a UV light curable sealant.

[0087]

980 The sealing member may alternatively be a weld between the first substrate and the second substrate.

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[0087] In other words, two plastic substrates are melted and connected to each other or using a third material, such as when using hot melt adhesive. Of course, care must be taken to apply the conductive material to the substrate surface so that the device does not short-circuit. In some embodiments, the weld between the first substrate and the second substrate is an ultrasonic weld. It should be noted that a combination of techniques may be used to seal the device. For example, a portion of the seal may be formed by welding uncoated areas of the substrates together and then applying a UV-cured sealing adhesive to areas of the substrates coated with a coating, such as a metal mesh coating or a nanowire coating.

[0088]

[0088] The sealing member may be a heat sealing film that attaches the first and second substrates at edges of the first and second substrates around the perimeter of the device.

[0088] Thus, the heat-sealing film covers the edge of the front surface of the first substrate and extends to the edge of the rear surface of the second substrate. This sealing component provides a barrier to the electrochromic medium or electrochromic film against moisture and oxygen. Heat seal films are typically multi-layered consisting of an inner sealant layer, a middle core layer, and an outer barrier layer, which may or may not include an aluminum foil layer. The film may be applied using a heat sealer to adhere the film to the edge of the device. An example of a heat seal film without a foil layer includes Toray's CBS2, and an example of a metallized heat seal film is Toray's PWX5. Additionally, a pressure sensitive adhesive may be added to the inner sealant layer to allow the film to adhere at room temperature or to improve adhesion during heat sealing. An example of a pressure sensitive adhesive for this purpose is 3M^{TM}8142KCL.

[0089]

[0089] In another aspect, any of the above electrochromic devices is provided, further comprising an electrochromic film in addition to or in place of the electrochromic medium.

[0090] The electrochromic film may be a polymer-based film (as described herein) that has one or more electrochromic substances incorporated therein in addition to a thermoplastic polymer. In addition to the thermoplastic polymer, the electrochromic film may also include an anode material, a cathode material, or both a cathode material and an anode material. The film may also include other additives such as plasticizers, cross-linking agents, electrochromic buffers, ultraviolet light absorbing materials, electrolyte salts, stabilizers, and gel-forming materials.

[0090]

[0090] Within the chamber, the first surface of the second substrate, the second surface of the first substrate, or both surfaces may be coated with a polymer-based film having one or more electrochromic substances incorporated therein.

[0090] As an illustration, the first surface of the second substrate may be coated with a polymer-based

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electrochromic film comprising an anode material and a thermoplastic polymer, as described above. In such illustrations, the chamber may then include a dielectric incorporating the cathode material, or the cathode material may be coated on the second surface of the first substrate as a polymer-based electrochromic film or as a metal oxide (eg, tungsten oxide).

[0091]

1031 Electrochromic devices including thermoplastic electrochromic films may be formed from flexible substrates.

1032 For example, the flexible substrate may be a flexible plastic substrate having a flexible coating. A flexible electrochromic device is thus formed. In one embodiment, the first and second flexible plastic substrates are coated with a gas barrier layer and a conductive material. The device is prepared in such a manner that the second surface of the first substrate is brought into proximity with the first surface of the second substrate, wherein a sealing member connects the first substrate to the second substrate with a chamber formed therebetween. However, before the substrates are connected, the second surface of the first substrate is coated with an electrochromic material (such as a metal oxide, such as tungsten oxide) or a thermoplastic electrochromic film, and the first surface of the second substrate is coated with a metal oxide or a thermoplastic electrochromic film. Alternatively, a thermoplastic electrochromic film incorporating a cathode material, an anode material, a thermoplastic polymer, and a solvent may be formed and applied to a substrate having a conductive surface. The electrochromic device can then be formed by applying a conductive surface to the second substrate and edge sealing the device to hold and protect the thermoplastic electrochromic film within the device cavity. The edge seal may comprise a polymer adhesive, such as an epoxy-containing material, or it may be a plastic weld, a heat seal film, a hot melt adhesive, a thermoset material or a UV curable material.

[0092]

1050 Devices, methods or making such devices as described above have been described.

1051 For example, a device having a polymer-based electrochromic film may be formed by assembling a first substrate, a second substrate, and disposing the polymer-based electrochromic film therebetween. This may include simple assembly of various components, or complete assembly from membrane fabrication to device fabrication.

[0093]

1058 In another aspect, a method of forming a substrate for an electrochromic device having a polymer film is provided.

1060 The method may include coating a first polymer-based electrochromic film on a first surface of a first substrate, the polymer-based electrochromic film having at least a first electroactive material and a first thermoplastic polymer. Illustrative coating techniques may include, but are not limited to, slot die coating, gravure coating, curtain coating, spray coating, dip coating, extrusion coating, or ramp coating. Such methods should be amenable to a wide variety of electrochromic materials, including the use of viologens, phenazine, phenothiazines, triphenodithiazines, carbazoles, indolocarbazoles, biscarbazoles, or ferrocene.

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This can be repeated multiple times for a multilayer device, or for separate substrates, each containing a different type of polymer-based electrochromic film, where it is the cathode material, the anode material, or both in the same film.

[0094]

1078 In another aspect, an electrochromic device comprises a first substrate having a first surface and a second surface; a second substrate having a first surface and a second surface; and a sealing member connecting the second surface of the first substrate to the first surface of the second substrate to form a chamber therebetween; wherein the first substrate contains an ultraviolet light absorbing material; the second surface is coated with a first polymer-based electrochromic film (as described herein) containing an anode material; and the chamber contains a fluid medium containing a UV-curable gelling agent.

1084 The UV-curable gellant may include a multifunctional vinyl compound or oligomer, such as an acrylate, methacrylate, or vinyl ether, and a free radical photoinitiator. Illustrative vinyl compounds include, but are not limited to, 1,4-butanediol diacrylate, tris[2-(acryloyloxy)ethyl]isocyanurate, poly(propylene glycol) diacrylate, poly(propylene glycol) dimethacrylate, poly(ethylene glycol) diacrylate, trimethylolpropane propoxylate triacrylate, and 1,4-butanediol divinyl ether, to name a few, and combinations thereof. In addition to multifunctional vinyl compounds, monomeric vinyl compounds may also be included in the UV curable gel to help modify the final properties of the gel (such as methyl methacrylate or butyl acrylate), to name a few. The free radical photoinitiator that needs to be incorporated can be (but is not limited to) 2-hydroxy-2-methylpropiophenone, 2,2-dimethoxy-2-phenylacetophenone (651), 2,2-diethoxyacetophenone, and phenylbis(2,4,6-trimethylbenzoyl)phosphine oxide (819).

[0095]

1100 In some embodiments, the fluid medium contains a cathode material, as described above.

1101 For example, the cathode material may be viologen.

[0096]

1105 In other embodiments, the fluid medium may further include an ultraviolet light absorbing material, an ultraviolet light curable gelling agent, or a mixture of any two or more thereof.

[0097]

1110 In some embodiments, the first surface of the second substrate is coated with a second polymer-based electrochromic film including a cathode material.

1112 In such embodiments, the cathode material can be any cathode material as described above.

1113 In some embodiments, the cathode material is viologen.

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[0098]

1117 The anode material in such devices can be any anode material as described above, including but not limited to phenazine, phenothiazine, triphendithiazine, carbazole, indolocarbazole, biscarbazole, or ferrocene.

[0099]

1122 In some embodiments, the first surface of the second substrate is coated with a metal oxide.

1123 For example, the metal oxide may be tungsten oxide.

[0100]

1127 The fluid medium in the device may include a solvent.

1128 In some embodiments, the fluid medium may also include electrolytic salts.

[0101]

1132 In another aspect, a method for gelling a fluid medium in an electrochromic device is provided, wherein an electrochromic device is provided, the device comprising: a first substrate having a first surface including a UV absorbing layer and a second surface; a second substrate having a first surface and a second surface; and a sealing member, wherein the second surface of the first substrate is connected to the first surface of the second substrate to form a chamber therebetween.

1137 The chamber may include a fluid medium containing an ultraviolet light-curable gellant, and the method further includes irradiating the ultraviolet light-curable gellant with ultraviolet light through the second substrate.

[0102]

1143 In such embodiments, the fluid medium may further include any of the above-mentioned cathode materials, ultraviolet light absorbing materials, or mixtures thereof.

1145 In the method, the second surface of the first substrate may include a first polymer-based electrochromic layer including an anode material.

1147 Illustrative anode materials are as described above, including, but not limited to, phenazine, phenothiazine, triphenodithiazine, carbazole, indolocarbazole, biscarbazole, or ferrocene. In the method, the first surface of the second substrate is coated with a second polymer-based electrochromic film, the electrochromic film comprising the cathode material as described above, or a metal oxide as the cathode material.

[0103]

1154 In the method, the step of applying a sealing member to the first substrate or the second substrate and applying the remaining substrate to the sealing member may be further included.

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1156 The method may further include curing the sealing member.

[0104]

1160 In the method, the sealing member may include a thermosetting resin, an ultraviolet light curing resin, or a combination thereof.

1162 Such resins may include, but are not limited to, epoxy resins, cyanoacrylates, silicones, urethanes, polyimides, acrylate resins, and/or methacrylate resins, and combinations of any two or more thereof. Where the resin is UV curable, the sealing member may then be cured by irradiating it with ultraviolet light through the second substrate, and where the resin is thermally curable, it may be cured by heating the resin or exposing it to heat. Alternatively, the sealing member comprises welding between the first substrate and the second substrate, heat fusion to a third thermoplastic, or a heat sealing film.

[0105]

1171 In another aspect, an electrochromic device is provided.

1172 The device has a first substrate having a front surface and a back surface including conductive nanowires or a conductive metal mesh. In the device, the front surface, the rear surface, or both the front surface and the rear surface of the first substrate include a gas diffusion barrier. The device also has a second substrate including a front surface having conductive nanowires or a conductive metal mesh. In the device, the front surface, the rear surface, or both the front surface and the rear surface of the second substrate include a gas diffusion barrier. In the device, a first substrate is connected to a second substrate through a sealing member, wherein a rear surface of the first substrate and a front surface of the second substrate define a cavity therebetween together with the sealing member and the first substrate is a plastic substrate.

[0106]

1183 In some embodiments, the second substrate is a plastic substrate and the front surface, the back surface, or both the front surface and the back surface of the second substrate include a gas diffusion barrier.

1185 The chamber of the device may include an electrochromic medium having a cathode material, an anode material, or both a cathode material and an anode material. In such embodiments, the electrochromic device is flexible or rigid having two plastic substrates that bend and flex.

[0107]

1191 The back surface of the first substrate may include a conductive nanowire coating, a conductive metal mesh, or an IMI stack, and the front surface of the second substrate may also include a conductive nanowire coating, a conductive metal mesh, or an IMI stack.

1194 The metal mesh materials and IMI stack are as described above. In addition to the metal mesh, nanowire coating, and IMI stack, the back surface of the first substrate and the front surface of the second substrate may include a conductive coating disposed between the conductive nanowire coating, the conductive metal mesh or the IMI stack and the chamber. Alternatively, in addition to the metal mesh and the IMI stack, the

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back surface of the first substrate and the front surface of the second substrate may include a conductive coating disposed between the nanowire coating/conductive metal mesh/IMI stack and the chamber, or a conductive coating disposed between the nanowire coating/conductive metal mesh/IMI stack and the substrate.

[0108]

1209 Illustrative conductive coatings may include thin metal layers, transparent conductive metal oxides, carbon nanotubes, graphene, or conductive polymers.

1211 For example, the conductive coating may include a thin layer of gold, a thin layer of a platinum group metal, indium tin oxide, indium zinc oxide, carbon nanotubes, graphene, or poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT-PSS). In some embodiments, the conductive coating may include indium tin oxide.

[0109]

1218 In some embodiments, the first substrate may include a plastic substrate, the second substrate may be a plastic substrate, or both the first substrate and the second substrate may be plastic.

1220 One or both of the first and second substrates may also be flexible or rigid.

[0110]

1224 As with other devices described herein, the sealing component of the device may include a UV curable resin, a heat curable resin, a hot melt adhesive, a weld, or a heat sealing film.

1226 Illustrative sealing components of this type are described above.

[0111]

1230 As with any of the devices described above, either or both of the first surface of the first substrate and the second surface of the second substrate may include a scratch resistant coating.

1232 The scratch resistant coating can be organic, inorganic, or a combination of both. The hard coating layer may be composed only of an organic resin, a hybrid coating formed by bonding an organic resin with inorganic particles, or a composite coating of an organic resin and an inorganic filler. Common hard coatings for plastic substrates are solvent-based UV-curable acrylics containing silica fillers. Illustrative anti-scratch coatings include, but are not limited to, Acier C50PG available from Nidek Company, which is a hybrid hardcoat based on a UV-curable organic/inorganic acrylic compound. Inorganic coatings applied by physical vapor deposition or chemical vapor deposition can be used to form the hardcoat. These layers are typically in the range of 100nm to 25 μm thick. The hard coating may use a combination of a hard organic layer as an undercoat followed by a much harder inorganic layer. The hard coating layer may also be one in which a diamond-like carbon (DLC) layer is applied on an inorganic hard coating layer. The organic layer typically has a thickness of 25 to 1000 microns, the inorganic layer typically has a thickness of 100nm to 25 microns and the diamond-like carbon layer typically has a thickness of 1 to 100nm.

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[0112]

1247 The gas diffusion barrier on the device may include (but is not limited to) layers applied by plasma enhanced chemical vapor deposition (PECVD), layers applied by neutral beam assisted sputtering (NBAS), layers applied by atomic layer deposition (ALD), poly(ethylene-co-vinyl alcohol) (EVOH) coatings, polyvinyl alcohol (PVOH) coatings, polymer films of self-assembled nanoparticles (SNAPs), multilayer barriers of alternating thin films of cationic polymers and anionic polymers deposited by layer-by-layer deposition, or multilayer barriers comprising alternating layers of organic and inorganic materials, or flexible thin glass films.

[0113]

1257 In the case where the cathode or anode material is enclosed in a polymer matrix, the polymer matrix may be a solid polymer or a gel polymer that is thermoplastic or cross-linked.

1259 For example, as illustrated in the examples, the polymer can be an acrylate based polymer dissolved in a solvent in combination with the anode or cathode material.

1261 This solution is then applied to the conductive surface of the substrate and the solvent is removed. The resulting film is an acrylate film that may be hard or sticky to the touch. Alternatively, the polymer membrane may be a gel containing a solvent and either the anode or cathode material. Furthermore, the polymer films can subsequently be crosslinked to increase the mechanical stability. Other possible polymer matrix systems that can be used to seal the anode and cathode materials: polyacrylates, polymethacrylates, polyethers, polyesters, polycarbonates and polyurethanes, polysiloxanes, polysilanes, polyacrylonitrile, polystyrene, polymethacrylonitrile, polyamides, polyimides, polyvinylidene halides, polyvinyl butyral, and copolymers or combinations of any two or more thereof. Other examples of polymer matrix materials used in electrochromic devices can be found in US Pat. Nos. 6,635,194 and 5,940,201.

[0114]

1273 As noted above, the anode or cathode material may also be part of a polymer matrix, wherein the anode or cathode material is covalently bonded to the polymer.

1275 This can be achieved by the presence of functional groups on the anode or cathode material that react with the polymer or the monomers that make up the polymer. For example, where the anode or cathode material contains hydroxyl groups, the anode or cathode material can be bonded into the polymer matrix via a condensation reaction or reacted with isocyanate functional groups to form a polyurethane-based polymer matrix. Amines can also be reacted with isocyanate functional groups to form urea and biuret bonds. It is also contemplated that other crosslinked polymer matrices may be formed using combinations of multifunctional epoxides or polymers with curing agents such as amines, alcohols or anhydrides or by base or acid catalyzed homopolymerization.

[0115]

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1286 Illustrative materials that can be used as the first and second polymer matrix materials include, but are not limited to, polymethyl methacrylate, polyacrylate, polystyrene, polyurethane, polyether, polyester, polycarbonate, polysiloxane, polysilane, polyacrylonitrile, polymethacrylonitrile, polyamide, polyimide, polyvinylidene halide, polyvinyl butyral, and copolymers and combinations thereof.

1286 Other examples of polymer matrix materials can be found in US Pat. Nos. 6,635,194 and 5,940,201.

[0116]

1294 The electrolyte may include a solvent and a salt.

1295 The salt may be a metal salt or an ammonium salt. Illustrative solvents for use in the electrolyte may include, but are not limited to, 3-methylcyclobutane, dimethyl sulfoxide, dimethylformamide, tetraethylene glycol dimethyl ether, and other polyethers; alcohols such as ethoxyethanol; nitriles such as acetonitrile, glutaronitrile, 3-hydroxypropionitrile, and 2-methylglutaronitrile; ketones including 2-acetylbutyrolactone and cyclopentanone; cyclic esters including β-propiolactone, γ-butyrolactone, and γ-valerolactone; carbonates including propylene carbonate (PC), ethylene carbonate, ethyl methyl carbonate; and homogeneous mixtures thereof. While specific solvents have been disclosed in connection with the electrolyte, the use of a variety of other solvents known to one of ordinary skill in the art prior to this disclosure is also contemplated. Illustrative salts include, but are not limited to, metal or ammonium salts of the following anions (such as, but not limited to, Li⁺, Na⁺, K⁺, NR'₄, where each R' is individually H, alkyl or cycloalkyl): F⁻, Cl⁻, Br⁻, I⁻, BF₄⁻, PF₆⁻, SbF₆⁻, AsF₆⁻, ClO₄⁻, SO₃CF₃⁻, N(CF₃SO₂)₂⁻, C(CF₃SO_NE R189_)₃⁻, N(SO₂C₂F₅)⁻, Al(OC(CF₃)₃)₄⁻, or BAr₄⁻, wherein Ar is an aryl or fluorinated aryl group, such as (but not limited to) C₆H₅, 3,5-(CF₃)₂C₆H₃, or C₆F₅.

[0117]

1319 The invention thus generally described will be more readily understood by reference to the following examples which are provided by way of illustration and not limitation of the invention.

[0118]

1324 Examples

[0119]

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1328 Example 1: Electrochromic gel medium.

1328 The electrochromic medium was prepared by combining: 38 mM N,N'-bis(n-octyl)viologen tetrafluoroborate; 27 mM 5,10-dihydro-5,10-dimethylphenazine; 15 mM 384-2 (obtained from BASF); 50 mM ethyl-2-cyano-3,3-diphenylacrylate; 0.5 mM decamethylferrocene; 0.5 mM decamethylferrocene tetrafluoroborate; 2.2 wt% of a random copolymer made from 2-hydroxyethyl methacrylate and methyl acrylate in a 1:10 molar ratio; 0.15 wt% of an isocyanate crosslinker (MI, obtained from BASF), and about 0.3 to 2.0 parts per million of a dibutyltin diacetate carbamate catalyst in a propylene carbonate solvent.

[0120]

1342 Example 2 Electrochromic device using a rigid plastic substrate with a heat-cured seal.

1343 A rigid plastic substrate (approximately 50 mm wide, 125 mm long, 1.8 mm thick) was formed by injection molding of Zeonor 1420R.

1345 The second surface of the top plate and the first surface of the bottom plate are coated with indium zinc oxide (IZO) under conditions suitable for polymer substrates.

1347 Epoxy beads containing spacer beads were dispensed on the IZO coating around the perimeter of the base plate. Small gaps are left in the bead to act as filling holes after the seal has cured. The top plate is positioned offset relative to the bottom plate to allow edge access to and electrical contact with the conductive coating. The top plate is pressed down onto the epoxy onto the spacer beads, forming the unit. The epoxy seal is heat cured at a temperature suitable for the seal and the polymer substrate. The cell was filled with the electrochromic gel medium of Example 1 and the filling holes were plugged using a UV curable epoxy. Busbars are applied to the offset edges and a heat-cured seal is used to produce a rigid plastic electrochromic device.

[0121]

1358 Example 3 Electrochromic device using a rigid plastic substrate with a UV-cured seal.

1359 The substrate preparation was the same as in Example 2. Epoxy beads containing spacer beads were dispensed on the IZO coating around the perimeter of the base plate. Small gaps are left in the bead to act as filling holes after the seal has cured. The top plate is positioned offset relative to the bottom plate to allow edge access to and electrical contact with the conductive coating. The top plate is pressed down onto the epoxy onto the spacer beads, forming the unit. The epoxy seal is UV cured at a time and intensity appropriate for the seal and polymer substrate. The cell was filled with the electrochromic gel medium of Example 1 and the filling holes were plugged using a UV curable epoxy. Busbars are applied to the offset edges and a UV-curable seal is used to produce a rigid plastic electrochromic device.

[0122]

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1370 Example 4: Electrochromic device using a rigid plastic substrate with a gas barrier coating and a heat cured seal.

1370 A rigid plastic substrate (approximately 50mm wide, 125mm long, 1.8mm thick) was formed by Zeonor 1420R injection molding. The second surface of the top plate and the first surface of the bottom plate are first coated with a gas barrier layer and then coated with indium zinc oxide (IZO) under conditions suitable for polymer substrates. Epoxy beads containing spacer beads were dispensed on the IZO coating around the perimeter of the base plate. Small gaps are left in the bead to act as filling holes after the seal has cured. The top plate is positioned offset relative to the bottom plate to allow edge access to and electrical contact with the conductive coating. The top plate is pressed down onto the epoxy onto the spacer beads, forming the unit. The epoxy seal is heat cured at a temperature suitable for the seal and the polymer substrate. The cell was filled with the electrochromic gel medium of Example 1 and the filling holes were plugged using a UV curable epoxy. Busbars are applied to the offset edges, resulting in a rigid plastic electrochromic device with a gas barrier coating and a heat-cured seal. The following illustrative gas barrier coatings may be applied: SiO₂--sputtered single or double layer, vacuum coated SiO₂--low temperature PVD method, Excapsulix ALD--Al₂O₃ atomic layer deposition, Gencoa-AlO_x/Poly-HMDSO multilayer, or PlasmaSi--PECVD SiNx

[0123]

1380 Example 5: Electrochromic device using a rigid plastic substrate with a gas barrier film and a heat-cured seal.

1390 A rigid plastic substrate (approximately 50mm wide, 125mm long, 1.8mm thick) was formed by Zeonor 1420R injection molding. A gas barrier film is applied to the second surface of the top sheet and the first surface of the bottom sheet using a UV curable liquid optically clear adhesive or a barrier optically clear adhesive with the barrier layer oriented toward the plastic substrate and the PET carrier film oriented outward. The exposed PET film was coated with indium zinc oxide (IZO) under conditions appropriate for the polymer substrate. Epoxy beads containing spacer beads were dispensed on the IZO coating around the perimeter of the base plate. Small gaps are left in the bead to act as filling holes after the seal has cured. The top plate is positioned offset relative to the bottom plate to allow edge access to and electrical contact with the conductive coating. The top plate is pressed down onto the epoxy onto the spacer beads, forming the unit. The epoxy seal is heat cured at a temperature suitable for the seal and the polymer substrate. The cell was filled with the electrochromic gel medium of Example 1 and the filling holes were plugged using a UV curable epoxy. Busbars are applied to the offset edges, resulting in a rigid plastic electrochromic device with a gas barrier film and a heat-cured seal. Illustrative gas barrier films include Kuraray EVAL - EvOH film (ethylene vinyl alcohol), Kuraray Exceval - PvOH film (propylene vinyl alcohol), Fujifilm - Clear Ultra Gas Barrier Film, and 3M - FTB3-125 Barrier Film.

[0124]

1408 Example 6: Electrochromic device using a flexible plastic substrate with a gas barrier film, a metal mesh conductor, and a UV-cured seal.

1410 Flexible gas barrier films (approximately 75mm wide, 82mm long, 125microns thick) were cut from stock. A flexible metal mesh conductor film (approximately 75mm wide, 82mm long, 125microns thick) coated

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with cold ITO was cut from stock. The metal mesh film is applied to the second surface of the top gas barrier film and the first surface of the bottom gas barrier film using a UV curable liquid optically clear adhesive or a barrier optically clear adhesive with the barrier layer oriented toward the plastic substrate and the PET carrier film oriented outward. Conductive silver ink traces were applied to the offset edges of the assembled films and heat cured. The silver traces will act as bus bars when the device is assembled. Epoxy beads containing spacer beads were dispensed around the perimeter of the bottom substrate on an ITO overcoated metal mesh. Small gaps are left in the bead to act as filling holes after the seal has cured. The positioning of the top substrate is offset relative to the bottom substrate to allow access to and electrical contact with the silver ink on the edges. The top substrate is pressed down onto the epoxy to the spacer beads, forming the cell. The epoxy seal is UV cured at a time and intensity appropriate for the seal and polymer substrate. The cell was filled with the electrochromic gel medium of Example 1 and the filling holes were plugged using a UV curable epoxy. Electrical connections were applied to the offset edges, resulting in a flexible plastic electrochromic device with a gas barrier film, metal mesh conductor, and UV heat-cured seal. The metal mesh film used was Exclucent^{TM}Copper metal film from Applied Nanotech, Inc. and the gas barrier film was 3M FTB3-125 barrier film.

[0125]

1422 Example 7: Electrochromic device using a glass-encapsulated rigid plastic substrate with a heat-cured seal.

1433 A rigid plastic substrate (approximately 100mm wide, 100mm long, 2.0mm thick) was cut from a polycarbonate sheet. The polycarbonate substrate is clad on one side with 0.3mm soda-lime glass coated with indium zinc oxide (IZO). The glass cladding is adhered to the plastic substrate using a UV curable liquid optically clear adhesive, or laminated using a thermoplastic or thermoset optical interlayer with the IZO coating facing outward. The epoxy containing the spacer beads was dispensed over the IZO coating around the perimeter of the bottom substrate. Small gaps are left in the bead to act as filling holes after the seal has cured. The top substrate is positioned offset relative to the bottom substrate to allow edge access and electrical contact to the conductive coating. The top substrate with the IZO coating oriented toward the bottom substrate IZO coating was pressed down on the epoxy to the spacer beads, forming a cell. The epoxy seal is heat cured at a temperature suitable for the seal and the polymer substrate. The cell was filled with electrochromic fluid and the fill orifice was plugged using UV curable epoxy. Busbars are applied to the offset edges and a heat-cured seal is used to produce a glass-encased rigid plastic electrochromic device.

[0126]

1448 Example 8: A representative plastic device of the present technology was placed in an oxygen autoclave chamber (400psi) and its optical properties were periodically measured using a UV/Vis spectrometer.

1450 The 461 nm absorbance is attributed to the contamination of the electrochromic medium with oxygen and was monitored and compared with reference components (01_Glass/IZO, and 02_Zeonor/IZO). Plastic devices without a gas barrier coating exhibited the largest change in absorbance over time. Figure 4 shows the oxygen test performance results of various gas barrier materials. Plastic devices without a barrier [02_Zeonor/IZO(-18)] exhibited an absorbance change of greater than 0.1 units after 3 days of exposure. The plastic device deposited with SiO_2 and Al_2O_3 by ALD [21-

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2B-02_100nmSiO₂/50nm ALD-Al₂O₃/IZO] showed better stability and did not pass the 0.1 absorbance unit increase threshold until the 8-day time point. For the device containing EVOH [04_EVOH (-35)] and SiO₂ [16_SiO₂ 100nm/100nm (-102)] gas barriers, the 0.1 unit absorbance change threshold occurred after 9 days. In addition, the performance of the plastic substrate coated with 100nm SiO₂ layers on both sides [21-1C-01_100SiO₂/Zeo/100nmSiO₂/25nm ALD-Al₂O₃/IZO] is almost 5 times better than the plastic device without a barrier. According to Figure 4, the device with AlO_x/polyacrylate multilayer barrier [P232-3_1_AlO_x/polyacrylate multilayer (-R302)] achieved similar performance as the barrier-free [02_Zeonor/IZO (-18)] plastic device in the oxygen autoclave test, achieving an absorbance change of 0.1 units after 3 days of testing. However, degradation after 3 days was slower than that of the barrier-free device. Thus, all plastic devices with gas barriers exhibited significantly slower degradation rates compared to devices without gas barriers.

[0127]

1479 Example 9: Construction of an electrochromic device with a flexible plastic substrate.

1480 A first film was formed by coating an 8" x 10" piece of indium tin oxide (ITO) coated PET (6 mil thickness; 120 Ω/sq sheet resistance) with a mixture prepared by dissolving 1.02 grams of bis(11-hydroxyundecyl) viologen bis[bis(trifluoromethanesulfonyl) imide] (NTf) and 0.38 grams of HDT (hexamethylene diisocyanate trimer, purchased from Sigma-Aldrich) in 7.0 grams of a solvent mixture ("SM1") and 117 microliters of SM1 solution containing 0.6 wt% dibutyltin diacetate (DBTDA) catalyst. This coating was produced using a No. 10 Mayer rod of controlled thickness. A second film was formed by coating a second 8" x 10" piece of PET with a solution prepared by dissolving 1.02 g of [5,10-(4-(3-hydroxypropyldimethylammonium) butyl]-5,10-dihydrophenazine NTf and 0.38 g of HDT in 7.0 g of SM1 and 117 microliters of SM1 containing DBTDA. This film was also produced with the aid of a No. 10 Mayer rod. The film was allowed to cure in an oven at 60° C under a nitrogen atmosphere overnight. The third coating was prepared as follows: 15 grams of Vinylec H (SPI Supplies), 15 grams of Vinylec E (SPI Supplies), 1.6 grams of tetramethylammonium tetrafluoroborate, and 88 grams of propylene carbonate were combined and heated (120° C.) under nitrogen with mechanical stirring to form a relatively high viscosity solution, which was then applied between two release liners (3M 4935). The release liner and fluid were fed through the nip on a manual extruder to give a 250 micron coating. The coating was then allowed to cool to ambient temperature and maintained under nitrogen until use. 3.5" x 3.5" squares of the first and second coatings were cut and the EC coating was removed along one edge using methanol and a cotton swab and electrical contact was made to the ITO via a 3M adhesive strip 3011. A section of the third coating slightly larger than 3.5" x 3.5" is cut and applied over the first coating so that the third coating covers the entire surface of the first coating. A second coating is then applied to the exposed surface of the third coating so that the electrical contacts of the first and second coatings are on opposite sides of the component. The component was then placed between two sheets of glass (2.2 mm, 5" x 5" each) and placed under reduced pressure for 30 minutes to remove air bubbles at the coating interface, followed by a slow nitrogen venting to return the component to ambient pressure. An epoxy seal was placed around the perimeter and electrical

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contacts and then cured overnight at ambient temperature to complete the component.

[0128]

1532 Illustrative Embodiments

[0129]

1535 The following is a description of non-limiting illustrative embodiments.

[0130]

1540 Paragraph A

1541 An electrochromic device comprises: a first flexible or rigid plastic substrate, the first flexible or rigid plastic substrate comprises: a front surface and a rear surface, wherein: the rear surface comprises a first conductive material; and the front surface, the rear surface, or the front surface and the rear surface of the first substrate comprise a gas diffusion barrier; a second flexible or rigid plastic substrate, the second flexible or rigid plastic substrate comprises: a front surface and a rear surface, wherein: the front surface comprises a second conductive material, wherein: the first substrate is connected to the second substrate by a sealing component, wherein the rear surface of the first substrate and the front surface of the second substrate together with the sealing component define a chamber therebetween.

[0131]

1552 Paragraph B

1553 An electrochromic device according to paragraph A, wherein the front surface, the rear surface, or both the front surface and the rear surface of the second substrate comprise a gas diffusion barrier; and optionally, wherein the front surface, the rear surface, or both the front surface and the rear surface of the first and second substrates comprise an adhesion promoting layer.

[0132]

1560 Paragraph C

1561 An electrochromic device according to paragraph A or B, wherein the chamber contains an electrochromic medium comprising a cathode material and an anode material.

[0133]

1566 Paragraph D

1567 An electrochromic device according to any of paragraphs A to C, wherein the gas diffusion barrier comprises a layer applied by plasma enhanced chemical vapor deposition (PECVD), a layer applied by neutral beam assisted sputtering (NBAS), a layer applied by atomic layer deposition (ALD), ethylene vinyl alcohol

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copolymer, polyvinyl alcohol, a polymer film of self-assembled nanoparticles (SNAP), a multilayer barrier comprising alternating layers of organic and inorganic materials, a multilayer barrier comprising alternating thin films of cationic and anionic polymers, or a flexible thin glass film adhered to or laminated with a substrate.

[0134]

1580 Paragraph E

1581 An electrochromic device according to any of paragraphs A to D, wherein the first substrate, the second substrate, or both the first substrate and the second substrate comprise polyethylene naphthalate (PEN), polyacrylonitrile, polyethylene terephthalate (PET), polycarbonate, cyclic olefin polymer (COP), cyclic olefin copolymer (COC), acrylic, polyamide, or epoxide.

[0135]

1588 Paragraph F

1589 An electrochromic device according to any of paragraphs A to E, wherein the first conductive material comprises a conductive nanowire coating, a conductive metal mesh, or an IMI stack.

[0136]

1594 Paragraph G

1595 An electrochromic device according to any of paragraphs A to F, wherein the second conductive material comprises a conductive nanowire coating, a conductive metal mesh, an insulator/metal/insulator stack (IMI stack), a transparent polymer filled with nanoparticles (such as indium tin oxide particles), carbon nanotubes, graphene, or a conductive polymer.

[0137]

1602 Paragraph H

1603 An electrochromic device according to any of paragraphs A to G, wherein the first conductive material comprises a first conductive nanowire coating, a first conductive metal mesh, or a first IMI stack; and the second conductive material comprises a second conductive nanowire coating, a second conductive metal mesh, or a second IMI stack, a second transparent polymer filled with nanoparticles (such as indium tin oxide particles), carbon nanotubes, graphene, or a second conductive polymer.

[0138]

1611 Paragraph I

1612 An electrochromic device according to any of paragraphs A to H, wherein the conductive nanowire coating, conductive metal mesh, IMI stack, nanoparticle-filled transparent polymer, carbon nanotubes, graphene or conductive polymer exhibits a resistance of less than 50Ω /sq.

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[0139]

1618 Paragraph J

1619 An electrochromic device according to any of paragraphs A to I, wherein the conductive nanowire coating, conductive metal mesh, IMI stack, nanoparticle-filled transparent polymer, carbon nanotubes, graphene or conductive polymer exhibits a resistance of less than 10Ω /sq or less than 5Ω /sq.

[0140]

1625 Paragraph K

1626 An electrochromic device according to any of paragraphs A to J, further comprising a conductive coating overlying either or both of the first or second conductive materials.

[0141]

1631 Paragraph L

1632 An electrochromic device according to paragraph K, wherein the conductive coating comprises a transparent conductive oxide, carbon nanotubes, graphene, or a conductive polymer.

[0142]

1637 Paragraph M

1638 An electrochromic device according to paragraph K or L, wherein the conductive coating comprises indium tin oxide, indium zinc oxide, carbon nanotubes, graphene, or poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT-PSS).

[0143]

1644 Paragraph N

1645 An electrochromic device according to paragraph M, wherein the conductive coating comprises indium tin oxide or indium zinc oxide.

[0144]

1650 Paragraph O

1651 An electrochromic device according to any of paragraphs A to N, wherein the sealing member comprises a heat-curable seal or a UV-curable seal.

[0145]

1656 Paragraph P

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1657 An electrochromic device according to any of paragraphs A to O, wherein the sealing component comprises an epoxy.

[0146]

1662 Paragraph Q

1663 An electrochromic device according to any of paragraphs A to P, wherein the sealing component comprises a weld between the first substrate and the second substrate.

[0147]

1668 Paragraph R

1669 An electrochromic device according to any of paragraphs A to Q, wherein the sealing member comprises a hot melt adhesive or ultrasonic welding between the first substrate and the second substrate, or a heat-sealing film covering the edge of the front surface of the first substrate and extending to the edge of the rear surface of the second substrate.

[0148]

1676 Paragraph S

1677 An electrochromic device according to any of paragraphs A to R, wherein the chamber comprises a first polymer-based electrochromic film, preferably a first thermoplastic electrochromic film.

[0149]

1682 Paragraph T

1683 An electrochromic device according to paragraph S, wherein the first polymer-based electrochromic film comprises a first electroactive material and a first thermoplastic polymer.

[0150]

1688 Paragraph U

1689 An electrochromic device according to paragraph S or T, wherein the first electroactive material is a cathode material and an anode material, or a mixture of a cathode material and an anode material.

[0151]

1694 Paragraph V

1695 An electrochromic device according to paragraph U, wherein the cathode material comprises viologen.

[0152]

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1699 Paragraph W.

1700 An electrochromic device according to paragraph U or V, wherein the anode material comprises phenazine, phenothiazine, triphenodithiazine, carbazole, indolocarbazole, biscarbazole, or ferrocene.

[0153]

1705 Paragraph X

1706 An electrochromic device according to any of paragraphs S to W, wherein the first polymer-based electrochromic film comprises a plasticizer.

[0154]

1711 Paragraph Y

1712 An electrochromic device according to any of paragraphs S to X, wherein the first polymer-based electrochromic film is a cross-linked film.

[0155]

1717 Paragraph Z

1718 An electrochromic device according to any of paragraphs S to Y, wherein the chamber comprises a second polymer-based electrochromic film, the electrochromic film comprising a second electroactive material and a second thermoplastic polymer, preferably, wherein the second polymer-based electrochromic film is a thermoplastic electrochromic film.

[0156]

1725 Paragraph AA.

1726 The electrochromic device according to paragraph Z, wherein the electrochromic film based on the first polymer and the electrochromic film based on the second polymer are separated by an ion exchange membrane or a porous membrane, preferably, wherein the electrochromic film based on the first polymer and the electrochromic film based on the second polymer are each independently a thermoplastic electrochromic film.

[0157]

1734 Paragraph AB.

1735 A method for forming a substrate for an electrochromic device, the method comprising coating a first polymer-based film on a first surface of a first flexible or rigid plastic substrate, the polymer-based electrochromic film comprising at least one first electroactive material and a first thermoplastic polymer, the first surface further comprising a conductive nanowire coating, a conductive metal mesh or an IMI stack, and a gas barrier coating is present on a second surface of the first flexible or rigid plastic substrate, the second surface being substantially parallel to and opposite to the first surface.

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[0158]

1744 Paragraph AC

1745 The method according to paragraph AB, wherein the coating comprises slot die, gravure coating, curtain coating, spray coating, dip coating, extrusion coating or ramp coating.

[0159]

1750 Paragraph AD.

1751 The method of paragraph AB or AC, further comprising connecting a first surface of a first substrate comprising a first polymer-based electrochromic film (preferably a thermoplastic electrochromic film) to a first surface of a second substrate with a sealing member and forming a cavity therebetween.

[0160]

1757 Paragraph AE.

1758 The method according to paragraph AD further comprises coating a second polymer-based electrochromic film (preferably a thermoplastic electrochromic film) on the first surface of the second substrate, the second electrochromic film comprising at least a second electroactive material and a second thermoplastic polymer.

[0161]

1764 Paragraph AF.

1765 The method of any of paragraphs AB to AE, wherein the first electroactive material is a cathode material.

[0162]

1769 Paragraph AG.

1770 The method of any of paragraphs AB to AF, wherein the first electroactive material is an anode material.

[0163]

1774 Paragraph AH.

1775 The method of any of paragraphs AE to AG, wherein the second electroactive material is a cathode material.

[0164]

1779 Paragraph AI.

1780 The method of paragraphs AH, wherein the second electroactive material is an anode material.

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[0165]

1783 Paragraph AJ.

1785 The method of any of paragraphs AE to AI, wherein the first electroactive material is a cathode material and the second electroactive material is an anode material.

[0166]

1790 Paragraph AK.

1791 The method of any of paragraphs AE to AI, wherein the first electroactive material is an anode material and the second electroactive material is a cathode material.

[0167]

1796 Paragraph AL.

1797 The method of any of paragraphs AD to AK further comprises filling the chamber with a fluid medium.

[0168]

1801 Paragraph AM.

1802 An electrochromic device comprises: a first flexible or rigid plastic substrate having a first surface and a second surface; a second flexible or rigid plastic substrate having a first surface and a second surface; and a sealing component, wherein the sealing component connects the second surface of the first substrate to the first surface of the second substrate, thereby forming a chamber therebetween; wherein: the first surface of the first substrate is coated with an ultraviolet light absorbing layer; the second surface is coated with an electrochromic film based on a first polymer containing an anode material; and the chamber contains a fluid medium containing a UV-curable gelling agent.

1809 The electrochromic film based on the first polymer is preferably a thermoplastic electrochromic film.

[0169]

1813 Paragraph AN.

1814 An electrochromic device according to paragraph AM, wherein the fluid medium further comprises a cathode material.

[0170]

1819 Paragraph AO.

1820 An electrochromic device according to paragraph AM or AN, wherein the cathode material is viologen.

[0171]

1824 Paragraph AP.

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1825 An electrochromic device according to any of paragraphs AM to AO, wherein the fluid medium further comprises an ultraviolet absorbing material.

[0172]

1830 Paragraph AQ.

1831 An electrochromic device according to any of paragraphs AM to AP, wherein the first surface of the second substrate is coated with a second polymer-based electrochromic film comprising a cathode material, preferably, wherein the second polymer-based electrochromic film is a thermoplastic electrochromic film.

[0173]

1837 Paragraph AR.

1838 An electrochromic device according to paragraph AQ, wherein the cathode material is viologen.

[0174]

1842 Paragraph AS.

1843 An electrochromic device according to any of paragraphs AM to AR, wherein the anode material comprises phenazine, phenothiazine, triphenodithiazine, carbazole, indolocarbazole, biscarbazole, or ferrocene.

[0175]

1848 Paragraph AT.

1849 An electrochromic device according to any of paragraphs AM to AS, wherein the first surface of the second substrate is coated with a metal oxide.

[0176]

1854 Paragraph AU.

1855 An electrochromic device according to paragraph AT, wherein the metal oxide is tungsten oxide.

[0177]

1859 Paragraph AV.

1860 An electrochromic device according to any of paragraphs AM to AU, wherein the sealing member comprises a UV curable resin or a thermal curable resin.

[0178]

1865 Paragraph AW.

1866 An electrochromic device according to any of paragraphs AM to AV, wherein the sealing component

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comprises a weld between the first substrate and the second substrate.

[0179]

1872 Paragraph AX.

1873 An electrochromic device comprises: a first flexible or rigid plastic substrate, the first flexible or rigid plastic substrate comprises: a front surface and a rear surface comprising a conductive nanowire coating, a conductive metal mesh or an IMI stack, wherein: the front surface, the rear surface, or both the front surface and the rear surface of the first substrate comprise a gas diffusion barrier; a second flexible or rigid plastic substrate, the second flexible or rigid plastic substrate comprises: a front surface and a rear surface comprising a conductive nanowire coating, a conductive metal mesh or an IMI stack; wherein: the first substrate is connected to the second substrate by a sealing component, wherein the rear surface of the first substrate and the front surface of the second substrate together with the sealing component define a chamber therebetween.

[0180]

1885 Paragraph AY.

1886 An electrochromic device according to paragraph AX, wherein the second substrate is a plastic substrate and the front surface, the back surface, or both the front surface and the back surface of the second substrate comprise a gas diffusion barrier.

[0181]

1892 Paragraphs A-Z.

1893 An electrochromic device according to paragraph AX or AY, wherein the chamber contains an electrochromic medium comprising a cathode material and an anode material.

[0182]

1898 Paragraph BA

1899 An electrochromic device according to any of paragraphs AX to AZ, wherein the rear surface of the first substrate comprises a conductive metal mesh; and the front surface of the second substrate comprises a conductive metal mesh.

[0183]

1905 Paragraph BB.

1906 An electrochromic device according to any of paragraphs AX to BA, wherein the conductive nanowire coating, conductive metal mesh or IMI stack exhibits a resistance of less than 50 Ω /sq.

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[0184]

1910 Paragraph BC.

1912 An electrochromic device according to any of paragraphs AX to BB, wherein the back surface of the first substrate and the front surface of the second substrate each include a conductive coating disposed between a conductive nanowire coating, a conductive metal mesh or an IMI stack and a chamber.

[0185]

1918 Paragraph BD.

1919 An electrochromic device according to paragraph BC, wherein the conductive coating comprises a transparent conductive oxide, carbon nanotubes, graphene, or a conductive polymer.

[0186]

1924 Paragraph BE.

1925 An electrochromic device according to any of paragraphs AX to BD, wherein the first surface of the first substrate and the second surface of the second substrate comprise a scratch resistant coating.

[0187]

1930 Paragraph BF.

1931 An electrochromic device according to paragraphs BE, wherein the anti-scratch coating comprises Acier C50PG.

[0188]

1936 Paragraph BG.

1937 An electrochromic device according to any of paragraphs AX to BF, wherein the gas diffusion barrier comprises a layer applied by plasma enhanced chemical vapor deposition (PECVD), a layer applied by neutral beam assisted sputtering (NBAS), a layer applied by atomic layer deposition (ALD), ethylene vinyl alcohol copolymer, polyvinyl alcohol, a polymer film of self-assembled nanoparticles (SNAP), or a multilayer barrier comprising alternating layers of organic and inorganic materials, or a multilayer barrier comprising alternating thin films of cationic and anionic polymers, or a flexible thin glass film.

[0189]

1946 Paragraph BG.

1947 An electrochromic device comprises: a flexible substrate, the flexible substrate comprises a front surface and a rear surface, wherein: the rear surface comprises a first conductive material, and the front surface, the rear surface, or both the front surface and the rear surface of the first substrate comprise a gas diffusion barrier; a rigid substrate, the rigid substrate comprises a front surface and a rear surface, wherein: the front surface comprises a second conductive material; wherein: the shape of the flexible substrate conforms to that of the

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rigid substrate; and the flexible substrate is connected to the rigid substrate via a sealing component, wherein the rear surface of the flexible substrate and the front surface of the rigid substrate together with the sealing component define a chamber therebetween.

[0190]

1963 Paragraph BH.

1964 An electrochromic device according to paragraphs BG, wherein the front surface, the back surface, or both the front surface and the back surface of the rigid or flexible substrate comprise a gas diffusion barrier.

[0191]

1969 Paragraph BI.

1970 An electrochromic device according to paragraph BG or BH, wherein the chamber contains an electrochromic medium comprising a cathode material and an anode material.

[0192]

1975 Paragraph BJ.

1976 An electrochromic device according to any of paragraphs BG to BI, wherein the gas diffusion barrier comprises a layer applied by plasma enhanced chemical vapor deposition (PECVD), a layer applied by neutral beam assisted sputtering (NBAS), a layer applied by atomic layer deposition (ALD), ethylene vinyl alcohol copolymer, polyvinyl alcohol, a polymer film of self-assembled nanoparticles (SNAP), a multilayer barrier comprising alternating layers of organic and inorganic materials, or a multilayer barrier comprising alternating thin films of cationic and anionic polymers.

[0193]

1985 Paragraph BK.

1986 An electrochromic device according to any of paragraphs BG to BJ, wherein the flexible substrate, the rigid substrate, or both the flexible substrate and the rigid substrate comprise polyethylene naphthalate (PEN), polyacrylonitrile, polyethylene terephthalate (PET), polycarbonate, cyclic olefin polymer (COP), cyclic olefin copolymer (COC), acrylic, polyamide, or epoxide.

[0194]

1993 Paragraph BL.

1994 An electrochromic device according to any of paragraphs BG to BK, wherein the first conductive material comprises a conductive nanowire coating, a conductive metal mesh, or an IMI stack.

[0195]

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1999 Paragraph BM.

1999 An electrochromic device according to any of paragraphs BG to BL, wherein the second conductive material comprises a conductive nanowire coating, a conductive metal mesh, or an IMI stack.

[0196]

2005 Paragraph BN.

2006 An electrochromic device according to any of paragraphs BG to BM, wherein the first conductive material comprises a first conductive metal mesh; and the second conductive material comprises a second conductive metal mesh.

[0197]

2012 Paragraph BO.

2013 An electrochromic device according to any of paragraphs BG to BN, wherein the conductive nanowire coating, conductive metal mesh, or IMI stack exhibits a resistance of less than 50 Ω/sq, or less than 10 Ω/sq, or less than 5 Ω/sq.

[0198]

2019 Paragraph BP.

2020 An electrochromic device according to any of paragraphs BG to BO, further comprising a conductive coating overlying either or both of the first or second conductive materials.

[0199]

2025 Paragraph BQ.

2026 An electrochromic device according to paragraph BP, wherein the conductive coating comprises a transparent conductive oxide, carbon nanotubes, graphene or a conductive polymer.

[0200]

2031 Paragraph BR.

2032 An electrochromic device according to paragraph BQ, wherein the conductive coating comprises indium tin oxide, indium zinc oxide, carbon nanotubes, graphene, or poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT-PSS).

[0201]

2038 Paragraph BS.

2039 An electrochromic device according to paragraph BR, wherein the conductive coating comprises indium tin oxide or indium zinc oxide.

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[0202]

2044 Paragraph BT.

2045 An electrochromic device according to any of paragraphs BG to BS, wherein the sealing member comprises a heat-curable seal or a UV-curable seal.

[0203]

2050 Paragraph BU.

2051 An electrochromic device according to any of paragraphs BG to BT, wherein the sealing component comprises an epoxy.

[0204]

2056 Paragraph BV.

2057 An electrochromic device according to any of paragraphs BG to BU, wherein the sealing component comprises a weld between the first substrate and the second substrate.

[0205]

2062 Paragraph BW.

2063 An electrochromic device according to any of paragraphs BG to BV, wherein the sealing member comprises a hot melt adhesive or ultrasonic welding between the first substrate and the second substrate, or a heat-sealing film covering the edge of the front surface of the first substrate and extending to the edge of the rear surface of the second substrate.

[0206]

2070 Paragraph BX.

2071 An electrochromic device according to any of paragraphs BG to BW, wherein the chamber comprises a first polymer-based electrochromic film, preferably a first thermoplastic electrochromic film.

[0207]

2076 Paragraph BY.

2077 An electrochromic device according to paragraph BX, wherein the first polymer-based electrochromic film comprises a first electroactive material and a first thermoplastic polymer.

[0208]

2082 Paragraph BZ.

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2083 An electrochromic device according to paragraph BY, wherein the first electroactive material is a cathode material and an anode material, or a mixture of a cathode material and an anode material.

[0209]

2088 Paragraph CA

2089 An electrochromic device according to paragraphs BZ, wherein the cathode material comprises viologen.

[0210]

2093 Paragraph CB.

2094 An electrochromic device according to paragraphs BZ or CA, wherein the anode material comprises phenazine, phenothiazine, triphenodithiazine, carbazole, indolocarbazole, biscarbazole, or ferrocene.

[0211]

2099 Paragraph CC.

2100 An electrochromic device according to any of paragraphs BX to CB, wherein the first polymer-based electrochromic film comprises a plasticizer.

[0212]

2105 Paragraph CD.

2106 An electrochromic device according to any of paragraphs BX to CC, wherein the first polymer-based electrochromic film is a cross-linked film.

[0213]

2111 Paragraph CE.

2112 An electrochromic device according to any of paragraphs BX to CD, wherein the chamber comprises a second polymer-based electrochromic film, the electrochromic film comprising a second electroactive material and a second thermoplastic polymer, preferably, wherein the second polymer-based electrochromic film is a thermoplastic electrochromic film.

[0214]

2119 Paragraph CF.

2120 An electrochromic device according to paragraphs CE, wherein the first polymer-based and second polymer-based electrochromic films are separated by an ion exchange membrane or a porous membrane, preferably wherein the first polymer-based and second polymer-based electrochromic films are each independently thermoplastic electrochromic films.

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[0215]

2128 Paragraph CG.

2129 An electrochromic device comprises: a rigid substrate, the rigid substrate comprises a front surface and a rear surface, wherein: the rear surface comprises a first conductive material, and the front surface, the rear surface, or both the front surface and the rear surface of the first substrate comprise a gas diffusion barrier; a flexible substrate, the flexible substrate comprises a front surface and a rear surface, wherein: the front surface comprises a second conductive material; wherein: the shape of the flexible substrate conforms to that of the rigid substrate; and the flexible substrate is connected to the rigid substrate via a sealing component, wherein the rear surface of the flexible substrate and the front surface of the rigid substrate together with the sealing component define a chamber therebetween.

[0216]

2140 Paragraph CH.

2141 An electrochromic device according to paragraph CG, wherein the front surface, the back surface, or both the front surface and the back surface of the rigid or flexible substrate comprise a gas diffusion barrier.

[0217]

2146 Paragraph CI.

2147 An electrochromic device according to paragraph CG or CH, wherein the chamber contains an electrochromic medium comprising a cathode material and an anode material.

[0218]

2152 Paragraph CJ.

2153 An electrochromic device according to any of paragraphs CG to CI, wherein the gas diffusion barrier comprises a layer applied by plasma enhanced chemical vapor deposition (PECVD), a layer applied by neutral beam assisted sputtering (NBAS), a layer applied by atomic layer deposition (ALD), ethylene vinyl alcohol copolymer, polyvinyl alcohol, a polymer film of self-assembled nanoparticles (SNAP), a multilayer barrier comprising alternating layers of organic and inorganic materials, or a multilayer barrier comprising alternating thin films of cationic and anionic polymers.

[0219]

2162 Paragraph CK.

2163 An electrochromic device according to any of paragraphs CG to CJ, wherein the flexible substrate, the rigid substrate, or both the flexible substrate and the rigid substrate comprise polyethylene naphthalate (PEN), polyacrylonitrile, polyethylene terephthalate (PET), polycarbonate, cyclic olefin polymer (COP), cyclic olefin copolymer (COC), acrylic, polyamide, or epoxide.

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[0220]

2171 Paragraph CL.

2172 An electrochromic device according to any of paragraphs CG to CL, wherein the first conductive material comprises a conductive nanowire coating, a conductive metal mesh, or an IMI stack.

[0221]

2177 Paragraph CM.

2178 An electrochromic device according to any of paragraphs CG to CL, wherein the second conductive material comprises a conductive nanowire coating, a conductive metal mesh, or an IMI stack.

[0222]

2183 Paragraph CN.

2184 An electrochromic device according to any of paragraphs CG to CM, wherein the first conductive material comprises a first conductive nanowire coating, a first conductive metal mesh, or a first IMI stack; and the second conductive material comprises a second conductive nanowire coating, a second conductive metal mesh, or a second IMI stack.

[0223]

2191 Paragraph CO.

2192 An electrochromic device according to any of paragraphs CG to CN, wherein the conductive nanowire coating, conductive metal mesh or IMI stack exhibits a resistance of less than 50 Ω /sq, or less than 10 Ω /sq, or less than 5 Ω /sq.

[0224]

2198 Paragraph CP.

2199 An electrochromic device according to any of paragraphs CG to CO, further comprising a conductive coating covering either or both of the first or second conductive materials.

[0225]

2204 Paragraph CQ.

2205 An electrochromic device according to paragraphs CP, wherein the conductive coating comprises a transparent conductive oxide, carbon nanotubes, graphene, or a conductive polymer.

[0226]

2210 Paragraph CR.

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221 An electrochromic device according to paragraph CQ, wherein the conductive coating comprises indium tin oxide, indium zinc oxide, carbon nanotubes, graphene, or poly(3,4-ethylenedioxythiophene) polystyrene sulfonate (PEDOT-PSS).

[0227]

217 Paragraph CS.

218 An electrochromic device according to paragraph CR, wherein the conductive coating comprises indium tin oxide or indium zinc oxide.

[0228]

223 Paragraph CT.

224 An electrochromic device according to any of paragraphs CG to CS, wherein the sealing member comprises a heat-curable seal or a UV-curable seal.

[0229]

229 Paragraph CU.

230 An electrochromic device according to any of paragraphs CG to CT, wherein the sealing component comprises epoxy.

[0230]

235 Paragraph CV.

236 An electrochromic device according to any of paragraphs CG to CS, wherein the sealing component comprises a weld between the first substrate and the second substrate.

[0231]

241 Paragraph CW.

242 An electrochromic device according to any of paragraphs CG to CS, wherein the sealing component comprises a hot melt adhesive or ultrasonic welding between the first substrate and the second substrate, or a heat-sealing film covering the edge of the front surface of the first substrate and extending to the edge of the rear surface of the second substrate.

[0232]

249 Paragraph CX.

250 An electrochromic device according to any of paragraphs CG to CW, wherein the chamber comprises a first polymer-based electrochromic film, preferably a first thermoplastic electrochromic film.

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[0233]

2256 Paragraph CY.

2257 An electrochromic device according to paragraph CX, wherein the first polymer-based electrochromic film comprises a first electroactive material and a first thermoplastic polymer.

[0234]

2262 Paragraph CZ.

2263 An electrochromic device according to paragraph CX or CY, wherein the first electroactive material is a cathode material and an anode material, or a mixture of a cathode material and an anode material.

[0235]

2268 Paragraph DA

2269 An electrochromic device according to paragraphs CZ, wherein the cathode material comprises viologen.

[0236]

2273 Paragraph DB.

2274 An electrochromic device according to paragraph CZ or DA, wherein the anode material comprises phenazine, phenothiazine, triphenodithiazine, carbazole, indolocarbazole, biscarbazole, or ferrocene.

[0237]

2279 Paragraph DC.

2280 An electrochromic device according to paragraph 108, wherein the first polymer-based electrochromic film comprises a plasticizer.

[0238]

2285 Paragraph DD.

2286 An electrochromic device according to any of paragraphs CX to DC, wherein the first polymer-based electrochromic film is a cross-linked film.

[0239]

2291 Paragraph DE.

2292 An electrochromic device according to any of paragraphs CX to DD, wherein the chamber comprises an electrochromic film based on a second polymer, the electrochromic film comprising a second electroactive material and a second thermoplastic polymer, preferably, wherein the electrochromic film based on the second polymer is a thermoplastic electrochromic film.

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[0240]

2299 Paragraph DF.

2300 The electrochromic device according to paragraph DE, wherein the first polymer-based and second polymer-based electrochromic films are separated by an ion exchange membrane or a porous membrane, preferably, wherein the first polymer-based and second polymer-based electrochromic films are each independently a thermoplastic electrochromic film.

[0241]

2307 Paragraph DG.

2308 An electrochromic device according to any of paragraphs A to AA and AM to DF, wherein the front surface, the back surface, or the front surface and the back surface of the first and second substrates include an adhesion promoting layer.

[0242]

2314 While certain embodiments have been illustrated and described, it will be appreciated that changes and modifications may be made therein in accordance with ordinary skill in the art without departing from the broader aspects of the technology as defined in the following claims.

[0243]

2320 The embodiments illustratively described herein may suitably be practiced in the absence of any element or elements, limitation or limitations not specifically disclosed herein.

2322 Thus, for example, the terms "comprising," "including," "containing," etc. should be read expansively and without limitation.

2324 Furthermore, the terms and expressions used herein are used for the purpose of description rather than limitation, and in the use of such terms and expressions there is no intention to exclude any equivalent features shown and described or portions thereof, but rather it is to be recognized that various modifications are possible within the scope of the claimed technology.

2328 Additionally, the phrase "consisting essentially of will be understood to include those elements specifically recited and those additional elements that do not materially affect the basic and novel characteristics of the claimed technology. The phrase "consisting of" excludes any elements not specified.

[0244]

2334 The present disclosure is not to be limited in scope to the particular embodiments described in this application.

2336 As will be apparent to those skilled in the art, many modifications and variations can be made without departing from the spirit and scope thereof. Functionally equivalent methods and compositions within the

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scope of the invention, in addition to those enumerated herein, will be apparent to those skilled in the art from the foregoing descriptions. Such modifications and variations are intended to fall within the scope of the appended claims. The present disclosure is to be limited only by the terms of the appended claims, along with the full scope of equivalents to which such claims are entitled. It is to be understood that this invention is not limited to particular methods, reagents, compounds compositions or biological systems, which can, of course, vary. It is also to be understood that the terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting.

[0245]

2350 In addition, where features or aspects of the disclosure are described in terms of Markush groups, those skilled in the art will recognize that the disclosure is also thereby described in terms of any individual member or subgroup of members of the Markush group.

[0246]

2356 As will be understood by one skilled in the art, for any and all purposes, particularly in terms of providing a written description, all ranges disclosed herein also encompass any and all possible subranges and combinations of subranges thereof.

2360 Any recited range can be readily recognized as fully descriptive and allowing the same range to be broken down into at least equal halves, thirds, quarters, fifths, tenths, etc.

2361 As a non-limiting example, each range discussed herein may be readily broken down into a lower third, a middle third, and an upper third, etc. Those skilled in the art will also understand that all expressions such as "at most," "at least," "greater than," "less than," and the like are inclusive of the recited numbers and refer to ranges that can subsequently be broken down into sub-ranges as discussed above. Finally, as one skilled in the art will understand, a range includes each individual member.

[0247]

2369 All publications, patent applications, issued patents, and other documents mentioned in this specification are herein incorporated by reference to the same extent as if each individual publication, patent application, issued patent, or other document was specifically and individually indicated to be incorporated by reference in its entirety.

2373 Definitions contained in text incorporated by reference shall not apply to the extent they conflict with a definition in the present disclosure.

[0248]

2378 Other embodiments are described within the following claims.

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(19)中华人民共和国国家知识产权局

(12)发明专利申请

(10)申请公布号 CN 107438793 A
(43)申请公布日 2017.12.05

(21)申请号 201680021339.7

(22)申请日 2016.03.09

(30)优先权数据
62/130,354 2015.03.09 US
62/135,003 2015.03.18 US
62/184,704 2015.06.25 US
62/257,950 2015.11.20 US
62/258,051 2015.11.20 US

(85)PCT国际申请进入国家阶段日
2017.10.11

(86)PCT国际申请的申请数据
PCT/US2016/021619 2016.03.09

(87)PCT国际申请的公布数据
WO2016/145120 EN 2016.09.15

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(51)Int.Cl.
G02F 1/153(2006.01)
G02F 1/15(2006.01)

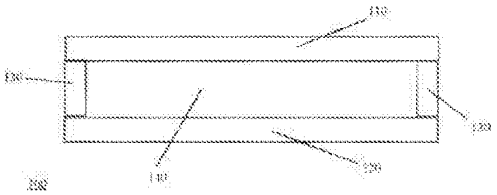
权利要求书8页 说明书29页 附图3页

(54)发明名称

具有塑料衬底的电化学装置

(57)摘要

一种电致变色装置，其包括第一柔性或刚性塑料衬底，所述第一柔性或刚性塑料衬底包括前表面和后表面，其中所述后表面包含第一导电材料；且所述第一衬底的所述前表面、所述后表面或所述前表面和所述后表面包含气体扩散屏障；和第二柔性或刚性塑料衬底，所述第二柔性或刚性塑料衬底包括前表面和后表面，其中所述前表面包含第二导电材料，其中所述第一衬底通过密封部件来连接到所述第二衬底，其中所述第一衬底的所述后表面和所述第二衬底的所述前表面与所述密封部件一起界定了其间的腔室。



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1.一种电致变色装置,包含:

第一柔性或刚性塑料衬底,其包含:

前表面;和

后表面;

其中:

所述后表面包含第一导电材料;且

所述第一衬底的所述前表面、所述后表面或所述前表面和所述后表面均包含气体扩散屏障;

第二柔性或刚性塑料衬底,其包含:

前表面;和

后表面;

其中:

所述前表面包含第二导电材料;

其中,所述第一衬底通过密封部件连接到所述第二衬底,其中所述第一衬底的所述后表面和所述第二衬底的所述前表面与所述密封部件一起界定了其间的腔室;

所述腔室包含含有阴极材料和阳极材料的电致变色介质。

2.根据权利要求1所述的电致变色装置,其中所述第二衬底的所述前表面、所述后表面或所述前表面和所述后表面均包含气体扩散屏障。

3.根据权利要求1所述的电致变色装置,其中所述第一和第二衬底的所述前表面、所述后表面或所述前表面和所述后表面均包含促粘层。

4.根据权利要求1所述的电致变色装置,其中所述腔室包含含有阴极材料和阳极材料的电致变色介质。

5.根据权利要求1到4中任一项所述的电致变色装置,其中所述气体扩散屏障包含通过等离子体增强化学气相沉积(PECVD)施加的层、通过中性束辅助溅镀(NBAS)施加的层、通过原子层沉积(ALD)施加的层、乙烯乙烯醇共聚物、聚乙烯醇、自组装纳米粒子(SNAP)的聚合物膜、包含有机和无机材料的交替层的多层屏障,或包含阳离子和阴离子型聚合物的交替薄膜的多层屏障,或柔性薄玻璃膜。

6.根据权利要求1到4中任一项所述的电致变色装置,其中所述第一衬底、所述第二衬底或所述第一衬底和所述第二衬底均包含聚萘二甲酸乙二酯(PEN)、聚丙烯腈、聚对苯二甲酸乙二酯(PET)、聚碳酸酯、环烯烃聚合物(COP)、环烯烃共聚物(COC)、丙烯酸类、聚酰胺或环氧化物。

7.根据权利要求1所述的电致变色装置,其中所述第一导电材料包含导电纳米线涂层、导电金属网,或绝缘体/金属/绝缘体堆栈(IMI堆栈)。

8.根据权利要求1所述的电致变色装置,其中第二导电材料包含导电纳米线涂层、导电金属网或IMI堆栈。

9.根据权利要求1所述的电致变色装置,其中所述第一导电材料包含第一导电纳米线涂层、第一导电金属网或第一IMI堆栈;且所述第二导电材料包含第二导电纳米线涂层、第二导电金属网或第二IMI堆栈。

10.根据权利要求7、8或9所述的电致变色装置,其中所述导电纳米线涂层、所述导电金

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属网或所述IMI堆栈展现小于50Ω/sq的电阻。

11.根据权利要求10所述的电致变色装置，其中所述导电纳米线涂层、所述导电金属网或所述IMI堆栈展现小于10Ω/sq的电阻。

12.根据权利要求11所述的电致变色装置，其中所述导电纳米线涂层、所述导电金属网或所述IMI堆栈展现小于5Ω/sq的电阻。

13.根据权利要求7、8或9所述的电致变色装置，其进一步包含覆盖所述第一或第二导电材料中的任一种或两种的导电涂层。

14.根据权利要求13所述的电致变色装置，其中所述导电涂层包含透明导电氧化物、碳纳米管、石墨烯或导电聚合物。

15.根据权利要求13所述的电致变色装置，其中所述导电涂层包含氧化铟锡、氧化铟锌、碳纳米管、石墨烯，或聚(3,4-亚乙二氧基噻吩)聚苯乙烯磺酸酯(PEDOT-PSS)。

16.根据权利要求1到4中任一项所述的电致变色装置，其中所述密封部件包含热可固化密封件或紫外线可固化密封件。

17.根据权利要求1到4中任一项所述的电致变色装置，其中所述密封部件包含环氧化物。

18.根据权利要求1到4中任一项所述的电致变色装置，其中所述密封部件包含所述第一衬底与所述第二衬底之间的焊接。

19.根据权利要求1到4中任一项所述的电致变色装置，其中所述密封部件包含所述第一衬底与所述第二衬底之间的热熔胶或超声波焊接，或覆盖所述第一衬底的所述前表面的边缘且延伸到所述第二衬底的所述后表面的边缘的热密封膜。

20.根据权利要求1到4中任一项所述的电致变色装置，其中所述腔室包含基于第一聚合物的电致变色膜，所述基于第一聚合物的电致变色膜是第一热塑性电致变色膜或第一交联膜。

21.根据权利要求20所述的电致变色装置，其中所述基于第一聚合物的电致变色膜是第一热塑性电致变色膜。

22.根据权利要求21所述的电致变色装置，其中所述第一热塑性电致变色膜包含第一电活性材料和第一热塑性聚合物。

23.根据权利要求22所述的电致变色装置，其中所述第一电活性材料是阴极材料，和阳极材料，或阴极材料和阳极材料的混合物。

24.根据权利要求23所述的电致变色装置，其中所述阴极材料包含紫精。

25.根据权利要求23所述的电致变色装置，其中所述阳极材料包含吩嗪、吩噻嗪、三苯二噻嗪、咔唑、吲哚并咔唑、双咔唑或二茂铁。

26.根据权利要求20所述的电致变色装置，其中所述基于第一聚合物的电致变色膜包含塑化剂。

27.根据权利要求20所述的电致变色装置，其中所述腔室包含含有第二电活性材料和第二热塑性聚合物的第二热塑性电致变色膜。

28.根据权利要求27所述的电致变色装置，其中所述第一和第二热塑性电致变色膜通过离子交换膜或多孔膜来分隔。

29.一种形成供电致变色装置用的衬底的方法，所述方法包含在第一柔性或刚性塑料

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衬底的第一表面上涂布基于第一聚合物的膜，所述基于聚合物的电致变色膜包含至少一种第一电活性材料和第一热塑性聚合物，所述第一表面进一步包含导电纳米线涂层、导电金属网或绝缘体/金属/绝缘体堆栈(IMI堆栈)，且所述第一柔性或刚性塑料衬底的第二表面上存在阻气涂层，所述第二表面与所述第一表面基本上平行且相对。

30.根据权利要求29所述的方法，其中所述涂层包含槽模涂布、凹板印刷式涂布、帘式涂布、喷涂、浸涂、挤压涂布或斜板式涂布。

31.根据权利要求29或30所述的方法，其进一步包含使用密封部件将包含所述基于第一聚合物的电致变色膜的所述第一衬底的所述第一表面连接到第二衬底的第一表面以及在其间形成腔室。

32.根据权利要求31所述的方法，其进一步包含在所述第二衬底的所述第一表面上涂布基于第二聚合物的电致变色膜，所述第二电致变色膜包含至少一种第二电活性材料和第二热塑性聚合物。

33.根据权利要求29或30所述的方法，其中所述第一电活性材料是阴极材料。

34.根据权利要求29或30所述的方法，其中所述第一电活性材料是阳极材料。

35.根据权利要求32所述的方法，其中所述第二电活性材料是阴极材料。

36.根据权利要求32所述的方法，其中所述第二电活性材料是阳极材料。

37.根据权利要求32所述的方法，其中所述第一电活性材料是阴极材料且所述第二电活性材料是阳极材料。

38.根据权利要求32所述的方法，其中所述第一电活性材料是阳极材料且所述第二电活性材料是阴极材料。

39.根据权利要求29或30所述的方法，其进一步包含用流体介质填充所述腔室。

40.一种电致变色装置，包含：

具有第一表面和第二表面的第一柔性或刚性塑料衬底；

具有第一表面和第二表面的第二柔性或刚性塑料衬底；和

密封部件，其使所述第一衬底的所述第二表面连接到所述第二衬底的所述第一表面，从而在其间形成腔室；

其中：

所述第一衬底的所述第一表面涂有紫外光吸收层；

所述第二表面涂有包含阳极材料的基于第一聚合物的电致变色膜；和

所述腔室包含含有UV可固化胶凝剂的流体介质。

41.根据权利要求40所述的电致变色装置，其中所述流体介质进一步包含阴极材料。

42.根据权利要求41所述的电致变色装置，其中所述阴极材料是紫精。

43.根据权利要求40、41或42所述的电致变色装置，其中所述流体介质进一步包含紫外线吸收材料。

44.根据权利要求40、41或42所述的电致变色装置，其中所述第二衬底的所述第一表面涂有包含阴极材料的基于第二聚合物的电致变色膜。

45.根据权利要求44所述的电致变色装置，其中所述阴极材料是紫精。

46.根据权利要求40、41或42所述的电致变色装置，其中所述阳极材料是吩嗪、吩噻嗪、三苯二噻嗪、咔唑、吲哚并咔唑、双咔唑或二茂铁。

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47.根据权利要求40、41或42所述的电致变色装置，其中所述第二衬底的所述第一表面涂有金属氧化物。

48.根据权利要求47所述的电致变色装置，其中所述金属氧化物是氧化钨。

49.根据权利要求40、41或42所述的电致变色装置，其中所述密封部件包含UV可固化树脂或热固化树脂。

50.根据权利要求40、41或42所述的电致变色装置，其中所述密封部件包含所述第一衬底与所述第二衬底之间的焊接。

51.一种电致变色装置，包含：

第一柔性或刚性塑料衬底，其包含：

前表面；和

包含导电纳米线涂层、导电金属网或绝缘体/金属/绝缘体堆栈(IMI堆栈)的后表面；

其中：

所述第一衬底的所述前表面、所述后表面或所述前表面和所述后表面均包含气体扩散屏障；

第二柔性或刚性塑料衬底，其包含：

包含导电纳米线涂层、导电金属网或IMI堆栈的前表面；和

后表面；

其中所述第一衬底通过密封部件连接到所述第二衬底，其中所述第一衬底的所述后表面和所述第二衬底的所述前表面与所述密封部件一起界定了其间的腔室；且

所述腔室包含含有阴极材料和阳极材料的电致变色介质。

52.根据权利要求51所述的电致变色装置，其中所述第二衬底是塑料衬底且所述第二衬底的所述前表面、所述后表面或所述前表面和所述后表面均包含气体扩散屏障。

53.根据权利要求51所述的电致变色装置，其中所述腔室包含含有阴极材料和阳极材料的热塑性电致变色膜。

54.根据权利要求51、52或53所述的电致变色装置，其中所述第一衬底的所述后表面包含所述导电金属网；且所述第二衬底的所述前表面包含所述导电金属网。

55.根据权利要求54所述的电致变色装置，其中所述金属网展现小于50Ω/sq的电阻。

56.根据权利要求51、52或53所述的电致变色装置，其中所述第一衬底的所述后表面和所述第二衬底的所述前表面各自包含安置于所述纳米线涂层或导电金属网与所述腔室之间的导电涂层。

57.根据权利要求56所述的电致变色装置，其中所述导电涂层包含透明导电氧化物、碳纳米管、石墨烯或导电聚合物。

58.根据权利要求51、52或53所述的电致变色装置，其中所述第一衬底的所述第一表面和所述第二衬底的所述第二表面包含抗刮擦涂层。

59.根据权利要求58所述的电致变色装置，其中所述抗刮擦涂层包含Acier C50PG。

60.根据权利要求51、52或53所述的电致变色装置，其中所述气体扩散屏障包含通过等离子体增强化学气相沉积(PECVD)施加的层、通过中性束辅助溅镀(NBAS)施加的层、通过原子层沉积(ALD)施加的层、乙烯乙烯醇共聚物、聚乙烯醇、自组装纳米粒子(SNAP)的聚合物膜，或包含有机和无机材料的交替层的多层屏障，或包含阳离子和阴离子型聚合物的交替

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薄膜的多层屏障，或柔性薄玻璃膜。

61.一种电致变色装置，包含：

柔性衬底，其包含：

前表面；和

后表面；

其中：

所述后表面包含第一导电材料；且

所述第一衬底的所述前表面、所述后表面或所述前表面和所述后表面均包含气体扩散屏障；

刚性衬底，其包含：

前表面；和

后表面；

其中：

所述前表面包含第二导电材料；

其中所述柔性衬底的形状与所述刚性衬底相符；且

所述柔性衬底通过密封部件连接到所述刚性衬底，其中所述柔性衬底的所述后表面和所述刚性衬底的所述前表面与所述密封部件一起界定了其间的腔室；且

所述腔室包含含有阴极材料和阳极材料的电致变色介质。

62.根据权利要求61所述的电致变色装置，其中所述刚性或柔性衬底的所述前表面、所述后表面或所述前表面和所述后表面均包含气体扩散屏障。

63.根据权利要求61所述的电致变色装置，其中所述腔室包含含有阴极材料和阳极材料的基于聚合物的电致变色膜。

64.根据权利要求61所述的电致变色装置，其中所述气体扩散屏障包含通过等离子体增强化学气相沉积(PECVD)施加的层、通过中性束辅助溅镀(NBAS)施加的层、通过原子层沉积(ALD)施加的层、乙烯乙烯醇共聚物、聚乙烯醇、自组装纳米粒子(SNAP)的聚合物膜、包含有机和无机材料的交替层的多层屏障，或包含阳离子和阴离子型聚合物的交替薄膜的多层屏障，或柔性薄玻璃膜。

65.根据权利要求61所述的电致变色装置，其中所述柔性衬底、所述刚性衬底或所述柔性衬底和所述刚性衬底均包含聚萘二甲酸乙二酯(PEN)、聚丙烯腈、聚对苯二甲酸乙二酯(PET)、聚碳酸酯、环烯烃聚合物(COP)、环烯烃共聚物(COC)、丙烯酸类、聚酰胺或环氧化物。

66.根据权利要求61所述的电致变色装置，其中所述第一导电材料包含导电纳米线涂层、导电金属网，或绝缘体/金属/绝缘体堆栈(IMI堆栈)。

67.根据权利要求61所述的电致变色装置，其中第二导电材料包含导电纳米线涂层、导电金属网或IMI堆栈。

68.根据权利要求61所述的电致变色装置，其中所述第一导电材料包含第一导电纳米线涂层、第一导电金属网或第一IMI堆栈；且所述第二导电材料包含第二导电纳米线涂层、第二导电金属网或第二IMI堆栈。

69.根据权利要求66、67或68所述的电致变色装置，其中所述导电纳米线涂层、所述导电金属网或所述IMI堆栈展现小于50Ω/sq的电阻。

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70.根据权利要求69所述的电致变色装置，其中所述导电纳米线涂层、所述导电金属网或所述IMI堆栈展现小于10Ω/sq的电阻。

71.根据权利要求69所述的电致变色装置，其中所述导电纳米线涂层、所述导电金属网或所述IMI堆栈展现小于5Ω/sq的电阻。

72.根据权利要求66、67或68所述的电致变色装置，其进一步包含覆盖所述第一或第二导电材料中的任一种或两种的导电涂层。

73.根据权利要求72所述的电致变色装置，其中所述导电涂层包含透明导电氧化物、碳纳米管、石墨烯或导电聚合物。

74.根据权利要求72所述的电致变色装置，其中所述导电涂层包含氧化铟锡、氧化铟锌、碳纳米管、石墨烯，或聚(3,4-亚乙二氧基噻吩)聚苯乙烯磺酸酯(PEDOT-PSS)。

75.根据权利要求72所述的电致变色装置，其中所述导电涂层包含氧化铟锡或氧化铟锌。

76.根据权利要求61所述的电致变色装置，其中所述密封部件包含热可固化密封件或紫外线可固化密封件。

77.根据权利要求61所述的电致变色装置，其中所述密封部件包含环氧化物。

78.根据权利要求61所述的电致变色装置，其中所述密封部件包含所述第一衬底与所述第二衬底之间的焊接。

79.根据权利要求61所述的电致变色装置，其中所述密封部件包含所述第一衬底与所述第二衬底之间的热熔胶或超声波，或覆盖所述第一衬底的所述前表面的边缘且延伸到所述第二衬底的所述后表面的边缘的热密封膜。

80.根据权利要求61所述的电致变色装置，其中所述腔室包含第一热塑性电致变色膜或第一交联电致变色膜。

81.根据权利要求61所述的电致变色装置，其中所述腔室包含第一热塑性电致变色膜。

82.根据权利要求81所述的电致变色装置，其中所述第一热塑性电致变色膜包含第一电活性材料和第一热塑性聚合物。

83.根据权利要求82所述的电致变色装置，其中所述第一电活性材料是阴极材料，和阳极材料，或阴极材料和阳极材料的混合物。

84.根据权利要求83所述的电致变色装置，其中所述阴极材料包含紫精。

85.根据权利要求83所述的电致变色装置，其中所述阳极材料包含吩嗪、吩噻嗪、三苯二噁嗪、咔唑、吲哚并咔唑、双咔唑或二茂铁。

86.根据权利要求81所述的电致变色装置，其中所述第一热塑性电致变色膜包含塑化剂。

87.根据权利要求81所述的电致变色装置，其中所述腔室包含含有第二电活性材料和第二热塑性聚合物的第二热塑性电致变色膜。

88.根据权利要求87所述的电致变色装置，其中所述第一和第二热塑性电致变色膜通过离子交换膜或多孔膜来分隔。

89.一种电致变色装置，包含：

刚性衬底，其包含：

前表面；和

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后表面；

其中：

所述后表面包含第一导电材料；且

所述第一衬底的所述前表面、所述后表面或所述前表面和所述后表面均包含气体扩散屏障；

柔性衬底，其包含：

前表面；和

后表面；

其中：

所述前表面包含第二导电材料；

其中所述柔性衬底的形状与所述刚性衬底相符；且所述柔性衬底通过密封部件连接到所述刚性衬底，其中所述柔性衬底的所述后表面和所述刚性衬底的所述前表面与所述密封部件一起界定了其间的腔室；且

所述腔室包含含有阴极材料和阳极材料的电致变色介质。

90.根据权利要求89所述的电致变色装置，其中所述刚性或柔性衬底的所述前表面、所述后表面或所述前表面和所述后表面均包含气体扩散屏障。

91.根据权利要求89所述的电致变色装置，其中所述腔室包含含有所述阴极材料和所述阳极材料的基于聚合物的电致变色膜。

92.根据权利要求89所述的电致变色装置，其中所述气体扩散屏障包含通过等离子体增强化学气相沉积(PECVD)施加的层、通过中性束辅助溅镀(NBAS)施加的层、通过原子层沉积(ALD)施加的层、乙烯乙烯醇共聚物、聚乙烯醇、自组装纳米粒子(SNAP)的聚合物膜、包含有机和无机材料的交替层的多层屏障，或包含阳离子和阴离子型聚合物的交替薄膜的多层屏障，或柔性薄玻璃膜。

93.根据权利要求89所述的电致变色装置，其中所述柔性衬底、所述刚性衬底或所述柔性衬底和所述刚性衬底均包含聚萘二甲酸乙二酯(PEN)、聚丙烯腈、聚对苯二甲酸乙二酯(PET)、聚碳酸酯、环烯烃聚合物(COP)、环烯烃共聚物(COC)、丙烯酸类、聚酰胺或环氧化物。

94.根据权利要求89所述的电致变色装置，其中所述第一导电材料包含导电纳米线涂层、导电金属网，或绝缘体/金属/绝缘体堆栈(IMI堆栈)。

95.根据权利要求89所述的电致变色装置，其中第二导电材料包含导电纳米线涂层、导电金属网或IMI堆栈。

96.根据权利要求89所述的电致变色装置，其中所述第一导电材料包含第一导电纳米线涂层、第一导电金属网或第一IMI堆栈；且所述第二导电材料包含第二导电纳米线涂层、第二导电金属网或第二IMI堆栈。

97.根据权利要求94、95或96所述的电致变色装置，其中所述导电纳米线涂层、所述导电金属网或所述IMI堆栈展现了小于50Ω/sq的电阻。

98.根据权利要求97所述的电致变色装置，其中所述导电纳米线涂层、所述导电金属网或所述IMI堆栈展现了小于10Ω/sq的电阻。

99.根据权利要求97所述的电致变色装置，所述导电纳米线涂层、所述导电金属网或所述IMI堆栈展现了小于5Ω/sq的电阻。

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100.根据权利要求94、95或96所述的电致变色装置，其进一步包含覆盖所述第一或第二导电纳米线涂层中的任一种或两种、所述第一或第二导电金属网中的任一种或两种，或所述第二IMI堆栈中的任一种或两种的导电涂层。

101.根据权利要求100所述的电致变色装置，其中所述导电涂层包含透明导电氧化物、碳纳米管、石墨烯或导电聚合物。

102.根据权利要求100所述的电致变色装置，其中所述导电涂层包含氧化铟锡、氧化铟锌、碳纳米管、石墨烯，或聚(3,4-亚乙二氧基噻吩)聚苯乙烯磺酸酯(PEDOT-PSS)。

103.根据权利要求100所述的电致变色装置，其中所述导电涂层包含氧化铟锡或氧化铟锌。

104.根据权利要求89所述的电致变色装置，其中所述密封部件包含热可固化密封件或紫外线可固化密封件。

105.根据权利要求89所述的电致变色装置，其中所述密封部件包含环氧化物。

106.根据权利要求89所述的电致变色装置，其中所述密封部件包含所述第一衬底与所述第二衬底之间的焊接。

107.根据权利要求89所述的电致变色装置，其中所述密封部件包含所述第一衬底与所述第二衬底之间的热熔胶或超声波焊接，或覆盖所述第一衬底的所述前表面的边缘且延伸到所述第二衬底的所述后表面的边缘的热密封膜。

108.根据权利要求89所述的电致变色装置，其中所述腔室包含第一热塑性电致变色膜或第一交联电致变色膜。

109.根据权利要求89所述的电致变色装置，其中所述腔室包含第一热塑性电致变色膜。

110.根据权利要求109所述的电致变色装置，其中所述第一热塑性电致变色膜包含第一电活性材料和第一热塑性聚合物。

111.根据权利要求110所述的电致变色装置，其中所述第一电活性材料是阴极材料，和阳极材料，或阴极材料和阳极材料的混合物。

112.根据权利要求111所述的电致变色装置，其中所述阴极材料包含紫精。

113.根据权利要求111所述的电致变色装置，其中所述阳极材料包含吩嗪、吩噻嗪、三苯二噻嗪、咔唑、吲哚并咔唑、双咔唑或二茂铁。

114.根据权利要求109所述的电致变色装置，其中所述第一热塑性电致变色膜包含塑化剂。

115.根据权利要求109所述的电致变色装置，其中所述腔室包含含有第二电活性材料和第二热塑性聚合物的第二热塑性电致变色膜。

116.根据权利要求115所述的电致变色装置，其中所述第一和第二热塑性电致变色膜通过离子交换膜或多孔膜来分隔。

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具有塑料衬底的电化学装置

[0001] 相关申请的交叉引用

[0002] 本申请要求美国临时专利申请第62/130,354号(2015年3月9日提交);第62/135,003号(2015年3月18日提交);第62/184,704号(2015年6月25日提交);第62/257,950号(2015年11月20日提交);以及第62/258,051号(2015年11月20日提交)的权益,所述美国临时专利申请的全部公开内容以引用的方式并入本文中以用于任何和所有目的。

技术领域

[0003] 本发明技术大体上涉及电致变色装置。更具体地说,本发明涉及具有至少一个塑料衬底的电致变色装置。

发明内容

[0004] 在一个方面中,电致变色装置包括第一柔性或刚性塑料衬底和第二柔性或刚性塑料衬底。第一柔性或刚性塑料衬底包括前表面和后表面,其中后表面包括第一导电材料,且第一衬底的前表面、后表面或前表面与后表面包括气体扩散屏障。第二柔性或刚性塑料衬底包括前表面和后表面,其中前表面包括第二导电材料。另外,在所述装置中,第一衬底通过密封部件连接到第二衬底,其中第一衬底的后表面和第二衬底的前表面与密封部件界定了其间的腔室。在一些实施例中,第二衬底的前表面、后表面或前表面和后表面包括气体扩散屏障。在任一个上述实施例中,所述腔室可以包括电致变色介质,所述电致变色介质包括阴极材料和阳极材料。在任一个上述实施例中,第一导电材料可以包括导电纳米线涂层、导电金属网、绝缘体/金属/绝缘体堆栈(IMI堆栈)、填有纳米粒子(如氧化铟锡粒子)的透明聚合物、碳纳米管、石墨烯或导电聚合物。在任一个上述实施例中,第二导电材料可以包括导电纳米线涂层、导电金属网或IMI堆栈。在一些实施例中,额外的导电涂层上可以覆盖第一或第二导电金属网或导电纳米线涂层中的任一个或两个。

[0005] 在任一个上述实施例中,密封部件可以包括使第一衬底固持到第二衬底的热可固化密封件、紫外线可固化密封件、使用第三种热塑料的热熔胶、焊接、压敏粘合剂(PSA)或热密封膜。

[0006] 在任一个上述实施例中,所述腔室可以包括基于第一聚合物的电致变色膜。在本文所述的任一实施例中,基于聚合物的电致变色膜可以是交联的电致变色膜或热塑性电致变色膜。在任一个上述实施例中,基于第一聚合物的电致变色膜可以包括第一电活性材料和第一热塑性聚合物。在任一个上述实施例中,第一电活性材料是阴极材料和阳极材料,或阴极材料和阳极材料的混合物。

[0007] 在任一个上述实施例中,所述腔室可以包括基于第二聚合物的电致变色膜。基于聚合物的电致变色膜可以是交联的电致变色膜或热塑性电致变色膜。基于聚合物的电致变色膜可以包括第二电活性材料和第二热塑性聚合物。在任一个上述实施例中,在所述装置包括基于第一和第二聚合物的电致变色膜(例如热塑性电致变色膜)的情况下,所述膜可以通过电解质层来隔离。电解质层可以合并多孔膜或能够进行离子输送的离子交换膜。

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[0008] 在另一方面中，电致变色装置包括具有第一表面和第二表面的第一柔性或刚性塑料衬底、具有第一表面和第二表面的第二柔性或刚性塑料衬底；以及密封部件，所述密封部件使第一衬底的第二表面连接到第二衬底的第一表面，从而在其间形成腔室。在所述装置中，第一衬底的一个表面或两个表面均涂有紫外光吸收层或材料，或基板浸渍有紫外光吸收层或材料，第二表面涂有导电材料和包括阳极材料的基于第一聚合物的电致变色膜，且腔室包括含有UV可固化或热可固化胶凝剂的流体介质。在一些实施例中，流体介质进一步包括阴极材料。在任一个上述实施例中，流体介质可以进一步包括紫外线吸收材料。在一些实施例中，第二衬底的第一表面涂有包括阴极材料的基于第二聚合物的电致变色膜。在其它实施例中，第二衬底的第一表面涂有导电涂层。密封部件可以包括UV可固化树脂、热固化树脂、热熔性塑料、PSA、热密封膜，或介于第一衬底与第二衬底之间的焊接。

[0009] 在另一方面中，电致变色装置包括第一柔性或刚性塑料衬底和第二柔性或刚性衬底。在所述装置中，第一柔性或刚性衬底包括前表面和后表面，所述后表面具有导电纳米线涂层、导电金属网、IMI堆栈、填有纳米粒子(如氧化铟锡粒子)的透明聚合物、碳纳米管、石墨烯或导电聚合物，其中第一衬底的前表面、后表面或前表面和后表面均具有气体扩散屏障。导电线网或导电纳米线涂层可以涂有另一导电涂层。在所述装置中，第二柔性或刚性塑料衬底包括前表面和后表面，所述前表面具有导电纳米线涂层、导电金属网、IMI堆栈、填有纳米粒子(如氧化铟锡粒子)的透明聚合物、碳纳米管、石墨烯或导电聚合物，其中第一衬底通过密封部件连接到第二衬底，且第一衬底的后表面和第二衬底的前表面与密封部件一起界定了其间的腔室。在一些实施例中，第二衬底是塑料衬底且第二衬底的前表面、后表面或前表面和后表面均包括气体扩散屏障。衬底可以包括吸收UV光的额外涂层或可以将UV吸收材料并入基板。在任一个上述实施例中，所述腔室包括电致变色介质，所述电致变色介质包括阴极材料和阳极材料。在任一个上述实施例中，第一衬底的后表面包括导电纳米线涂层、导电金属网、IMI堆栈、填有纳米粒子(如氧化铟锡粒子)的透明聚合物、碳纳米管、石墨烯或导电聚合物；且第二衬底的前表面包含导电纳米线涂层、导电金属网、IMI堆栈、填有纳米粒子(如氧化铟锡粒子)的透明聚合物、碳纳米管、石墨烯或导电聚合物。在任一个上述实施例中，第一衬底的后表面和第二衬底的前表面各自包括安置于导电材料与腔室之间的导电涂层。在任一个上述实施例中，第一衬底的第一表面和/或第二衬底的第二表面包括抗刮擦涂层。施加到表面的额外涂层可以包括(但不限于)抗反射涂层和/或防污或防指纹涂层。

[0010] 在另一方面中，提供一种形成供电致变色装置用的基板的方法。所述方法包括在第一柔性或刚性塑料衬底的表面上涂布基于第一聚合物的电致变色膜。基于第一聚合物的电致变色膜具有至少一种第一电活性材料和第一热塑性聚合物，所述第一表面进一步包括导电纳米线涂层、导电金属网、IMI堆栈、填有纳米粒子(如氧化铟锡粒子)的透明聚合物、碳纳米管、石墨烯或导电聚合物，且第一柔性或刚性塑料衬底的第二表面上具有气障涂层。导电纳米线涂层或导电金属网可以进一步涂有另一导电涂层。在所述方法的一些实施例中，使用槽模涂布、喷墨印刷、丝网印刷、凹板印刷式涂布、帘式涂布、喷涂、浸涂、挤压涂布或斜板式涂布来施加涂层。在任一个上述实施例中，所述方法还包括使用密封部件将包括基于第一聚合物的电致变色膜的第一衬底表面连接到第二衬底的第一表面以及在其间形成腔室。在任一个上述实施例中，所述方法还包括在第二衬底的第一表面上涂布基于第二聚合物的电致变色膜，所述第二电致变色膜包括至少一种第二电活性材料和第二热塑性聚合

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物。在任一个上述实施例中，所述方法还可以包括用流体或凝胶电解质介质填充腔室。流体介质随后可以原位胶凝化或固化。

[0011] 在另一方面中，电致变色装置包括柔性衬底，所述柔性衬底包括前表面和后表面，其中：所述后表面包含第一导电材料，且第一衬底的前表面、后表面或前表面和后表面均包含气体扩散屏障；刚性衬底，所述刚性衬底包括前表面和后表面，其中：所述前表面包含第二导电材料；其中：柔性衬底的形状与所述刚性衬底相符；柔性衬底通过密封部件连接到刚性衬底，其中柔性衬底的后表面和刚性衬底的前表面与密封部件一起界定其间的腔室。

[0012] 在另一方面中，电致变色装置包括刚性衬底，所述刚性衬底包括前表面和后表面，其中：所述后表面包含第一导电材料，且第一衬底的前表面、后表面或前表面和后表面均包含气体扩散屏障；柔性衬底，所述柔性衬底包括前表面和后表面，其中：所述前表面包含第二导电材料；其中：柔性衬底的形状与刚性衬底相符；柔性衬底通过密封部件连接到刚性衬底，其中柔性衬底的后表面和刚性衬底的前表面与密封部件一起界定其间的腔室。

附图说明

[0013] 图1是根据一些实施例的电致变色装置的示意性横截面图。

[0014] 图2是一个表面上具有导电层的根据一些实施例的基板的示意图。

[0015] 图3是导电线和网状图案的示意图。

[0016] 图4说明了根据工作实例的电致变色装置由于氧气进入所述装置而出现吸收率增加。

具体实施方式

[0017] 下文中描述了多个实施例。应注意，不希望具体实施例是一种穷尽性描述或是对本文论述的较宽方面的限制。结合特定实施例所述的一个方面不必局限于那个实施例，且可以利用任何其它实施例实施。

[0018] 如本文所用，“约”将为所属领域的一般技术人员所理解并且将根据其使用背景而在一定程度上变化。如果使用所属领域的一般技术人员不清楚的术语，那么考虑到其使用背景，“约”将意味着特定术语的至多正10％或负10％。

[0019] 除非本文中另有说明或与本文有明显抵触，否则在描述元件的上下文中(尤其在以下权利要求书的上下文中)，使用术语“一(a/an)”和“所述”以及类似指代语应解释为涵盖单数和复数。除非本文中另有说明，否则本文中的数值范围的叙述仅旨在充当个别提及属于所述范围的每个单独值的速记方法，且每个单独值并入说明书中，如同其在本文中个别地叙述一般。除非本文中另有说明或另外与上下文抵触，否则本文所述的所有方法可以按任何适合的顺序进行。除非另有说明，否则本文中提供的任何和所有实例或示例性语言(例如“如”)的使用仅旨在更好地说明实施例并且不对权利要求书的范围构成限制。说明书中的言辞均不应解释为表示任何未要求的元件是必不可少的。

[0020] 如本文所用，术语“基本上透明”将为所属领域的一般技术人员所理解且根据其使用背景而在一定程度上变化。如果使用了所属领域的一般技术人员不清楚的术语，那么考虑到其使用背景，所述术语意味着所述材料允许以10°的镜面角度引向材料的400nm波长光束的约75％或更多光透过材料的2mm厚度。

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[0021] 对具有塑料衬底的电致变色装置已期望了很多年。本发明人在本文中针对已困扰塑料衬底电致变色装置实施的问题提供了多种解决方案。这类问题包括(但不限于)氧气进入、无法获得低电阻导电涂层、使用紫外(UV)光固化材料的能力、电致变色膜随基板挠曲，以及制造这类材料和装置的方法。

[0022] 本文所述的电致变色装置包括至少一个腔室，所述腔室由具有第一导电表面的第一衬底、具有第二导电表面的第二衬底和密封部件界定，所述密封部件通过使第一和第二导电表面接触密封部件的至少一部分的方式来使第一衬底连接到第二衬底。电致变色介质可以安置在其中界定的腔室内，在向导电表面中的一个或两个施加电势后，所述电致变色介质实现了装置的颜色变化。如本文所用，电致变色介质可以至少含有阴极材料(即，可还原材料)、阳极材料(即，可氧化材料)，或阴极材料和阳极材料的混合物。电致变色介质可以是固态、溶液相、凝胶或基于聚合物的材料，如热塑性材料或交联材料。阴极材料和阳极材料中的一个或两个可以围束于第一和第二衬底中的一个或两个上。在一些实施例中，在阴极材料和阳极材料中的一个或两个受到表面限制的情况下，阳极材料可以封锁于第一或第二导电表面上，而阴极材料可以封锁于第二或第一导电表面上。电致变色介质还可以含有电解质以促进电荷从一个电极移动到另一个电极。第一和第二衬底可以彼此偏移，以允许与第一和第二导电表面产生电接触。

[0023] 由于这些装置是电致变色装置，因此应了解，当向所述装置施加足够的电势时，电致变色介质或涂层的透射率发生变化。透光率变化可以是介质或涂层颜色变化的结果，以致阳极和阴极物质的氧化和还原改变了介质的吸光性，导致在施加电势后，透射率降低。当阳极材料和阴极材料就移动通过腔室而言被围束时，释放电势可以维持降低的透射状态，或如果允许阳极材料和阴极材料迁移通过腔室或如果还原的阴极和氧化的阳极在腔室中不保持隔离，那么释放电势可以引起透射率增加。施加电势之后，装置的短接可以使透射状态恢复到电势施加前的原始透光率所必需的时间加快。瞬时逆转外施电势也可以加快从低透光率到高透光率的透射率变化。

[0024] 大体参见图1，提供电致变色装置100。装置100具有第一衬底110和第二衬底120，各衬底具有前表面和后表面。第一衬底110将通过密封部件130连接到第二衬底120，以便形成腔室。所述腔室由第一衬底110的后表面、第二衬底120的前表面和密封部件130的内表面界定。如图2中所说明，第一衬底110的后表面可以包括第一导电材料112。所述装置可以是一种镜子，其中第一衬底是基本透明的且第二衬底是镜面衬底，其中前表面或后表面是镜面表面。所述装置还可以是一种窗，如建筑窗、轿车窗或飞行器窗，其中两个衬底是基本透明的。所述装置还可以是滤光器。所述装置还可以是眼镜。所述装置还可以是用于任何其它特定应用的中等透明或基本透明的镜面型柔性或刚性电致变色装置。

[0025] 气体扩散屏障

[0026] 在所述装置中，第一衬底的前表面、后表面或前表面和后表面包括气体扩散屏障。气体扩散屏障是防止气体(如氧气或水蒸汽)进入装置的屏障。因此，气体扩散屏障防止或至少限制气体进入装置。在第二衬底由可渗透材料(见下文)制成的情况下，第二衬底的前表面、后表面或前表面和后表面也可以包括气体扩散屏障。气障优选位于最接近电致变色介质的衬底表面上。例如第一衬底的背表面和/或第二衬底的前表面。

[0027] 在装置中使用气体扩散屏障的任何情况下，气体扩散屏障可以最小化或防止气体

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进入装置。举例来说，在扩散屏障欲排除的气体是氧气的情况下，气体扩散屏障防止或至少最小化氧气进入装置中。在欲排除的气体是水蒸汽的情况下，气体扩散屏障防止或至少最小化水进入装置中。在一些实施例中，气体扩散屏障是针对单一气体的屏障，而在其它实施例中，气体扩散屏障是针对多种气体的屏障。这可以由单层气体扩散屏障或多层气体扩散屏障提供。对于电致变色装置来说，衬底和气障应该具有每天小于$10^{-2}cm^3/m^2/atm$的透氧率。这可以包括每天小于$10^{-3}cm^3/m^2/atm$和每天小于$10^{-4}cm^3/m^2/atm$。

[0028] 说明性气体扩散屏障可以包括施加到衬底的聚合物和/或无机物膜、通过物理气相沉积(如真空蒸发或溅镀)、等离子体增强化学气相沉积(PECVD)施加到衬底的层；通过原子层沉积(ALD)施加的层；或通过中性束辅助溅镀(NBAS)施加到衬底的层。说明性阻障膜可以包括(但不限于)Al_2O_3、Si_3N_4、SN、TiN、SiO_xN_y、氧化铟锡(ITO)SiO_2、ZnO_2或TiO_2阻障膜，其中x和y是大于0到4。在气体扩散层是聚合物的情况下，说明性聚合物可以包括(但不限于)聚酰亚胺、聚酯(如聚对苯二甲酸乙二酯(PET)和/或聚萘二甲酸乙二酯(PEN))、环烯烃共聚物(COC)、环烯烃聚合物(COP)、聚(乙烯-共-乙烯醇)(EVOH)、丙烯酸酯、甲基丙烯酸酯、聚乙烯醇(PVOH)、Saran®(PVDC)、Saranex®(HDPE、EVA和PVDC)、表氯醇、Barex®(一种丙烯腈共聚物)。其它说明性屏障包括自组装纳米粒子(SNAP)的膜、多层混合有机和无机薄膜，如(但不限于)Vitex®屏障系统、富士膜屏障和3M屏障。Vitex系统是具有DC反应性溅镀氧化铝与可UV固化的气相沉积有机单体的交替层的膜。富士膜和3M系统类似于Vitex之处在于其是无机物膜与聚合物膜交替的膜。多层阻障膜通常由位于聚对苯二甲酸乙二酯或聚萘二甲酸乙二酯衬底上的交替的有机物(通常为丙烯酸酯)层和无机物(金属氧化物或氮化物)层(二联体)组成。可市购的阻障膜通常具有2到3个二联体和保护性面涂层。另一个说明性屏障系统是通过逐层沉积技术沉积的阳离子型聚合物和阴离子型聚合物交替薄膜，如以下参考文献所说明：Yang,Y.H.等人，《高分子(Macromol)》,2011,44,1450-1459。另一个说明性阻障膜包括施加到塑料衬底上的柔性薄玻璃膜(小于0.5mm厚度)。薄玻璃可以使用液体光学偶联型粘合剂粘附到塑料衬底上或使用光学透明的压敏粘合剂进行层合。适合的柔性薄玻璃膜包括(但不限于)获自康宁公司(Corning Inc.)(Corning,NY)的Willow®玻璃。

[0029] 衬底

[0030] 在所述装置中，至少第一衬底是塑料衬底。塑料衬底可以是聚合物衬底，包括(但不限于)聚乙烯(低密度和高密度)、聚对苯二甲酸乙二酯(PET)、聚萘二甲酸乙二酯(PEN)、聚碳酸酯(PC)、聚砜、丙烯酸类聚合物(包括(但不限于)聚甲基丙烯酸甲酯(PMMA)、聚甲基丙烯酸酯类)、聚酰胺(包括(但不限于)环脂族二胺十二烷二酸聚合物(即，Trogamid® CX7323))、环氧化物、环烯烃聚合物(COP)(如Zeonor 1420R)、环烯烃共聚物(COC)(如Topas 6013S-04或Mitsui Apel)、聚甲基戊烯、基于纤维素酯的塑料(如纤维素三乙酸酯)和聚丙烯腈。关于第二衬底，其可以是聚合物材料与第一衬底相同或不同的塑料衬底。在第一和第二衬底均是塑料衬底的情况下，其可以是柔性或刚性衬底，使得由其形成的电致变色装置是柔性或刚性电致变色装置。

[0031] 塑料衬底上的透明导电氧化物(TCO)涂层的一个普遍问题是电致变色装置不能达成足够低的薄层电阻。第一衬底的后(或第二)表面和第二衬底的前(或第一)表面包括导电

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材料。在第二衬底是金属的情况下，薄层电阻足够低，然而对于作为基本透明衬底的第一衬底来说，后表面包括可在衬底上提供导电表面的导电材料。举例来说，导电材料可以是TCO，如氧化铟锡(ITO)、氧化铟锌(IZO)、氧化锌和氧化锡。然而，在欲由第一衬底展现柔性的情况下，且具体来说，在两个衬底均呈柔性或刚性的情况下，氧化铟锡非常脆且可能经受不住反复弯曲。因此，在本发明技术中，导电材料可以是导电纳米线涂层或导电金属网材料，其尺寸使得其在镜子的情况下基本上不影响反射或在窗的情况下基本上不影响透光度。举例来说，网或纳米线涂层可以具有大于50％的透射率。在任一个上述实施例中，所述网可以具有大于60％、大于70％、大于80％或大于90％的透射率。导电材料还可以是绝缘体/金属/绝缘体堆栈(“IMI堆栈”)，如美国专利第7,830,583号和第8,368,992号中所公开的那些导电材料。所述绝缘体可以是TCO，如ITO，且所述金属可以是导电金属，如银。这类结构能够获得5到9Ω/sq的薄层电阻，同时具有高于80％的透射率和低于110nm的厚度，这厚度比在860nm厚度下具有5Ω/sq的塑料上的ITO涂层小得多。另外，所述网、纳米线涂层和或IMI堆栈可以具有小于50Ω/sq的薄层电阻。这可以包括小于10Ω/sq、小于1Ω/sq、小于0.5Ω/sq、小于0.2Ω/sq、小于0.1Ω/sq、小于0.05Ω/sq或小于0.01Ω/sq的薄层电阻。在任一个上述实施例中，所述网可以具有约0.0001Ω/sq到约50Ω/sq的薄层电阻。这可以包括薄层电阻为约0.0001Ω/sq到约10Ω/sq、约0.0001Ω/sq到约5Ω/sq、约0.0001Ω/sq到约1Ω/sq、约0.001Ω/sq到约10Ω/sq和约0.001Ω/sq到约1Ω/sq的网、纳米线涂层和IMI堆栈。脆性TCO(如ITO)可以涂有(底涂、外涂或这两种)柔性更大的导电膜，如填有导电纳米粒子(如ITO纳米粒子)的导电聚合物或透明聚合物，以使其更耐受衬底弯曲。如果脆性TCO中产生裂纹，那么柔性导电膜将电桥接间隙且维持受损区域的导电性。

[0032] 塑料衬底(特定地说，具有化学惰性倾向的衬底，如COC或COP)上的涂层的一个问题是，在施加气体扩散屏障和导电涂层之前，在不活化促粘层或衬底表面的情况下，衬底上的涂层将容易出现分层区域。涂层从衬底剥离提供了氧气或水蒸汽渗入元件腔室中的通道，尤其在密封件附近出现分层时。或者，靠近EC装置的中心发生的分层还会在气体扩散屏障中产生氧气或水蒸汽进入的开口且因此阻碍了其目标。因此，促粘层可以是优选使用磁控溅镀法涂布的金属涂层的半透明层，如铝、钛、铜或铬，优选铬，其厚度低于20nm、优选低于5nm且透射率大于50％。可以使用基于聚合物的促粘层或底漆，如聚酰亚胺涂层。衬底在涂布之前可以在大气压下使用等离子体射流(如使用气体混合物(如氮气、氩气和氧气)的电晕等离子体)活化表面。另一个选项是在真空环境下使用离子束蚀刻(还使用气体，如氧气和氮气)，其中离子能可以在100到5000keV之间且离子剂量为1×10^{14}到1×10^{18}。用于表面活化的其它选项是氧气等离子体蚀刻和臭氧气氛中的紫外光。用于活化表面的又一个选项是使用火焰处理和使用SiO_2火焰热解处理。

[0033] 说明性纳米线涂层或导电金属网材料包括(但不限于)银、金、不锈钢、铝、铜、镍、钼、钨、铱、铑、钌、铂、钴、钯、铬、钛及其合金。基于纳米线的膜可以通过溶液涂布化学方法、印刷方法、摄影技术、滚压光刻技术或自组装法形成。通过溶液涂布化学方法涂布的膜实例包括康博技术公司(Cambrios Technologies Corporation)的ClearOhm™(10-300Ω/sq，>80％T)和康世医疗公司(Carestream Advanced Materials)的Flexx™(10-100Ω/sq，>80％T)。这些膜是基于PET。通过自组装法制成的基于纳米线的膜是芝麻纳米技术公司(Cima NanoTech)的Sante®(10-100Ω/sq，>80％T)。导电金属网膜是使用包括印刷、滚压

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光刻技术和摄影技术在内的多种加工技术制成。应用纳米技术公司(Applied Nanotech)的Exclucent™膜(<0.1Ω/sq,80%T)是通过印刷方法制成。诺利思公司(Rolith Inc.)的NanoWeb™金属网(5Ω/sq,>80%T)是通过滚压光刻技术制成。富士膜提供了使用卤化银摄影方法制成的Exclear™金属网(1-50Ω/sq,>80%T)。

[0034] 基于纳米线的膜具有随机图案的优点,其将莫尔条纹问题减到最少。金属网导体的重复图案容易产生莫尔条纹问题且需要重叠膜具有正确的取向以将影响最小化。

[0035] 重复图案(如在金属线网导体中)的一个主要问题是,当用近点光源(如前照灯)、街灯或阳光照明时,当通过透射和/或反射导体查看时可以看到强烈的衍射图案。图案的严重程度可能足以使导体无法用于许多商用应用,如建筑物和航空航天用的窗以及自动调光后视镜。衍射图案的可见度可以如下最小化:改变网中的金属线间距、改变网图案中的金属线宽度、连续地改变网线相对于彼此的角度、从而改变网线之间的相对距离,或使得金属网特征尺寸(网间距和金属线宽度)大足以或小足以不会在可见光范围内产生衍射图案。降低这些衍射图案的可见强度的另一种方式是使得金属表面呈黑色或无反射性,以便其吸收入射到其的光。这可以通过多种方式完成,如在金属网底下、在金属网顶上或这两者上印刷黑墨,或在金属网表面上形成镍或铬或其它金属的黑色树突状层。如果金属网层上或底下施加了第二连续导电涂层,那么可以在所述第二连续导电涂层顶上或底下施加吸光性黑色图案化涂层。对于电致变色装置应用来说,在金属网顶上施加的黑色涂层优选具有导电性。

[0036] 在其它实施例中,一个衬底上的网图案相对于第二衬底上的图案可以是偏移的。举例来说,所述网可以偏移10到80度。或者,可以改变图案,使得一个方向上的丝线具有不规则的间距,从而使导电材料在衬底的整个表面上发生随机变化。图3说明了导电网或涂层的多种沉积图案和偏移。

[0037] 根据电致变色装置配置,可以优选在一个方向上比在另一个方向上具有更高导电性或更低电阻。典型地,较高导电性的取向垂直于高导电性电力汇流排,所述汇流排通常位于电致变色装置的周边。这可以如下实现:使取向垂直于汇流排的纳米线比平行于汇流排更多,或使丝网图案中的较多网线垂直于汇流排或较宽线垂直于汇流排,或较厚线垂直于汇流排。以此方式,装置会更快速地变色而透射率不会有损失或损失最小。垂直于汇流排的电阻与平行于汇流排的电阻的比率可以是约10%或更大,或20%或更大,或50%或更大。对于能重复弯曲的柔性衬底来说,为了赋予柔性和拉伸性,优选除以90度角相交的直线之外的网图案。优选以小于90度角相交的线和/或并入曲形或波纹形图案的线,所述图案向所述网赋予拉伸性。

[0038] 在另一个实施例中,导电层可以是施加到极薄层的衬底上的金属片。举例来说,可以使用喷墨技术施加铜、银或金薄片,其中所述薄片具有大于50%的透射率和0.1Ω/sq或更小的电阻。这包括所述薄片具有大于60%、70%或80%透射率的情况。这包括所述薄片具有50%到90%或其间任何范围的透射率的情况。

[0039] 应注意,通过喷墨技术施加金属图案称为添加法。其它添加式印刷方法包括凹版印刷和丝网印刷。可以使用减除方法,使用蚀刻或激光烧蚀法形成图案。

[0040] 虽然金属网导体的薄层电阻极低,但是金属迹线的密度高不足以防止围绕迹线发生选择性着色。为了进一步促进电荷从衬底和导电材料转移到腔室和其中所围束的电致变色介质,且为了在循环期间防止金属网溶解于电致变色介质中,可以在导电纳米线涂层或

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导电金属网上施加导电涂层。涂层可以只施加于金属上以保护金属，或其可以施加于金属和未被金属覆盖的衬底上。金属之间的涂层可以具有小于10,000Ω/sq的薄层电阻。这可以包括小于1,000Ω/sq、小于100Ω/sq或小于10Ω/sq。说明性导电涂层材料包括(但不限于)薄金属涂层，如金、透明导电金属氧化物(例如氧化铟锡(ITO)、氧化铟锌(IZO)、氧化锌和氧化锡)、石墨烯、碳纳米管，或导电聚合物，如聚(3,4-亚乙二氧基噻吩)聚苯乙烯磺酸酯(PEDOT-PSS)、聚噻吩、聚苯胺、聚乙炔、聚吡咯和聚苯亚乙烯。举例来说，所述材料可以是氧化铟锡、氧化铟锌、石墨烯或碳纳米管。

[0041] TCO涂层的另一个问题是，典型的TCO(如ITO)需要热处理以便达到所述材料的最高导电性。由于衬底的玻璃态化温度低(典型地低于100℃)，因此在塑料上进行热处理的温度受到极大的限制。因此，塑料上的TCO的另一缺点是所述材料由于热限制而具有次优的导电性，比热处理的ITO低3到5倍。为了降低薄层电阻，需要增加TCO厚度以补偿降低的导电性。脆性膜(如TCO)的问题是，当膜变得较厚时，涂层对弯曲变得更敏感；换句话说，弯曲量相同时，厚涂层比更薄涂层更早失效，且因此优选薄层电阻与较厚涂层相同的较薄涂层。可以通过用氙气灯或激光的高强度光脉冲对TCO进行闪光处理来降低TCO(如ITO)的薄层电阻而不会显著加热衬底。这种处理允许较薄TCO涂层具有与未处理较厚涂层相同的薄层电阻。

[0042] 在另一方面中，提供任一种上述电致变色装置，其进一步包括位于第一衬底上的紫外光吸收膜。这种膜可以包括于第一衬底的前表面或后表面上。还可以在塑料衬底材料形成时将紫外光吸收材料直接并入其自身中。如下文所说明，电致变色介质可以包括紫外光吸收材料以防止或至少最小化电致变色介质和塑料衬底因紫外光而发生的降解。出于关于紫外光吸收膜应用的此特定论述的目的，第一衬底是面向紫外光源的衬底。举例来说，如果电致变色装置是一种窗，那么第一衬底是暴露于建筑物外部且接受阳光入射光的衬底。因此，第一衬底的第一表面可以包括紫外光吸收膜。可替代地或另外，第一衬底的第二表面可以包括紫外光吸收材料。各衬底本身可以包括紫外光吸收材料。由此提供了两种优点。

[0043] 第一个优点涉及电致变色介质保存。电致变色介质可能对紫外光的降解作用敏感。因此，紫外线吸收膜可以保护电致变色介质以防通过第一衬底暴露于紫外光。第二个优点是通过具有较高UV透射率的第二衬底暴露于UV光而能够对电致变色介质中的一些或全部进行UV固化。电致变色介质可以发生胶凝化以防止电致变色介质在装置内移动、防止装置在破裂情况下泄漏，或通过使第一衬底与第二衬底粘合来提供一体式结构。然而，在许多情况下，电致变色介质包括所溶解的紫外光吸收物质；因此，不能使用可使用紫外光固化的凝胶。在第一衬底上使用紫外光吸收膜允许电致变色介质所包括的紫外光吸收物质的量减少或不包括紫外光吸收物质，同时允许电致变色介质以紫外光可固化凝胶形式固化，因为所述电致变色介质可以通过用紫外光通过第二衬底照射足以在腔室中产生凝胶的时间来活化。用于密封EC装置周边的材料还能够以此方式进行UV固化。

[0044] 本文所述的任何塑料衬底可以包括位于表面上的抗刮擦涂层以尽可能地防止或至少最小化装置外表面的损伤。在一些实施例中，所述装置在装置外表面上具有抗刮擦涂层，而装置内表面上包括气体扩散屏障，以便塑料衬底提供针对气体进入装置的第一屏障，而气体扩散屏障提供针对气体通过塑料衬底的第二屏障。

[0045] 任一装置上的其它涂层可以包括抗指纹涂层、防雾涂层以及抗污涂层和抗反射涂层。

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[0046] 电致变色介质

[0047] 电致变色介质可以采取许多不同形式，如热塑性聚合物膜、溶液相或胶体相。说明性电致变色介质是美如国专利第4,902,108号；第5,888,431号；第5,940,201号；第6,057,956号；第6,268,950号；第6,635,194号和第8,928,966号以及美国专利申请公开第2002/0015214号中所述的那些电致变色介质。阳极和阴极电致变色材料还可以包括如美国专利第6,249,369号中所述的偶联材料。并且，电致变色材料的浓度可以如美国专利第6,137,620号中所教导来选择。另外，单层、单相介质可以包括其中阳极和阴极材料并入聚合物基质中的介质，如国际专利申请第PCT/EP98/03862号和第PCT/US98/05570号中所述。

[0048] 电致变色介质可以是多层或多相电致变色介质。在多层电致变色介质中，介质可以由多个层组成且包括电活性材料，所述电活性材料直接附接到导电电极或被约束成紧邻导电电极，从而在发生电化学氧化或还原时，所述电活性材料保持附接或受约束状态。在多相电致变色介质中，介质中的一种或多种材料在装置操作期间经历了相变，例如当发生电化学氧化或还原时，离子导电电解质溶液中所含的材料在导电电极上形成一个单独的层。

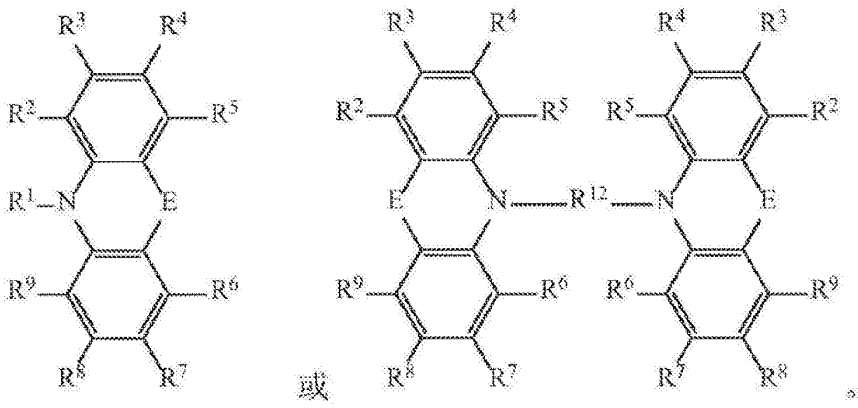
[0049] 电致变色介质可以包括如(但不限于)以下材料：阳极材料、阴极材料、光吸收剂、光稳定剂、热稳定剂、抗氧化剂、增稠剂、粘度调节剂、着色剂、氧化还原缓冲剂以及其混合物。适合的氧化还原缓冲剂尤其包括美国专利第6,188,505号中所公开的那些缓冲剂。适合的UV稳定剂可以包括：丙烯酸2-乙基-2-氰基-3,3-二苯基酯、丙烯酸(2-乙基己基)-2-氰基-3,3-二苯基酯、2-(2'-羟基-4'-甲基苯基)苯并三唑、3-[3-(2H-苯并三唑-2-基)-5-(1,1-二甲基乙基)-4-羟基苯基]丙酸戊酯、2,4-二羟基二苯甲酮、2-羟基-4-甲氧基二苯甲酮、2-乙基-2'-乙氧基苯胺和其类似物。

[0050] 根据一些实施例，阳极材料可以包括(但不限于)二茂铁、二茂铁盐、吩嗪(phenazines)、吩噻嗪(phenothiazines)和噻蒽(thianthrenes)。阳极材料的说明性实例可以包括二-叔丁基-二乙基二茂铁；5,10-二甲基-5,10-二氢吩嗪(DMP)；3,7,10-三甲基吩噻嗪、2,3,7,8-四甲氧基-噻蒽、10-甲基吩噻嗪、四甲基吩嗪(TMP)，以及双(丁基三乙基铵)-对-甲氧基吩二噻嗪(TPDT)。阳极材料还可以包括并入聚合物膜中的那些材料，如聚苯胺、聚噻吩、聚合物茂金属或固体过渡金属氧化物，包括(但不限于)钒、镍、铱的氧化物，以及多种杂环化合物。其它阳极材料可以包括如美国专利第4,902,108号；第6,188,505号；和第6,710,906号中所述的那些材料。

[0051] 在任一种上述态样中，所述阳极材料可以是围束在第二聚合物基质内的吩嗪、吩噁嗪、三苯二噁嗪、咔唑、吲哚并咔唑、双咔唑或二茂铁，所述第二聚合物基质被配置成防止或最小化呈活化状态的阳极材料的实质性扩散。如同紫精一样，阳极材料也可以通过以物理方式滞留在聚合物基质内而封锁于聚合物基质中，或者可以使阳极材料官能化，使得它能够聚合或与聚合物反应，从而共价键结到聚合物上。

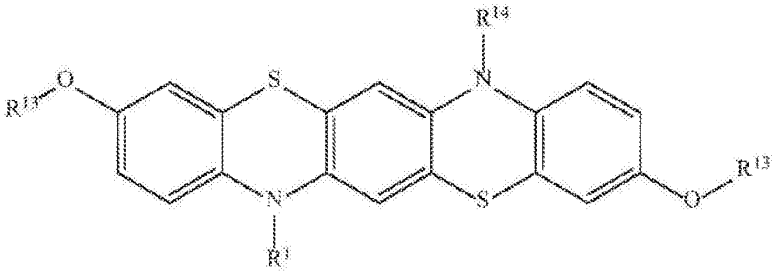
[0052] 在一些实施例中，阳极材料可以是由以下表示的化合物：

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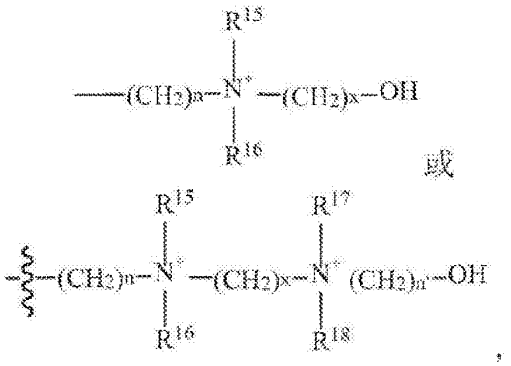
[0053] 

[0054] 在上式中，E是S或NR^{10}；R^1和R^{10}个别地是间杂有至少一个铵基的烷基；R^2到R^9个别地是H、F、Cl、Br、I、CN、OR^{11}、SR^{11}、NO_2、烷基、芳基、氨基，或者R^2-R^9的任何两个相邻基团可以连接形成单环、多环或杂环基团；每个R^{11}个别地是H或烷基；且R^{12}是亚烷基。在一些实施例中，E是NR^{10}且R^2-R^9是H或OR^{11}。在其它实施例中，E是S且R^7和R^8连接形成杂环基。

[0055] 阳极材料可以是由以下表示的化合物：

[0056] 

[0057] 在上式中，R^{14}是间杂有至少一个铵基的烷基。在任一种上述化合物中，R^1、R^{14}和R^{13}可以由以下表示：

[0058] 

[0059] 其中R^{15}-R^{18}个别地是H或烷基；n是1、2、3、4、5、6、7、8、9、10、11或12；n'是1、2、3、4、5、6、7、8、9、10、11或12；且x是1、2、3、4、5、6、7、8、9、10、11或12。在一些实施例中，n是4，x是2，且n'是11。

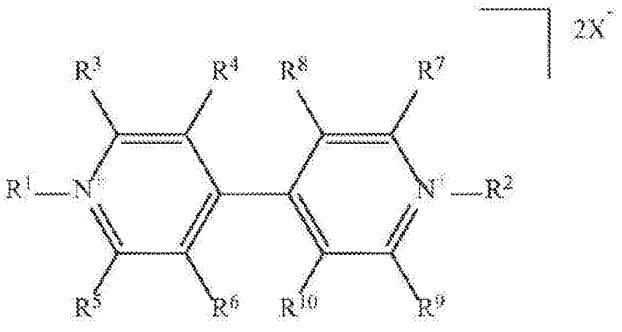
[0060] 阴极材料可以包括(例如)紫精，如甲基紫精、辛基紫精或苯甲基紫精；二茂铁盐，如(6-(三-叔丁基二茂铁)己基)三乙铵。应了解，所有这类物质(仅指分子的阳离子部分和多种多样的阴离子)可以用作相对离子。虽然特定阴极材料仅为了说明性目的而提供，但是

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同样涵盖使用多种其它传统阴极材料，包括(但不限于)此前提及和并入的美国专利第4,902,108号、美国专利第6,188,505号和美国专利第6,710,906号中所公开的那些材料。此外，预期所述阴极材料可以包括聚合物膜，如各种聚噻吩、聚合物紫精、无机物膜或固体过渡金属氧化物，包括(但不限于)氧化钨。

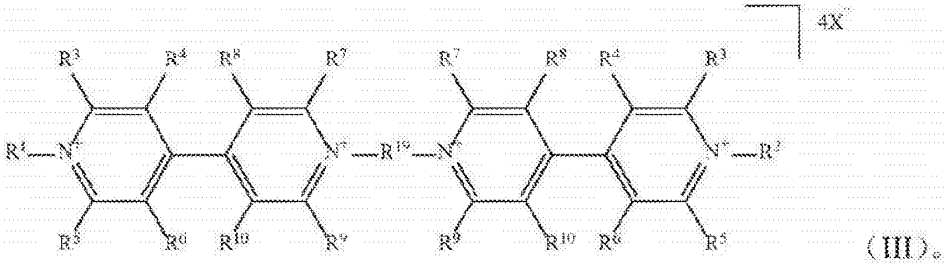
[0061] 本文所述的任一种装置中使用的说明性阴极材料包括紫精和金属氧化物。说明性金属氧化物包括电致变色的那些金属氧化物，如氧化钨。氧化钨可以充当阴极材料以及导电材料。

[0062] 在任一个上述方面中，阴极材料可以是紫精或非二聚或低二聚紫精。说明性紫精包括(但不限于)甲基紫精、辛基紫精、苯甲基紫精、聚合紫精，以及美国专利第7,372,609号、第4,902,108号、第6,188,505号和第6,710,906号中所述的紫精。其它紫精可以包括式(I)、式(III)或式(IV)的紫精：

[0063] 

(I)。

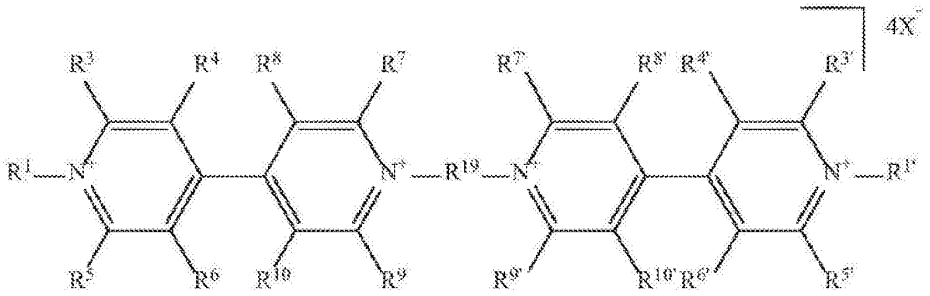
[0064] 在式I中，R^1和R^2个别地是烷基、硅烷氧基烷基、羟基烷基、烯基或芳烷基；R^4、R^6、R^8和R^{10}个别地是H、OH、F、Cl、Br、I、CN、NO_2、烷基或芳基；R^3、R^5、R^7和R^9个别地是H、OH、F、Cl、Br、I、CN、NO_2、烷基或芳基，且X是阴离子。然而，式(I)可以满足以下条件：R^3和R^5、或R^7和R^9、或R^3、R^5、R^7和R^9个别地是仲烷基、叔烷基或芳基。式(III)：

[0065] 

(III)。

[0066] 在式(III)中，R^1和R^2个别地是烷基、硅氧基烷基、羟基烷基、烯基或芳烷基；R^4、R^6、R^8、R^{10}个别地是H、OH、F、Cl、Br、I、CN、NO_2、烷基或芳基；R^3、R^5、R^7和R^9个别地是H、OH、F、Cl、Br、I、CN、NO_2、烷基或芳基；R^{19}是$(CH_2)_{n'}$或亚芳基，且n'是1到12；X是阴离子；且其中R^3和R^5、或R^7和R^9个别地是仲烷基、叔烷基或芳基。式(IV)

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[0067] 

[0068] 在式(IV)中，R^1和$R^{1'}$个别地是烷基、硅氧基烷基、羟基烷基、烯基或芳烷基；R^4、R^6、R^8、R^{10}、$R^{4'}$、$R^{6'}$、$R^{8'}$和$R^{10'}$个别地是H、OH、F、Cl、Br、I、CN、NO_2、烷基或芳基；R^7、R^9、$R^{7'}$和$R^{9'}$个别地是H、OH、F、Cl、Br、I、CN、NO_2、烷基或芳基；R^{19}是$(CH_2)_{n'}$或亚芳基，且n'是1到12；X是阴离子；且R^3、R^5、$R^{3'}$和$R^{5'}$个别地是伸烷基、叔烷基或芳基；R^7、R^9、$R^{7'}$和$R^{9'}$个别地是伸烷基、叔烷基或芳基。在一些实施例中，对于由式(IV)表示的非二聚电致变色化合物来说，R^{19}是$(CH_2)_{n'}$或亚芳基，且n'是1到12。关于所述紫精中的任一种，相对离子(阴离子)可以是以下中的任一种：卤离子、硼酸根、氟硼酸根、四芳基硼酸根、六氟金属或类金属、硫酸根、磺酸根、磺酰胺、羧酸根、过氯酸根、四氯高铁酸根或其类似物，或其任何两种或更多种的混合物。说明性相对离子/阴离子包括(但不限于)：F^-、Cl^-、Br^-、I^-、BF_4^-、PF_6^-、SbF_6^-、AsF_6^-、ClO_4^-、$SO_3CF_3^-$、$N(CF_3SO_2)_2^-$、$C(CF_3SO_2)_3^-$、三氟甲磺酸根(三氟甲烷磺酸根)、$N(SO_2C_2F_5)^-$或BAr_4^-，其中Ar是芳基或氟化芳基或双(三氟甲基)芳基。在一些实施例中，X是四氟硼酸根或双(三氟甲基磺酰基)酰亚胺阴离子。

[0069] 阴极材料可以是质子可溶性电致变色材料(例如可溶于如乙醇和/或水的质子溶剂中)，或单组分电致变色材料(即，电致变色材料包括在同一分子或阳离子/阴离子组合中含有阴极和阳极部分的化合物，如美国临时申请第62/257,950号(2015年11月20日提交)和第62/258,051号(2015年11月20日提交)中所述。

[0070] 阳极和阴极材料的其它实例可以发现于美国专利第4,902,108号、第5,294,376号、第5,998,617号、第6,193,912号以及第8,228,590号中。

[0071] 仅出于说明性目的，阳极材料和/或阴极材料在电致变色介质中的浓度可以在约1毫摩尔浓度(mM)到约500mM范围内且更优选在约2mM到约100mM范围内。虽然已经提供阳极材料以及阴极材料的特定浓度，但应了解所期望的浓度可以根据含有电致变色介质的腔室的几何构形而有很大变化。

[0072] 出于本公开的目的，电致变色介质的溶剂可以包含任意数目种常见的可市购溶剂，包括3-甲基环丁砜、二甲亚砜、二甲基甲酰胺、四乙二醇二甲醚和其它聚醚；醇类，如乙氧基乙醇；腈类，如乙腈、戊二腈、3-羟基丙腈和2-甲基戊二腈；酮类，包括2-乙酰基丁内酯和环戊酮；环酯类，包括β-丙内酯、γ-丁内酯和γ-戊内酯；有机碳酸酯，包括碳酸丙二酯(PC)、碳酸乙二酯和碳酸甲酯乙酯；和其任何两种或更多种的混合物。

[0073] 电致变色介质可以包括电致变色材料围束于其中的热塑性聚合物(“电致变色热塑性材料”)。这类介质描述于2015年5月25日提交的美国临时申请第62/184,704号中。这类介质可以包括热塑性聚合物、电致变色材料和溶剂或塑化剂，其中热塑性聚合物的存在量足以形成电致变色材料的基本可成形凝胶基质(即，基质含有溶剂，但其是可自支撑的、可成型且可成形的)。这类介质是通过在加热下将热塑性聚合物溶解于溶剂中且还将电致变

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色材料溶解于溶剂中来制备。冷却后，热塑性聚合物建立，从而形成可成形的凝胶材料。可成形的凝胶材料可以成型或按尺寸切割。

[0074] 可成形的凝胶材料可以含有阴极材料、阳极材料或阴极材料和阳极材料作为电致变色材料。在电致变色材料仅是阴极材料或仅是阳极材料的情况下，所述装置可以制备成夹层样式，使得第一衬底可以与包括阴极材料的热塑性聚合物材料相连，且第二衬底与阳极热塑性材料相连，其中两个衬底在单独侧面之间有或无电解质层的情况下连接。换句话说，阴极材料被围束于所述装置的一半中，而阳极材料被围束于所述装置的另一半中，其间有或无单独的电解质层或离子交换膜或多孔膜。在一些实施例中，热塑性材料可以仅包括阳极材料且与第一衬底相关，而第二衬底含有阴极涂层，如金属氧化物涂层。当然，热塑性材料可以含有阳极材料和阴极材料。

[0075] 如上文所提及，可成形的凝胶可以通过将热塑性材料连同电致变色材料和所期望的任何其它添加剂(如电解质、UV吸收材料、电致变色缓冲剂和其它稳定剂)一起溶解于溶剂中来形成。热塑性材料的溶液一经制备，即可以将其倒入模具中，用削皮刀将层拉延到所期望的厚度，或放在脱模层之间，以便可以将其卷到所期望的厚度。可以在离型衬垫上成型或倾倒，以便在材料冷却且形成可成形的凝胶之后，可以使离型衬垫脱离现在的电致变色热塑性基质。所得可成形的凝胶可以切割或削减成所期望形状。

[0076] 热塑性电致变色膜可以如下形成：将热塑性聚合物和电致变色材料和任选的其它添加剂一起溶解于溶剂中，以形成成膜组合物。材料的溶解可以在高温下进行。举例来说，说明性高温可以是约30℃到约150℃。溶剂中所包括的热塑性聚合物的浓度使得热塑性聚合物在冷却后形成自支撑式基质，所述基质容纳溶剂、电致变色材料以及(如果存在)任选的任何添加剂。为了形成膜，在溶解之后，但在自支撑式基质建立之前，可以将成膜组合物浇筑在导电衬底上，或可以将成膜组合物浇筑在离型衬垫上。冷却后，热塑性聚合物、电致变色材料和任选的添加剂形成了自支撑式膜。在使用离型衬垫的情况下，将成膜组合物施加到离型衬垫后，可以施加重叠的第二离型衬垫，所述成膜组合物夹在其间，且使整个装配件通过挤压机或辊系统，以便形成均一厚度的热塑性电致变色膜。然后去除离型衬垫且将膜施加到第一衬底的导电表面上，接着可以去除第二离型衬垫且施加第二衬底的导电表面。边缘密封后，由此形成电致变色装置。

[0077] 在电致变色装置已经使用热塑性膜构筑的情况下，可以设想进一步后处理，其中另外使热塑性材料发生交联以增强热塑性膜的长期机械稳定性，由此产生交联的电致变色膜。这可以通过热塑性膜的额外UV固化来进行。

[0078] 在电致变色装置包括超过一个热塑性膜和/或交联的电致变色膜的情况下(例如第一热塑性膜含有阴极材料且第二热塑性膜含有阳极材料)，第一和第二热塑性膜可以通过离子交换膜或多孔膜或分隔第一膜和第二膜的第三热塑性膜来分隔。第三热塑性膜可以含有有助于在第一膜和第二膜之间导电的电解质或盐。类似地，含有阴极材料的第一交联膜和含有阳极材料的第二交联膜、第一交联膜和第二交联膜可以通过离子交换或多孔膜或第三膜来分隔，所述第三膜具有热塑性或发生交联以分隔第一和第二膜。第三膜可以含有有助于在第一膜和第二膜之间导电的电解质或盐。另一个实例是含有阴极材料的第一热塑性膜和含有阳极材料的第二交联膜，所述第一膜和第二膜可以通过离子交换膜或多孔膜或第三膜来分隔，所述第三膜具有热塑性或发生交联以分隔第一和第二膜。第三膜可以含有

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有助于在第一膜和第二膜之间导电的电解质或盐。又另一个实例包括含有阴极材料的第一交联膜和含有阳极材料的第二热塑性膜，所述第一膜和第二膜可以通过离子交换膜或多孔膜或第三膜来分隔，所述第三膜具有热塑性或发生交联以分隔第一和第二膜。第三膜可以含有有助于在第一膜和第二膜之间导电的电解质或盐。

[0079] 基于聚合物的电致变色膜中所包括的电致变色材料可以是阴极材料、阳极材料，或阳极材料和阳极材料。因此，不同情形存在多种可能组合。基于聚合物的电致变色膜可以含有各种材料用于各种应用。作为非限制性说明，基于聚合物的电致变色膜可以含有电致变色装置必需的所有组分，使得所述膜仅需安置于导电衬底之间，从而可以向装置施加电势以实现颜色变化。

[0080] 说明性热塑性聚合物包括(但不限于)丙烯酸酯、甲基丙烯酸酯、聚酯、聚碳酸酯、聚丙交酯、聚乙烯酯、聚氨基甲酸酯、纤维素酯、聚乙烯基缩甲醛、聚乙烯基缩丁醛、聚乙烯-共-乙酸乙烯酯，和其任何两种或更多种的共聚物。交联膜可以进一步通过使这类热塑性聚合物发生交联来制造。

[0081] 密封部件

[0082] 密封部件用于使第一衬底连接到第二衬底。密封部件可以是施加到一个衬底或另一个衬底的粘合材料，或双重系统粘合剂，其中第一组分施加到一个衬底且第二组分施加到另一个衬底且两种组分接触合并以使所述衬底粘结在一起。说明性粘合剂包括(但不限于)含有环氧化物、氨基甲酸酯、氰基丙烯酸酯、丙烯酸类化合物、聚酰亚胺、聚酰胺、聚硫化物、苯氧树脂、聚烯烃和硅酮的粘合剂。密封部件可以包括热固化系统，如热固化环氧化合物或紫外光可固化密封件。

[0083] 密封部件可替代地是第一衬底与第二衬底之间的焊接。换句话说，使两个塑料衬底彼此熔融和连接或使用第三种材料，如使用热熔胶时。当然，必须注意将导电材料施加在衬底表面上，使得装置不发生短接。在一些实施例中，第一衬底和第二衬底之间的焊接是超声波焊接。应注意可以使用技术组合来密封所述装置。举例来说，可以如下形成密封的一部分：将衬底的未涂布区域焊接在一起，随后将UV固化的密封性粘合剂施加到衬底的涂有涂层(如金属网涂层或纳米线涂层)的区域上。

[0084] 密封部件可以是热密封膜，所述热密封膜使第一和第二衬底在第一和第二衬底的围绕装置周边的边缘处附接。因此，热密封膜覆盖第一衬底的前表面的边缘且延伸到第二衬底的后表面的边缘。这个密封部件提供了电致变色介质或电致变色膜防止湿气和氧气的屏障。热密封膜典型地是由内密封剂层、中核心层和外阻障层组成的多层，所述外阻障层可以或可以不包括铝箔层。所述膜可以使用热封机施加，以使所述膜附着到装置边缘。无箔层的热密封膜的一个实例包括东丽(Toray)的Torayfan®CBS2，且金属化热密封膜的一个实例是东丽的Torayfan®PWX5。另外，可以向内密封剂层中添加压敏粘合剂，以使所述膜在室温下粘附或改善热密封期间的粘合力。用于这个目的的压敏粘合剂的一个实例是3M™的8142KCL。

[0085] 在另一个方面中，提供任一种上述电致变色装置，除电致变色介质之外或替代电致变色介质，所述电致变色装置进一步包括电致变色膜。电致变色膜可以是基于聚合物的膜(如本文所述)，除热塑性聚合物之外，所述膜中还并入了一种或多种电致变色物质。除热塑性聚合物之外，电致变色膜还可以包括阳极材料、阴极材料，或阴极材料和阳极材料。所

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述膜还可以包括其它添加剂，如塑化剂、交联剂、电致变色缓冲剂、紫外光吸收物质、电解质盐、稳定剂和凝胶形成材料。

[0086] 在所述腔室内，第二衬底的第一表面、第一衬底的第二表面或这两个表面可以涂有基于聚合物的膜，所述膜中并入一种或多种电致变色物质。作为说明，第二衬底的第一表面可以涂有基于聚合物的电致变色膜，所述电致变色膜包括阳极材料和热塑性聚合物，如上文所述。在这类说明中，腔室于是可以包括并有阴极材料的介质，或阴极材料可以作为基于聚合物的电致变色膜或作为金属氧化物(如氧化钨)涂布于第一衬底的第二表面上。

[0087] 包括热塑性电致变色膜的电致变色装置可以由柔性衬底形成。举例来说，柔性衬底可以是具有柔性涂层的柔性塑料衬底。由此形成柔性电致变色装置。在一个实施例中，第一与第二柔性塑料衬底涂有气障层和导电材料。以如下方式制备装置：使第一衬底的第二表面接近第二衬底的第一表面，其中密封部件使第一衬底连接到第二衬底，且在其间形成腔室。然而，在连接衬底之前，第一衬底的第二表面涂有电致变色材料(如金属氧化物，如氧化钨)或热塑性电致变色膜，而第二衬底的第一表面涂有金属氧化物或热塑性电致变色膜。或者，可以形成并有阴极材料、阳极材料、热塑性聚合物和溶剂的热塑性电致变色膜且将所述热塑性电致变色膜施加到具有导电表面的衬底上。然后可以如下形成电致变色装置：向第二衬底施加导电表面且对装置进行边缘密封，以将热塑性电致变色膜固持且保护于装置腔室内。边缘密封可以包括聚合物粘合剂，如含环氧基材料，或其可以是塑料焊接、热密封膜、热熔胶、热固性材料或UV固化材料。

[0088] 如此描述的装置、方法或制备此类装置已有描述。举例来说，具有基于聚合物的电致变色膜的装置可以通过组装第一衬底、第二衬底和将基于聚合物的电致变色膜安置于其间来形成。这可以包括各种部件的单纯组装，或从膜制造到装置制造的完全组装。

[0089] 在另一个方面中，提供一种为具有聚合物膜的电致变色装置形成衬底的方法。所述方法可以包括在第一衬底的第一表面上涂布基于第一聚合物的电致变色膜，所述基于聚合物的电致变色膜具有至少一种第一电活性材料和第一热塑性聚合物。说明性涂布技术可以包括(但不限于)槽模涂布、凹板印刷式涂布、帘式涂布、喷涂、浸涂、挤压涂布或斜板式涂布。这类方法应该能够接受多种多样的电致变色材料，包括使用紫精、吩嗪、吩噻嗪、三苯二噻嗪、咔唑、吲哚并咔唑、双咔唑或二茂铁。对于多层装置来说，或对于单独的衬底来说(各含有不同类型的基于聚合物的电致变色膜，其中其在同一膜中是阴极物质、阳极物质，或阴极物质和阳极物质)，这可以重复多次。

[0090] 在另一方面中，电致变色装置包括具有第一表面和第二表面的第一衬底；具有第一表面和第二表面的第二衬底；以及密封部件，所述密封部件使第一衬底的第二表面连接到第二衬底的第一表面，从而在其间形成腔室；其中第一衬底含有紫外光吸收材料；第二表面涂有包含阳极材料的基于第一聚合物的电致变色膜(如本文所述)；且所述腔室包含含有UV可固化胶凝剂的流体介质。UV可固化胶凝剂可以包括多官能乙烯基化合物或寡聚物，如丙烯酸酯、甲基丙烯酸酯或乙烯醚，以及自由基光引发剂。仅举几例，说明性乙烯基化合物包括(但不限于)1,4-丁二醇二丙烯酸酯、参[2-(丙烯酰氧基)乙基]异氰尿酸酯、聚(丙二醇)二丙烯酸酯、聚(丙二醇)二甲基丙烯酸酯、聚(乙二醇)二丙烯酸酯、三羟甲基丙烷丙氧基化物三丙烯酸酯和1,4-丁二醇二乙烯基醚，以及其组合。仅举几例，除多官能乙烯基化合物之外，UV可固化凝胶中还可以包括单体乙烯基化合物以有助于修改凝胶(如甲基丙烯酸

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甲酯或丙烯酸丁酯)的最终特性。还需要并入的自由基光引发剂可以是(但不限于)2-羟基-2-甲基苯丙酮、2,2-二甲氧基-2-苯基苯乙酮(Irgacure®651)、2,2-二乙氧基苯乙酮,以及苯基双(2,4,6-三甲基苯甲酰基)膦氧化物(Irgacure®819)。

[0091] 在一些实施例中,流体介质含有阴极材料,如上文所述。举例来说,阴极材料可以是紫精。

[0092] 在其它实施例中,流体介质可以进一步包括紫外光吸收材料、紫外线可固化胶凝剂,或其任何两种或更多种的混合物。

[0093] 在一些实施例中,第二衬底的第一表面涂有包括阴极材料的基于第二聚合物的电致变色膜。在这类实施例中,阴极材料可以是如上文所述的任何阴极材料。在一些实施例中,阴极材料是紫精。

[0094] 这类装置中的阳极材料可以是如上文所述的任何阳极材料,包括(但不限于)吩噻嗪、吩噻嗪、三苯二噻嗪、咔唑、吲哚并咔唑、双咔唑或二茂铁。

[0095] 在一些实施例中,第二衬底的第一表面涂有金属氧化物。举例来说,金属氧化物可以是氧化钨。

[0096] 装置中的流体介质可以包括溶剂。在一些实施例中,流体介质还可以包括电解盐。

[0097] 在另一方面中,提供一种使电致变色装置中的流体介质凝胶化的方法,其中提供电致变色装置,所述装置包括:具有包含紫外线吸收层的第一表面和第二表面的第一衬底;具有第一表面和第二表面的第二衬底;以及密封部件,所述密封部件是第一衬底的第二表面连接到第二衬底的第一表面,从而在其间形成腔室。所述腔室可以包括含有紫外光可固化胶凝剂的流体介质,所述方法进一步包括用紫外光通过第二衬底照射紫外光可固化胶凝剂。

[0098] 在这类实施例中,流体介质可以进一步包括任一种上述阴极材料、紫外光吸收材料或其混合物。在所述方法中,第一衬底的第二表面可以包括含有阳极材料的基于第一聚合物的电致变色层。说明性阳极材料是如上文所述的阳极材料,包括(但不限于)吩噻嗪、吩噻嗪、三苯二噻嗪、咔唑、吲哚并咔唑、双咔唑或二茂铁。在所述方法中,第二衬底的第一表面涂有基于第二聚合物的电致变色膜,所述电致变色膜包括如上文所述的阴极材料,或作为阴极材料的金属氧化物。

[0099] 在所述方法中,还可以包括将密封部件施加到第一衬底或第二衬底上且将其余衬底施加到密封部件的步骤。所述方法还可以包括使密封部件固化。

[0100] 在所述方法中,密封部件可以包括热固化树脂、紫外光固化树脂或其组合。这类树脂可以包括(但不限于)环氧树脂、氰基丙烯酸酯、硅酮、氨基甲酸酯、聚酰亚胺、丙烯酸酯树脂和/或甲基丙烯酸酯树脂,以及其任何两种或更多种的组合。在树脂是UV可固化的情况下,然后可以用紫外光通过第二衬底照射密封部件来使其固化,且在树脂是热可固化的情况下,可以通过加热树脂或使树脂暴露于热量来使其固化。或者,密封部件包括第一衬底与第二衬底之间的焊接、对第三热塑料的热熔融,或热密封膜。

[0101] 在另一方面中,提供一种电致变色装置。所述装置具有第一衬底,所述第一衬底具有前表面和包括导电纳米线或导电金属网的后表面。在所述装置中,第一衬底的前表面、后表面或前表面和后表面均包括气体扩散屏障。所述装置还具有第二衬底,所述第二衬底包括具有导电纳米线或导电金属网的前表面。在所述装置中,第二衬底的前表面、后表面或前

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表面和后表面均包括气体扩散屏障。在所述装置中，第一衬底通过密封部件来连接到第二衬底，其中第一衬底的后表面和第二衬底的前表面与密封部件一起界定其间的腔室且第一衬底是塑料衬底。

[0102] 在一些实施例中，第二衬底是塑料衬底且第二衬底的前表面、后表面或前表面和后表面均包括气体扩散屏障。所述装置的腔室可以包括具有阴极材料、阳极材料或阴极材料和阳极材料的电致变色介质。在这类实施例中，电致变色装置呈柔性或刚性，其具有弯曲和挠曲的两个塑料衬底。

[0103] 第一衬底的后表面可以包括导电纳米线涂层、导电金属网或IMI堆栈，且第二衬底的前表面也可以包括导电纳米线涂层、导电金属网或IMI堆栈。金属网材料和IMI堆栈如上文所述。除金属网、纳米线涂层和IMI堆栈之外，第一衬底的后表面和第二衬底的前表面可以包括安置于导电纳米线涂层、导电金属网或IMI堆栈与腔室之间的导电涂层。或者，除金属网和IMI堆栈之外，第一衬底的后表面和第二衬底的前表面可以包括安置于纳米线涂层/导电金属网/IMI堆栈与腔室之间的导电涂层，或安置于纳米线涂层/导电金属网/IMI堆栈与衬底之间的导电涂层。

[0104] 说明性导电涂层可以包括薄金属层、透明导电金属氧化物、碳纳米管、石墨烯或导电聚合物。举例来说，导电涂层可以包括薄金层、薄铂族金属层、氧化铟锡、氧化铟锌、碳纳米管、石墨烯或聚(3,4-亚乙二氧基噻吩)聚苯乙烯磺酸酯(PEDOT-PSS)。在一些实施例中，导电涂层可以包括氧化铟锡。

[0105] 在一些实施例中，第一衬底可以包括塑料衬底，第二衬底可以是塑料衬底，或第一衬底和第二衬底均是塑料。第一和第二衬底中的一个或两个还可以呈柔性或刚性。

[0106] 如同本文所述的其它装置，装置的密封部件可以包括UV可固化树脂、热可固化树脂、热熔胶、焊接或热密封膜。这类说明性密封部件描述如上。

[0107] 如同上述任何装置，第一衬底的第一表面和第二衬底的第二表面中的任一个或两个均可以包括抗刮擦涂层。抗刮擦涂层可以是有机物、无机物涂层，或两者的组合。硬涂层可以是仅由有机树脂组成，通过有机树脂与无机粒子粘结而成的混合式涂层，或有机树脂与无机填充剂的复合涂层。塑料衬底常用的硬涂层是基于溶剂的含有二氧化硅填充剂的UV可固化丙烯酸类化合物。说明性抗刮擦涂层包括(但不限于)获自尼德克公司(Nidek Company)的Acier C50PG，其基于UV可固化的有机/无机丙烯酸类化合物的混合式硬涂层。通过物理气相沉积或化学气相沉积施加的无机涂层可以用于形成硬涂层。这些层典型地在100nm到25μm厚的范围内。硬涂层可以使用如下组合：硬有机层作为底涂层，继之为硬得多的无机层。硬涂层还可以是其中无机硬涂层上施加有类金刚石碳(DLC)层的硬涂层。有机层典型地具有25到1000微米厚度，无机层典型地具有100nm到25微米厚度且类金刚石碳层典型地具有1到100nm厚度。

[0108] 装置上的气体扩散屏障可以包括(但不限于)通过等离子体增强化学气相沉积(PECVD)施加的层、通过中性束辅助溅镀(NBAS)施加的层、通过原子层沉积(ALD)施加的层、聚(乙烯-共-乙烯醇)(EVOH)涂层、聚乙烯醇(PVOH)涂层、自组装纳米粒子(SNAP)的聚合物膜、通过逐层沉积法沉积的阳离子聚合物和阴离子聚合物的交替薄膜的多层屏障，或包含有机和无机材料的交替层的多层屏障，或柔性薄玻璃膜。

[0109] 在阴极或阳极材料封锁于聚合物基质内的情况下，聚合物基质可以是具有热塑性

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或发生交联的固体聚合物或凝胶聚合物。举例来说，如实例所说明，聚合物可以是基于丙烯酸酯的聚合物，其溶解于并有阳极或阴极材料的溶剂中。然后把这个溶液涂布到衬底的导电表面上，然后去除溶剂。所得膜是丙烯酸酯膜，其触摸起来可能是硬的或粘的。或者，聚合物膜可以是含有溶剂以及阳极或阴极材料的凝胶。此外，聚合物膜可以随后发生交联以提高机械稳定性。可用于封锁阳极和阴极材料的其它可能的聚合物基质系统：聚丙烯酸酯、聚甲基丙烯酸酯、聚醚、聚酯、聚碳酸酯和聚氨基甲酸酯、聚硅氧烷、聚硅烷、聚丙烯腈、聚苯乙烯、聚甲基丙烯腈、聚酰胺、聚酰亚胺、聚偏二卤乙烯、聚乙烯醇缩丁醛，以及其任何两种或更多种的共聚物或组合。电致变色装置中所用的聚合物基质材料的其它实例可见于美国专利第6,635,194号和第5,940,201号中。

[0110] 如上文所指出，阳极或阴极材料还可以是聚合物基质的一部分，其中阳极或阴极材料共价键结到聚合物。这可以通过阳极或阴极材料上存在与聚合物或组成聚合物的单体反应的官能团来实现。举例来说，在阳极或阴极材料含有羟基的情况下，阳极或阴极材料可以通过缩合反应键结到聚合物基质中或与异氰酸酯官能团反应形成基于聚氨酯的聚合物基质。还可以使胺与异氰酸酯官能团反应形成脲键和缩二脲键。还可以预期，可以使用多官能环氧化物或聚合物与固化剂(如胺、醇或酸酐)的组合或通过碱或酸催化的均聚反应，形成其它交联聚合物基质。

[0111] 可以用作第一和第二聚合物基质材料的说明性材料包括(但不限于)聚甲基丙烯酸甲酯、聚丙烯酸酯、聚苯乙烯、聚氨基甲酸酯、聚醚、聚酯、聚碳酸酯、聚硅氧烷、聚硅烷、聚丙烯腈、聚甲基丙烯腈、聚酰胺、聚酰亚胺、聚偏二卤乙烯、聚乙烯醇缩丁醛，以及其共聚物和组合。聚合物基质材料的其它实例可见于美国专利第6,635,194号和第5,940,201号中。

[0112] 电解质可以包括溶剂和盐。盐可以是金属盐或铵盐。用于电解质中的说明性溶剂可以包括(但不限于)3-甲基环丁砜、二甲亚砜、二甲基甲酰胺、四乙二醇二甲醚和其它聚醚；醇类，如乙氧基乙醇；腈类，如乙腈、戊二腈、3-羟基丙腈和2-甲基戊二腈；酮类，包括2-乙酰基丁内酯和环戊酮；环酯类，包括β-丙内酯、γ-丁内酯和γ-戊内酯；碳酸酯类，包括碳酸丙二酯(PC)、碳酸乙二酯、碳酸甲酯乙酯；以及其均质混合物。虽然已经公开了与电解质相关的特定溶剂，但是同样涵盖使用所属领域的普通技术人员在本公开之前已知的多种其它溶剂。说明性盐包括(但不限于)以下阴离子的金属或铵盐(如(但不限于)Li^+、Na^+、K^+、NR'_4，其中每个R'个别地是H、烷基或环烷基)：F^-、Cl^-、Br^-、I^-、BF_4^-、PF_6^-、SbF_6^-、AsF_6^-、ClO_4^-、$SO_3CF_3^-$、$N(CF_3SO_2)_2^-$、$C(CF_3SO_2)_3^-$、$N(SO_2C_2F_5)^-$、$Al(OC(CF_3)_3)_4^-$、or BAr_4^-，其中Ar是芳基或氟化芳基，如(但不限于)C_6H_5、3,5-$(CF_3)_2C_6H_3$，或C_6F_5。

[0113] 参考以下实例将更容易理解如此大体描述的本发明，所述实例是为了说明而非限制本发明而提供。

[0114] 实例

[0115] 实例1：电致变色凝胶介质。通过将以下合并来制备电致变色介质：38mM的N,N'-双(正辛基)紫精四氟硼酸盐；27mM的5,10-二氢-5,10-二甲基吩嗪；15mM的Tinuvin®384-2(得自巴斯夫(BASF))；50mM的乙基-2-氰基-3,3-二苯基丙烯酸酯；0.5mM的十甲基二茂铁；0.5mM的十甲基二茂铁四氟硼酸盐；2.2重量％的由甲基丙烯酸2-羟乙酯和丙烯酸甲酯按1:10摩尔比制成的无规共聚物；0.15重量％的异氰酸酯交联剂(Lupmate®M1，得自巴斯夫)，以及百万分之约0.3到2.0的存在于碳酸丙二酯溶剂中的二丁基二乙酸锡氨基甲酸酯

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催化剂。

[0116] 实例2:使用刚性塑料衬底、利用热固化密封件的电致变色装置。通过Zeonor 1420R注塑成型来形成刚性塑料衬底(约50mm宽、125mm长、1.8mm厚)。顶板的第二表面和底板的第一表面在适于聚合物衬底的条件下用氧化铟锌(IZO)涂布。使含有隔离珠粒的环氧化物珠粒在IZO涂层上围绕底板的周边分配。珠粒中留有小间隙以在密封件固化之后充当填充孔口。顶板的定位相对于底板偏移,从而允许从边缘接近导电涂层且与导电涂层发生电接触。顶板在环氧化物上向下按压到隔离珠粒,从而形成单元。环氧化物密封件在适于密封件和聚合物衬底的温度下热固化。用实例1的电致变色凝胶介质填充单元且填充孔口使用UV可固化环氧化物堵塞。将汇流排施加到偏移边缘,使用热固化密封件产生刚性塑料电致变色装置。

[0117] 实例3:使用刚性塑料衬底、利用UV固化密封件的电致变色装置。衬底制备与实例2相同。使含有隔离珠粒的环氧化物珠粒在IZO涂层上围绕底板的周边分配。珠粒中留有小间隙以在密封件固化之后充当填充孔口。顶板的定位相对于底板偏移,从而允许从边缘接近导电涂层且与导电涂层发生电接触。顶板在环氧化物上向下按压到隔离珠粒,从而形成单元。环氧化物密封件在适于密封件和聚合物衬底的时间和强度下进行UV固化。用实例1的电致变色凝胶介质填充单元且填充孔口使用UV可固化环氧化物堵塞。将汇流排施加到偏移边缘,使用UV固化密封件产生刚性塑料电致变色装置。

[0118] 实例4:使用具有气障涂层的刚性塑料衬底和热固化密封件的电致变色装置。通过Zeonor 1420R注塑成型来形成刚性塑料衬底(约50mm宽、125mm长、1.8mm厚)。顶板的第二表面和底板的第一表面在适于聚合物衬底的条件下先涂布气障层,后涂布氧化铟锌(IZO)。使含有隔离珠粒的环氧化物珠粒在IZO涂层上围绕底板的周边分配。珠粒中留有小间隙以在密封件固化之后充当填充孔口。顶板的定位相对于底板偏移,从而允许从边缘接近导电涂层且与导电涂层发生电接触。顶板在环氧化物上向下按压到隔离珠粒,从而形成单元。环氧化物密封件在适于密封件和聚合物衬底的温度下热固化。用实例1的电致变色凝胶介质填充单元且填充孔口使用UV可固化环氧化物堵塞。将汇流排施加到偏移边缘,从而产生具有气障涂层和热固化密封件的刚性塑料电致变色装置。可以施加如下说明性气障涂层:SiO_2---溅镀的单层或双层,真空涂布SiO_2---低温PVD方法,Excapsulix ALD--Al_2O_3原子层沉积,Gencoa-AlO_x/聚HMDSO多层,或PlasmaSi--PECVD SiNx

[0119] 实例5:使用具有阻气膜的刚性塑料衬底和热固化密封件的电致变色装置。通过Zeonor 1420R注塑成型来形成刚性塑料衬底(约50mm宽、125mm长、1.8mm厚)。使用UV可固化液体光学透明粘合剂或阻隔性光学透明粘合剂将阻气膜施加到顶板的第二表面和底板的第一表面上,其中阻障层向塑料衬底定向且PET载体膜向外部定向。暴露的PET膜在适于聚合物衬底的条件下用氧化铟锌(IZO)涂布。使含有隔离珠粒的环氧化物珠粒在IZO涂层上围绕底板的周边分配。珠粒中留有小间隙以在密封件固化之后充当填充孔口。顶板的定位相对于底板偏移,从而允许从边缘接近导电涂层且与导电涂层发生电接触。顶板在环氧化物上向下按压到隔离珠粒,从而形成单元。环氧化物密封件在适于密封件和聚合物衬底的温度下热固化。用实例1的电致变色凝胶介质填充单元且填充孔口使用UV可固化环氧化物堵塞。将汇流排施加到偏移边缘,从而产生具有阻气膜和热固化密封件的刚性塑料电致变色装置。说明性阻气膜包括Kuraray EVAL--EvOH膜(乙烯乙烯醇)、Kuraray Exceval--PvOH膜

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(丙烯乙烯醇)、富士膜--透明超阻气膜,和3M--FTB3-125阻障膜。

[0120] 实例6:使用具有阻气膜的柔性塑料衬底、金属网导体和UV固化密封件的电致变色装置。从存货中切取柔性阻气膜(约75mm宽、82mm长、125微米厚)。从存货中切取外涂有冷ITO的柔性金属网导体膜(约75mm宽、82mm长、125微米厚)。使用UV可固化液体光学透明粘合剂或阻障性光学透明粘合剂将金属网膜施加到顶部阻气膜的第二表面和底部阻气膜的第一表面上,其中阻障层向塑料衬底定向且PET载体膜向外部定向。将导电性银墨迹线施加到所组装膜的偏移边缘上且热固化。组装装置时,银墨迹线将充当汇流排。含有隔离珠粒的环氧化物珠粒在ITO外涂的金属网上围绕底部衬底的周边分配。珠粒中留有小间隙以在密封件固化之后充当填充孔口。顶部衬底的定位相对于底部衬底偏移,从而允许接近边缘上的银墨且与边缘上的银墨发生电接触。顶部衬底在环氧化物上向下按压到隔离珠粒,从而形成单元。环氧化物密封件在适于密封件和聚合物衬底的时间和强度下进行UV固化。用实例1的电致变色凝胶介质填充单元且填充孔口使用UV可固化环氧化物堵塞。向偏移边缘施加电连接,从而产生具有阻气膜、金属网导体和UV热固化密封件的柔性塑料电致变色装置。所用金属网膜是应用纳米技术公司(Applied Nanotech,Inc)的Exclucent™钢金属膜且阻气膜是3M FTB3-125阻障膜。

[0121] 实例7:使用玻璃包覆型刚性塑料衬底、利用热固化密封件的电致变色装置。从聚碳酸酯薄片中切取刚性塑料衬底(约100mm宽、100mm长、2.0mm厚)。聚碳酸酯衬底在一侧上包覆0.3mm碱石灰玻璃,所述碱石灰玻璃涂有氧化铟锌(IZO)。使用UV可固化液体光学透明粘合剂将玻璃包层粘附到塑料衬底,或使用热塑性或热固性光学夹层进行层合,其中IZO涂层面向外。使含有隔离珠粒的环氧化物在IZO涂层上围绕底部衬底的周边分配。珠粒中留有小间隙以在密封件固化之后充当填充孔口。顶部衬底的定位相对于底部衬底偏移,从而允许从边缘接近导电涂层且与导电涂层发生电接触。其中IZO涂层向底部衬底IZO涂层定向的顶部衬底在环氧化物上向下按压到隔离珠粒,从而形成单元。环氧化物密封件在适于密封件和聚合物衬底的温度下热固化。用电致变色流体填充单元且使用UV可固化环氧化物堵塞填充孔口。将汇流排施加到偏移边缘,使用热固化密封件产生玻璃包覆型刚性塑料电致变色装置。

[0122] 实例8:将本发明技术的代表性塑料装置放入氧气高压釜腔室(400psi)内且使用UV/Vis光谱仪定期测量其光学特性。461nm吸光度归因于电致变色介质被氧气污染且加以监测且与参考部件(01_玻璃/IZO,和02_Zeonor/IZO)进行比较。不具有阻气涂层的塑料装置呈现了吸光度随时间的变化最大。图4表明了各种阻气材料的氧气测试性能结果。无屏障[02_Zeonor/IZO(-18)]的塑料装置在暴露3天之后展现大于0.1单位的吸光度变化。通过ALD沉积有SiO_2和Al_2O_3的塑料装置[21-2B-02_100nmSiO_2/50nm ALD-Al_2O_3/IZO]展现了更佳稳定性且直到第8天时点才通过0.1个吸光度单位增幅阈值。对于包含EVOH[04_EVOH(-35)]和SiO_2[16_SiO_2 100nm/100nm(-102)]气体屏障的装置来说,在9天之后出现0.1单位吸光度变化阈值。另外,与不具有屏障的塑料装置相比,塑料衬底两侧均涂布100nm SiO_2层[21-1C-01_100SiO_2/Zeo/100nmSiO_2/25nm ALD-Al_2O_3/IZO]的性能好几乎5倍。根据图4,具有AlO_x/聚丙烯酸酯多层屏障的装置[P232-3 1 AlO_x/聚丙烯酸酯多层(-R302)]在氧气高压釜测试中获得了与无屏障[02_Zeonor/IZO(-18)]塑料装置类似的性能,测试3天之后,达到0.1单位的吸光度变化。然而,3天之后的降解速度比无屏障装置慢。因此,与不具有气体屏

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障的装置相比，具有气体屏障的所有塑料装置展现显著更慢的降解速率。

[0123] 实例9：构建具有柔性塑料衬底的电致变色装置。用混合物涂布一块8″×10″的涂有氧化铟锡(ITO)的PET(6密耳厚度；120Ω/sq薄层电阻)，借此形成第一膜，所述混合物如下制得：将1.02克双(11-羟基十一烷基)紫精双[双(三氟甲磺酰基)酰亚胺](NTf)和0.38克HDT(六亚甲基二异氰酸酯三聚体，购自西格玛-奥德里奇公司(Sigma-Aldrich))溶解于7.0克溶剂混合物(“SM1”)和117微升含有0.6wt％二丁基二乙酸锡(DBTDA)催化剂的SM1溶液中。使用控制厚度的10号迈尔棒(Mayer rod)产生这个涂层。用溶液涂布第二块8″×10″PET，借此形成第二膜，所述溶液如下制得：将1.02克[5,10-(4-(3-羟基丙基二甲基铵)丁基]-5,10-二氢吩嗪NTf和0.38克HDT溶解于7.0克SM1和117微升含DBTDA的SM1中。这层膜也是借助于10号迈尔棒制得。允许所述膜在烘箱中在60℃下、在氮气氛围下固化整夜。如下制备第三涂层：合并15克Vinylec H(SPI Supplies)、15克Vinylec E(SPI Supplies)、1.6克四甲基四氟硼酸铵和88克碳酸丙二酯且在氮气下，在机械搅拌下加热(120℃)，从而形成粘度相对较高的溶液，然后将所述溶液施加于两个离型衬垫(3M 4935)之间。馈送离型衬垫和流体通过人工挤出机上的辊隙，得到250微米涂层。然后允许涂层冷却到环境温度且在氮气下维持直到使用。切取第一和第二涂层的3.5″×3.5″方块且使用甲醇和棉签沿着一个边缘去除EC涂层且通过3M粘合条3011使其与ITO产生电接触。切取稍微大于3.5″×3.5″的一段第三涂层且施加到第一涂层上，以便第三涂层覆盖第一涂层的整个表面。然后将第二涂层施加到第三涂层的暴露表面上，以便第一和第二涂层的电触点位于元件的相对侧。然后将所述元件放在两片玻璃(2.2mm，各5″×5″)之间且在减压下放30分钟以去除涂层界面处的气泡，随后通过缓慢的氮气排放使元件恢复到环境压力。使环氧化物密封件围绕周边和电触点放置，且随后在环境温度下固化整夜以完成元件。

[0124] 说明性实施例

[0125] 以下是非限制性说明性实施例的描述。

[0126] 段落A.一种电致变色装置，包含：第一柔性或刚性塑料衬底，所述第一柔性或刚性塑料衬底包含：前表面和后表面，其中：所述后表面包含第一导电材料；且第一衬底的前表面、后表面或前表面和后表面包含气体扩散屏障；第二柔性或刚性塑料衬底，所述第二柔性或刚性塑料衬底包含：前表面和后表面，其中：所述前表面包含第二导电材料，其中：所述第一衬底通过密封部件来连接到第二衬底，其中第一衬底的后表面和第二衬底的前表面与密封部件一起界定其间的腔室。

[0127] 段落B.根据段落A的电致变色装置，其中第二衬底的前表面、后表面或前表面和后表面均包含气体扩散屏障；且任选地，其中第一和第二衬底的前表面、后表面或前表面和后表面均包含促粘层。

[0128] 段落C.根据段落A或B的电致变色装置，其中所述腔室包含含有阴极材料和阳极材料的电致变色介质。

[0129] 段落D.根据段落A到C中任一段落的电致变色装置，其中所述气体扩散屏障包含通过等离子体增强化学气相沉积(PECVD)施加的层、通过中性束辅助溅镀(NBAS)施加的层、通过原子层沉积(ALD)施加的层、乙烯乙烯醇共聚物、聚乙烯醇、自组装纳米粒子(SNAP)的聚合物膜、包含有机和无机材料的交替层的多层屏障、包含阳离子和阴离子型聚合物的交替薄膜的多层屏障，或粘附到衬底或与衬底层合的柔性薄玻璃膜。

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[0130] 段落E.根据段落A到D中任一段落的电致变色装置，其中第一衬底、第二衬底或第一衬底和第二衬底均包含聚萘二甲酸乙二酯(PEN)、聚丙烯腈、聚对苯二甲酸乙二酯(PET)、聚碳酸酯、环烯烃聚合物(COP)、环烯烃共聚物(COC)、丙烯酸类、聚酰胺或环氧化物。

[0131] 段落F.根据段落A到E中任一段落的电致变色装置，其中第一导电材料包含导电纳米线涂层、导电金属网或IMI堆栈。

[0132] 段落G.根据段落A到F中任一段落的电致变色装置，其中第二导电材料包含导电纳米线涂层、导电金属网、绝缘体/金属/绝缘体堆栈(IMI堆栈)、填有纳米粒子(如氧化铟锡粒子)的透明聚合物、碳纳米管、石墨烯或导电聚合物。

[0133] 段落H.根据段落A到G中任一段落的电致变色装置，其中第一导电材料包含第一导电纳米线涂层、第一导电金属网或第一IMI堆栈；且第二导电材料包含第二导电纳米线涂层、第二导电金属网或第二IMI堆栈、填有纳米粒子(如氧化铟锡粒子)的第二透明聚合物、碳纳米管、石墨烯或第二导电聚合物。

[0134] 段落I.根据段落A到H中任一段落的电致变色装置，其中导电纳米线涂层、导电金属网、IMI堆栈、填有纳米粒子的透明聚合物、碳纳米管、石墨烯或导电聚合物展现小于50Ω/sq的电阻。

[0135] 段落J.根据段落A到I中任一段落的电致变色装置，其中导电纳米线涂层、导电金属网、IMI堆栈、填有纳米粒子的透明聚合物、碳纳米管、石墨烯或导电聚合物展现小于10Ω/sq或小于5Ω/sq的电阻。

[0136] 段落K.根据段落A到J中任一段落的电致变色装置，其进一步包含覆盖于第一或第二导电材料中的任一种或两种上的导电涂层。

[0137] 段落L.根据段落K的电致变色装置，其中导电涂层包含透明导电氧化物、碳纳米管、石墨烯或导电聚合物。

[0138] 段落M.根据段落K或L的电致变色装置，其中所述导电涂层包含氧化铟锡、氧化铟锌、碳纳米管、石墨烯或聚(3,4-亚乙二氧基噻吩)聚苯乙烯磺酸酯(PEDOT-PSS)。

[0139] 段落N.根据段落M的电致变色装置，其中所述导电涂层包含氧化铟锡或氧化铟锌。

[0140] 段落O.根据段落A到N中任一段落的电致变色装置，其中所述密封部件包含热可固化密封件或紫外线可固化密封件。

[0141] 段落P.根据段落A到O中任一段落的电致变色装置，其中所述密封部件包含环氧化物。

[0142] 段落Q.根据段落A到P中任一段落的电致变色装置，其中所述密封部件包含第一衬底与第二衬底之间的焊接。

[0143] 段落R.根据段落A到Q中任一段落的电致变色装置，其中所述密封部件包含介于第一衬底与第二衬底之间的热熔胶或超声波焊接，或覆盖第一衬底前表面的边缘且延伸到第二衬底后表面的边缘的热密封膜。

[0144] 段落S.根据段落A到R中任一段落的电致变色装置，其中所述腔室包含基于第一聚合物的电致变色膜，优选第一热塑性电致变色膜。

[0145] 段落T.根据段落S的电致变色装置，其中基于第一聚合物的电致变色膜包含第一电活性材料和第一热塑性聚合物。

[0146] 段落U.根据段落S或T的电致变色装置，其中所述第一电活性材料是阴极材料和阳

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极材料，或阴极材料和阳极材料的混合物。

[0147] 段落V.根据段落U的电致变色装置，其中所述阴极材料包含紫精。

[0148] 段落W.根据段落U或V的电致变色装置，其中所述阳极材料包含吩嗪、吩噻嗪、三苯二噻嗪、咔唑、吲哚并咔唑、双咔唑或二茂铁。

[0149] 段落X.根据段落S到W中任一段落的电致变色装置，其中所述基于第一聚合物的电致变色膜包含塑化剂。

[0150] 段落Y.根据段落S到X中任一段落的电致变色装置，其中所述基于第一聚合物的电致变色膜是交联膜。

[0151] 段落Z.根据段落S到Y中任一段落的电致变色装置，其中所述腔室包含基于第二聚合物的电致变色膜，所述电致变色膜包含第二电活性材料和第二热塑性聚合物，优选地，其中所述基于第二聚合物的电致变色膜是热塑性电致变色膜。

[0152] 段落AA.根据段落Z的电致变色装置，其中基于第一聚合物和基于第二聚合物的电致变色膜通过离子交换膜或多孔膜来分隔，优选地，其中基于第一聚合物和基于第二聚合物的电致变色膜各自独立地是热塑性电致变色膜。

[0153] 段落AB.一种形成供电致变色装置用的衬底的方法，所述方法包含在第一柔性或刚性塑料衬底的第一表面上涂布基于第一聚合物的膜，所述基于聚合物的电致变色膜包含至少一种第一电活性材料和第一热塑性聚合物，所述第一表面进一步包含导电纳米线涂层、导电金属网或IMI堆栈，且第一柔性或刚性塑料衬底的第二表面上存在阻气涂层，所述第二表面与所述第一表面基本上平行且相对。

[0154] 段落AC.根据段落AB的方法，其中所述涂层包含槽模法、凹板印刷式涂布、帘式涂布、喷涂、浸涂、挤压涂布或斜板式涂布。

[0155] 段落AD.根据段落AB或AC的方法，其进一步包含用密封部件使包含基于第一聚合物的电致变色膜(优选热塑性电致变色膜)的第一衬底的第一表面连接到第二衬底的第一表面，以及在其间形成腔室。

[0156] 段落AE.根据段落AD的方法，其进一步包含在第二衬底的第一表面上涂布基于第二聚合物的电致变色膜(优选热塑性电致变色膜)，所述第二电致变色膜包含至少一种第二电活性材料和第二热塑性聚合物。

[0157] 段落AF.根据段落AB到AE中任一段落的方法，其中所述第一电活性材料是阴极材料。

[0158] 段落AG.根据段落AB到AF中任一段落的方法，其中所述第一电活性材料是阳极材料。

[0159] 段落AH.根据段落AE到AG中任一段落的方法，其中所述第二电活性材料是阴极材料。

[0160] 段落AI.根据段落AH的方法，其中所述第二电活性材料是阳极材料。

[0161] 段落AJ.根据段落AE到AI中任一段落的方法，其中所述第一电活性材料是阴极材料且所述第二电活性材料是阳极材料。

[0162] 段落AK.根据段落AE到AI中任一段落的方法，其中所述第一电活性材料是阳极材料且所述第二电活性材料是阴极材料。

[0163] 段落AL.根据段落AD到AK中任一段落的方法，进一步包含用流体介质填充所述腔

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室。

[0164] 段落AM.一种电致变色装置，包含：具有第一表面和第二表面的第一柔性或刚性塑料衬底；具有第一表面和第二表面的第二柔性或刚性塑料衬底；以及密封部件，所述密封部件使所述第一衬底的所述第二表面连接到所述第二衬底的所述第一表面，从而在其间形成腔室；其中：所述第一衬底的第一表面涂有紫外光吸收层；所述第二表面涂有包含阳极材料的基于第一聚合物的电致变色膜；且所述腔室包含含有UV可固化胶凝剂的流体介质。基于第一聚合物的电致变色膜优选热塑性电致变色膜。

[0165] 段落AN.根据段落AM的电致变色装置，其中所述流体介质进一步包含阴极材料。

[0166] 段落AO.根据段落AM或AN的电致变色装置，其中所述阴极材料是紫精。

[0167] 段落AP.根据段落AM到AO中任一段落的电致变色装置，其中所述流体介质进一步包含紫外线吸收材料。

[0168] 段落AQ.根据段落AM到AP中任一段落的电致变色装置，其中所述第二衬底的所述第一表面涂有包含阴极材料的基于第二聚合物的电致变色膜，优选地，其中所述基于第二聚合物的电致变色膜是热塑性电致变色膜。

[0169] 段落AR.根据段落AQ的电致变色装置，其中所述阴极材料是紫精。

[0170] 段落AS.根据段落AM到AR中任一段落的电致变色装置，其中所述阳极材料包含吩嗪、吩噻嗪、三苯二噻嗪、咔唑、吲哚并咔唑、双咔唑或二茂铁。

[0171] 段落AT.根据段落AM到AS中任一段落的电致变色装置，其中所述第二衬底的所述第一表面涂有金属氧化物。

[0172] 段落AU.根据段落AT的电致变色装置，其中所述金属氧化物是氧化钨。

[0173] 段落AV.根据段落AM到AU中任一段落的电致变色装置，其中所述密封部件包含UV可固化树脂或热固化树脂。

[0174] 段落AW.根据段落AM到AV中任一段落的电致变色装置，其中所述密封部件包含第一衬底与第二衬底之间的焊接。

[0175] 段落AX.一种电致变色装置，包含：第一柔性或刚性塑料衬底，所述第一柔性或刚性塑料衬底包含：前表面和包含导电纳米线涂层、导电金属网或IMI堆栈的后表面，其中：所述第一衬底的前表面、后表面或前表面和后表面均包含气体扩散屏障；第二柔性或刚性塑料衬底，所述第二柔性或刚性塑料衬底包含：包含导电纳米线涂层、导电金属网或IMI堆栈的前表面，和后表面；其中：所述第一衬底通过密封部件连接到所述第二衬底，其中所述第一衬底的后表面和所述第二衬底的前表面与所述密封部件一起界定其间的腔室。

[0176] 段落AY.根据段落AX的电致变色装置，其中所述第二衬底是塑料衬底且所述第二衬底的前表面、后表面或前表面和后表面均包含气体扩散屏障。

[0177] 段落AZ.根据段落AX或AY的电致变色装置，其中所述腔室包含含有阴极材料和阳极材料的电致变色介质。

[0178] 段落BA.根据段落AX到AZ中任一段落的电致变色装置，其中所述第一衬底的后表面包含导电金属网；且第二衬底的前表面包含导电金属网。

[0179] 段落BB.根据段落AX到BA中任一段落的电致变色装置，其中导电纳米线涂层、导电金属网或IMI堆栈展现小于50Ω/sq的电阻。

[0180] 段落BC.根据段落AX到BB中任一段落的电致变色装置，其中所述第一衬底的后表

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面和所述第二衬底的前表面各自包含安置于导电纳米线涂层、导电金属网或IMI堆栈与腔室之间的导电涂层。

[0181] 段落BD.根据段落BC的电致变色装置，其中所述导电涂层包含透明导电氧化物、碳纳米管、石墨烯或导电聚合物。

[0182] 段落BE.根据段落AX到BD中任一段落的电致变色装置，其中所述第一衬底的第一表面和所述第二衬底的第二表面包含抗刮擦涂层。

[0183] 段落BF.根据段落BE的电致变色装置，其中所述抗刮擦涂层包含Acier C50PG。

[0184] 段落BG.根据段落AX到BF中任一段落的电致变色装置，其中所述气体扩散屏障包含通过等离子体增强化学气相沉积(PECVD)施加的层、通过中性束辅助溅镀(NBAS)施加的层、通过原子层沉积(ALD)施加的层、乙烯乙烯醇共聚物、聚乙烯醇、自组装纳米粒子(SNAP)的聚合物膜，或包含有机和无机材料的交替层的多层屏障，或包含阳离子和阴离子型聚合物的交替薄膜的多层屏障，或柔性薄玻璃膜。

[0185] 段落BG.一种电致变色装置，包含：柔性衬底，所述柔性衬底包含前表面和后表面，其中：所述后表面包含第一导电材料，且所述第一衬底的前表面、后表面或前表面和后表面均包含气体扩散屏障；刚性衬底，所述刚性衬底包含前表面和后表面，其中：所述前表面包含第二导电材料；其中：柔性衬底的形状与刚性衬底相符；且柔性衬底通过密封部件连接到刚性衬底，其中柔性衬底的后表面和刚性衬底的前表面与密封部件一起界定其间的腔室。

[0186] 段落BH.根据段落BG的电致变色装置，其中所述刚性或柔性衬底的前表面、后表面或前表面和后表面均包含气体扩散屏障。

[0187] 段落BI.根据段落BG或BH的电致变色装置，其中所述腔室包含含有阴极材料和阳极材料的电致变色介质。

[0188] 段落BJ.根据段落BG到BI中任一段落的电致变色装置，其中所述气体扩散屏障包含通过等离子体增强化学气相沉积(PECVD)施加的层、通过中性束辅助溅镀(NBAS)施加的层、通过原子层沉积(ALD)施加的层、乙烯乙烯醇共聚物、聚乙烯醇、自组装纳米粒子(SNAP)的聚合物膜、包含有机和无机材料的交替层的多层屏障，或包含阳离子和阴离子聚合物的交替薄膜的多层屏障。

[0189] 段落BK.根据段落BG到BJ中任一段落的电致变色装置，其中所述柔性衬底、刚性衬底或柔性衬底和刚性衬底均包含聚萘二甲酸乙二酯(PEN)、聚丙烯腈、聚对苯二甲酸乙二酯(PET)、聚碳酸酯、环烯烃聚合物(COP)、环烯烃共聚物(COC)、丙烯酸类、聚酰胺或环氧化物。

[0190] 段落BL.根据段落BG到BK中任一段落的电致变色装置，其中所述第一导电材料包含导电纳米线涂层、导电金属网或IMI堆栈。

[0191] 段落BM.根据段落BG到BL中任一段落的电致变色装置，其中第二导电材料包含导电纳米线涂层、导电金属网或IMI堆栈。

[0192] 段落BN.根据段落BG到BM中任一段落的电致变色装置，其中所述第一导电材料包含第一导电金属网；且第二导电材料包含第二导电金属网。

[0193] 段落BO.根据段落BG到BN中任一段落的电致变色装置，其中所述导电纳米线涂层、导电金属网或IMI堆栈展现小于50Ω/sq或小于10Ω/sq或小于5Ω/sq的电阻。

[0194] 段落BP.根据段落BG到BO中任一段落的电致变色装置，其进一步包含覆盖于第一或第二导电材料中的任一种或两种上的导电涂层。

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[0195] 段落BQ.根据段落BP的电致变色装置，其中导电涂层包含透明导电氧化物、碳纳米管、石墨烯或导电聚合物。

[0196] 段落BR.根据段落BQ的电致变色装置，其中所述导电涂层包含氧化铟锡、氧化铟锌、碳纳米管、石墨烯或聚(3,4-亚乙二氧基噻吩)聚苯乙烯磺酸酯(PEDOT-PSS)。

[0197] 段落BS.根据段落BR的电致变色装置，其中所述导电涂层包含氧化铟锡或氧化铟锌。

[0198] 段落BT.根据段落BG到BS中任一段落的电致变色装置，其中所述密封部件包含热可固化密封件或紫外线可固化密封件。

[0199] 段落BU.根据段落BG到BT中任一段落的电致变色装置，其中所述密封部件包含环氧化物。

[0200] 段落BV.根据段落BG到BU中任一段落的电致变色装置，其中所述密封部件包含第一衬底与第二衬底之间的焊接。

[0201] 段落BW.根据段落BG到BV中任一段落的电致变色装置，其中所述密封部件包含介于第一衬底与第二衬底之间的热熔胶或超声波焊接，或覆盖第一衬底前表面的边缘且延伸到第二衬底后表面的边缘的热密封膜。

[0202] 段落BX.根据段落BG到BW中任一段落的电致变色装置，其中所述腔室包含基于第一聚合物的电致变色膜，优选第一热塑性电致变色膜。

[0203] 段落BY.根据段落BX的电致变色装置，其中基于第一聚合物的电致变色膜包含第一电活性材料和第一热塑性聚合物。

[0204] 段落BZ.根据段落BY的电致变色装置，其中所述第一电活性材料是阴极材料和阳极材料，或阴极材料和阳极材料的混合物。

[0205] 段落CA.根据段落BZ的电致变色装置，其中所述阴极材料包含紫精。

[0206] 段落CB.根据段落BZ或CA的电致变色装置，其中所述阳极材料包含吩嗪、吩噻嗪、三苯二噻嗪、咔唑、吲哚并咔唑、双咔唑或二茂铁。

[0207] 段落CC.根据段落BX到CB中任一段落的电致变色装置，其中所述基于第一聚合物的电致变色膜包含塑化剂。

[0208] 段落CD.根据段落BX到CC中任一段落的电致变色装置，其中所述基于第一聚合物的电致变色膜是交联膜。

[0209] 段落CE.根据段落BX到CD中任一段落的电致变色装置，其中所述腔室包含基于第二聚合物的电致变色膜，所述电致变色膜包含第二电活性材料和第二热塑性聚合物，优选地，其中所述基于第二聚合物的电致变色膜是热塑性电致变色膜。

[0210] 段落CF.根据段落CE的电致变色装置，其中基于第一聚合物和基于第二聚合物的电致变色膜通过离子交换膜或多孔膜来分隔，优选地，其中基于第一聚合物和基于第二聚合物的电致变色膜各自独立地是热塑性电致变色膜。

[0211] 段落CG.一种电致变色装置，包含：刚性衬底，所述刚性衬底包含前表面和后表面，其中：所述后表面包含第一导电材料，且所述第一衬底的前表面、后表面或前表面和后表面均包含气体扩散屏障；柔性衬底，所述柔性衬底包含前表面和后表面，其中：所述前表面包含第二导电材料；其中：柔性衬底的形状与刚性衬底相符；且柔性衬底通过密封部件连接到刚性衬底，其中柔性衬底的后表面和刚性衬底的前表面与密封部件一起界定其间的腔室。

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[0212] 段落CH.根据段落CG的电致变色装置，其中所述刚性或柔性衬底的前表面、后表面或前表面和后表面均包含气体扩散屏障。

[0213] 段落CI.根据段落CG或CH的电致变色装置，其中所述腔室包含含有阴极材料和阳极材料的电致变色介质。

[0214] 段落CJ.根据段落CG到CI中任一段落的电致变色装置，其中所述气体扩散屏障包含通过等离子体增强化学气相沉积(PECVD)施加的层、通过中性束辅助溅镀(NBAS)施加的层、通过原子层沉积(ALD)施加的层、乙烯乙烯醇共聚物、聚乙烯醇、自组装纳米粒子(SNAP)的聚合物膜、包含有机和无机材料的交替层的多层屏障，或包含阳离子和阴离子聚合物的交替薄膜的多层屏障。

[0215] 段落CK.根据段落CG到CJ中任一段落的电致变色装置，其中所述柔性衬底、刚性衬底或柔性衬底和刚性衬底均包含聚萘二甲酸乙二酯(PEN)、聚丙烯腈、聚对苯二甲酸乙二酯(PET)、聚碳酸酯、环烯烃聚合物(COP)、环烯烃共聚物(COC)、丙烯酸类、聚酰胺或环氧化物。

[0216] 段落CL.根据段落CG到CL中任一段落的电致变色装置，其中第一导电材料包含导电纳米线涂层、导电金属网或IMI堆栈。

[0217] 段落CM.根据段落CG到CL中任一段落的电致变色装置，其中第二导电材料包含导电纳米线涂层、导电金属网或IMI堆栈。

[0218] 段落CN.根据段落CG到CM中任一段落的电致变色装置，其中所述第一导电材料包含第一导电纳米线涂层、第一导电金属网或第一IMI堆栈；且所述第二导电材料包含第二导电纳米线涂层、第二导电金属网或第二IMI堆栈。

[0219] 段落CO.根据段落CG到CN中任一段落的电致变色装置，其中所述导电纳米线涂层、导电金属网或IMI堆栈展现小于50Ω/sq或小于10Ω/sq或小于5Ω/sq的电阻。

[0220] 段落CP.根据段落CG到CO中任一段落的电致变色装置，其进一步包含覆盖于第一或第二导电材料中的任一种或两种上的导电涂层。

[0221] 段落CQ.根据段落CP的电致变色装置，其中导电涂层包含透明导电氧化物、碳纳米管、石墨烯或导电聚合物。

[0222] 段落CR.根据段落CQ的电致变色装置，其中所述导电涂层包含氧化铟锡、氧化铟锌、碳纳米管、石墨烯或聚(3,4-亚乙二氧基噻吩)聚苯乙烯磺酸酯(PEDOT-PSS)。

[0223] 段落CS.根据段落CR的电致变色装置，其中所述导电涂层包含氧化铟锡或氧化铟锌。

[0224] 段落CT.根据段落CG到CS中任一段落的电致变色装置，其中所述密封部件包含热可固化密封件或紫外线可固化密封件。

[0225] 段落CU.根据段落CG到CT中任一段落的电致变色装置，其中所述密封部件包含环氧化物。

[0226] 段落CV.根据段落CG到CS中任一段落的电致变色装置，其中所述密封部件包含第一衬底与第二衬底之间的焊接。

[0227] 段落CW.根据段落CG到CS中任一段落的电致变色装置，其中所述密封部件包含介于第一衬底与第二衬底之间的热熔胶或超声波焊接，或覆盖第一衬底前表面的边缘且延伸到第二衬底后表面的边缘的热密封膜。

[0228] 段落CX.根据段落CG到CW中任一段落的电致变色装置，其中所述腔室包含基于第

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一聚合物的电致变色膜，优选第一热塑性电致变色膜。

[0229] 段落CY.根据段落CX的电致变色装置，其中基于第一聚合物的电致变色膜包含第一电活性材料和第一热塑性聚合物。

[0230] 段落CZ.根据段落CX或CY的电致变色装置，其中所述第一电活性材料是阴极材料和阳极材料，或阴极材料和阳极材料的混合物。

[0231] 段落DA.根据段落CZ的电致变色装置，其中所述阴极材料包含紫精。

[0232] 段落DB.根据段落CZ或DA的电致变色装置，其中所述阳极材料包含吩嗪、吩噻嗪、三苯二噻嗪、咔唑、吲哚并咔唑、双咔唑或二茂铁。

[0233] 段落DC.根据段落108的电致变色装置，其中所述基于第一聚合物的电致变色膜包含塑化剂。

[0234] 段落DD.根据段落CX到DC中任一段落的电致变色装置，其中所述基于第一聚合物的电致变色膜是交联膜。

[0235] 段落DE.根据段落CX到DD中任一段落的电致变色装置，其中所述腔室包含基于第二聚合物的电致变色膜，所述电致变色膜包含第二电活性材料和第二热塑性聚合物，优选地，其中所述基于第二聚合物的电致变色膜是热塑性电致变色膜。

[0236] 段落DF.根据段落DE的电致变色装置，其中基于第一聚合物和基于第二聚合物的电致变色膜通过离子交换膜或多孔膜来分隔，优选地，其中基于第一聚合物和基于第二聚合物的电致变色膜各自独立地是热塑性电致变色膜。

[0237] 段落DG.根据段落A到AA和AM到DF中任一段落的电致变色装置，其中第一和第二衬底的前表面、后表面或前表面和后表面包含促粘层。

[0238] 虽然已经说明且描述了某些实施例，但应了解，可以根据所属领域中的一般技术在其中进行变更和润饰，而这些变更和润饰不偏离如以下权利要求书中所限定的技术的较宽方面。

[0239] 本文说明性描述的实施例可以适当地在本文未专门公开的任何一个或多个元件、一个或多个局限不存在的情况下实施。因此，举例来说，应广泛地而非限制性地阅读术语“包含(comprising)”、“包括(including)”、“含有(containing)”等。另外，本文所用的术语和表述是为了描述而非限制而使用，且在使用这类术语和表述时不希望排除所示和所述的任何等效特征或其一部分，而是应认识到在所要求的技术范围内可以进行各种润饰。另外，短语“主要由…组成”将理解为包括具体叙述的那些元件和对所要求的技术的基本和新颖特征无实质影响的那些额外元件。短语“由……组成”不包括未指定的任何元件。

[0240] 本公开不限于本申请中所述的特定实施例。如所属领域的技术人员将显而易见，可以进行多处润饰和变更，而这些润饰和变更不偏离其精神和范围。除本文中所列举的那些之外，所属领域的技术人员根据前文描述将显而易知本发明范围内的功能等效方法和组合物。这类润饰和变更旨在属于所附权利要求书的范围内。本公开仅由所附权利要求书以及此权利要求书所授权的等效物的完整范围来限定。应了解本发明不限于特定方法、试剂、化合物组合物或生物系统，这些当然可以改变。还应了解，本文中所用的术语仅仅是为了描述特定实施例且而非限制的目的。

[0241] 另外，当根据马库什群组(Markush groups)描述本公开的特征或方面时，所属领域的技术人员应认识到本公开也由此根据马库什群组中的任何个别成员或子组成员描述。

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[0242] 如所属领域的技术人员将了解，出于任何和所有目的，特别是就提供书面说明来说，本文所公开的所有范围还涵盖任何和所有可能的子范围和其子范围组合。任何列举的范围可以容易认知为充分描述且允许将相同范围分解为至少相等的二分之一、三分之一、四分之一、五分之一、十分之一等。作为非限制性实例，本文中论述的每个范围可容易分解为下三分之一、中三分之一和上三分之一等。所属领域的技术人员还将了解，所有言辞，例如“至多”、“至少”、“大于”、“小于”和其类似言辞都包括所列举的数字并且指可以随后如上文所论述而分解为子范围的范围。最后，如所属领域的技术人员将了解，范围包括每一个别成员。

[0243] 本说明书中所提到的所有公开、专利申请、授权专利以及其它文献都通过引用并入本文中，如同每个个别公开、专利申请、授权专利或其它文献经具体地且个别地指出以全文引用的方式并入本文中那样。就与本公开中的定义相抵触来说，不包括以引用方式并入的文本中所含的定义。

[0244] 其它实施例阐述于以下权利要求书内。

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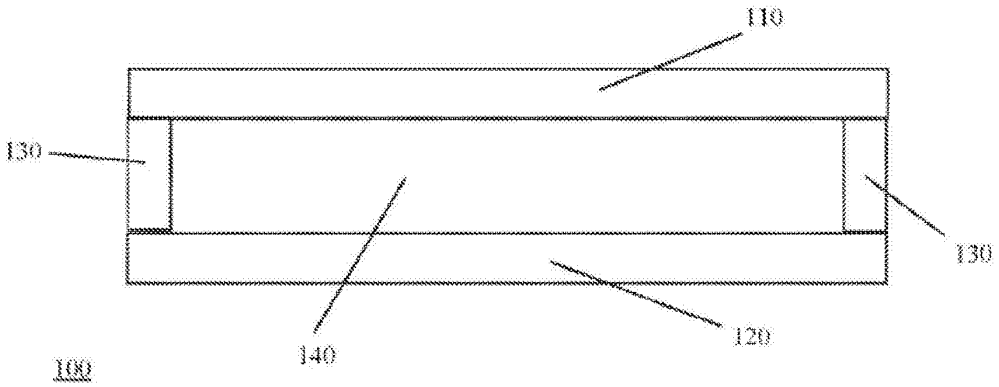


图1

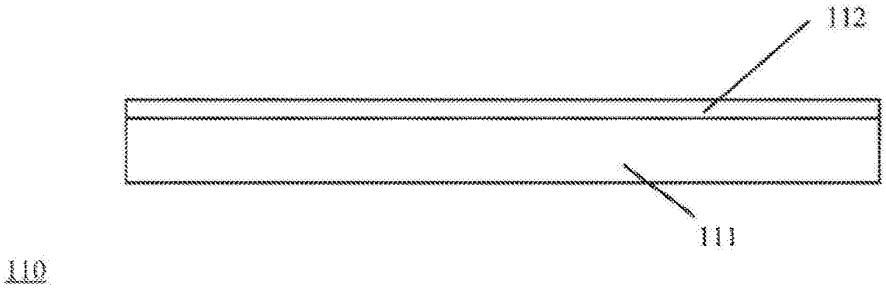
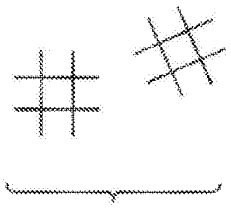
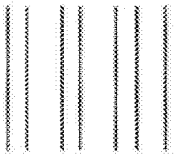


图2

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或随机化



图案

图3

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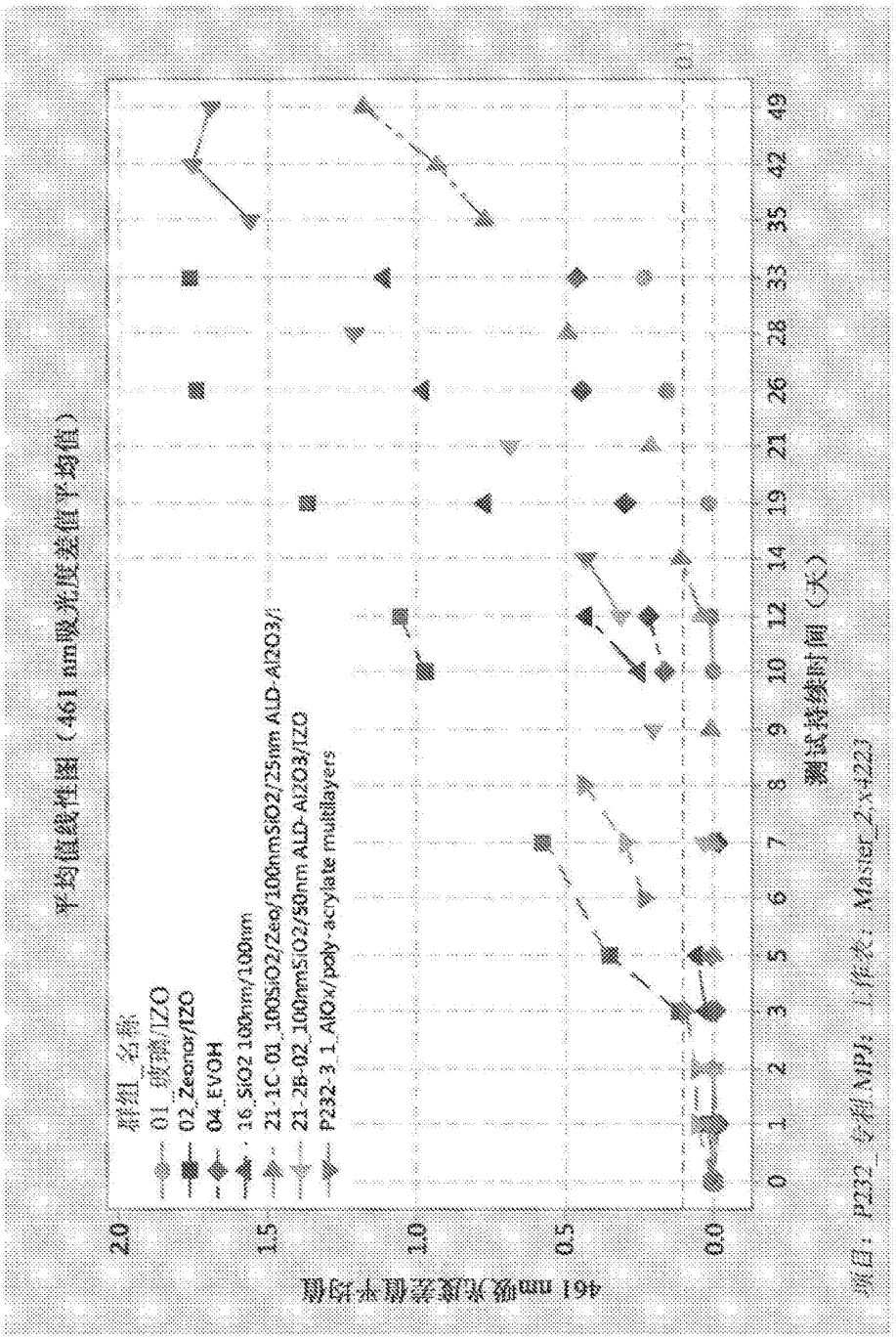


图4

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	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] ¡	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	104375350	CN	A	2015-02-25	HEFEI BOYI ENVIRONMENTAL PROT TECHNOLOGY CO LTD		☒
	2	108463912	CN	A	2018-08-28	FURCIFER INC		☒
	3	107438793	CN	A	2017-12-05	GENTEX CORP		☒

AMBILIGHT EX. 1002; Page 464
Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

	4	107709003	CN	A	2018-02-16	RESEARCH FRONTIERS INC		☒

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	1	First Office Action for Chinese Application No. 202310481813.6 mailed on December 31, 2024.	☒

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Examiner Signature		Date Considered	

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AMBILIGHT EX. 1002; Page 465
Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

CERTIFICATION STATEMENT

Please see 37 CFR 1.97(e) to make the appropriate selection(s):

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☐ See attached certification statement.

☒ A certification statement is not submitted herewith.

FEE

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

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☐ An identification of an earlier application pursuant to 37 CFR 1.98 (d) (1) is attached.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Pengju Shang/	Date (YYYY-MM-DD)	2025-01-06
Name/Print	Pengju Shang	Registration Number	80050

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Ambilight v. Lannray PGR2026-00053

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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Ambilight v. Lannray PGR2026-00053

UNITED STATES
PATENT AND TRADEMARK OFFICE

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Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/606,980	**01/06/2025 05:52:04 PM Z ET**	**50WF-383698-US**

Title of Invention

ELECTROCHROMIC FILMS WITH EDGE PROTECTION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9999	FILED BY	Chizu Sato
PATENT CENTER #	68621144	FILING DATE	03/15/2024
CUSTOMER #	139780	FIRST NAMED INVENTOR	Zhao CHEN
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	PJ Shang

Documents

TOTAL DOCUMENTS: 6

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
FOR_CN107709003A.pdf	29	Foreign Reference	2827 KB
Furcifer12USC3_50WF-383698-US_IDS.pdf	4	Information Disclosure Statement (IDS) Form (SB08)	1313 KB
NPL_CNOA1.pdf	15	Non Patent Literature	764 KB
FOR_CN108463912A.pdf	29	Foreign Reference	2289 KB
FOR_CN104375350A.pdf	27	Foreign Reference	2091 KB
FOR_CN107438793A.pdf	97	Foreign Reference	8358 KB

Digest

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FOR_CN107709003A.pdf	132BE8AE747A700AAF8C1188573FFFAD78995081CBD2B028F7569B7B9094F8493AB2B2063E5190DAD32B39CA74225E06CEFF2D683B46003911D5526C850AABE4
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FOR_CN107438793A.pdf	C160EA9732998A890AEDAD1C13911CD90F6A886AF11373978319AEC37978FD1B538269A30302964F19F473328A64907C3B9D4C90B809675640D2F1270D04298A

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If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

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Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/606,980	CHEN et al.
	Examiner	Art Unit
	JACK DINH	2872

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	12/17/2024	01/16/2025							
	1	÷	✓							
	2	÷	✓							
	3	÷	✓							
	4	÷	✓							
	5	÷	✓							
	6	÷	✓							
	7	÷	✓							
	8	÷	✓							
	9	÷	✓							
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	11	÷	✓							
	12	÷	✓							
	13	÷	N							
	14	÷	N							
	15	÷	N							
	16	÷	N							
	17	÷	N							
	18	÷	N							
	19	÷	N							
	20	÷	N							

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/606,980	CHEN et al.
	Examiner	Art Unit
	JACK DINH	2872

CPC - Searched*		
Symbol	Date	Examiner
G02F 1/1533, 1/1508, 1/153, 1/161, 2201/50, 2201/1536	01/16/2025	JD

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Restrict claims.	12/17/2024	JD
Review parent applications. Search PE2E.	01/16/2025	JD

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/JACK DINH/ Primary Examiner, Art Unit 2872	/JACK DINH/ Primary Examiner, Art Unit 2872

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Ambilight v. Lannray PGR2026-00053

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18606980
Filing Date	2024-03-15
First Named Inventor	Zhao CHEN
Art Unit	
Examiner Name	
Attorney Docket Number	50WF-383698-US

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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AMBILIGHT EX. 1002; Page 472
Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	
	Examiner Name	
	Attorney Docket Number	50WF-383698-US

	1	Communication pursuant to Article 94(3) EPC for European Application No. 23164353.7 mailed on May 22, 2024.	☐

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AMBILIGHT EX. 1002; Page 473
Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	
	Examiner Name	
	Attorney Docket Number	50WF-383698-US

CERTIFICATION STATEMENT

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☐ See attached certification statement.

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Signature	/Pengju Shang/	Date (YYYY-MM-DD)	2024-05-28
Name/Print	Pengju Shang	Registration Number	80050

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Ambilight v. Lannray PGR2026-00053

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AMBILIGHT EX. 1002; Page 475
Ambilight v. Lannray PGR2026-00053

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

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	Filing Date	
	First Named Inventor	Zhao CHEN
	Art Unit	
	Examiner Name	
	Attorney Docket Number	50WF-383698-US

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	5818625		1998-10-06	Forgette et al.	
	2	5406414		1995-04-11	O'farrell et al.	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20130010347		2013-01-10	Tajima et al.	
	2	20160282645		2016-09-29	Wang et al.	
	3	20170298682		2017-10-19	Wang et al.	
	4	20170299932		2017-10-19	Wang et al.	

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AMBILIGHT EX. 1002; Page 476
Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	Zhao CHEN
	Art Unit	
	Examiner Name	
	Attorney Docket Number	50WF-383698-US

	5	20120013969		2012-01-19	Wang et al.	
	6	20150323849		2015-11-12	Han	
	7	20150301367		2015-10-22	Mennig	
	8	20160357082		2016-12-08	Kubo et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] ¡	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2010/032068	WO	A1	2010-03-25	PILKINGTON GROUP LTD		☐
	2	104698715	CN	A	2015-06-10	ZHUHAI SINGYES GREEN BUILDING TECHNOLOGY CO LTD		☒
	3	2014/134714	WO	A2	2014-09-12	SWITCH MATERIALS INC.		☐
	4	2000231125	JP	A	2000-08-22	MURAKAMI CORP		☒
	5	2001033830	JP	A	2001-02-09	MURAKAMI CORP		☒

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /J.D/

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Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	Zhao CHEN
	Art Unit	
	Examiner Name	
	Attorney Docket Number	50WF-383698-US

	6	2011095406	JP	A	2011-05-12	TOKAI RIKA CO LTD		☒
	7	H11316395	JP	A	1999-11-16	NIKON CORP		☒

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	Search Report for European Application No 19206363.4 mailed on February 20, 2020, 9 pages.	☐
	2	Office Action for European Application No. 19206363.4 mailed on April 30, 2021, 5 pages.	☐
	3	First Search for Chinese Application No.: 201911095986.4 mailed on July 15, 2022. [**new]	☐
	4	Supplemental Search Report for Chinese Application No. 201911095986.4 mailed on February 2, 2023.	☐
	5	Extended European Search Report for European Patent Application No 23164353.7 mailed on June 9, 2023.	☐
	6	Non-Final Office Action for U.S. Application No. 18/326,866 mailed on December 20, 2023.	☐

If you wish to add additional non-patent literature document citation information please click the Add button Add

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Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	Zhao CHEN
	Art Unit	
	Examiner Name	
	Attorney Docket Number	50WF-383698-US

EXAMINER SIGNATURE			
Examiner Signature	/JACK DINH/	Date Considered	01/16/2025

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	Zhao CHEN
	Art Unit	
	Examiner Name	
	Attorney Docket Number	50WF-383698-US

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Pengju Shang/	Date (YYYY-MM-DD)	2024-03-15
Name/Print	Pengju Shang	Registration Number	80050

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L25	1	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L26	2	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L27	2	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L28	2	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L29	2	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L30	66827	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2021/11/20 10:08 AM
L31	2	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L32	2	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L33	2	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L34	0	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L35	8	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L36	4	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L37	4	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L38	4	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L39	1307	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2021/11/20 10:08 AM
L40	167	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2021/11/20 10:08 AM
L41	11819	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2021/11/20 10:08 AM
L42	2089	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2021/11/20 10:08 AM

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			IBM_TDB)				
L43	1336	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2021/11/20 10:08 AM
L44	419	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2021/11/20 10:08 AM
L45	14551	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2021/11/20 10:08 AM
L46	26	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2021/11/20 10:08 AM
L47	17	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2021/11/20 10:08 AM
L48	2	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:26 AM
L49	1	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:36 AM
L50	1	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L51	2	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L52	2	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L53	2	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L54	2	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L55	67365	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L56	2	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L57	2	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L58	2	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L59	0	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM

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L60	8	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L61	4	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L62	4	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L63	4	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L64	4847	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L65	874	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L66	13683	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L67	3126	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L68	9593	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L69	1608	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L70	26515	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L71	27	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L72	25	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L73	2	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L74	1	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM

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L75	2	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 12:54 PM
L76	2	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 12:55 PM
L77	2	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 12:55 PM
L78	2	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 01:10 PM
L79	0	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 01:10 PM
L80	2	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 01:11 PM
L81	2	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 01:20 PM
L82	1	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L83	2	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L84	2	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L85	2	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L86	2	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L87	78767	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L88	2	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L89	2	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L90	2	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L91	0	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L92	8	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L93	4	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L94	4	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L95	4	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L96	5163	G02F1/1533	(US-PGPUB; USPAT;	OR	OFF	OFF	2022/09/30

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			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)				01:52 AM
L97	935	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L98	14617	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L99	3382	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L100	10095	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L101	1762	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L102	28164	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L103	30	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L104	27	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L105	2	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L106	1	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L107	1	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L108	2	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L109	2	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L110	2	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L111	2	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM

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L112	78767	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L113	2	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L114	2	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L115	2	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L116	0	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L117	8	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L118	4	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L119	4	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L120	4	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L121	5163	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L122	935	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L123	14617	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L124	3382	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L125	10095	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L126	1762	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L127	28164	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L128	30	(electrochrom$5) same (electrode$1) same	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2022/09/30 01:52 AM

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		(charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	JPO; DERWENT; IBM_TDB)				
L129	27	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L130	2	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L131	1	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L132	2	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L133	2	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L134	2	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L135	2	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L136	0	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L137	2	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L138	2	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L139	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2022/09/30 01:52 AM
L140	27	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:59 AM
L141	3	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 02:01 AM
L142	3	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L143	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L144	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L145	3	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03

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							09:05 PM
L146	3	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L147	88313	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L148	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L149	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L150	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L151	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L152	11	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L153	5	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L154	5	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L155	5	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L156	5509	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L157	1007	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L158	15577	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L159	3623	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L160	10596	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L161	1867	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L162	29769	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2023/06/03 09:05 PM

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			IBM_TDB)				
L163	33	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L164	29	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L165	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L166	3	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L167	3	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L168	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L169	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L170	3	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L171	3	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L172	88313	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L173	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L174	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L175	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L176	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L177	11	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L178	5	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L179	5	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L180	5	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L181	5509	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2023/06/03 09:05 PM

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			JPO; DERWENT; IBM_TDB)				
L182	1007	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L183	15577	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L184	3623	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L185	10596	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L186	1867	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L187	29769	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L188	33	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L189	29	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L190	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L191	3	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L192	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L193	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L194	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L195	3	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM

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L196	1	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L197	3	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L198	3	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L199	3	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L200	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L201	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L202	3	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L203	3	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L204	88313	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L205	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L206	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L207	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L208	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L209	11	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L210	5	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L211	5	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L212	5	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L213	5509	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L214	1007	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L215	15577	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM

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L216	3623	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L217	10596	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L218	1867	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L219	29769	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L220	33	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L221	29	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L222	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L223	3	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L224	3	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L225	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L226	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L227	3	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L228	3	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L229	88313	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L230	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L231	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L232	3	L26 and (polyvinyl or polyurethane or	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM

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		ethylene)					
L233	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L234	11	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L235	5	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L236	5	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L237	5	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L238	5509	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L239	1007	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L240	15577	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L241	3623	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L242	10596	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L243	1867	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L244	29769	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L245	33	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L246	29	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L247	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM

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L248	3	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L249	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L250	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L251	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L252	3	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L253	1	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L254	3	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L255	3	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L256	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 09:05 PM
L257	29	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L258	5	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L259	7	("20120013969"|"20130010347"|"20150323849"|"20160282645"|"20170298682"|"20170299932"|"5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 09:07 PM
L260	608	"5818625"	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:10 PM
L261	1	("5818625").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:10 PM
L262	1	L261 AND (seal$1 WITH epoxy)	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:11 PM
L263	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva))	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:17 PM
L264	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva OR polyvinyl OR siloxane OR	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:18 PM

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		thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate))					
L265	1	L261 AND (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate)	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:19 PM
L266	0	L261 AND (electrochromic WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:20 PM
L267	1	L261 AND (electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:21 PM
L268	1	L261 AND (electrochromic WITH ITO)	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:24 PM
L269	493051	((Zhao WITH Chen) OR (Jian WITH Wang) OR (Yan WITH Zhou)).in.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/06/03 10:32 PM
L270	133	L269 AND (Furcifer ADJ Inc)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/06/03 10:32 PM
L271	133	L270 AND electrochromic$1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/06/03 10:33 PM
L272	3	"20160259152"	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/11 12:08 PM
L273	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16

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							06:43 PM
L274	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L275	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L276	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L277	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L278	88857	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L279	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L280	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L281	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L282	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L283	14	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L284	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L285	7	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L286	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L287	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L288	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L289	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L290	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L291	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM

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L292	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L293	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L294	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L295	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L296	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L297	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L298	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L299	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L300	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L301	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L302	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L303	88857	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L304	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L305	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L306	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L307	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L308	14	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L309	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L310	7	L35 and (electrolyte	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16

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		with polymer with (salt$1 or matrix))					06:43 PM
L311	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L312	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L313	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L314	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L315	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L316	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L317	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L318	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L319	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L320	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L321	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L322	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L323	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L324	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM

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L325	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L326	3	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L327	1	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L328	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L329	6	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L330	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L331	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L332	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L333	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L334	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L335	88857	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L336	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L337	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L338	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L339	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L340	14	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L341	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L342	7	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L343	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L344	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L345	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2023/12/16 06:43 PM

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			JPO; DERWENT; IBM_TDB)				
L346	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L347	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L348	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L349	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L350	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L351	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L352	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L353	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L354	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L355	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L356	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L357	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L358	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L359	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L360	88857	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM

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L361	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L362	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L363	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L364	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L365	14	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L366	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L367	7	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L368	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L369	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L370	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L371	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L372	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L373	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L374	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L375	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L376	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM

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L377	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L378	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L379	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L380	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L381	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L382	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L383	3	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L384	1	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L385	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L386	6	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L387	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L388	30	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L389	6	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L390	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L391	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L392	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L393	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L394	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L395	88857	((zhao with chen) or (jian with wang) or (yan	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2023/12/16 06:43 PM

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		with zhou)).in.	JPO; DERWENT; IBM_TDB)				
L396	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L397	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L398	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L399	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L400	14	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L401	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L402	7	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L403	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L404	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L405	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L406	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L407	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L408	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L409	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L410	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L411	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM

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		(electrolyte$1) same (edge$1 with (protect$3 or seal$3))					
L412	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L413	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L414	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L415	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L416	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L417	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L418	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L419	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L420	88857	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L421	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L422	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L423	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L424	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L425	14	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L426	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L427	7	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L428	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L429	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L430	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2023/12/16 06:43 PM

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			IBM_TDB)				
L431	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L432	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L433	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L434	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L435	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L436	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L437	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L438	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L439	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L440	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L441	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L442	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L443	3	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L444	1	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L445	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM

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L446	6	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L447	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L448	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L449	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L450	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L451	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L452	88857	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L453	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L454	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L455	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L456	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L457	14	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L458	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L459	7	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L460	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L461	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L462	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L463	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L464	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM

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L465	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L466	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L467	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L468	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L469	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L470	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L471	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L472	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L473	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L474	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L475	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L476	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L477	88857	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L478	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L479	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L480	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L481	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L482	14	L26 or L27 or L28 or	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16

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		L29					06:43 PM
L483	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L484	7	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L485	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L486	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L487	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L488	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L489	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L490	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L491	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L492	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L493	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L494	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L495	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L496	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L497	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16

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							06:43 PM
L498	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L499	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L500	3	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L501	1	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L502	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L503	6	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L504	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L505	30	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L506	6	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L507	7	("20120013969"|"20130010347"|"20150323849"|"20160282645"|"20170298682"|"20170299932"|"5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L508	615	"5818625"	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L509	1	("5818625").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L510	1	L261 AND (seal$1 WITH epoxy)	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L511	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva))	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L512	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate))	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM

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L513	1	L261 AND (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate)	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L514	0	L261 AND (electrochromic WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L515	1	L261 AND (electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L516	1	L261 AND (electrochromic WITH ITO)	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L517	513871	((Zhao WITH Chen) OR (Jian WITH Wang) OR (Yan WITH Zhou)).in.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/12/16 06:43 PM
L518	139	L269 AND (Furcifer ADJ Inc)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/12/16 06:43 PM
L519	139	L270 AND electrochromic$1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/12/16 06:43 PM
L520	4	"20160259152"	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L521	2	"18152033"	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:44 PM
L522	9	("20160357082"|"20150301367"|"20120013969"|"20130010347"|"2015	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 07:11 PM

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		0323849"|"20160282645"|"20170298682"|"20170299932"|"5818625"). PN.					
L523	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L524	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L525	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L526	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L527	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L528	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L529	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L530	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L531	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L532	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L533	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L534	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L535	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L536	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L537	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L538	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L539	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L540	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM

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L541	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L542	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L543	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L544	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L545	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L546	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L547	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L548	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L549	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L550	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L551	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L552	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L553	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L554	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L555	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L556	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L557	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L558	20	L26 or L27 or L28 or	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16

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		L29					06:04 AM
L559	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L560	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L561	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L562	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L563	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L564	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L565	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L566	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L567	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L568	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L569	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L570	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L571	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L572	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L573	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16

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							06:04 AM
L574	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L575	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L576	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L577	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L578	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L579	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L580	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L581	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L582	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L583	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L584	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L585	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L586	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L587	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L588	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L589	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L590	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L591	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L592	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L593	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L594	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/01/16 06:04 AM

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			JPO; DERWENT; IBM_TDB)				
L595	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L596	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L597	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L598	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L599	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L600	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L601	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L602	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L603	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L604	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L605	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L606	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L607	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L608	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L609	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM

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L610	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L611	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L612	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L613	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L614	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L615	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L616	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L617	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L618	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L619	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L620	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L621	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L622	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L623	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L624	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L625	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L626	39	(electrochrom$5) same (electrode$1) same	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/01/16 06:04 AM

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		(charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	JPO; DERWENT; IBM_TDB)				
L627	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L628	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L629	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L630	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L631	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L632	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L633	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L634	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L635	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L636	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L637	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L638	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L639	9	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L640	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L641	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L642	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L643	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16

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							06:04 AM
L644	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L645	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L646	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L647	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L648	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L649	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L650	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L651	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L652	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L653	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L654	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L655	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L656	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L657	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L658	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L659	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L660	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2025/01/16 06:04 AM

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			IBM_TDB)				
L661	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L662	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L663	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L664	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L665	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L666	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L667	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L668	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L669	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L670	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L671	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L672	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L673	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L674	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L675	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L676	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L677	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L678	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L679	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/01/16 06:04 AM

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			JPO; DERWENT; IBM_TDB)				
L680	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L681	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L682	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L683	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L684	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L685	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L686	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L687	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L688	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L689	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L690	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L691	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L692	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L693	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM

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L694	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L695	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L696	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L697	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L698	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L699	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L700	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L701	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L702	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L703	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L704	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L705	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L706	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L707	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L708	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L709	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L710	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L711	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L712	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L713	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM

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L714	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L715	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L716	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L717	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L718	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L719	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L720	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L721	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L722	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L723	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L724	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L725	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L726	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L727	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L728	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L729	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L730	5	L26 and (polyvinyl or polyurethane or	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM

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		ethylene)					
L731	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L732	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L733	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L734	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L735	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L736	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L737	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L738	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L739	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L740	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L741	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L742	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L743	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L744	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L745	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM

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L746	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L747	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L748	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L749	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L750	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L751	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L752	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L753	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L754	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L755	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L756	9	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L757	7	("20120013969"|"20130010347"|"20150323849"|"20160282645"|"20170298682"|"20170299932"|"5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L758	628	"5818625"	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L759	1	("5818625").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L760	1	L261 AND (seal$1 WITH epoxy)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L761	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva))	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L762	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva OR polyvinyl OR siloxane OR	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM

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		thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate))					
L763	1	L261 AND (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L764	0	L261 AND (electrochromic WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L765	1	L261 AND (electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L766	1	L261 AND (electrochromic WITH ITO)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L767	619774	((Zhao WITH Chen) OR (Jian WITH Wang) OR (Yan WITH Zhou)).in.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/01/16 06:04 AM
L768	166	L269 AND (Furcifer ADJ Inc)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/01/16 06:04 AM
L769	166	L270 AND electrochromic$1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/01/16 06:04 AM
L770	7	"20160259152"	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L771	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16

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							06:04 AM
L772	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L773	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L774	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L775	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L776	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L777	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L778	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L779	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L780	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L781	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L782	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L783	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L784	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L785	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L786	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L787	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L788	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L789	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM

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L790	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L791	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L792	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L793	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L794	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L795	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L796	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L797	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L798	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L799	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L800	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L801	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L802	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L803	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L804	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L805	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L806	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L807	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L808	11	L35 and (electrolyte	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16

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		with polymer with (salt$1 or matrix))					06:04 AM
L809	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L810	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L811	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L812	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L813	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L814	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L815	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L816	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L817	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L818	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L819	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L820	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L821	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L822	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM

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L823	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L824	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L825	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L826	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L827	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L828	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L829	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L830	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L831	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L832	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L833	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L834	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L835	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L836	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L837	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L838	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L839	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L840	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L841	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L842	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L843	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/01/16 06:04 AM

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			JPO; DERWENT; IBM_TDB)				
L844	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L845	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L846	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L847	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L848	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L849	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L850	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L851	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L852	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L853	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L854	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L855	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L856	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L857	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L858	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM

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L859	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L860	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L861	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L862	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L863	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L864	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L865	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L866	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L867	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L868	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L869	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L870	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L871	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L872	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L873	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L874	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM

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L875	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L876	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L877	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L878	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L879	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L880	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L881	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L882	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L883	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L884	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L885	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L886	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L887	9	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L888	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L889	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L890	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L891	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L892	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L893	90058	((zhao with chen) or (jian with wang) or (yan	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/01/16 06:04 AM

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		with zhou)).in.	JPO; DERWENT; IBM_TDB)				
L894	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L895	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L896	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L897	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L898	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L899	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L900	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L901	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L902	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L903	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L904	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L905	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L906	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L907	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L908	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L909	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM

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		(electrolyte$1) same (edge$1 with (protect$3 or seal$3))					
L910	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L911	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L912	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L913	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L914	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L915	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L916	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L917	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L918	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L919	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L920	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L921	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L922	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L923	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L924	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L925	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L926	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L927	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L928	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2025/01/16 06:04 AM

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			IBM_TDB)				
L929	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L930	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L931	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L932	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L933	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L934	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L935	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L936	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L937	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L938	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L939	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L940	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L941	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L942	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L943	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM

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L944	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L945	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L946	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L947	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L948	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L949	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L950	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L951	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L952	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L953	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L954	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L955	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L956	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L957	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L958	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L959	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L960	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L961	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L962	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM

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L963	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L964	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L965	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L966	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L967	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L968	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L969	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L970	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L971	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L972	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L973	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L974	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L975	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L976	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L977	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L978	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L979	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L980	20	L26 or L27 or L28 or	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16

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		L29					06:04 AM
L981	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L982	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L983	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L984	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L985	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L986	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L987	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L988	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L989	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L990	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L991	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L992	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L993	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L994	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L995	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16

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							06:04 AM
L996	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L997	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L998	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L999	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L1000	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L1001	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L1002	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1003	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L1004	9	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L1005	7	("20120013969"|"20130010347"|"20150323849"|"20160282645"|"20170298682"|"20170299932"|"5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1006	628	"5818625"	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1007	1	("5818625").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1008	1	L261 AND (seal$1 WITH epoxy)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1009	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva))	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1010	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate))	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM

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L1011	1	L261 AND (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1012	0	L261 AND (electrochromic WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1013	1	L261 AND (electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1014	1	L261 AND (electrochromic WITH ITO)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1015	619774	((Zhao WITH Chen) OR (Jian WITH Wang) OR (Yan WITH Zhou)).in.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/01/16 06:04 AM
L1016	166	L269 AND (Furcifer ADJ Inc)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/01/16 06:04 AM
L1017	166	L270 AND electrochromic$1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/01/16 06:04 AM
L1018	7	"20160259152"	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1019	5	"18152033"	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1020	9	("20160357082"|"20150301367"|"20120013969"|"20130010347"|"2015	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM

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		0323849"|"20160282645"|"20170298682"|"20170299932"|"5818625").PN.					
L1021	1	"18606980"	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:05 AM
L1022	10	("20120013969"|"20130010347"|"20150301367"|"20150323849"|"20160282645"|"20160357082"|"20170298682"|"20170299932"|"5406414"|"5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:06 AM

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N1	3	((electrochrom$5) SAME (electrode$1) SAME (charg$3 OR storage$1 OR batter$3) SAME (electrolyte$1) SAME (edge$1 WITH (protect$3 OR seal$3))).clm.	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 02:00 AM

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Ambilight v. Lannray PGR2026-00053

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /J.D/

PTO/SB/08a (01-22)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99**)		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

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	1	104375350	CN	A	2015-02-25	HEFEI BOYI ENVIRONMENTAL PROT TECHNOLOGY CO LTD		☒
	2	108463912	CN	A	2018-08-28	FURCIFER INC		☒
	3	107438793	CN	A	2017-12-05	GENTEX CORP		☒

PC 6.1.24

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

	4	107709003	CN	A	2018-02-16	RESEARCH FRONTIERS INC		☒

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	1	First Office Action for Chinese Application No. 202310481813.6 mailed on December 31, 2024.	☒

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Examiner Signature	/JACK DINH/	Date Considered	01/16/2025

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

CERTIFICATION STATEMENT

Please see 37 CFR 1.97(e) to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☒ A certification statement is not submitted herewith.

FEE

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

COPIES

☐ An identification of an earlier application pursuant to 37 CFR 1.98 (d) (1) is attached.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Pengju Shang/	Date (YYYY-MM-DD)	2025-01-06
Name/Print	Pengju Shang	Registration Number	80050

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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AMBILIGHT EX. 1002; Page 545
Ambilight v. Lannray PGR2026-00053

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /J.D/

AMBILIGHT EX. 1002; Page 546
Ambilight v. Lannray PGR2026-00053

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/606,980	03/15/2024	Zhao CHEN	50WF-383698-US	9999

139780 7590 01/22/2025

Sheppard Mullin Richter & Hampton LLP
Weiguo Chen
650 Town Center Drive, 10th Floor
Costa Mesa, CA 92626

EXAMINER	
DINH, JACK	

ART UNIT	PAPER NUMBER
2872	

NOTIFICATION DATE	DELIVERY MODE
01/22/2025	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

SheppardMullin_Pair@firsttofile.com
svpatents@sheppardmullin.com
wchen@sheppardmullin.com

AMBILIGHT EX. 1002; Page 547
Ambilight v. Lannray PGR2026-00053

Office Action Summary	**Application No.** 18/606,980	**Applicant(s)** CHEN et al.	
	Examiner JACK DINH	**Art Unit** 2872	**AIA (FITF) Status** Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 1/6/25.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-20 is/are pending in the application.

5a) Of the above claim(s) 13-20 is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-12 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

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DETAILED ACTION

Election/Restrictions

Applicant's election without traverse of group I, claims 1-12, in the reply filed on 1/3/25 is acknowledged.

Claim Rejections - 35 USC § 112

The following is a quotation of 35 U.S.C. 112(b):
(b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-12 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor (or for applications subject to pre-AIA 35 U.S.C. 112, the applicant), regards as the invention.

Claim 1 recites the limitation "the second electrochromic file". There is insufficient antecedent basis for this limitation in the claim. Claims 2-12 are rejected based upon the rejected base claim.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JACK DINH whose telephone number is (571)272-2327. The examiner can normally be reached Monday - Friday 9am-5pm.

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Ambilight v. Lannray PGR2026-00053

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wyatt Stoffa can be reached on 571-270-1782. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/JACK DINH/
Primary Examiner, Art Unit 2872
1/16/25

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/606,980	**02/14/2025 01:37:53 PM Z ET**	**50WF-383698-US**

Title of Invention

ELECTROCHROMIC FILMS WITH EDGE PROTECTION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9999	FILED BY	Chizu Sato
PATENT CENTER #	69191212	FILING DATE	03/15/2024
CUSTOMER #	139780	FIRST NAMED INVENTOR	Zhao CHEN
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	PJ Shang

Documents

TOTAL DOCUMENTS: 2

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
Furcifer12USC3_50WF-383698-US_IDS.pdf	5	Information Disclosure Statement (IDS) Form (SB08)	1273 KB
NPL_EP_Allowance.pdf	31	Non Patent Literature	2832 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
Furcifer12USC3_50WF-383698-US_IDS.pdf	B8FB0EFE8B72E5172299ECB7D72B5263327E258278A8A8F4A4D54128A0024FA13B31188952DE937E97D1900C689A11DADFA4F7EB8CFFBD8BA2EDC5B0EDFCBF96
NPL_EP_Allowance.pdf	EE8E2FE689EC4383D1265F88119EE8843316CE26CF0262A28E4C0FE8CF69DDA16340238BEBB4E2D9DBFC39AA60530A76B

68D20604DF4C61359343093188DD75E

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-25)
Approved for use through 11/30/2027. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

Application Number	18606980
Filing Date	2024-03-15
First Named Inventor	Zhao CHEN
Art Unit	2872
Examiner Name	JACK DINH
Attorney Docket Number	50WF-383698-US

U.S. PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Inventor of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Patent citation information, please click the Add button. Add

U.S. PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Inventor or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Published Application citation information, please click the Add button Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] ¡	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐

If you wish to add additional Foreign Patent Document citation information, please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

	1	Communication under Rule 71(3) EPC for European Application No. 23164353.7 mailed on January 15, 2025.	☐

If you wish to add additional non-patent literature document citation information, please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered and whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

AMBILIGHT EX. 1002; Page 554
Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

TIMING STATEMENT

Please see 37 CFR 1.97(e) to make the appropriate selection(s):

☒ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached timing statement under 37 CFR 1.97(e).

☐ A timing statement under 37 CFR 1.97(e) is not submitted herewith.

TIMING FEE

☐ The fee set forth in 37 CFR 1.17(p) has been submitted herewith.

COPIES

☐ An identification of an earlier application pursuant to 37 CFR 1.98(d)(1) is attached.

SIZE FEE ASSERTION

Please see 37 CFR 1.17(v) and the IDS Auto-Load Instructions for completing this form to make the appropriate selection of an assertion under 37 CFR 1.98. For the information disclosure statement (IDS) submitted herewith, the applicant or patent owner certifies the following with respect to the cumulative number of applicant-provided or patent-owner provided items of information submitted to date including those in the accompanying IDS (select only one):

☒ No IDS size fee is required under 37 CFR 1.17(v) at this time.

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(1).

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(2).

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(3).

SIGNATURE

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 11.18. Please see 37 CFR 1.4(d) for the form of the signature.

Signature	/Pengju Shang/	Date (YYYY-MM-DD)	2025-02-14
Name/Print	Pengju Shang	Registration Number	80050

PC.1.19.25

AMBILIGHT EX. 1002; Page 555
Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

AMBILIGHT EX. 1002; Page 556
Ambilight v. Lannray PGR2026-00053

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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Ambilight v. Lannray PGR2026-00053

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 18/606,980	Filing Date 03/15/2024	☐ To be Mailed

ENTITY: ☐ LARGE ☑ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $40 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $192 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	03/14/2025	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0		x $80 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $240 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/ANGELA S WHITE/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	)	Confirmation No.: 9999
	)	
Zhao CHEN et al.	)	
	)	Examiner: JACK DINH
Application No.: 18/606,980	)	
	)	
	)	Art Unit: 2872
Filed: March 15, 2024	)	
	)	
	)	***VIA Patent Center***
For: ELECTROCHROMIC FILMS WITH EDGE PROTECTION	)	

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

RESPONSE TO OFFICE ACTION

This is in response to the Non-Final Office Action mailed January 22, 2025. The period for response extends through April 22, 2025. Applicant respectfully requests the Examiner to reconsider this Application in light of the following.

Amendments to the Claims, which begin on page 2 of this paper.

Remarks begin on page 6 of this paper.

AMBILIGHT EX. 1002; Page 559
Ambilight v. Lannray PGR2026-00053

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions and listings of claims in the application:

1. (Currently Amended) An electrochromic device comprising:

an electrochromic film comprising a first electrode layer and a second electrode layer facing the first electrode layer of the electrochromic film, wherein:

a first edge of the first electrode layer is cut such that a portion of an inner surface of the second electrode layer is exposed, and

a second edge of the second electrode layer ~~electrochromic file~~ is cut such that a portion of an inner surface of the first electrode layer is exposed, the first edge and the second edge are opposing edges;

a first edge protection material sealing the exposed portion of the inner surface of the second electrode layer; and

a second edge protection material sealing the exposed portion of the inner surface of the first electrode layer.

2. (Original) The electrochromic device of claim 1, wherein:

the first edge protection material is in an L shape, further sealing a side surface of the first electrode layer and a portion of an external surface of the first electrode layer.

3. (Original) The electrochromic device of claim 1, wherein:

the second edge protection material is in an L shape, further sealing a side surface of the second electrode layer and a portion of an external surface of the second electrode layer.

4. (Original) The electrochromic device of claim 1, wherein:

the first edge protection material and the second edge protection material comprise epoxy.

5. (Original) The electrochromic device of claim 1, wherein

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the first edge protection material and the second edge protection material comprise electrically conductive material.

6. (Original) The electrochromic device of claim 1, wherein:

the first edge protection material and the second edge protection material are cured with heat or ultraviolet light, functioning as oxygen and moisture blockers.

7. (Original) The electrochromic device of claim 1, further comprising:

a first substrate;

a second substrate;

an interlayer between the first substrate and the second substrate, wherein:

the first electrode layer, the second electrode layer, the first edge protection material, and the second edge protection material are laminated within the interlayer.

8. (Original) The electrochromic device of claim 1, wherein the first electrode layer and the second electrode layer sandwich a layer of electrochromic material, a layer of electrolyte material, and a layer of charge storage material.

9. (Original) The electrochromic device of claim 8, wherein the first edge of the layer of electrochromic material, the layer of electrolyte material, and the layer of charge storage material are cut in a same way as the first edge of the first electrode layer to expose the portion of the inner surface of the second electrode layer.

10. (Original) The electrochromic device of claim 8, wherein the second edge of the layer of electrochromic material, the layer of electrolyte material, and the layer of charge storage material are cut in a same way as the second edge of the second electrode layer to expose the portion of the inner surface of the first electrode layer.

11. (Original) The electrochromic device of claim 1, wherein the first electrode layer comprises a first electrode layer including tin doped indium oxide (ITO).

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12. (Original) The electrochromic device of claim 1, wherein the second electrode layer comprises a second electrode layer including tin doped indium oxide (ITO).

13. (Withdrawn) An electrochromic device comprising:

an electrochromic film comprising a first electrode layer and a second electrode layer facing the first electrode layer, wherein a first edge and a second edge of the second electrode layer are cut such a first portion and a second portion of an inner surface of the first electrode layer respectively at the first edge and the second edge are exposed; and

a first edge protection material sealing the first portion of the inner surface of the first electrode layer; and

a second edge protection material sealing the second portion of the inner surface of the first electrode layer.

14. (Withdrawn) The electrochromic device of claim 13, wherein:

the first electrode layer and the second electrode layer sandwich a layer of electrochromic material, a layer of electrolyte material, and a layer of charge storage material.

15. (Withdrawn) The electrochromic device of claim 14, wherein:

the first edges of the layer of electrochromic material, the layer of electrolyte material, and the layer of charge storage material are cut in a same way as the first edge of the second electrochromic film, and

the first edge protection material seals the first edges of the layer of electrochromic material, the layer of electrolyte material, and the layer of charge storage material.

16. (Withdrawn) The electrochromic device of claim 14, wherein:

the second edges of the layer of electrochromic material, the layer of electrolyte material, and the layer of charge storage material are cut in a same way as the second edge of the electrochromic film, and

the second edge protection material seals the second edges of the layer of electrochromic material, the layer of electrolyte material, and the layer of charge storage material.

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17. (Withdrawn) The electrochromic device of claim 13, wherein:

the first edge protection material comprises epoxy.

18. (Withdrawn) The electrochromic device of claim 13, wherein:

the first edge protection material comprises electrically conductive material.

19. (Withdrawn) The electrochromic device of claim 13, wherein the first electrode layer comprises a first electrode layer including tin doped indium oxide (ITO).

20. (Withdrawn) The electrochromic device of claim 13, wherein the second electrode layer comprises a second electrode layer including tin doped indium oxide (ITO).

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REMARKS:

In the Non-Final Office Action[1], the Examiner:

I. rejects claims 1-12 under 35 U.S.C. § 112(b) as allegedly being indefinite, *Office Action* at 2.

To expedite allowance of this Application, Applicant has made clarifying amendments to claim 1. No new matter has been added by the amendments to the claims. Applicant respectfully requests reconsideration of this application, and the timely allowance of the pending claims for at least the following reasons.

I. The Rejection of Claims 1-12 under 35 U.S.C. § 112(b)

The Examiner rejects claims 1-12 under 35 U.S.C. § 112(b) as failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor regards as the invention. Although Applicant does not necessarily agree with the Examiner, to expedite allowance of this Application, Applicant has made clarifying amendments to claim 1. Applicant respectfully requests withdrawal of this rejection.

[1] The Office Action may contain statements reflecting characterizations of the related art and the claims. Regardless of whether any such statement is identified herein, Applicant declines to subscribe to any statement or characterization in the Office Action unless explicitly stated otherwise.

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CONCLUSION

In view of the foregoing amendments and remarks, Applicant respectfully requests reconsideration of this application and the timely allowance of the pending claims.

If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided. Please grant any extensions of time required to enter this response and charge any additional required fees to Deposit Account No. 50-4561.

Respectfully submitted,

SHEPPARD MULLIN RICHTER & HAMPTON LLP

Dated: March 14, 2025

By: /Pengju Shang/
Pengju Shang
Reg. No. 80050
650-352-1971

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UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/606,980	**03/14/2025 06:01:09 PM Z ET**	**50WF-383698-US**

Title of Invention

ELECTROCHROMIC FILMS WITH EDGE PROTECTION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9999	FILED BY	Chizu Sato
PATENT CENTER #	69592568	FILING DATE	03/15/2024
CUSTOMER #	139780	FIRST NAMED INVENTOR	Zhao CHEN
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	PJ Shang

Documents

TOTAL DOCUMENTS: 3

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
Furcifer12USC3_50WF-383698-US_ResponseNFOA.pdf		7	-	40 KB
Furcifer12USC3_50WF-383698-US_ResponseNFOA-A....pdf	(1-1)	1	Amendment/Request for Reconsideration-After Non-Final Rejection	18 KB
Furcifer12USC3_50WF-383698-US_ResponseNFOA-CLM.pdf	(2-5)	4	Claims	24 KB
Furcifer12USC3_50WF-383698-US_ResponseNFOA-	(6-7)	2	Applicant Arguments/Remarks Made in an Amendment	23 KB

REM.pdf

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
Furcifer12USC3_50WF-383698-US_ResponseNFOA.pdf	1EFA3D5F10EA10165199439431B575DB961A56EFA64B7A2E820A638883AEACAD3D279BF5D16DD3DB931E73F59DC03249311DFDF24E72E9EF03C8AA1A50C2F061
Furcifer12USC3_50WF-383698-US_ResponseNFOA-A....pdf	8F2C3BF2D5391CF20C86D6EBF273E270D95ADB67752ADC9C562C5103954E956C43F94735CD3FDCBEFDEE8EFE3B91DDA00337CDA8277BAD8B8171AD05B2630A55
Furcifer12USC3_50WF-383698-US_ResponseNFOA-CLM.pdf	6DF899F78A9CCDFD9D16AB860C1E1AB672024C1C29BDA7F894AD199AFB04D0EB7F4BA3AAED59D6C717D49DB04FFB630B90088EA6AEB618991B7A34CE11D44BF9
Furcifer12USC3_50WF-383698-US_ResponseNFOA-REM.pdf	BB939CEA848F3A866A406647FBB94E81F8C131CD25EC12ADAFFE9D146451671A9088B06A6215BED50E3533B220ADCE45D419AEE2B9FAD7715D98A95B382B1944

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/606,980	CHEN et al.
	Examiner	Art Unit
	JACK DINH	2872

CPC - Searched*		
Symbol	**Date**	**Examiner**
G02F 1/1533, 1/1508, 1/153, 1/161, 2201/50, 2201/1536	01/16/2025	JD
ABOVE UPDATED	05/18/2025	JD

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	**Date**	**Examiner**
Restrict claims.	12/17/2024	JD
Review parent applications. Search PE2E.	01/16/2025	JD
Update PE2E search.	05/18/2025	JD

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**

/JACK DINH/ Primary Examiner, Art Unit 2872	/JACK DINH/ Primary Examiner, Art Unit 2872

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Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/606,980	CHEN et al.
	Examiner	**Art Unit**
	JACK DINH	2872

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	12/17/2024	01/16/2025	05/18/2025						
	1	÷	✓	✓						
	2	÷	✓	✓						
	3	÷	✓	✓						
	4	÷	✓	✓						
	5	÷	✓	✓						
	6	÷	✓	✓						
	7	÷	✓	✓						
	8	÷	✓	✓						
	9	÷	✓	✓						
	10	÷	✓	✓						
	11	÷	✓	✓						
	12	÷	✓	✓						
	13	÷	N	N						
	14	÷	N	N						
	15	÷	N	N						
	16	÷	N	N						
	17	÷	N	N						
	18	÷	N	N						
	19	÷	N	N						
	20	÷	N	N						

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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-25)
Approved for use through 11/30/2027. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

Application Number	18606980
Filing Date	2024-03-15
First Named Inventor	Zhao CHEN
Art Unit	2872
Examiner Name	JACK DINH
Attorney Docket Number	50WF-383698-US

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

	1	Communication under Rule 71(3) EPC for European Application No. 23164353.7 mailed on January 15, 2025.	☐

If you wish to add additional non-patent literature document citation information, please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/JACK DINH/	Date Considered	05/18/2025

*EXAMINER: Initial if reference considered and whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

PC.1.19.25

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

Application Number	18606980
Filing Date	2024-03-15
First Named Inventor	Zhao CHEN
Art Unit	2872
Examiner Name	JACK DINH
Attorney Docket Number	50WF-383698-US

TIMING STATEMENT

Please see 37 CFR 1.97(e) to make the appropriate selection(s):

☒ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached timing statement under 37 CFR 1.97(e).

☐ A timing statement under 37 CFR 1.97(e) is not submitted herewith.

TIMING FEE

☐ The fee set forth in 37 CFR 1.17(p) has been submitted herewith.

COPIES

☐ An identification of an earlier application pursuant to 37 CFR 1.98(d)(1) is attached.

SIZE FEE ASSERTION

Please see 37 CFR 1.17(v) and the IDS Auto-Load Instructions for completing this form to make the appropriate selection of an assertion under 37 CFR 1.98. For the information disclosure statement (IDS) submitted herewith, the applicant or patent owner certifies the following with respect to the cumulative number of applicant-provided or patent-owner provided items of information submitted to date including those in the accompanying IDS (select only one):

☒ No IDS size fee is required under 37 CFR 1.17(v) at this time.

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(1).

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(2).

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(3).

SIGNATURE

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 11.18. Please see 37 CFR 1.4(d) for the form of the signature.

Signature	/Pengju Shang/	Date (YYYY-MM-DD)	2025-02-14
Name/Print	Pengju Shang	Registration Number	80050

PC.1.19.25

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L25	1	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L26	2	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L27	2	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L28	2	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L29	2	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L30	66827	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2021/11/20 10:08 AM
L31	2	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L32	2	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L33	2	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L34	0	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L35	8	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L36	4	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L37	4	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L38	4	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
L39	1307	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2021/11/20 10:08 AM
L40	167	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2021/11/20 10:08 AM
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L42	2089	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2021/11/20 10:08 AM

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			IBM_TDB)				
L43	1336	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2021/11/20 10:08 AM
L44	419	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2021/11/20 10:08 AM
L45	14551	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2021/11/20 10:08 AM
L46	26	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2021/11/20 10:08 AM
L47	17	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2021/11/20 10:08 AM
L48	2	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:26 AM
L49	1	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:36 AM
L50	1	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L51	2	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L52	2	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L53	2	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L54	2	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L55	67365	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L56	2	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L57	2	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L58	2	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L59	0	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM

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L60	8	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L61	4	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L62	4	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L63	4	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L64	4847	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L65	874	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L66	13683	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L67	3126	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L68	9593	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L69	1608	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L70	26515	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L71	27	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L72	25	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L73	2	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L74	1	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM

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L75	2	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 12:54 PM
L76	2	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 12:55 PM
L77	2	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 12:55 PM
L78	2	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 01:10 PM
L79	0	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 01:10 PM
L80	2	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 01:11 PM
L81	2	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 01:20 PM
L82	1	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L83	2	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L84	2	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L85	2	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L86	2	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L87	78767	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L88	2	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L89	2	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L90	2	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L91	0	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L92	8	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L93	4	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L94	4	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L95	4	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L96	5163	G02F1/1533	(US-PGPUB; USPAT;	OR	OFF	OFF	2022/09/30

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			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)				01:52 AM
L97	935	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L98	14617	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L99	3382	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L100	10095	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L101	1762	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L102	28164	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L103	30	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L104	27	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L105	2	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L106	1	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L107	1	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L108	2	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L109	2	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L110	2	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L111	2	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM

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L112	78767	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L113	2	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L114	2	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L115	2	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L116	0	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L117	8	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L118	4	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L119	4	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L120	4	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L121	5163	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L122	935	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L123	14617	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L124	3382	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L125	10095	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L126	1762	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L127	28164	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L128	30	(electrochrom$5) same (electrode$1) same	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2022/09/30 01:52 AM

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		(charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	JPO; DERWENT; IBM_TDB)				
L129	27	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L130	2	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L131	1	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L132	2	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L133	2	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L134	2	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L135	2	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L136	0	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L137	2	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L138	2	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L139	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2022/09/30 01:52 AM
L140	27	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:59 AM
L141	3	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 02:01 AM
L142	3	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L143	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L144	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L145	3	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03

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							09:05 PM
L146	3	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L147	88313	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L148	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L149	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L150	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L151	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L152	11	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L153	5	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L154	5	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L155	5	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L156	5509	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L157	1007	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L158	15577	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L159	3623	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L160	10596	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L161	1867	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L162	29769	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2023/06/03 09:05 PM

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			IBM_TDB)				
L163	33	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L164	29	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L165	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L166	3	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L167	3	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L168	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L169	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L170	3	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L171	3	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L172	88313	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L173	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L174	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L175	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L176	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L177	11	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L178	5	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L179	5	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L180	5	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L181	5509	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2023/06/03 09:05 PM

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			JPO; DERWENT; IBM_TDB)				
L182	1007	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L183	15577	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L184	3623	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L185	10596	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L186	1867	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L187	29769	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L188	33	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L189	29	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L190	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L191	3	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L192	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L193	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L194	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L195	3	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM

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L196	1	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L197	3	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L198	3	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L199	3	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L200	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L201	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L202	3	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L203	3	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L204	88313	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L205	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L206	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L207	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L208	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L209	11	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L210	5	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L211	5	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L212	5	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L213	5509	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L214	1007	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L215	15577	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM

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L216	3623	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L217	10596	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L218	1867	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L219	29769	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L220	33	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L221	29	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L222	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L223	3	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L224	3	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L225	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L226	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L227	3	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L228	3	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L229	88313	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L230	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L231	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L232	3	L26 and (polyvinyl or polyurethane or	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM

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		ethylene)					
L233	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L234	11	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L235	5	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L236	5	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L237	5	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L238	5509	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L239	1007	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L240	15577	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L241	3623	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L242	10596	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L243	1867	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L244	29769	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L245	33	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L246	29	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L247	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM

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L248	3	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L249	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L250	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L251	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L252	3	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L253	1	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L254	3	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L255	3	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L256	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 09:05 PM
L257	29	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L258	5	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L259	7	("20120013969"|"20130010347"|"20150323849"|"20160282645"|"20170298682"|"20170299932"|"5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 09:07 PM
L260	608	"5818625"	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:10 PM
L261	1	("5818625").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:10 PM
L262	1	L261 AND (seal$1 WITH epoxy)	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:11 PM
L263	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva))	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:17 PM
L264	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva OR polyvinyl OR siloxane OR	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:18 PM

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		thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate))					
L265	1	L261 AND (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate)	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:19 PM
L266	0	L261 AND (electrochromic WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:20 PM
L267	1	L261 AND (electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:21 PM
L268	1	L261 AND (electrochromic WITH ITO)	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:24 PM
L269	493051	((Zhao WITH Chen) OR (Jian WITH Wang) OR (Yan WITH Zhou)).in.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/06/03 10:32 PM
L270	133	L269 AND (Furcifer ADJ Inc)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/06/03 10:32 PM
L271	133	L270 AND electrochromic$1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/06/03 10:33 PM
L272	3	"20160259152"	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/11 12:08 PM
L273	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16

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							06:43 PM
L274	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L275	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L276	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L277	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L278	88857	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L279	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L280	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L281	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L282	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L283	14	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L284	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L285	7	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L286	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L287	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L288	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L289	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L290	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L291	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM

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L292	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L293	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L294	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L295	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L296	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L297	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L298	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L299	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L300	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L301	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L302	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L303	88857	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L304	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L305	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L306	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L307	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L308	14	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L309	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L310	7	L35 and (electrolyte	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16

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		with polymer with (salt$1 or matrix))					06:43 PM
L311	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L312	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L313	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L314	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L315	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L316	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L317	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L318	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L319	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L320	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L321	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L322	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L323	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L324	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM

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L325	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L326	3	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L327	1	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L328	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L329	6	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L330	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L331	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L332	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L333	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L334	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L335	88857	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L336	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L337	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L338	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L339	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L340	14	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L341	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L342	7	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L343	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L344	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L345	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2023/12/16 06:43 PM

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			JPO; DERWENT; IBM_TDB)				
L346	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L347	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L348	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L349	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L350	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L351	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L352	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L353	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L354	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L355	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L356	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L357	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L358	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L359	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L360	88857	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM

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L361	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L362	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L363	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L364	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L365	14	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L366	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L367	7	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L368	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L369	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L370	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L371	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L372	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L373	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L374	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L375	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L376	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM

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L377	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L378	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L379	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L380	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L381	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L382	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L383	3	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L384	1	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L385	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L386	6	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L387	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L388	30	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L389	6	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L390	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L391	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L392	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L393	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L394	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L395	88857	((zhao with chen) or (jian with wang) or (yan	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2023/12/16 06:43 PM

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		with zhou)).in.	JPO; DERWENT; IBM_TDB)				
L396	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L397	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L398	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L399	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L400	14	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L401	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L402	7	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L403	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L404	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L405	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L406	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L407	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L408	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L409	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L410	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L411	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM

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		(electrolyte$1) same (edge$1 with (protect$3 or seal$3))					
L412	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L413	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L414	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L415	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L416	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L417	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L418	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L419	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L420	88857	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L421	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L422	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L423	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L424	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L425	14	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L426	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L427	7	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L428	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L429	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L430	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2023/12/16 06:43 PM

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			IBM_TDB)				
L431	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L432	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L433	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L434	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L435	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L436	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L437	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L438	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L439	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L440	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L441	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L442	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L443	3	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L444	1	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L445	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM

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L446	6	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L447	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L448	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L449	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L450	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L451	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L452	88857	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L453	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L454	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L455	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L456	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L457	14	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L458	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L459	7	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L460	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L461	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L462	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L463	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L464	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM

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L465	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L466	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L467	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L468	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L469	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L470	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L471	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L472	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L473	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L474	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L475	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L476	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L477	88857	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L478	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L479	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L480	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L481	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L482	14	L26 or L27 or L28 or	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16

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		L29					06:43 PM
L483	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L484	7	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L485	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L486	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L487	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L488	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L489	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L490	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L491	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L492	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L493	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L494	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L495	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L496	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L497	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16

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							06:43 PM
L498	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L499	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L500	3	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L501	1	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L502	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L503	6	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L504	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L505	30	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L506	6	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L507	7	("20120013969"|"20130010347"|"20150323849"|"20160282645"|"20170298682"|"20170299932"|"5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L508	615	"5818625"	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L509	1	("5818625").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L510	1	L261 AND (seal$1 WITH epoxy)	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L511	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva))	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L512	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate))	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM

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L513	1	L261 AND (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate)	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L514	0	L261 AND (electrochromic WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L515	1	L261 AND (electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L516	1	L261 AND (electrochromic WITH ITO)	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L517	513871	((Zhao WITH Chen) OR (Jian WITH Wang) OR (Yan WITH Zhou)).in.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/12/16 06:43 PM
L518	139	L269 AND (Furcifer ADJ Inc)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/12/16 06:43 PM
L519	139	L270 AND electrochromic$1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/12/16 06:43 PM
L520	4	"20160259152"	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L521	2	"18152033"	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:44 PM
L522	9	("20160357082"|"20150301367"|"20120013969"|"20130010347"|"2015	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 07:11 PM

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		0323849"|"20160282645"|"20170298682"|"20170299932"|"5818625"). PN.					
L523	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L524	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L525	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L526	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L527	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L528	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L529	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L530	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L531	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L532	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L533	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L534	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L535	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L536	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L537	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L538	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L539	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L540	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM

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L541	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L542	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L543	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L544	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L545	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L546	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L547	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L548	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L549	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L550	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L551	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L552	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L553	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L554	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L555	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L556	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L557	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L558	20	L26 or L27 or L28 or	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16

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		L29					06:04 AM
L559	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L560	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L561	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L562	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L563	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L564	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L565	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L566	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L567	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L568	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L569	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L570	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L571	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L572	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L573	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16

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							06:04 AM
L574	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L575	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L576	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L577	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L578	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L579	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L580	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L581	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L582	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L583	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L584	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L585	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L586	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L587	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L588	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L589	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L590	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L591	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L592	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L593	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L594	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/01/16 06:04 AM

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			JPO; DERWENT; IBM_TDB)				
L595	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L596	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L597	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L598	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L599	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L600	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L601	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L602	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L603	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L604	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L605	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L606	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L607	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L608	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L609	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM

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L610	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L611	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L612	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L613	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L614	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L615	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L616	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L617	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L618	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L619	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L620	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L621	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L622	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L623	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L624	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L625	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L626	39	(electrochrom$5) same (electrode$1) same	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/01/16 06:04 AM

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		(charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	JPO; DERWENT; IBM_TDB)				
L627	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L628	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L629	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L630	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L631	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L632	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L633	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L634	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L635	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L636	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L637	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L638	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L639	9	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L640	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L641	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L642	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L643	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16

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							06:04 AM
L644	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L645	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L646	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L647	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L648	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L649	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L650	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L651	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L652	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L653	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L654	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L655	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L656	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L657	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L658	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L659	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L660	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2025/01/16 06:04 AM

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			IBM_TDB)				
L661	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L662	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L663	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L664	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L665	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L666	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L667	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L668	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L669	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L670	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L671	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L672	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L673	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L674	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L675	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L676	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L677	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L678	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L679	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/01/16 06:04 AM

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			JPO; DERWENT; IBM_TDB)				
L680	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L681	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L682	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L683	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L684	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L685	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L686	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L687	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L688	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L689	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L690	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L691	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L692	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L693	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM

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L694	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L695	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L696	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L697	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L698	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L699	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L700	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L701	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L702	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L703	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L704	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L705	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L706	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L707	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L708	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L709	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L710	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L711	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L712	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L713	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM

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L714	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L715	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L716	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L717	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L718	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L719	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L720	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L721	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L722	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L723	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L724	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L725	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L726	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L727	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L728	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L729	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L730	5	L26 and (polyvinyl or polyurethane or	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM

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		ethylene)					
L731	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L732	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L733	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L734	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L735	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L736	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L737	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L738	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L739	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L740	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L741	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L742	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L743	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L744	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L745	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM

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L746	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L747	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L748	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L749	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L750	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L751	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L752	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L753	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L754	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L755	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L756	9	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L757	7	("20120013969"|"20130010347"|"20150323849"|"20160282645"|"20170298682"|"20170299932"|"5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L758	628	"5818625"	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L759	1	("5818625").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L760	1	L261 AND (seal$1 WITH epoxy)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L761	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva))	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L762	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva OR polyvinyl OR siloxane OR	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM

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		thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate))					
L763	1	L261 AND (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L764	0	L261 AND (electrochromic WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L765	1	L261 AND (electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L766	1	L261 AND (electrochromic WITH ITO)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L767	619774	((Zhao WITH Chen) OR (Jian WITH Wang) OR (Yan WITH Zhou)).in.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/01/16 06:04 AM
L768	166	L269 AND (Furcifer ADJ Inc)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/01/16 06:04 AM
L769	166	L270 AND electrochromic$1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/01/16 06:04 AM
L770	7	"20160259152"	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L771	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16

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							06:04 AM
L772	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L773	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L774	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L775	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L776	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L777	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L778	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L779	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L780	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L781	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L782	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L783	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L784	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L785	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L786	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L787	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L788	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L789	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM

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L790	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L791	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L792	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L793	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L794	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L795	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L796	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L797	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L798	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L799	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L800	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L801	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L802	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L803	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L804	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L805	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L806	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L807	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L808	11	L35 and (electrolyte	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16

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		with polymer with (salt$1 or matrix))					06:04 AM
L809	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L810	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L811	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L812	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L813	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L814	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L815	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L816	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L817	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L818	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L819	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L820	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L821	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L822	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM

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L823	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L824	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L825	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L826	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L827	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L828	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L829	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L830	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L831	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L832	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L833	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L834	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L835	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L836	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L837	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L838	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L839	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L840	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L841	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L842	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L843	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/01/16 06:04 AM

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			JPO; DERWENT; IBM_TDB)				
L844	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L845	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L846	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L847	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L848	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L849	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L850	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L851	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L852	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L853	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L854	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L855	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L856	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L857	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L858	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM

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L859	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L860	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L861	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L862	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L863	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L864	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L865	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L866	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L867	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L868	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L869	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L870	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L871	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L872	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L873	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L874	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM

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L875	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L876	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L877	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L878	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L879	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L880	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L881	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L882	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L883	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L884	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L885	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L886	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L887	9	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L888	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L889	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L890	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L891	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L892	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L893	90058	((zhao with chen) or (jian with wang) or (yan	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/01/16 06:04 AM

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		with zhou)).in.	JPO; DERWENT; IBM_TDB)				
L894	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L895	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L896	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L897	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L898	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L899	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L900	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L901	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L902	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L903	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L904	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L905	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L906	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L907	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L908	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L909	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM

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		(electrolyte$1) same (edge$1 with (protect$3 or seal$3))					
L910	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L911	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L912	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L913	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L914	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L915	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L916	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L917	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L918	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L919	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L920	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L921	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L922	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L923	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L924	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L925	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L926	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L927	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L928	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2025/01/16 06:04 AM

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			IBM_TDB)				
L929	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L930	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L931	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L932	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L933	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L934	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L935	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L936	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L937	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L938	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L939	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L940	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L941	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L942	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L943	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM

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L944	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L945	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L946	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L947	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L948	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L949	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L950	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L951	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L952	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L953	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L954	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L955	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L956	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L957	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L958	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L959	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L960	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L961	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L962	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM

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L963	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L964	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L965	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L966	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L967	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L968	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L969	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L970	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L971	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L972	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L973	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L974	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L975	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L976	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L977	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L978	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L979	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L980	20	L26 or L27 or L28 or	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16

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		L29					06:04 AM
L981	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L982	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L983	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L984	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L985	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L986	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L987	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L988	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L989	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L990	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L991	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L992	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L993	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L994	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L995	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16

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							06:04 AM
L996	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L997	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L998	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L999	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L1000	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L1001	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L1002	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1003	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L1004	9	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L1005	7	("20120013969"|"20130010347"|"20150323849"|"20160282645"|"20170298682"|"20170299932"|"5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1006	628	"5818625"	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1007	1	("5818625").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1008	1	L261 AND (seal$1 WITH epoxy)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1009	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva))	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1010	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate))	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM

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L1011	1	L261 AND (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1012	0	L261 AND (electrochromic WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1013	1	L261 AND (electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1014	1	L261 AND (electrochromic WITH ITO)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1015	619774	((Zhao WITH Chen) OR (Jian WITH Wang) OR (Yan WITH Zhou)).in.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/01/16 06:04 AM
L1016	166	L269 AND (Furcifer ADJ Inc)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/01/16 06:04 AM
L1017	166	L270 AND electrochromic$1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/01/16 06:04 AM
L1018	7	"20160259152"	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1019	5	"18152033"	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1020	9	("20160357082"|"20150301367"|"20120013969"|"20130010347"|"2015	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM

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		0323849"|"2016028264 5"|"20170298682"|"201 70299932"|"5818625"). PN.					
L1021	1	"18606980"	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:05 AM
L1022	10	("20120013969"|"20130 010347"|"20150301367 "|"20150323849"|"2016 0282645"|"2016035708 2"|"20170298682"|"201 70299932"|"5406414"|" 5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:06 AM
L1023	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1024	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1025	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1026	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1027	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1028	90367	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1029	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1030	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1031	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1032	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1033	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1034	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1035	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1036	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1037	5905	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1038	1058	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2025/05/18 09:54 PM

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			IBM_TDB)				
L1039	16749	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1040	3944	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1041	11260	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1042	1975	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1043	31781	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1044	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1045	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1046	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1047	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1048	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1049	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1050	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1051	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1052	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1053	90367	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1054	3	L26 and ("80" with	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18

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		conduct$3)					09:54 PM
L1055	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1056	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1057	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1058	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1059	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1060	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1061	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1062	5905	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1063	1058	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1064	16749	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1065	3944	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1066	11260	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1067	1975	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1068	31781	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1069	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM

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L1070	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1071	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1072	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1073	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1074	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1075	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1076	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1077	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1078	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1079	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1080	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1081	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1082	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1083	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1084	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1085	90367	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1086	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1087	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1088	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1089	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1090	20	L26 or L27 or L28 or	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18

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		L29					09:54 PM
L1091	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1092	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1093	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1094	5905	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1095	1058	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1096	16749	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1097	3944	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1098	11260	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1099	1975	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1100	31781	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1101	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1102	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1103	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1104	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1105	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18

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							09:54 PM
L1106	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1107	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1108	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1109	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1110	90367	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1111	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1112	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1113	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1114	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1115	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1116	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1117	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1118	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1119	5905	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1120	1058	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1121	16749	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1122	3944	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1123	11260	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM

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L1124	1975	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1125	31781	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1126	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1127	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1128	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1129	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1130	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1131	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1132	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1133	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1134	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1135	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1136	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1137	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/05/18 09:54 PM
L1138	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1139	9	L87 AND (electrochromic WITH	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/05/18 09:54 PM

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		film WITH edge WITH protect$3)	JPO; DERWENT; IBM_TDB)				
L1140	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1141	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1142	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1143	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1144	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1145	90367	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1146	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1147	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1148	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1149	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1150	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1151	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1152	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1153	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1154	5905	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1155	1058	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1156	16749	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1157	3944	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1158	11260	G02F2201/50	(US-PGPUB; USPAT;	OR	OFF	OFF	2025/05/18

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			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)				09:54 PM
L1159	1975	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1160	31781	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1161	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1162	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1163	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1164	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1165	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1166	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1167	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1168	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1169	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1170	90367	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1171	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1172	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1173	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1174	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1175	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM

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L1176	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1177	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1178	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1179	5905	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1180	1058	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1181	16749	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1182	3944	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1183	11260	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1184	1975	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1185	31781	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1186	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1187	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1188	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1189	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1190	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM

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L1191	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1192	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1193	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1194	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1195	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1196	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1197	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1198	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1199	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1200	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1201	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1202	90367	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1203	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1204	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1205	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1206	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1207	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1208	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1209	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1210	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1211	5905	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2025/05/18 09:54 PM

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			IBM_TDB)				
L1212	1058	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1213	16749	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1214	3944	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1215	11260	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1216	1975	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1217	31781	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1218	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1219	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1220	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1221	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1222	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1223	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1224	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1225	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1226	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1227	90367	((zhao with chen) or	(US-PGPUB; USPAT;	OR	OFF	OFF	2025/05/18

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		(jian with wang) or (yan with zhou)).in.	USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)				09:54 PM
L1228	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1229	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1230	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1231	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1232	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1233	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1234	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1235	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1236	5905	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1237	1058	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1238	16749	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1239	3944	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1240	11260	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1241	1975	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1242	31781	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1243	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2025/05/18 09:54 PM

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		or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	IBM_TDB)				
L1244	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1245	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1246	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1247	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1248	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1249	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1250	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1251	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1252	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1253	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1254	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/05/18 09:54 PM
L1255	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1256	9	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1257	7	("20120013969"|"20130010347"|"20150323849"|"20160282645"|"20170298682"|"20170299932"|"5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/05/18 09:54 PM
L1258	634	"5818625"	(US-PGPUB; USPAT)	OR	ON	ON	2025/05/18 09:54 PM
L1259	1	("5818625").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2025/05/18

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							09:54 PM
L1260	1	L261 AND (seal$1 WITH epoxy)	(US-PGPUB; USPAT)	OR	ON	ON	2025/05/18 09:54 PM
L1261	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva))	(US-PGPUB; USPAT)	OR	ON	ON	2025/05/18 09:54 PM
L1262	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate))	(US-PGPUB; USPAT)	OR	ON	ON	2025/05/18 09:54 PM

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N1	3	((electrochrom$5) SAME (electrode$1) SAME (charg$3 OR storage$1 OR batter$3) SAME (electrolyte$1) SAME (edge$1 WITH (protect$3 OR seal$3))).clm.	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 02:00 AM

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/606,980	03/15/2024	Zhao CHEN	50WF-383698-US	9999

139780 7590 05/21/2025

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EXAMINER
DINH, JACK

ART UNIT	PAPER NUMBER
2872	

NOTIFICATION DATE	DELIVERY MODE
05/21/2025	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

SheppardMullin_Pair@firsttofile.com
svpatents@sheppardmullin.com
wchen@sheppardmullin.com

AMBILIGHT EX. 1002; Page 650
Ambilight v. Lannray PGR2026-00053

Office Action Summary	**Application No.** 18/606,980	**Applicant(s)** CHEN et al.	
	Examiner JACK DINH	**Art Unit** 2872	**AIA (FITF) Status** Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 3/14/25.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☑ This action is **FINAL.** 2b) ☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-20 is/are pending in the application.

5a) Of the above claim(s) 13-20 is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-12 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

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Ambilight v. Lannray PGR2026-00053

DETAILED ACTION

Claim Rejections - 35 USC § 112

The following is a quotation of 35 U.S.C. 112(b):
(b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-12 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor (or for applications subject to pre-AIA 35 U.S.C. 112, the applicant), regards as the invention.

Regarding claim 1, the phrase “a first edge of the first electrode layer” renders the claim indefinite. The claim recites “a first edge of the first electrode layer” without reciting “a second edge of the first electrode layer”. The phrase “a second edge of the second electrode layer” renders the claim indefinite. The claim recites “a second edge of the second electrode layer” without reciting “a first edge of the second electrode layer”. The phrase “the first edge and the second edge are opposing edges” renders the claim indefinite. It is unclear whether “the first edge and the second edge” reference to those of the first electrode layer and/or the second electrode layer. Therefore, it is unclear of the configuration being claimed.

Regarding claim 9, the phrase “the first edge of the layer of electrochromic material” renders the claim indefinite. There is insufficient antecedent basis for this limitation in the claim.

Regarding claim 10, the phrase “the second edge of the layer of electrochromic material” renders the claim indefinite. There is insufficient antecedent basis for this limitation in the claim.

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Ambilight v. Lannray PGR2026-00053

Claims 2-12 are rejected based upon the rejected base claim.

Response to Arguments

Applicant's arguments with respect to the claims have been considered but are moot because the new ground of rejection does not rely on any reference applied in the prior rejection of record for any teaching or matter specifically challenged in the argument.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any nonprovisional extension fee (37 CFR 1.17(a)) pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

AMBILIGHT EX. 1002; Page 653
Ambilight v. Lannray PGR2026-00053

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JACK DINH whose telephone number is (571)272-2327. The examiner can normally be reached Monday - Friday 9am-5pm.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bumsuk Won can be reached at 571-272-2713. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/JACK DINH/
Primary Examiner, Art Unit 2872
5/18/25

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/606,980	03/15/2024	Zhao CHEN	50WF-383698-US	9999

139780 7590 05/27/2025

Sheppard Mullin Richter & Hampton LLP
Weiguo Chen
650 Town Center Drive, 10th Floor
Costa Mesa, CA 92626

EXAMINER
DINH, JACK

ART UNIT	PAPER NUMBER
2872	

NOTIFICATION DATE	DELIVERY MODE
05/27/2025	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

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SheppardMullin_Pair@firsttofile.com
svpatents@sheppardmullin.com
wchen@sheppardmullin.com

AMBILIGHT EX. 1002; Page 655
Ambilight v. Lannray PGR2026-00053

Applicant-Initiated Interview Summary	**Application No.** 18/606,980	**Applicant(s)** CHEN et al.		
	Examiner JACK DINH	**Art Unit** 2872	**AIA (First Inventor to File) Status** Yes	**Page** 1 of 1

All Participants (applicant, applicants representative, PTO personnel)	**Title**	**Type**
JACK DINH	Primary Examiner	Telephonic
PENGJU SHANG	Attorney	

Date of Interview: 22 May 2025

Issues Discussed:

Proposed Amendment(s)

Discussed proposed amendments. No agreement has been reach.

/JACK DINH/ Primary Examiner, Art Unit 2872	

Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04
Please further see:
MPEP 713.04
Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b)
37 CFR § 1.2 Business to be transacted in writing

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

AMBILIGHT EX. 1002; Page 656
Ambilight v. Lannray PGR2026-00053

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-25)
Approved for use through 11/30/2027. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

Application Number	18606980
Filing Date	2024-03-15
First Named Inventor	Zhao CHEN
Art Unit	2872
Examiner Name	JACK DINH
Attorney Docket Number	50WF-383698-US

U.S. PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Inventor of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
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	1							☐

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NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

AMBILIGHT EX. 1002; Page 657
Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

	1	Communication under Rule 71(3) EPC for European Application No. 23 164 353.7 mailed on May 20, 2025.	☐

If you wish to add additional non-patent literature document citation information, please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered and whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

AMBILIGHT EX. 1002; Page 658
Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

TIMING STATEMENT

Please see 37 CFR 1.97(e) to make the appropriate selection(s):

☒ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached timing statement under 37 CFR 1.97(e).

☐ A timing statement under 37 CFR 1.97(e) is not submitted herewith.

TIMING FEE

☒ The fee set forth in 37 CFR 1.17(p) has been submitted herewith.

COPIES

☐ An identification of an earlier application pursuant to 37 CFR 1.98(d)(1) is attached.

SIZE FEE ASSERTION

Please see 37 CFR 1.17(v) and the IDS Auto-Load Instructions for completing this form to make the appropriate selection of an assertion under 37 CFR 1.98. For the information disclosure statement (IDS) submitted herewith, the applicant or patent owner certifies the following with respect to the cumulative number of applicant-provided or patent-owner provided items of information submitted to date including those in the accompanying IDS (select only one):

☒ No IDS size fee is required under 37 CFR 1.17(v) at this time.

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(1).

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(2).

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(3).

SIGNATURE

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 11.18. Please see 37 CFR 1.4(d) for the form of the signature.

Signature	/Pengju Shang/	Date (YYYY-MM-DD)	2025-07-18
Name/Print	Pengju Shang	Registration Number	80050

PC.1.19.25

INFORMATION DISCLOSURE STATEMENT BY APPLICANT		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

AMBILIGHT EX. 1002; Page 660
Ambilight v. Lannray PGR2026-00053

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

AMBILIGHT EX. 1002; Page 661
Ambilight v. Lannray PGR2026-00053

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/606,980	**07/18/2025 11:53:40 AM Z ET**	**50WF-383698-US**

Title of Invention

ELECTROCHROMIC FILMS WITH EDGE PROTECTION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9999	FILED BY	Chizu Fong
PATENT CENTER #	71429387	AUTHORIZED BY	PJ Shang
CUSTOMER #	139780	FILING DATE	03/15/2024
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Zhao CHEN

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
DA / 504561	**E20257HB53587815**	**Chizu Fong**

PRE-AUTHORIZED ACCOUNT	PRE-AUTHORIZED CATEGORY
504561	**37 CFR 1.16 (National application filing, search, and examination fees); 37 CFR 1.17 (Patent application and reexamination processing fees); 37 CFR 1.19 (Document supply fees); 37 CFR 1.20 (Post Issuance fees); 37 CFR 1.21 (Miscellaneous fees and charges)**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
2806	SUBMISSION OF AN INFORMATION DISCLOSURE STATEMENT	112.00	1	112.00
			TOTAL AMOUNT:	**$112.00**

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

AMBILIGHT EX. 1002; Page 662
Ambilight v. Lannray PGR2026-00053

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES
PATENT AND TRADEMARK OFFICE

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Alexandria, VA 22313 - 1450
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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/606,980	**07/18/2025 11:53:40 AM Z ET**	**50WF-383698-US**

Title of Invention

ELECTROCHROMIC FILMS WITH EDGE PROTECTION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
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PATENT CENTER #	71429387	FILING DATE	03/15/2024
CUSTOMER #	139780	FIRST NAMED INVENTOR	Zhao CHEN
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	PJ Shang

Documents

TOTAL DOCUMENTS: 2

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
NPL_EP-NOA.pdf	8	Non Patent Literature	175 KB
50WF-383698-US_IDS_31refs_IDSfee.pdf	5	Information Disclosure Statement (IDS) Form (SB08)	1273 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
NPL_EP-NOA.pdf	D09451B3621E212F2E846EC8FDC7DF7246D4FF54D34CA04805F655808957BAD71A088D97FD9538CFAB73D47057A459900899D36DC9F9F8F7D222FD29D97B4B29
50WF-383698-US_IDS_31refs_IDSfee.pdf	2D3B6E22EBE8D86126142E621236DCCB34C891EDA64B2618784B097BB08100C06B416B26F98235BC7901103A3B6FB537FC

AMBILIGHT EX. 1002; Page 664
Ambilight v. Lannray PGR2026-00053

F25229E6FACDC00A145DA293094B13

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

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National Stage of an International Application under 35 U.S.C. 371

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New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

REMARKS:

In the Non-Final Office Action[1], the Examiner:

I. rejects claims 1-12 under 35 U.S.C. § 112(b) as allegedly being indefinite, *Office Action* at 2.

In this response, claims 1-20 are pending, with claims 1 and 13 being independent. Claims 13-20 have been withdrawn. Claims 1, 7, 9, and 10 have been amended. No new subject matter has been added. Applicant respectfully requests reconsideration of this application, and the timely allowance of the pending claims for at least the following reasons.

I. Statement of substance of interview

Applicant thanks Examiner Dinh for the interview of May 22, 2025, during which the Examiner and Applicant's representative discussed the rejection of claim 1 under 35 U.S.C. §112 and proposed amendments to claim 1. The Examiner indicated that the proposed amendments would likely advance prosecution, but that additional searches and consideration are needed. No agreement regarding allowability was reached. In this Response, Applicant presents amendments consistent with the proposed amendments discussed over the interview.

II. The Rejection of Claims 1-12 under 35 U.S.C. § 112(b)

The Examiner rejects claims 1-12 under 35 U.S.C. § 112(b) as failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor regards as the invention. To expedite allowance of this Application, Applicant has made clarifying amendments to claim 1, 7, 9, and 10. Applicant respectfully requests withdrawal of this rejection.

CONCLUSION

In view of the foregoing amendments and remarks, Applicant respectfully requests reconsideration of this application and the timely allowance of the pending claims.

If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the

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number provided. Please grant any extensions of time required to enter this response and charge any additional required fees to Deposit Account No. 50-4561.

Respectfully submitted,

SHEPPARD MULLIN RICHTER & HAMPTON LLP

Dated: July 21, 2025

By: /Pengju Shang/
Pengju Shang
Reg. No. 80050
650-352-1971

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Ambilight v. Lannray PGR2026-00053

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 18/606,980	Filing Date 03/15/2024	☐ To be Mailed

ENTITY: ☐ LARGE ☑ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $40 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $192 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	07/21/2025	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0		x $80 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $240 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	SLIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/JULIET MCMILLAN/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	)	Confirmation No.: 9999
	)	
Zhao CHEN et al.	)	
	)	Examiner: JACK DINH
Application No.: 18/606,980	)	
	)	
	)	Art Unit: 2872
Filed: March 15, 2024	)	
	)	
	)	***VIA Patent Center***
For: ELECTROCHROMIC FILMS WITH EDGE PROTECTION	)	

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

RESPONSE TO OFFICE ACTION

This is in response to the Final Office Action mailed May 21, 2025. The period for response extends through August 21, 2025. Applicant respectfully requests the Examiner to reconsider this Application in light of the following.

Amendments to the Claims, which begin on page 2 of this paper.

Remarks begin on page 6 of this paper.

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UNITED STATES
PATENT AND TRADEMARK OFFICE

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Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/606,980	**07/21/2025 11:20:03 AM Z ET**	**50WF-383698-US**

Title of Invention

ELECTROCHROMIC FILMS WITH EDGE PROTECTION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9999	FILED BY	Chizu Fong
PATENT CENTER #	71456668	FILING DATE	03/15/2024
CUSTOMER #	139780	FIRST NAMED INVENTOR	Zhao CHEN
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	PJ Shang

Documents

TOTAL DOCUMENTS: 3

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
Furcifer12USC3_50WF-383698-US_ResponseFinalOA.pdf		7	-	42 KB
Furcifer12USC3_50WF-383698-US_ResponseFinalOA-A.NE.pdf	(1-1)	1	Response After Final Action	19 KB
Furcifer12USC3_50WF-383698-US_ResponseFinalOA-CLM.pdf	(2-5)	4	Claims	25 KB
Furcifer12USC3_50WF-383698-US_ResponseFinalOA-	(6-7)	2	Applicant Arguments/Remarks Made in an Amendment	25 KB

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REM.pdf

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
Furcifer12USC3_50WF-383698-US_ResponseFinalOA.pdf	E03B6A1FD80CB8440A3B033F5F846E9CCA95D86BA3660DAD81C570F801F9C32AAD91BF5F83994BE1D6A73746BB46D8FEE90CF706AAC8D6D81193753B2A1F1590
Furcifer12USC3_50WF-383698-US_ResponseFinalOA-A.NE.pdf	0F985141F507A983409F11F773AB59510F8004ED4E95C5072E1AA9BD307F9D10377F227CC6154574CDEC4D45A3643C82FD82819CC409F44E8CD24C74886D3E9E
Furcifer12USC3_50WF-383698-US_ResponseFinalOA-CLM.pdf	AEF58BA6B55C596734ADB4BB67D5B04D00570BF0B8B84AF51D5EFEDD88E79AA74EE738739E11E060973E53F4A6E33CA10B829DE7FD6BA5B75E241410FEDA1A98
Furcifer12USC3_50WF-383698-US_ResponseFinalOA-REM.pdf	EE30C44CA1880BE0A6E638BB2A45EF5D82D92B9C9C7518E387478AE1C4A5C4EDA8636744E20C01023F00ABA56B53D19CBF07E73E846573B824C9992DBCF7011F

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	)	Confirmation No.: 9999
	)	
Zhao CHEN et al.	)	
	)	Examiner: JACK DINH
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	)	
	)	Art Unit: 2872
Filed: March 15, 2024	)	
	)	
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For: ELECTROCHROMIC FILMS WITH EDGE PROTECTION	)	

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Remarks begin on page 6 of this paper.

AMBILIGHT EX. 1002; Page 672
Ambilight v. Lannray PGR2026-00053

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions and listings of claims in the application:

1. (Currently Amended) An electrochromic device comprising:

an electrochromic film comprising a first electrode layer and a second electrode layer facing the first electrode layer of the electrochromic film, wherein:

an first edge of the first electrode layer is cut such that a portion of an inner surface of the second electrode layer is exposed, and

an second edge of the second electrode layer is cut such that a portion of an inner surface of the first electrode layer is exposed, the first edge of the first electrode layer and the second edge of the second electrode layer are opposing edges;

a first edge protection material sealing the exposed portion of the inner surface of the second electrode layer; and

a second edge protection material sealing the exposed portion of the inner surface of the first electrode layer.

2. (Original) The electrochromic device of claim 1, wherein:

the first edge protection material is in an L shape, further sealing a side surface of the first electrode layer and a portion of an external surface of the first electrode layer.

3. (Original) The electrochromic device of claim 1, wherein:

the second edge protection material is in an L shape, further sealing a side surface of the second electrode layer and a portion of an external surface of the second electrode layer.

4. (Original) The electrochromic device of claim 1, wherein:

the first edge protection material and the second edge protection material comprise epoxy.

5. (Original) The electrochromic device of claim 1, wherein

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the first edge protection material and the second edge protection material comprise electrically conductive material.

6. (Original) The electrochromic device of claim 1, wherein:

the first edge protection material and the second edge protection material are cured with heat or ultraviolet light, functioning as oxygen and moisture blockers.

7. (Currently Amended) The electrochromic device of claim 1, further comprising:

a first substrate;

a second substrate; and

an interlayer between the first substrate and the second substrate, wherein:

the first electrode layer, the second electrode layer, the first edge protection material, and the second edge protection material are laminated within the interlayer.

8. (Original) The electrochromic device of claim 1, wherein the first electrode layer and the second electrode layer sandwich a layer of electrochromic material, a layer of electrolyte material, and a layer of charge storage material.

9. (Currently Amended) The electrochromic device of claim 8, wherein ~~the first edge of~~ the layer of electrochromic material, the layer of electrolyte material, and the layer of charge storage material are cut in a same way as the ~~first~~ edge of the first electrode layer to expose the portion of the inner surface of the second electrode layer.

10. (Currently Amended) The electrochromic device of claim 8, wherein ~~the second edge of~~ the layer of electrochromic material, the layer of electrolyte material, and the layer of charge storage material are cut in a same way as the ~~second~~ edge of the second electrode layer to expose the portion of the inner surface of the first electrode layer.

11. (Original) The electrochromic device of claim 1, wherein the first electrode layer comprises a first electrode layer including tin doped indium oxide (ITO).

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12. (Original) The electrochromic device of claim 1, wherein the second electrode layer comprises a second electrode layer including tin doped indium oxide (ITO).

13. (Withdrawn) An electrochromic device comprising:

an electrochromic film comprising a first electrode layer and a second electrode layer facing the first electrode layer, wherein a first edge and a second edge of the second electrode layer are cut such a first portion and a second portion of an inner surface of the first electrode layer respectively at the first edge and the second edge are exposed; and

a first edge protection material sealing the first portion of the inner surface of the first electrode layer; and

a second edge protection material sealing the second portion of the inner surface of the first electrode layer.

14. (Withdrawn) The electrochromic device of claim 13, wherein:

the first electrode layer and the second electrode layer sandwich a layer of electrochromic material, a layer of electrolyte material, and a layer of charge storage material.

15. (Withdrawn) The electrochromic device of claim 14, wherein:

the first edges of the layer of electrochromic material, the layer of electrolyte material, and the layer of charge storage material are cut in a same way as the first edge of the second electrochromic film, and

the first edge protection material seals the first edges of the layer of electrochromic material, the layer of electrolyte material, and the layer of charge storage material.

16. (Withdrawn) The electrochromic device of claim 14, wherein:

the second edges of the layer of electrochromic material, the layer of electrolyte material, and the layer of charge storage material are cut in a same way as the second edge of the electrochromic film, and

the second edge protection material seals the second edges of the layer of electrochromic material, the layer of electrolyte material, and the layer of charge storage material.

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17. (Withdrawn) The electrochromic device of claim 13, wherein:

the first edge protection material comprises epoxy.

18. (Withdrawn) The electrochromic device of claim 13, wherein:

the first edge protection material comprises electrically conductive material.

19. (Withdrawn) The electrochromic device of claim 13, wherein the first electrode layer comprises a first electrode layer including tin doped indium oxide (ITO).

20. (Withdrawn) The electrochromic device of claim 13, wherein the second electrode layer comprises a second electrode layer including tin doped indium oxide (ITO).

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Ambilight v. Lannray PGR2026-00053

REMARKS:

In the Non-Final Office Action[1], the Examiner:

I. rejects claims 1-12 under 35 U.S.C. § 112(b) as allegedly being indefinite, *Office Action* at 2.

In this response, claims 1-20 are pending, with claims 1 and 13 being independent. Claims 13-20 have been withdrawn. Claims 1, 7, 9, and 10 have been amended. No new subject matter has been added. Applicant respectfully requests reconsideration of this application, and the timely allowance of the pending claims for at least the following reasons.

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AMBILIGHT EX. 1002; Page 677
Ambilight v. Lannray PGR2026-00053

number provided. Please grant any extensions of time required to enter this response and charge any additional required fees to Deposit Account No. 50-4561.

Respectfully submitted,

SHEPPARD MULLIN RICHTER & HAMPTON LLP

Dated: July 21, 2025

By: /Pengju Shang/
Pengju Shang
Reg. No. 80050
650-352-1971

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Ambilight v. Lannray PGR2026-00053

UNITED STATES PATENT AND TRADEMARK OFFICE

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United States Patent and Trademark Office
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/606,980	03/15/2024	Zhao CHEN	50WF-383698-US	9999

139780 7590 07/29/2025

Sheppard Mullin Richter & Hampton LLP
Weiguo Chen
650 Town Center Drive, 10th Floor
Costa Mesa, CA 92626

EXAMINER
DINH, JACK

ART UNIT	PAPER NUMBER
2872	

NOTIFICATION DATE	DELIVERY MODE
07/29/2025	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

SheppardMullin_Pair@firsttofile.com
svpatents@sheppardmullin.com
wchen@sheppardmullin.com

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Advisory Action Before the Filing of an Appeal Brief	**Application No.** 18/606,980	**Applicant(s)** CHEN et al.	
	Examiner JACK DINH	**Art Unit** 2872	**AIA (First Inventor to File) Status** Yes

--The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

THE REPLY FILED 21 July 2025 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE.

NO NOTICE OF APPEAL FILED

1. ☑ The reply was filed after a final rejection. No Notice of Appeal has been filed. To avoid abandonment of this application, applicant must timely file one of the following replies: (1) an amendment, affidavit, or other evidence, which places the application in condition for allowance; (2) a Notice of Appeal (with appeal fee) in compliance with 37 CFR 41.31; or (3) a Request for Continued Examination (RCE) in compliance with 37 CFR 1.114 if this is a utility or plant application. Note that RCEs are not permitted in design applications. The reply must be filed within one of the following time periods:
   - a) ☐ The period for reply expires ____ months from the mailing date of the final rejection.
   - b) ☑ The period for reply expires on: (1) the mailing date of this Advisory Action; or (2) the date set forth in the final rejection, whichever is later. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection.
   - c) ☐ A prior Advisory Action was mailed more than 3 months after the mailing date of the final rejection in response to a first after-final reply filed within 2 months of the mailing date of the final rejection.The current period for reply expires ____ months from the mailing date of *the prior Advisory Action* or SIX MONTHS from the mailing date of the final rejection, whichever is earlier.

   Examiner Note: If box 1 is checked, check either box (a), (b) or (c). ONLY CHECK BOX (b) WHEN THIS ADVISORY ACTION IS THE FIRST RESPONSE TO APPLICANTS FIRST AFTER-FINAL REPLY WHICH WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION. ONLY CHECK BOX (c) IN THE LIMITED SITUATION SET FORTH UNDER BOX (c). See MPEP 706.07(f).

Extensions of time may be obtained under 37 CFR 1.136(a). The date on which the petition under 37 CFR 1.136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee. The appropriate extension fee under 37 CFR 1.17(a) is calculated from: (1) the expiration date of the shortened statutory period for reply originally set in the final Office action; or (2) as set forth in (b) or (c) above, if checked. Any reply received by the Office later than three months after the mailing date of the final rejection, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

NOTICE OF APPEAL

2. ☐ The Notice of Appeal was filed on _____. A brief in compliance with 37 CFR 41.37 must be filed within two months of the date of filing the Notice of Appeal (37 CFR 41.37(a)), or any extension thereof (37 CFR 41.37(e)), to avoid dismissal of the appeal. Since a Notice of Appeal has been filed, any reply must be filed within the time period set forth in 37CFR 41.37(a).

AMENDMENTS

3. ☑ The proposed amendments filed after a final rejection, but prior to the date of filing a brief, will not be entered because
   - a) ☑ They raise new issues that would require further consideration and/or search (see NOTE below);
   - b) ☐ They raise the issue of new matter (see NOTE below);
   - c) ☐ They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal; and/or
   - d) ☐ They present additional claims without canceling a corresponding number of finally rejected claims.

   NOTE: See Continuation Sheet (See 37 CFR 1.116 and 41.33(a)).
4. ☐ The amendments are not in compliance with 37 CFR 1.121. See attached Notice of Non-Compliant Amendment (PTOL-324).
5. ☐ Applicant's reply has overcome the following rejection(s): _____
6. ☐ Newly proposed or amended claim(s) _____ would be allowable if submitted in a separate, timely filed amendment canceling the non-allowable claim(s).
7. ☐ For purposes of appeal, the proposed amendment(s):(a)☐ will not be entered; or (b)☐ will be entered and an explanation of how the new or amended claims would be rejected is provided below or appended.

AFFIDAVIT OR OTHER EVIDENCE

8. ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____
9. ☐ The affidavit or other evidence filed after final action, but before or on the date of filing a Notice of Appeal will not be entered because applicant failed to provide a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented. See 37 CFR 1.116(e).
10. ☐ The affidavit or other evidence filed after the date of filing the Notice of Appeal, but prior to the date of filing a brief, will not be entered because the affidavit or other evidence failed to overcome all rejections under appeal and/or appellant fails to provide a showing of good and sufficient reasons why it is necessary and was not earlier presented. See 37 CFR 41.33(d)(1).
11. ☐ The affidavit or other evidence is entered. An explanation of the status of the claims after entry is below or attached.

REQUEST FOR RECONSIDERATION/OTHER

12. ☐ The request for reconsideration has been considered but does NOT place the application in condition for allowance because: _____.
13. ☐ Note the attached Information *Disclosure Statement*(s). (PTO/SB/08) Paper No(s). _____
14. ☐ Other: _____.

STATUS OF CLAIMS

15. The status of the claim(s) is (or will be) as follows:
    Claim(s) allowed:_____.
    Claim(s) objected to:_____.
    Claim(s) rejected:1-12.
    Claim(s) withdrawn from consideration:13-20.

/JACK DINH/
Primary Examiner, Art Unit 2872

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Continuation of 3. NOTE: The proposed amendments raise new issues that would require further consideration and/or search because they were not presented in the previous searches.

DO NOT ENTER: /J.D/
07/25/2025

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	)	Confirmation No.: 9999
	)	
Zhao CHEN et al.	)	
	)	Examiner: JACK DINH
Application No.: 18/606,980	)	
	)	
	)	Art Unit: 2872
Filed: March 15, 2024	)	
	)	
	)	***VIA Patent Center***
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P.O. Box 1450
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Commissioner:

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AMBILIGHT EX. 1002; Page 682
Ambilight v. Lannray PGR2026-00053

PTO/SB/06 (09-11)
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 18/606,980	Filing Date 03/15/2024	☐ To be Mailed

ENTITY: ☐ LARGE ☑ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $40 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $ 192 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

AMENDMENT	07/31/2025	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0		x $80 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $240 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/JAMES T WASHINGTON/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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UNITED STATES
PATENT AND TRADEMARK OFFICE

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Alexandria, VA 22313 - 1450
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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/606,980	**07/31/2025 11:09:06 AM Z ET**	**50WF-383698-US**

Title of Invention

ELECTROCHROMIC FILMS WITH EDGE PROTECTION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9999	FILED BY	Chizu Fong
PATENT CENTER #	71628085	FILING DATE	03/15/2024
CUSTOMER #	139780	FIRST NAMED INVENTOR	Zhao CHEN
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	PJ Shang

Documents

TOTAL DOCUMENTS: 1

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
50WF-383698-US_RCE.pdf	3	Request for Continued Examination (RCE)	1628 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
50WF-383698-US_RCE.pdf	E31BFB847519069CFD74FD8DBACF6BC2E1655BE9780610F139AB746383D0A5D7892DF2718AADC9F37BE7008DE2E466F25C1AB7464443C7FF18A0A9F7287AF9E3

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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PATENT AND TRADEMARK OFFICE

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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/606,980	**07/31/2025 11:09:06 AM Z ET**	**50WF-383698-US**

Title of Invention

ELECTROCHROMIC FILMS WITH EDGE PROTECTION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9999	FILED BY	Chizu Fong
PATENT CENTER #	71628085	AUTHORIZED BY	PJ Shang
CUSTOMER #	139780	FILING DATE	03/15/2024
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Zhao CHEN

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
DA / 504561	**E20257UB09288902**	**Chizu Fong**

PRE-AUTHORIZED ACCOUNT	PRE-AUTHORIZED CATEGORY
504561	**37 CFR 1.16 (National application filing, search, and examination fees); 37 CFR 1.17 (Patent application and reexamination processing fees); 37 CFR 1.19 (Document supply fees); 37 CFR 1.20 (Post Issuance fees); 37 CFR 1.21 (Miscellaneous fees and charges)**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
2801	REQUEST FOR CONTINUED EXAMINATION (RCE) - 1ST REQUEST (SEE 37 CFR 1.114)	600.00	1	600.00
			TOTAL AMOUNT:	**$600.00**

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

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New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Doc code: RCEX
Doc description: Request for Continued Examination (RCE)

PTO/SB/30EFS (01-22)
Approved for use through 05/31/2024. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	18606980	Filing Date	2024-03-15	Docket Number (if applicable)	50WF-383698-US	Art Unit	2872
First Named Inventor	Zhao CHEN			Examiner Name	JACK DINH		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☒ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____

☒ Other Response After Final Action filed on July 21, 2025.

☐ Enclosed

☐ Amendment/Reply

☐ Information Disclosure Statement (IDS)

☐ Affidavit(s)/ Declaration(s)

☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____ (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

☒ **The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**
The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No 504561

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

☐ Applicant Signature

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Ambilight v. Lannray PGR2026-00053

PTO/SB/30EFS (01-22)
Approved for use through 05/31/2024. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Signature of Registered U.S. Patent Practitioner			
Signature	/Pengju Shang/	Date (YYYY-MM-DD)	2025-07-31
Name	Pengju Shang	Registration Number	80050

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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Ambilight v. Lannray PGR2026-00053

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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PTO/SB/08a (01-25)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

Application Number	18606980
Filing Date	2024-03-15
First Named Inventor	Zhao CHEN
Art Unit	2872
Examiner Name	JACK DINH
Attorney Docket Number	50WF-383698-US

U.S. PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Inventor of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Patent citation information, please click the Add button. Add

U.S. PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Inventor or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	20040067343		2004-04-08	Beteille et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] ¡	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐

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NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

AMBILIGHT EX. 1002; Page 691
Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

	1	Search Report for European Patent Application No. 25165105.5 mailed on July 24, 2025.	☐

If you wish to add additional non-patent literature document citation information, please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered and whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

TIMING STATEMENT

Please see 37 CFR 1.97(e) to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached timing statement under 37 CFR 1.97(e).

☒ A timing statement under 37 CFR 1.97(e) is not submitted herewith.

TIMING FEE

☐ The fee set forth in 37 CFR 1.17(p) has been submitted herewith.

COPIES

☐ An identification of an earlier application pursuant to 37 CFR 1.98(d)(1) is attached.

SIZE FEE ASSERTION

Please see 37 CFR 1.17(v) and the IDS Auto-Load Instructions for completing this form to make the appropriate selection of an assertion under 37 CFR 1.98. For the information disclosure statement (IDS) submitted herewith, the applicant or patent owner certifies the following with respect to the cumulative number of applicant-provided or patent-owner provided items of information submitted to date including those in the accompanying IDS (select only one):

☒ No IDS size fee is required under 37 CFR 1.17(v) at this time.

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(1).

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(2).

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(3).

SIGNATURE

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 11.18. Please see 37 CFR 1.4(d) for the form of the signature.

Signature	/Pengju Shang/	Date (YYYY-MM-DD)	2025-08-01
Name/Print	Pengju Shang	Registration Number	80050

PC.1.19.25

AMBILIGHT EX. 1002; Page 693
Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

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AMBILIGHT EX. 1002; Page 694
Ambilight v. Lannray PGR2026-00053

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

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Ambilight v. Lannray PGR2026-00053

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/606,980	**08/01/2025 01:48:32 PM Z ET**	**50WF-383698-US**

Title of Invention

ELECTROCHROMIC FILMS WITH EDGE PROTECTION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9999	FILED BY	Chizu Fong
PATENT CENTER #	71653791	FILING DATE	03/15/2024
CUSTOMER #	139780	FIRST NAMED INVENTOR	Zhao CHEN
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	PJ Shang

Documents

TOTAL DOCUMENTS: 2

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
NPL_EP_SearchReport.pdf	10	Non Patent Literature	173 KB
Furcifer12USC3_50WF-383698-US_IDS_33refs.pdf	5	Information Disclosure Statement (IDS) Form (SB08)	1273 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
NPL_EP_SearchReport.pdf	41411C55F3B055A5068E90CA98E5CE6697FA62425D041F4583B01945E995F0C0DBEF212460B28856765C40505255D893123596808DC53950511D0CB95BB67E02
Furcifer12USC3_50WF-383698-US_IDS_33refs.pdf	CEC198C7D775630E3B698F17CB14F3DB7FE79D3C339CA6A729DFD477CEF90D41889E22614620E8CEAB102821E6797D445

AF2F5495DE05FF75D84D9A792448902

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/08a (01-25)
Approved for use through 11/30/2027. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

Application Number	18606980
Filing Date	2024-03-15
First Named Inventor	Zhao CHEN
Art Unit	2872
Examiner Name	JACK DINH
Attorney Docket Number	50WF-383698-US

U.S. PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Inventor of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
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NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

AMBILIGHT EX. 1002; Page 698
Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

	1	Notification on Registration for Chinese Application No. 202310481813.6 maield on July 16, 2025.	☒

If you wish to add additional non-patent literature document citation information, please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered and whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

AMBILIGHT EX. 1002; Page 699
Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

TIMING STATEMENT

Please see 37 CFR 1.97(e) to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached timing statement under 37 CFR 1.97(e).

☒ A timing statement under 37 CFR 1.97(e) is not submitted herewith.

TIMING FEE

☐ The fee set forth in 37 CFR 1.17(p) has been submitted herewith.

COPIES

☐ An identification of an earlier application pursuant to 37 CFR 1.98(d)(1) is attached.

SIZE FEE ASSERTION

Please see 37 CFR 1.17(v) and the IDS Auto-Load Instructions for completing this form to make the appropriate selection of an assertion under 37 CFR 1.98. For the information disclosure statement (IDS) submitted herewith, the applicant or patent owner certifies the following with respect to the cumulative number of applicant-provided or patent-owner provided items of information submitted to date including those in the accompanying IDS (select only one):

☒ No IDS size fee is required under 37 CFR 1.17(v) at this time.

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(1).

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(2).

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(3).

SIGNATURE

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 11.18. Please see 37 CFR 1.4(d) for the form of the signature.

Signature	/Pengju Shang/	Date (YYYY-MM-DD)	2025-09-16
Name/Print	Pengju Shang	Registration Number	80050

PC.1.19.25

AMBILIGHT EX. 1002; Page 700
Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

AMBILIGHT EX. 1002; Page 701
Ambilight v. Lannray PGR2026-00053

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/606,980	**09/16/2025 04:49:23 PM Z ET**	**50WF-383698-US**

Title of Invention

ELECTROCHROMIC FILMS WITH EDGE PROTECTION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9999	FILED BY	Chizu Fong
PATENT CENTER #	72320660	FILING DATE	03/15/2024
CUSTOMER #	139780	FIRST NAMED INVENTOR	Zhao CHEN
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	PJ Shang

Documents

TOTAL DOCUMENTS: 2

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
NPL_CN-NOA.pdf	5	Non Patent Literature	492 KB
50WF-383698-US_IDS_34refs.pdf	5	Information Disclosure Statement (IDS) Form (SB08)	1273 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
NPL_CN-NOA.pdf	C387067A6E4D3AAD44554A0C29629ED24B4BF2EAF9D5917E F9F846FBA705E6BA72EA6EDDE445DB283ACC663E8FA287DF 2A69E7F2C83364D3314A4ABB9703B6E9
50WF-383698-US_IDS_34refs.pdf	23C092C689524B7DD2A12955C41ADE63E98BE57EFCAA6656 D084735E93AB5294CC6A3F358F95FCDB1157A4EF88471C927

AMBILIGHT EX. 1002; Page 703
Ambilight v. Lannray PGR2026-00053

5C28F157256545469F21400DAD89E54

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
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www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

139780 7590 09/30/2025

Sheppard Mullin Richter & Hampton LLP
Weiguo Chen
650 Town Center Drive, 10th Floor
Costa Mesa, CA 92626

EXAMINER	
DINH, JACK	
ART UNIT	**PAPER NUMBER**
2872	

DATE MAILED: 09/30/2025

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/606,980	03/15/2024	Zhao CHEN	50WF-383698-US	9999

TITLE OF INVENTION: ELECTROCHROMIC FILMS WITH EDGE PROTECTION

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$516	$0.00	$0.00	$516	12/30/2025

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

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Ambilight v. Lannray PGR2026-00053

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via the USPTO patent electronic filing system.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

139780 7590 09/30/2025
Sheppard Mullin Richter & Hampton LLP
Weiguo Chen
650 Town Center Drive, 10th Floor
Costa Mesa, CA 92626

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via the USPTO patent electronic filing system or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/606,980	03/15/2024	Zhao CHEN	50WF-383698-US	9999

TITLE OF INVENTION: ELECTROCHROMIC FILMS WITH EDGE PROTECTION

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$516	$0.00	$0.00	$516	12/30/2025

EXAMINER	ART UNIT	CLASS-SUBCLASS
DINH, JACK	2872	359-265000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via the USPTO patent electronic filing system ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

❑ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

❑ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

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Ambilight v. Lannray PGR2026-00053

UNITED STATES PATENT AND TRADEMARK OFFICE

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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/606,980	03/15/2024	Zhao CHEN	50WF-383698-US	9999

139780 7590 09/30/2025

Sheppard Mullin Richter & Hampton LLP
Weiguo Chen
650 Town Center Drive, 10th Floor
Costa Mesa, CA 92626

EXAMINER	
DINH, JACK	

ART UNIT	PAPER NUMBER
2872	

DATE MAILED: 09/30/2025

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

AMBILIGHT EX. 1002; Page 707
Ambilight v. Lannray PGR2026-00053

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. The United States Patent and Trademark Office (USPTO) collects the information in this record under authority of 35 U.S.C. 2. The USPTO's system of records is used to manage all applicant and owner information including name, citizenship, residence, post office address, and other information with respect to inventors and their legal representatives pertaining to the applicant's/owner's activities in connection with the invention for which a patent is sought or has been granted. The applicable Privacy Act System of Records Notice for the information collected in this form is COMMERCE/PAT-TM-7 Patent Application Files, available in the Federal Register at 78 FR 19243 (March 29, 2013).
https://www.govinfo.gov/content/pkg/FR-2013-03-29/pdf/2013-07341.pdf

Routine uses of the information in this record may include disclosure to:

1) law enforcement, in the event that the system of records indicates a violation or potential violation of law;
2) a federal, state, local, or international agency, in response to its request;
3) a contractor of the USPTO having need for the information in order to perform a contract;
4) the Department of Justice for determination of whether the Freedom of Information Act (FOIA) requires disclosure of the record;
5) a Member of Congress submitting a request involving an individual to whom the record pertains, when the individual has requested the Member's assistance with respect to the subject matter of the record;
6) a court, magistrate, or administrative tribunal, in the course of presenting evidence, including disclosures to opposing counsel in the course of settlement negotiations;
7) the Administrator, General Services Administration (GSA), or their designee, during an inspection of records conducted by GSA under authority of 44 U.S.C. 2904 and 2906, in accordance with the GSA regulations and any other relevant (i.e., GSA or Commerce) directive, where such disclosure shall not be used to make determinations about individuals;
8) another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c));
9) the Office of Personnel Management (OPM) for personnel research purposes; and
10) the Office of Management and Budget (OMB) for legislative coordination and clearance.

If you do not furnish the information requested on this form, the USPTO may not be able to process and/or examine your submission, which may result in termination of proceedings, abandonment of the application, and/or expiration of the patent.

Notice of Allowability	Application No. 18/606,980	Applicant(s) CHEN et al.	
	Examiner JACK DINH	Art Unit 2872	AIA (First Inventor to File) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to the communication filed on 9/16/25.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 1-12 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☑ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☑ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/JACK DINH/
Primary Examiner, Art Unit 2872

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DETAILED ACTION

Election/Restrictions

Applicant's election without traverse of Group I, claims 1-12, in the reply filed on 12/20/24 is acknowledged.

This application is in condition for allowance except for the presence of claims 13-20, directed to species non-elected without traverse. Accordingly, claims 13-20 have been cancelled.

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in an interview with Pengju Shang on 9/16/25.

The application has been amended as follows:

Claims 13-20. (cancelled)

REASONS FOR ALLOWANCE

Claims 13-20 are allowed. The following is an examiner's statement of reasons for allowance. Regarding claim 13, the prior art fails to disclose wherein a first edge protection material sealing the exposed portion of the inner surface of the second electrode layer, and a second edge protection material sealing the exposed portion of the inner surface of the first electrode layer.

The prior art taken either singly or in combination fails to anticipate or fairly suggest the limitations of the independent claims, in such a manner that a rejection under 35 USC 102 or 103 would be improper. Any comments considered necessary by applicant must be submitted no later than the

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payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

OTHER INFORMATION/REMARKS

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JACK DINH whose telephone number is (571)272-2327. The examiner can normally be reached Monday - Friday 9am-5pm.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bumsuk Won can be reached on 571-272-2713. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/JACK DINH/
Primary Examiner, Art Unit 2872
9/17/25

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Examiner-Initiated Interview Summary	**Application No.** 18/606,980	**Applicant(s)** CHEN et al.		
	Examiner JACK DINH	**Art Unit** 2872	**AIA (First Inventor to File) Status** Yes	**Page** 1 of 1

All Participants (applicant, applicants representative, PTO personnel)	**Title**	**Type**
JACK DINH	Primary Examiner	Telephonic
PENGJU SHANG	Attorney	

Date of Interview: 16 September 2025

Issues Discussed:

Other

The cancellation of the claims, as set forth in the Examiner's amendment, was discussed and agreed upon in order to place the application in condition for allowance.

/JACK DINH/ Primary Examiner, Art Unit 2872	

Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04
Please further see:
MPEP 713.04
Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b)
37 CFR § 1.2 Business to be transacted in writing

Applicant recordation instructions: It is not necessary for applicant to provide a separate record of the substance of interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

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Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/606,980	CHEN et al.
	Examiner	**Art Unit**
	JACK DINH	2872

CPC						
Symbol					**Type**	**Version**
B32B	/	17	/	10	F	2013-01-01
G02F	/	1	/	1508	I	2013-01-01
G02F	/	1	/	1533	I	2013-01-01
B32B	/	17	/	10036	I	2013-01-01
B32B	/	17	/	10211	I	2013-01-01
B32B	/	17	/	10302	I	2013-01-01
B32B	/	17	/	10513	I	2013-01-01
B32B	/	17	/	10761	I	2013-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	12	
/JACK DINH/ Primary Examiner, Art Unit 2872	17 September 2025	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	2

U.S. Patent and Trademark Office — Part of Paper No.: 20250917

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Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/606,980	CHEN et al.
	Examiner	**Art Unit**
	JACK DINH	2872

INTERNATIONAL CLASSIFICATION					
CLAIMED					
G02F	/	1	/	153	
G02F	/	1	/	1506	
B32B	/	17	/	10	

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	12	
/JACK DINH/ Primary Examiner, Art Unit 2872	17 September 2025	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	2

U.S. Patent and Trademark Office

Part of Paper No.: 20250917

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Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/606,980	CHEN et al.
	Examiner	**Art Unit**
	JACK DINH	2872

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	10	10		19										
2	2	11	11		20										
3	3	12	12												
4	4		13												
5	5		14												
6	6		15												
7	7		16												
8	8		17												
9	9		18												

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	12	
/JACK DINH/ Primary Examiner, Art Unit 2872	17 September 2025	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	2

U.S. Patent and Trademark Office Part of Paper No.: 20250917

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Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/606,980	CHEN et al.
	Examiner	**Art Unit**
	JACK DINH	2872

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	12/17/2024	01/16/2025	05/18/2025	09/17/2025					
1	1	÷	✓	✓	=					
2	2	÷	✓	✓	=					
3	3	÷	✓	✓	=					
4	4	÷	✓	✓	=					
5	5	÷	✓	✓	=					
6	6	÷	✓	✓	=					
7	7	÷	✓	✓	=					
8	8	÷	✓	✓	=					
9	9	÷	✓	✓	=					
10	10	÷	✓	✓	=					
11	11	÷	✓	✓	=					
12	12	÷	✓	✓	=					
	13	÷	N	N	-					
	14	÷	N	N	-					
	15	÷	N	N	-					
	16	÷	N	N	-					
	17	÷	N	N	-					
	18	÷	N	N	-					
	19	÷	N	N	-					
	20	÷	N	N	-					

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/606,980	CHEN et al.
	Examiner	Art Unit
	JACK DINH	2872

CPC - Searched*		
Symbol	**Date**	**Examiner**
G02F 1/1533, 1/1508, 1/153, 1/161, 2201/50, 2201/1536	01/16/2025	JD
ABOVE UPDATED	05/18/2025	JD
ABOVE UPDATED	09/17/2025	JD

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	**Date**	**Examiner**
Restrict claims.	12/17/2024	JD
Review parent applications. Search PE2E.	01/16/2025	JD
Update PE2E search.	05/18/2025	JD
Update PE2E search. Search similarity. Contacted Attomey regarding Examiner's amendment.	09/17/2025	JD

/JACK DINH/ Primary Examiner, Art Unit 2872	/JACK DINH/ Primary Examiner, Art Unit 2872

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/606,980	CHEN et al.
	Examiner	Art Unit
	JACK DINH	2872

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
See search history.		09/17/2025	JD

/JACK DINH/ Primary Examiner, Art Unit 2872	/JACK DINH/ Primary Examiner, Art Unit 2872

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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-25)
Approved for use through 11/30/2027. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

Application Number	18606980
Filing Date	2024-03-15
First Named Inventor	Zhao CHEN
Art Unit	2872
Examiner Name	JACK DINH
Attorney Docket Number	50WF-383698-US

U.S. PATENTS

Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Inventor of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
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	1							☐

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NON-PATENT LITERATURE DOCUMENTS

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

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Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

	1	Notification on Registration for Chinese Application No. 202310481813.6 maield on July 16, 2025.	☒

If you wish to add additional non-patent literature document citation information, please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/JACK DINH/	Date Considered	09/17/2025

*EXAMINER: Initial if reference considered and whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

PC.1.19.25

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Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

Application Number	18606980
Filing Date	2024-03-15
First Named Inventor	Zhao CHEN
Art Unit	2872
Examiner Name	JACK DINH
Attorney Docket Number	50WF-383698-US

TIMING STATEMENT

Please see 37 CFR 1.97(e) to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached timing statement under 37 CFR 1.97(e).

☒ A timing statement under 37 CFR 1.97(e) is not submitted herewith.

TIMING FEE

☐ The fee set forth in 37 CFR 1.17(p) has been submitted herewith.

COPIES

☐ An identification of an earlier application pursuant to 37 CFR 1.98(d)(1) is attached.

SIZE FEE ASSERTION

Please see 37 CFR 1.17(v) and the IDS Auto-Load Instructions for completing this form to make the appropriate selection of an assertion under 37 CFR 1.98. For the information disclosure statement (IDS) submitted herewith, the applicant or patent owner certifies the following with respect to the cumulative number of applicant-provided or patent-owner provided items of information submitted to date including those in the accompanying IDS (select only one):

☒ No IDS size fee is required under 37 CFR 1.17(v) at this time.

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(1).

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(2).

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(3).

SIGNATURE

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 11.18. Please see 37 CFR 1.4(d) for the form of the signature.

Signature	/Pengju Shang/	Date (YYYY-MM-DD)	2025-09-16
Name/Print	Pengju Shang	Registration Number	80050

PC.1.19.25

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /J.D/

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /J.D/

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Ambilight v. Lannray PGR2026-00053

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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AMBILIGHT EX. 1002; Page 723
Ambilight v. Lannray PGR2026-00053

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

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PTO/SB/08a (01-25)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

Application Number	18606980
Filing Date	2024-03-15
First Named Inventor	Zhao CHEN
Art Unit	2872
Examiner Name	JACK DINH
Attorney Docket Number	50WF-383698-US

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AMBILIGHT EX. 1002; Page 724
Ambilight v. Lannray PGR2026-00053

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	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

	1	Search Report for European Patent Application No. 25165105.5 mailed on July 24, 2025.	☐

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EXAMINER SIGNATURE

Examiner Signature	/JACK DINH/	Date Considered	09/17/2025

*EXAMINER: Initial if reference considered and whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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AMBILIGHT EX. 1002; Page 725
Ambilight v. Lannray PGR2026-00053

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	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

TIMING STATEMENT

Please see 37 CFR 1.97(e) to make the appropriate selection(s):

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OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached timing statement under 37 CFR 1.97(e).

☒ A timing statement under 37 CFR 1.97(e) is not submitted herewith.

TIMING FEE

☐ The fee set forth in 37 CFR 1.17(p) has been submitted herewith.

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SIZE FEE ASSERTION

Please see 37 CFR 1.17(v) and the IDS Auto-Load Instructions for completing this form to make the appropriate selection of an assertion under 37 CFR 1.98. For the information disclosure statement (IDS) submitted herewith, the applicant or patent owner certifies the following with respect to the cumulative number of applicant-provided or patent-owner provided items of information submitted to date including those in the accompanying IDS (select only one):

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Signature	/Pengju Shang/	Date (YYYY-MM-DD)	2025-08-01
Name/Print	Pengju Shang	Registration Number	80050

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AMBILIGHT EX. 1002; Page 726
Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT		
	Application Number	18606980
	Filing Date	2024-03-15
	First Named Inventor	Zhao CHEN
	Art Unit	2872
	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

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AMBILIGHT EX. 1002; Page 727
Ambilight v. Lannray PGR2026-00053

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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AMBILIGHT EX. 1002; Page 728
Ambilight v. Lannray PGR2026-00053

Doc code: IDS
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Filing Date	2024-03-15
First Named Inventor	Zhao CHEN
Art Unit	2872
Examiner Name	JACK DINH
Attorney Docket Number	50WF-383698-US

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AMBILIGHT EX. 1002; Page 729
Ambilight v. Lannray PGR2026-00053

INFORMATION DISCLOSURE STATEMENT BY APPLICANT		
	Application Number	18606980
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	Examiner Name	JACK DINH
	Attorney Docket Number	50WF-383698-US

	1	Communication under Rule 71(3) EPC for European Application No. 23 164 353.7 mailed on May 20, 2025.	☐

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Signature	/Pengju Shang/	Date (YYYY-MM-DD)	2025-07-18
Name/Print	Pengju Shang	Registration Number	80050

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AMBILIGHT EX. 1002; Page 731
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AMBILIGHT EX. 1002; Page 733
Ambilight v. Lannray PGR2026-00053

Bibliographic Data

Application No: 18/606,980

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /JACK DINH/ Examiner's Signature | Initials

Title: ELECTROCHROMIC FILMS WITH EDGE PROTECTION

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
03/15/2024	359	2872	50WF-383698-US
RULE			

APPLICANTS

LannRay Optoelectronics (Zhenjiang) Co. Ltd., Yangzhong City, CHINA

INVENTORS

Zhao CHEN, Camarillo, CA, UNITED STATES

Jian WANG, Fremont, CA, UNITED STATES

Yan ZHOU, Fremont, CA, UNITED STATES

CONTINUING DATA

This application is a CON of 18152033 01/09/2023 PAT 11969970

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Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
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L26	2	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
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L30	66827	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2021/11/20 10:08 AM
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L34	0	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:08 AM
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Ambilight v. Lannray PGR2026-00053

			IBM_TDB)				
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L46	26	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2021/11/20 10:08 AM
L47	17	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2021/11/20 10:08 AM
L48	2	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:26 AM
L49	1	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2021/11/20 10:36 AM
L50	1	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L51	2	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L52	2	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L53	2	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L54	2	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L55	67365	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L56	2	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L57	2	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L58	2	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L59	0	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM

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L60	8	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L61	4	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L62	4	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L63	4	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L64	4847	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L65	874	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L66	13683	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L67	3126	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L68	9593	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L69	1608	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L70	26515	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L71	27	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L72	25	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/03/20 11:41 AM
L73	2	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM
L74	1	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 11:41 AM

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L75	2	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 12:54 PM
L76	2	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 12:55 PM
L77	2	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 12:55 PM
L78	2	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 01:10 PM
L79	0	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 01:10 PM
L80	2	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 01:11 PM
L81	2	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/03/20 01:20 PM
L82	1	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L83	2	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L84	2	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L85	2	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L86	2	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L87	78767	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L88	2	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L89	2	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L90	2	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L91	0	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L92	8	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L93	4	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L94	4	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L95	4	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L96	5163	G02F1/1533	(US-PGPUB; USPAT;	OR	OFF	OFF	2022/09/30

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			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)				01:52 AM
L97	935	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L98	14617	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L99	3382	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L100	10095	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L101	1762	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L102	28164	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L103	30	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L104	27	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L105	2	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L106	1	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L107	1	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L108	2	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L109	2	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L110	2	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L111	2	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM

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L112	78767	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L113	2	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L114	2	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L115	2	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L116	0	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L117	8	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L118	4	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L119	4	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L120	4	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L121	5163	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L122	935	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L123	14617	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L124	3382	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L125	10095	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L126	1762	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L127	28164	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L128	30	(electrochrom$5) same (electrode$1) same	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2022/09/30 01:52 AM

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		(charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	JPO; DERWENT; IBM_TDB)				
L129	27	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:52 AM
L130	2	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L131	1	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L132	2	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L133	2	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L134	2	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L135	2	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L136	0	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L137	2	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L138	2	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 01:52 AM
L139	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2022/09/30 01:52 AM
L140	27	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 01:59 AM
L141	3	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2022/09/30 02:01 AM
L142	3	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L143	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L144	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L145	3	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03

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							09:05 PM
L146	3	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L147	88313	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L148	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L149	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L150	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L151	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L152	11	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L153	5	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L154	5	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L155	5	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L156	5509	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L157	1007	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L158	15577	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L159	3623	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L160	10596	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L161	1867	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L162	29769	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2023/06/03 09:05 PM

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			IBM_TDB)				
L163	33	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L164	29	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L165	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L166	3	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L167	3	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L168	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L169	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L170	3	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L171	3	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L172	88313	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L173	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L174	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L175	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L176	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L177	11	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L178	5	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L179	5	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L180	5	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L181	5509	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2023/06/03 09:05 PM

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			JPO; DERWENT; IBM_TDB)				
L182	1007	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L183	15577	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L184	3623	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L185	10596	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L186	1867	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L187	29769	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L188	33	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L189	29	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L190	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L191	3	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L192	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L193	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L194	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L195	3	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM

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L196	1	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L197	3	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L198	3	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L199	3	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L200	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L201	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L202	3	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L203	3	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L204	88313	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L205	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L206	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L207	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L208	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L209	11	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L210	5	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L211	5	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L212	5	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L213	5509	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L214	1007	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L215	15577	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM

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L216	3623	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L217	10596	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L218	1867	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L219	29769	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L220	33	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L221	29	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L222	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L223	3	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L224	3	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L225	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L226	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L227	3	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L228	3	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L229	88313	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L230	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L231	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L232	3	L26 and (polyvinyl or polyurethane or	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM

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		ethylene)					
L233	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L234	11	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L235	5	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L236	5	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L237	5	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L238	5509	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L239	1007	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L240	15577	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L241	3623	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L242	10596	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L243	1867	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L244	29769	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L245	33	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L246	29	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L247	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM

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L248	3	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L249	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L250	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L251	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L252	3	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L253	1	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L254	3	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L255	3	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/06/03 09:05 PM
L256	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 09:05 PM
L257	29	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L258	5	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/06/03 09:05 PM
L259	7	("20120013969"|"20130010347"|"20150323849"|"20160282645"|"20170298682"|"20170299932"|"5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 09:07 PM
L260	608	"5818625"	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:10 PM
L261	1	("5818625").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:10 PM
L262	1	L261 AND (seal$1 WITH epoxy)	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:11 PM
L263	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva))	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:17 PM
L264	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva OR polyvinyl OR siloxane OR	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:18 PM

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		thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate))					
L265	1	L261 AND (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate)	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:19 PM
L266	0	L261 AND (electrochromic WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:20 PM
L267	1	L261 AND (electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:21 PM
L268	1	L261 AND (electrochromic WITH ITO)	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/03 10:24 PM
L269	493051	((Zhao WITH Chen) OR (Jian WITH Wang) OR (Yan WITH Zhou)).in.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/06/03 10:32 PM
L270	133	L269 AND (Furcifer ADJ Inc)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/06/03 10:32 PM
L271	133	L270 AND electrochromic$1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/06/03 10:33 PM
L272	3	"20160259152"	(US-PGPUB; USPAT)	OR	ON	ON	2023/06/11 12:08 PM
L273	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16

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							06:43 PM
L274	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L275	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L276	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L277	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L278	88857	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L279	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L280	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L281	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L282	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L283	14	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L284	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L285	7	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L286	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L287	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L288	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L289	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L290	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L291	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM

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L292	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L293	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L294	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L295	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L296	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L297	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L298	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L299	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L300	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L301	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L302	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L303	88857	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L304	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L305	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L306	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L307	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L308	14	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L309	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L310	7	L35 and (electrolyte	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16

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		with polymer with (salt$1 or matrix))					06:43 PM
L311	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L312	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L313	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L314	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L315	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L316	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L317	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L318	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L319	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L320	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L321	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L322	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L323	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L324	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM

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L325	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L326	3	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L327	1	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L328	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L329	6	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L330	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L331	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L332	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L333	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L334	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L335	88857	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L336	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L337	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L338	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L339	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L340	14	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L341	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L342	7	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L343	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L344	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L345	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2023/12/16 06:43 PM

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			JPO; DERWENT; IBM_TDB)				
L346	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L347	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L348	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L349	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L350	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L351	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L352	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L353	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L354	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L355	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L356	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L357	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L358	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L359	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L360	88857	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM

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L361	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L362	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L363	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L364	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L365	14	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L366	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L367	7	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L368	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L369	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L370	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L371	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L372	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L373	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L374	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L375	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L376	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM

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L377	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L378	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L379	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L380	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L381	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L382	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L383	3	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L384	1	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L385	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L386	6	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L387	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L388	30	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L389	6	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L390	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L391	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L392	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L393	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L394	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L395	88857	((zhao with chen) or (jian with wang) or (yan	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2023/12/16 06:43 PM

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		with zhou)).in.	JPO; DERWENT; IBM_TDB)				
L396	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L397	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L398	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L399	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L400	14	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L401	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L402	7	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L403	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L404	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L405	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L406	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L407	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L408	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L409	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L410	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L411	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM

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		(electrolyte$1) same (edge$1 with (protect$3 or seal$3))					
L412	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L413	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L414	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L415	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L416	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L417	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L418	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L419	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L420	88857	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L421	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L422	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L423	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L424	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L425	14	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L426	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L427	7	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L428	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L429	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L430	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2023/12/16 06:43 PM

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			IBM_TDB)				
L431	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L432	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L433	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L434	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L435	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L436	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L437	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L438	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L439	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L440	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L441	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L442	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L443	3	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L444	1	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L445	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM

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L446	6	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L447	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L448	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L449	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L450	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L451	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L452	88857	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L453	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L454	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L455	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L456	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L457	14	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L458	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L459	7	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L460	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L461	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L462	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L463	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L464	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM

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L465	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L466	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L467	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L468	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L469	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L470	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L471	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L472	4	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L473	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L474	4	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L475	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L476	5	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L477	88857	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L478	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L479	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L480	3	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L481	1	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L482	14	L26 or L27 or L28 or	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16

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		L29					06:43 PM
L483	7	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L484	7	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L485	7	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L486	5594	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L487	1018	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L488	15939	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L489	3719	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L490	10788	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L491	1911	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L492	30363	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L493	34	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L494	30	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L495	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L496	4	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L497	4	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16

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							06:43 PM
L498	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L499	4	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L500	3	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L501	1	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L502	6	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L503	6	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2023/12/16 06:43 PM
L504	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L505	30	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L506	6	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2023/12/16 06:43 PM
L507	7	("20120013969"|"20130010347"|"20150323849"|"20160282645"|"20170298682"|"20170299932"|"5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L508	615	"5818625"	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L509	1	("5818625").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L510	1	L261 AND (seal$1 WITH epoxy)	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L511	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva))	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L512	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate))	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM

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L513	1	L261 AND (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate)	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L514	0	L261 AND (electrochromic WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L515	1	L261 AND (electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L516	1	L261 AND (electrochromic WITH ITO)	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L517	513871	((Zhao WITH Chen) OR (Jian WITH Wang) OR (Yan WITH Zhou)).in.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/12/16 06:43 PM
L518	139	L269 AND (Furcifer ADJ Inc)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/12/16 06:43 PM
L519	139	L270 AND electrochromic$1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/12/16 06:43 PM
L520	4	"20160259152"	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:43 PM
L521	2	"18152033"	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 06:44 PM
L522	9	("20160357082"|"20150301367"|"20120013969"|"20130010347"|"2015	(US-PGPUB; USPAT)	OR	ON	ON	2023/12/16 07:11 PM

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		0323849"|"20160282645"|"20170298682"|"20170299932"|"5818625"). PN.					
L523	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L524	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L525	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L526	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L527	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L528	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L529	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L530	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L531	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L532	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L533	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L534	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L535	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L536	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L537	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L538	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L539	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L540	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM

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L541	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L542	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L543	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L544	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L545	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L546	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L547	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L548	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L549	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L550	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L551	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L552	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L553	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L554	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L555	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L556	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L557	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L558	20	L26 or L27 or L28 or	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16

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		L29					06:04 AM
L559	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L560	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L561	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L562	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L563	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L564	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L565	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L566	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L567	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L568	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L569	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L570	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L571	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L572	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L573	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16

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							06:04 AM
L574	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L575	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L576	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L577	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L578	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L579	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L580	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L581	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L582	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L583	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L584	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L585	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L586	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L587	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L588	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L589	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L590	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L591	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L592	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L593	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L594	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/01/16 06:04 AM

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			JPO; DERWENT; IBM_TDB)				
L595	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L596	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L597	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L598	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L599	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L600	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L601	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L602	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L603	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L604	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L605	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L606	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L607	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L608	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L609	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM

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L610	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L611	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L612	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L613	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L614	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L615	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L616	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L617	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L618	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L619	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L620	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L621	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L622	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L623	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L624	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L625	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L626	39	(electrochrom$5) same (electrode$1) same	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/01/16 06:04 AM

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		(charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	JPO; DERWENT; IBM_TDB)				
L627	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L628	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L629	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L630	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L631	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L632	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L633	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L634	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L635	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L636	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L637	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L638	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L639	9	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L640	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L641	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L642	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L643	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16

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							06:04 AM
L644	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L645	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L646	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L647	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L648	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L649	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L650	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L651	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L652	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L653	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L654	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L655	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L656	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L657	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L658	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L659	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L660	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2025/01/16 06:04 AM

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			IBM_TDB)				
L661	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L662	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L663	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L664	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L665	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L666	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L667	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L668	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L669	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L670	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L671	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L672	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L673	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L674	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L675	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L676	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L677	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L678	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L679	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/01/16 06:04 AM

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			JPO; DERWENT; IBM_TDB)				
L680	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L681	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L682	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L683	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L684	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L685	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L686	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L687	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L688	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L689	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L690	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L691	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L692	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L693	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM

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L694	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L695	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L696	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L697	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L698	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L699	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L700	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L701	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L702	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L703	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L704	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L705	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L706	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L707	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L708	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L709	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L710	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L711	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L712	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L713	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM

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L714	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L715	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L716	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L717	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L718	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L719	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L720	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L721	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L722	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L723	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L724	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L725	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L726	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L727	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L728	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L729	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L730	5	L26 and (polyvinyl or polyurethane or	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM

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		ethylene)					
L731	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L732	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L733	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L734	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L735	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L736	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L737	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L738	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L739	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L740	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L741	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L742	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L743	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L744	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L745	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM

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L746	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L747	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L748	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L749	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L750	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L751	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L752	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L753	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L754	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L755	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L756	9	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L757	7	("20120013969"|"20130010347"|"20150323849"|"20160282645"|"20170298682"|"20170299932"|"5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L758	628	"5818625"	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L759	1	("5818625").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L760	1	L261 AND (seal$1 WITH epoxy)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L761	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva))	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L762	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva OR polyvinyl OR siloxane OR	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM

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		thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate))					
L763	1	L261 AND (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L764	0	L261 AND (electrochromic WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L765	1	L261 AND (electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L766	1	L261 AND (electrochromic WITH ITO)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L767	619774	((Zhao WITH Chen) OR (Jian WITH Wang) OR (Yan WITH Zhou)).in.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/01/16 06:04 AM
L768	166	L269 AND (Furcifer ADJ Inc)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/01/16 06:04 AM
L769	166	L270 AND electrochromic$1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/01/16 06:04 AM
L770	7	"20160259152"	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L771	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16

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							06:04 AM
L772	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L773	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L774	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L775	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L776	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L777	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L778	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L779	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L780	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L781	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L782	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L783	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L784	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L785	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L786	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L787	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L788	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L789	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM

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L790	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L791	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L792	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L793	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L794	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L795	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L796	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L797	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L798	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L799	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L800	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L801	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L802	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L803	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L804	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L805	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L806	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L807	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L808	11	L35 and (electrolyte	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16

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		with polymer with (salt$1 or matrix))					06:04 AM
L809	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L810	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L811	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L812	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L813	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L814	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L815	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L816	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L817	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L818	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L819	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L820	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L821	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L822	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM

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L823	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L824	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L825	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L826	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L827	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L828	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L829	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L830	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L831	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L832	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L833	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L834	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L835	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L836	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L837	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L838	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L839	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L840	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L841	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L842	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L843	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/01/16 06:04 AM

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			JPO; DERWENT; IBM_TDB)				
L844	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L845	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L846	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L847	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L848	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L849	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L850	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L851	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L852	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L853	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L854	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L855	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L856	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L857	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L858	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM

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L859	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L860	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L861	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L862	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L863	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L864	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L865	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L866	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L867	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L868	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L869	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L870	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L871	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L872	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L873	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L874	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM

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L875	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L876	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L877	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L878	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L879	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L880	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L881	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L882	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L883	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L884	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L885	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L886	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L887	9	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L888	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L889	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L890	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L891	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L892	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L893	90058	((zhao with chen) or (jian with wang) or (yan	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/01/16 06:04 AM

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		with zhou)).in.	JPO; DERWENT; IBM_TDB)				
L894	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L895	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L896	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L897	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L898	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L899	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L900	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L901	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L902	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L903	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L904	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L905	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L906	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L907	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L908	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L909	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM

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		(electrolyte$1) same (edge$1 with (protect$3 or seal$3))					
L910	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L911	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L912	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L913	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L914	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L915	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L916	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L917	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L918	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L919	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L920	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L921	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L922	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L923	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L924	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L925	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L926	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L927	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L928	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2025/01/16 06:04 AM

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			IBM_TDB)				
L929	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L930	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L931	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L932	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L933	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L934	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L935	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L936	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L937	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L938	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L939	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L940	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L941	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L942	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L943	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM

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L944	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L945	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L946	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L947	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L948	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L949	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L950	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L951	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L952	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L953	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L954	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L955	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L956	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L957	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L958	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L959	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L960	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L961	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L962	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM

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L963	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L964	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L965	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L966	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L967	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L968	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L969	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L970	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L971	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L972	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L973	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L974	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L975	90058	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L976	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L977	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L978	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L979	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L980	20	L26 or L27 or L28 or	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16

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		L29					06:04 AM
L981	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L982	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L983	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L984	5837	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L985	1048	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L986	16569	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L987	3896	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L988	11191	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L989	1980	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L990	31510	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L991	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L992	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L993	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L994	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L995	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16

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							06:04 AM
L996	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L997	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L998	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L999	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L1000	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L1001	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/01/16 06:04 AM
L1002	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1003	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L1004	9	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/01/16 06:04 AM
L1005	7	("20120013969"|"20130010347"|"20150323849"|"20160282645"|"20170298682"|"20170299932"|"5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1006	628	"5818625"	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1007	1	("5818625").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1008	1	L261 AND (seal$1 WITH epoxy)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1009	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva))	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1010	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate))	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM

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L1011	1	L261 AND (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1012	0	L261 AND (electrochromic WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1013	1	L261 AND (electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1014	1	L261 AND (electrochromic WITH ITO)	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1015	619774	((Zhao WITH Chen) OR (Jian WITH Wang) OR (Yan WITH Zhou)).in.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/01/16 06:04 AM
L1016	166	L269 AND (Furcifer ADJ Inc)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/01/16 06:04 AM
L1017	166	L270 AND electrochromic$1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/01/16 06:04 AM
L1018	7	"20160259152"	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1019	5	"18152033"	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM
L1020	9	("20160357082"|"20150301367"|"20120013969"|"20130010347"|"2015	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:04 AM

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		0323849"|"2016028264 5"|"20170298682"|"201 70299932"|"5818625"). PN.					
L1021	1	"18606980"	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:05 AM
L1022	10	("20120013969"|"20130 010347"|"20150301367 "|"20150323849"|"2016 0282645"|"2016035708 2"|"20170298682"|"201 70299932"|"5406414"|" 5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/01/16 06:06 AM
L1023	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1024	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1025	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1026	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1027	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1028	90367	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1029	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1030	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1031	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1032	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1033	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1034	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1035	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1036	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1037	5905	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1038	1058	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2025/05/18 09:54 PM

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			IBM_TDB)				
L1039	16749	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1040	3944	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1041	11260	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1042	1975	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1043	31781	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1044	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1045	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1046	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1047	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1048	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1049	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1050	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1051	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1052	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1053	90367	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1054	3	L26 and ("80" with	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18

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		conduct$3)					09:54 PM
L1055	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1056	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1057	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1058	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1059	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1060	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1061	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1062	5905	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1063	1058	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1064	16749	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1065	3944	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1066	11260	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1067	1975	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1068	31781	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1069	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM

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L1070	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1071	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1072	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1073	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1074	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1075	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1076	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1077	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1078	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1079	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1080	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1081	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1082	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1083	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1084	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1085	90367	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1086	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1087	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1088	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1089	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1090	20	L26 or L27 or L28 or	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18

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		L29					09:54 PM
L1091	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1092	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1093	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1094	5905	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1095	1058	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1096	16749	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1097	3944	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1098	11260	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1099	1975	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1100	31781	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1101	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1102	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1103	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1104	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1105	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18

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							09:54 PM
L1106	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1107	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1108	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1109	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1110	90367	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1111	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1112	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1113	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1114	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1115	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1116	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1117	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1118	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1119	5905	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1120	1058	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1121	16749	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1122	3944	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1123	11260	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM

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L1124	1975	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1125	31781	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1126	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1127	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1128	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1129	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1130	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1131	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1132	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1133	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1134	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1135	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1136	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1137	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/05/18 09:54 PM
L1138	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1139	9	L87 AND (electrochromic WITH	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/05/18 09:54 PM

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		film WITH edge WITH protect$3)	JPO; DERWENT; IBM_TDB)				
L1140	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1141	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1142	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1143	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1144	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1145	90367	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1146	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1147	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1148	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1149	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1150	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1151	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1152	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1153	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1154	5905	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1155	1058	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1156	16749	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1157	3944	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1158	11260	G02F2201/50	(US-PGPUB; USPAT;	OR	OFF	OFF	2025/05/18

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			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)				09:54 PM
L1159	1975	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1160	31781	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1161	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1162	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1163	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1164	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1165	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1166	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1167	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1168	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1169	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1170	90367	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1171	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1172	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1173	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1174	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1175	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM

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L1176	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1177	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1178	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1179	5905	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1180	1058	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1181	16749	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1182	3944	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1183	11260	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1184	1975	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1185	31781	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1186	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1187	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1188	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1189	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1190	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM

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L1191	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1192	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1193	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1194	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1195	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1196	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1197	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1198	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1199	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1200	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1201	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1202	90367	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1203	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1204	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1205	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1206	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1207	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1208	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1209	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1210	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1211	5905	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2025/05/18 09:54 PM

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			IBM_TDB)				
L1212	1058	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1213	16749	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1214	3944	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1215	11260	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1216	1975	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1217	31781	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1218	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1219	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1220	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1221	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1222	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1223	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1224	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1225	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1226	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1227	90367	((zhao with chen) or	(US-PGPUB; USPAT;	OR	OFF	OFF	2025/05/18

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		(jian with wang) or (yan with zhou)).in.	USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)				09:54 PM
L1228	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1229	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1230	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1231	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1232	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1233	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1234	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1235	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1236	5905	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1237	1058	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1238	16749	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1239	3944	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1240	11260	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1241	1975	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1242	31781	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1243	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2025/05/18 09:54 PM

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		or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	IBM_TDB)				
L1244	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1245	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1246	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1247	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1248	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1249	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1250	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1251	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1252	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1253	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/05/18 09:54 PM
L1254	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/05/18 09:54 PM
L1255	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1256	9	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/05/18 09:54 PM
L1257	7	("20120013969"|"20130010347"|"20150323849"|"20160282645"|"20170298682"|"20170299932"|"5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/05/18 09:54 PM
L1258	634	"5818625"	(US-PGPUB; USPAT)	OR	ON	ON	2025/05/18 09:54 PM
L1259	1	("5818625").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2025/05/18

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							09:54 PM
L1260	1	L261 AND (seal$1 WITH epoxy)	(US-PGPUB; USPAT)	OR	ON	ON	2025/05/18 09:54 PM
L1261	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva))	(US-PGPUB; USPAT)	OR	ON	ON	2025/05/18 09:54 PM
L1262	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate))	(US-PGPUB; USPAT)	OR	ON	ON	2025/05/18 09:54 PM
L2021	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2022	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2023	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2024	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2025	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2026	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2027	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2028	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2029	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2030	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2031	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2032	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2033	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2034	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2035	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2036	1066	G02F1/1508	(US-PGPUB; USPAT;	OR	OFF	OFF	2025/09/17

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			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)				12:24 AM
L2037	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2038	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2039	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2040	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2041	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2042	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2043	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2044	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2045	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2046	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2047	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2048	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2049	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2050	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2051	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM

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L2052	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2053	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2054	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2055	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2056	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2057	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2058	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2059	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2060	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2061	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2062	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2063	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2064	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2065	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2066	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2067	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM

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L2068	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2069	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2070	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2071	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2072	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2073	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2074	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2075	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2076	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2077	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2078	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2079	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2080	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2081	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2082	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2083	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2084	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2085	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2086	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2087	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2088	20	L26 or L27 or L28 or	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17

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		L29					12:24 AM
L2089	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2090	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2091	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2092	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2093	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2094	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2095	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2096	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2097	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2098	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2099	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2100	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2101	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2102	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2103	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17

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							12:24 AM
L2104	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2105	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2106	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2107	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2108	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2109	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2110	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2111	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2112	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2113	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2114	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2115	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2116	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2117	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2118	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2119	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2120	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2121	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM

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L2122	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2123	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2124	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2125	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2126	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2127	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2128	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2129	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2130	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2131	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2132	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2133	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2134	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2135	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2136	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2137	9	L87 AND (electrochromic WITH	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/09/17 12:24 AM

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		film WITH edge WITH protect$3)	JPO; DERWENT; IBM_TDB)				
L2138	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2139	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2140	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2141	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2142	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2143	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2144	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2145	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2146	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2147	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2148	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2149	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2150	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2151	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2152	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2153	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2154	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2155	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2156	11309	G02F2201/50	(US-PGPUB; USPAT;	OR	OFF	OFF	2025/09/17

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			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)				12:24 AM
L2157	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2158	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2159	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2160	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2161	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2162	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2163	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2164	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2165	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2166	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2167	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2168	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2169	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2170	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2171	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2172	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2173	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM

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L2174	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2175	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2176	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2177	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2178	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2179	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2180	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2181	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2182	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2183	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2184	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2185	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2186	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2187	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2188	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM

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L2189	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2190	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2191	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2192	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2193	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2194	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2195	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2196	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2197	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2198	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2199	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2200	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2201	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2202	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2203	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2204	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2205	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2206	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2207	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2208	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2209	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2025/09/17 12:24 AM

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			IBM_TDB)				
L2210	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2211	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2212	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2213	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2214	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2215	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2216	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2217	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2218	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2219	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2220	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2221	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2222	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2223	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2224	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2225	90713	((zhao with chen) or	(US-PGPUB; USPAT;	OR	OFF	OFF	2025/09/17

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		(jian with wang) or (yan with zhou)).in.	USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)				12:24 AM
L2226	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2227	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2228	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2229	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2230	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2231	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2232	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2233	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2234	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2235	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2236	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2237	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2238	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2239	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2240	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2241	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2025/09/17 12:24 AM

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		or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	IBM_TDB)				
L2242	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2243	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2244	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2245	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2246	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2247	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2248	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2249	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2250	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2251	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2252	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2253	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2254	9	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2255	7	("20120013969"|"20130010347"|"20150323849"|"20160282645"|"20170298682"|"20170299932"|"5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2256	636	"5818625"	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2257	1	("5818625").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17

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							12:24 AM
L2258	1	L261 AND (seal$1 WITH epoxy)	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2259	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva))	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2260	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate))	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2261	1	L261 AND (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate)	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2262	0	L261 AND (electrochromic WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2263	1	L261 AND (electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2264	1	L261 AND (electrochromic WITH ITO)	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2265	660791	((Zhao WITH Chen) OR (Jian WITH Wang) OR (Yan WITH Zhou)).in.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/09/17 12:24 AM
L2266	171	L269 AND (Furcifer ADJ Inc)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/09/17 12:24 AM
L2267	171	L270 AND electrochromic$1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY,	OR	ON	ON	2025/09/17 12:24 AM

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			CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L2268	7	"20160259152"	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2269	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2270	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2271	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2272	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2273	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2274	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2275	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2276	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2277	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2278	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2279	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2280	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2281	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2282	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2283	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2284	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2285	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/09/17 12:24 AM

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			JPO; DERWENT; IBM_TDB)				
L2286	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2287	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2288	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2289	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2290	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2291	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2292	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2293	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2294	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2295	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2296	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2297	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2298	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2299	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2300	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2301	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM

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L2302	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2303	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2304	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2305	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2306	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2307	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2308	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2309	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2310	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2311	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2312	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2313	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2314	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2315	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2316	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM

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L2317	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2318	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2319	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2320	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2321	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2322	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2323	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2324	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2325	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2326	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2327	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2328	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2329	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2330	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2331	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2332	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2333	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2334	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2335	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2336	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2337	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2338	11	L35 and (electrolyte	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17

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		with polymer with (salt$1 or matrix))					12:24 AM
L2339	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2340	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2341	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2342	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2343	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2344	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2345	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2346	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2347	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2348	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2349	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2350	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2351	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2352	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2353	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17

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							12:24 AM
L2354	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2355	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2356	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2357	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2358	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2359	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2360	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2361	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2362	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2363	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2364	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2365	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2366	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2367	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2368	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2369	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2370	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2371	32017	L39 or L40 or L41 or	(US-PGPUB; USPAT;	OR	OFF	OFF	2025/09/17

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		L42 or L43 or L44	USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)				12:24 AM
L2372	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2373	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2374	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2375	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2376	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2377	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2378	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2379	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2380	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2381	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2382	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2383	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2384	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2385	9	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2386	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM

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L2387	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2388	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2389	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2390	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2391	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2392	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2393	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2394	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2395	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2396	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2397	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2398	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2399	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2400	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2401	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2402	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2403	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2404	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2405	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/09/17 12:24 AM

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			JPO; DERWENT; IBM_TDB)				
L2406	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2407	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2408	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2409	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2410	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2411	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2412	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2413	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2414	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2415	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2416	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2417	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2418	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2419	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2420	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2421	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2422	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2423	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM

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L2424	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2425	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2426	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2427	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2428	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2429	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2430	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2431	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2432	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2433	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2434	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2435	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2436	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2437	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2438	6	L75 AND (protect$3 WITH (conduct$3 OR	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM

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		electric$4 OR electrode$1))					
L2439	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2440	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2441	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2442	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2443	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2444	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2445	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2446	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2447	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2448	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2449	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2450	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2451	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2452	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2453	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2454	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2455	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2456	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2457	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2458	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM

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L2459	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2460	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2461	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2462	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2463	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2464	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2465	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2466	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2467	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2468	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2469	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2470	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2471	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2472	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2473	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2474	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM

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L2475	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2476	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2477	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2478	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2479	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2480	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2481	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2482	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2483	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2484	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2485	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2486	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2487	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2488	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2489	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2490	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/09/17 12:24 AM

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			JPO; DERWENT; IBM_TDB)				
L2491	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2492	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2493	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2494	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2495	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2496	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2497	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2498	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2499	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2500	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2501	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2502	9	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2503	7	("20120013969"|"20130010347"|"20150323849"|"20160282645"|"20170298682"|"20170299932"|"5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2504	636	"5818625"	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2505	1	("5818625").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2506	1	L261 AND (seal$1 WITH epoxy)	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2507	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva))	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM

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L2508	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate))	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2509	1	L261 AND (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate)	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2510	0	L261 AND (electrochromic WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2511	1	L261 AND (electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2512	1	L261 AND (electrochromic WITH ITO)	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2513	660791	((Zhao WITH Chen) OR (Jian WITH Wang) OR (Yan WITH Zhou)).in.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/09/17 12:24 AM
L2514	171	L269 AND (Furcifer ADJ Inc)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/09/17 12:24 AM
L2515	171	L270 AND electrochromic$1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO;	OR	ON	ON	2025/09/17 12:24 AM

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			DERWENT; IBM_TDB)				
L2516	7	"20160259152"	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2517	5	"18152033"	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2518	9	("20160357082"|"20150301367"|"20120013969"|"20130010347"|"20150323849"|"20160282645"|"20170298682"|"20170299932"|"5818625"). PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2519	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2520	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2521	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2522	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2523	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2524	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2525	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2526	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2527	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2528	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2529	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2530	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2531	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2532	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2533	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2534	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2025/09/17 12:24 AM

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			IBM_TDB)				
L2535	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2536	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2537	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2538	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2539	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2540	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2541	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2542	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2543	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2544	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2545	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2546	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2547	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2548	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2549	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2550	3	L26 and ("80" with	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17

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		conduct$3)					12:24 AM
L2551	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2552	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2553	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2554	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2555	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2556	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2557	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2558	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2559	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2560	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2561	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2562	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2563	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2564	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2565	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM

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L2566	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2567	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2568	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2569	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2570	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2571	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2572	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2573	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2574	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2575	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2576	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2577	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2578	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2579	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2580	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2581	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2582	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2583	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2584	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2585	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2586	20	L26 or L27 or L28 or	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17

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		L29					12:24 AM
L2587	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2588	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2589	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2590	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2591	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2592	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2593	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2594	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2595	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2596	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2597	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2598	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2599	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2600	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2601	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17

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							12:24 AM
L2602	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2603	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2604	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2605	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2606	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2607	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2608	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2609	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2610	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2611	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2612	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2613	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2614	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2615	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2616	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2617	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2618	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2619	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM

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L2620	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2621	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2622	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2623	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2624	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2625	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2626	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2627	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2628	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2629	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2630	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2631	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2632	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2633	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2634	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2635	9	L87 AND (electrochromic WITH	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/09/17 12:24 AM

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		film WITH edge WITH protect$3)	JPO; DERWENT; IBM_TDB)				
L2636	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2637	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2638	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2639	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2640	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2641	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2642	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2643	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2644	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2645	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2646	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2647	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2648	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2649	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2650	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2651	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2652	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2653	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2654	11309	G02F2201/50	(US-PGPUB; USPAT;	OR	OFF	OFF	2025/09/17

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			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)				12:24 AM
L2655	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2656	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2657	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2658	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2659	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2660	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2661	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2662	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2663	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2664	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2665	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2666	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2667	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2668	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2669	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2670	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2671	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM

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L2672	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2673	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2674	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2675	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2676	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2677	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2678	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2679	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2680	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2681	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2682	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2683	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2684	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2685	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2686	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM

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L2687	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2688	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2689	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2690	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2691	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2692	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2693	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2694	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2695	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2696	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2697	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2698	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2699	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2700	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2701	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2702	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2703	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2704	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2705	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2706	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2707	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2025/09/17 12:24 AM

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			IBM_TDB)				
L2708	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2709	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2710	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2711	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2712	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2713	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2714	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2715	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2716	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2717	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2718	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2719	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2720	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2721	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2722	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2723	90713	((zhao with chen) or	(US-PGPUB; USPAT;	OR	OFF	OFF	2025/09/17

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		(jian with wang) or (yan with zhou)).in.	USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)				12:24 AM
L2724	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2725	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2726	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2727	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2728	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2729	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2730	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2731	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2732	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2733	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2734	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2735	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2736	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2737	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2738	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2739	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2025/09/17 12:24 AM

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		or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	IBM_TDB)				
L2740	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2741	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2742	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2743	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2744	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2745	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2746	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2747	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2748	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2749	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2750	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2751	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2752	9	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2753	7	("20120013969"|"20130010347"|"20150323849"|"20160282645"|"20170298682"|"20170299932"|"5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2754	636	"5818625"	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2755	1	("5818625").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17

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							12:24 AM
L2756	1	L261 AND (seal$1 WITH epoxy)	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2757	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva))	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2758	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate))	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2759	1	L261 AND (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate)	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2760	0	L261 AND (electrochromic WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2761	1	L261 AND (electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2762	1	L261 AND (electrochromic WITH ITO)	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2763	660791	((Zhao WITH Chen) OR (Jian WITH Wang) OR (Yan WITH Zhou)).in.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/09/17 12:24 AM
L2764	171	L269 AND (Furcifer ADJ Inc)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/09/17 12:24 AM
L2765	171	L270 AND electrochromic$1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY,	OR	ON	ON	2025/09/17 12:24 AM

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			CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L2766	7	"20160259152"	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2767	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2768	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2769	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2770	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2771	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2772	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2773	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2774	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2775	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2776	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2777	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2778	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2779	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2780	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2781	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2782	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2783	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/09/17 12:24 AM

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			JPO; DERWENT; IBM_TDB)				
L2784	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2785	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2786	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2787	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2788	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2789	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2790	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2791	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2792	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2793	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2794	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2795	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2796	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2797	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2798	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2799	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM

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L2800	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2801	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2802	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2803	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2804	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2805	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2806	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2807	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2808	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2809	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2810	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2811	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2812	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2813	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2814	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM

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L2815	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2816	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2817	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2818	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2819	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2820	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2821	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2822	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2823	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2824	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2825	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2826	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2827	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2828	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2829	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2830	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2831	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2832	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2833	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2834	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2835	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2836	11	L35 and (electrolyte	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17

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		with polymer with (salt$1 or matrix))					12:24 AM
L2837	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2838	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2839	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2840	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2841	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2842	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2843	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2844	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2845	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2846	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2847	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2848	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2849	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2850	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2851	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17

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							12:24 AM
L2852	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2853	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2854	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2855	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2856	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2857	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2858	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2859	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2860	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2861	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2862	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2863	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2864	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2865	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2866	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2867	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2868	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2869	32017	L39 or L40 or L41 or	(US-PGPUB; USPAT;	OR	OFF	OFF	2025/09/17

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		L42 or L43 or L44	USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)				12:24 AM
L2870	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2871	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2872	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2873	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2874	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2875	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2876	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2877	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2878	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2879	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2880	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2881	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2882	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2883	9	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2884	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM

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L2885	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2886	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2887	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2888	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2889	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2890	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2891	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2892	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2893	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2894	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2895	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2896	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2897	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2898	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2899	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2900	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2901	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2902	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2903	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/09/17 12:24 AM

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			JPO; DERWENT; IBM_TDB)				
L2904	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2905	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2906	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2907	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2908	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2909	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2910	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2911	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2912	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2913	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2914	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2915	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2916	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2917	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2918	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2919	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2920	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2921	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM

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L2922	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2923	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2924	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2925	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2926	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2927	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2928	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2929	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2930	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2931	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2932	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2933	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2934	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2935	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2936	6	L75 AND (protect$3 WITH (conduct$3 OR	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM

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		electric$4 OR electrode$1))					
L2937	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2938	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2939	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2940	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2941	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2942	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2943	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2944	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2945	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2946	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2947	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2948	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2949	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2950	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2951	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2952	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2953	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2954	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2955	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2956	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM

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L2957	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2958	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2959	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2960	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2961	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2962	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2963	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2964	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2965	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2966	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2967	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2968	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2969	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2970	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2971	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2972	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM

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L2973	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2974	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2975	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2976	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2977	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2978	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2979	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2980	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2981	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2982	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2983	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2984	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2985	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2986	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2987	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L2988	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/09/17 12:24 AM

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			JPO; DERWENT; IBM_TDB)				
L2989	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2990	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2991	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2992	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2993	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2994	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2995	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2996	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2997	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L2998	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L2999	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3000	9	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3001	7	("20120013969"|"20130010347"|"20150323849"|"20160282645"|"20170298682"|"20170299932"|"5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L3002	636	"5818625"	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L3003	1	("5818625").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L3004	1	L261 AND (seal$1 WITH epoxy)	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L3005	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva))	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM

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L3006	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate))	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L3007	1	L261 AND (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate)	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L3008	0	L261 AND (electrochromic WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L3009	1	L261 AND (electrolyte$1)	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L3010	1	L261 AND (electrochromic WITH ITO)	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L3011	660791	((Zhao WITH Chen) OR (Jian WITH Wang) OR (Yan WITH Zhou)).in.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/09/17 12:24 AM
L3012	171	L269 AND (Furcifer ADJ Inc)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2025/09/17 12:24 AM
L3013	171	L270 AND electrochromic$1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO); FPRS; EPO; JPO;	OR	ON	ON	2025/09/17 12:24 AM

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			DERWENT; IBM_TDB)				
L3014	7	"20160259152"	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L3015	5	"18152033"	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L3016	9	("20160357082"|"20150301367"|"20120013969"|"20130010347"|"20150323849"|"20160282645"|"20170298682"|"20170299932"|"5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L3017	1	"18606980"	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L3018	10	("20120013969"|"20130010347"|"20150301367"|"20150323849"|"20160282645"|"20160357082"|"20170298682"|"20170299932"|"5406414"|"5818625").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L3019	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3020	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3021	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3022	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3023	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3024	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3025	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3026	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3027	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3028	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3029	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3030	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3031	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM

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L3032	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3033	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3034	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3035	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3036	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3037	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3038	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3039	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3040	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3041	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3042	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3043	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3044	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3045	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3046	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3047	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17

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							12:24 AM
L3048	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3049	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3050	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3051	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3052	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3053	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3054	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3055	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3056	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3057	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3058	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3059	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3060	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3061	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3062	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3063	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3064	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2025/09/17 12:24 AM

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			IBM_TDB)				
L3065	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3066	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3067	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3068	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3069	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3070	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3071	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3072	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3073	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3074	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3075	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3076	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3077	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3078	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3079	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3080	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3081	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3082	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM

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L3083	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3084	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3085	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3086	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3087	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3088	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3089	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3090	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3091	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3092	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3093	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3094	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3095	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3096	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3097	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3098	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	OFF	OFF	2025/09/17 12:24 AM

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			JPO; DERWENT; IBM_TDB)				
L3099	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3100	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3101	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3102	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3103	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3104	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3105	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3106	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3107	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3108	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3109	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3110	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3111	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3112	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3113	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3114	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3115	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3116	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3117	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM

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L3118	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3119	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3120	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3121	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3122	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3123	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3124	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3125	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3126	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3127	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3128	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3129	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3130	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3131	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3132	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3133	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM

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		645"|"20170298682"|"20170299932").PN.					
L3134	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3135	9	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3136	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3137	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3138	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3139	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3140	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3141	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3142	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3143	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3144	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3145	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3146	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3147	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3148	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3149	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3150	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3151	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3152	16917	G02F1/153	(US-PGPUB; USPAT;	OR	OFF	OFF	2025/09/17

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			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)				12:24 AM
L3153	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3154	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3155	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3156	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3157	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3158	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3159	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3160	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3161	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3162	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3163	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3164	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3165	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3166	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3167	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3168	3	L26 and (protective with	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17

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		layer$1 with conduct$3)					12:24 AM
L3169	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3170	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3171	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3172	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3173	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3174	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3175	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3176	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3177	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3178	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3179	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3180	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3181	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3182	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3183	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	OFF	2025/09/17 12:24 AM

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			IBM_TDB)				
L3184	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3185	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3186	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3187	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3188	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3189	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3190	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3191	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3192	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3193	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3194	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3195	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3196	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3197	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3198	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3199	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3200	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3201	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3202	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3203	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3204	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM

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L3205	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3206	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3207	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3208	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3209	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3210	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3211	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3212	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3213	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3214	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3215	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3216	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3217	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3218	7	"16190723"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3219	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM

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L3220	7	"20160282645"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3221	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3222	8	"20170299932"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3223	90713	((zhao with chen) or (jian with wang) or (yan with zhou)).in.	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3224	3	L26 and ("80" with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3225	3	L26 and (protective with layer$1 with conduct$3)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3226	5	L26 and (polyvinyl or polyurethane or ethylene)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3227	3	L26 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3228	20	L26 or L27 or L28 or L29	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3229	11	L35 and (electrolyte with polymer)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3230	11	L35 and (electrolyte with polymer with (salt$1 or matrix))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3231	10	L35 and (pvs or tpu or eva)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3232	5937	G02F1/1533	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3233	1066	G02F1/1508	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3234	16917	G02F1/153	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3235	3976	G02F1/161	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3236	11309	G02F2201/50	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3237	1974	G02F2001/1536	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM

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L3238	32017	L39 or L40 or L41 or L42 or L43 or L44	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3239	39	(electrochrom$5) same (electrode$1) same (charg$3 or storage$1 or batter$3) same (electrolyte$1) same (edge$1 with (protect$3 or seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3240	35	L45 and L46	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3241	3	L26 and (protective with layer$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3242	7	L25 and (edge with protect$3 with electrode$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3243	7	"20130010347"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3244	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3245	6	L75 AND (protect$3 WITH (conduct$3 OR electric$4 OR electrode$1))	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3246	5	L75 AND (solid WITH electrolyte$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3247	3	L75 AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3248	9	"20170298682"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3249	9	"20170298682" AND (electrolyte$1 WITH salt$1)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:24 AM
L3250	7	("20120013969"|"20150323849"|"5818625"|"20130010347"|"20160282645"|"20170298682"|"20170299932").PN.	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L3251	35	L127 AND L128	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3252	9	L87 AND (electrochromic WITH film WITH edge WITH protect$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:24 AM
L3253	7	("20120013969"|"20130010347"|"20150323849	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM

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		"|"20160282645"|"20170298682"|"201702999 32"|"5818625").PN.					
L3254	636	"5818625"	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L3255	1	("5818625").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L3256	1	L261 AND (seal$1 WITH epoxy)	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L3257	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva))	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L3258	0	L261 AND (seal$1 WITH (pvs OR tpu OR eva OR polyvinyl OR siloxane OR thermoplastic OR polyurethane OR ethylene OR vinyl OR acetate))	(US-PGPUB; USPAT)	OR	ON	ON	2025/09/17 12:24 AM
L3259	1	"18606980"	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:31 AM
L3260	11	("20040067343"|"20120013969"|"20130010347"|"20150301367"|"20150323849"|"20160282645"|"20160357082"|"20170298682"|"20170299932"|"5406414"|"5818625").PN.	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17 12:33 AM
L3261	192	(electrochrom$5) SAME (electrode$1) SAME (electrolyte$1) SAME (edge$1 WITH (protect$3 OR seal$3))	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:36 AM
L3262	4	(electrochrom$5) SAME (electrode$1) SAME (electrolyte$1) SAME (edge$1 WITH protect$3 WITH seal$3)	(US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	OFF	OFF	2025/09/17 12:36 AM

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N1	3	((electrochrom$5) SAME (electrode$1) SAME (charg$3 OR storage$1 OR batter$3) SAME (electrolyte$1) SAME (edge$1 WITH (protect$3 OR seal$3))).clm.	(US-PGPUB; USPAT)	OR	OFF	OFF	2022/09/30 02:00 AM
N2	0	((electrochrom$5)	(US-PGPUB; USPAT)	OR	OFF	OFF	2025/09/17

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		SAME (electrode$1) SAME (electrolyte$1) SAME (edge$1 WITH protect$3 WITH seal$3)).clm.					12:36 AM

PE2E SEARCH - Search History (Similarity Search)

No Similarity Results available

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/606,980	**11/19/2025 01:58:49 PM Z ET**	**50WF-383698-US**

Title of Invention

ELECTROCHROMIC FILMS WITH EDGE PROTECTION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9999	FILED BY	Chizu Fong
PATENT CENTER #	73246703	FILING DATE	03/15/2024
CUSTOMER #	139780	FIRST NAMED INVENTOR	Zhao CHEN
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	PJ Shang

Documents

TOTAL DOCUMENTS: 1

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
Furcifer12USC3_50WF-383698-US_IssueFeeTransmittal-FINAL.pdf	1	Issue Fee Payment (PTO-85B)	214 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
Furcifer12USC3_50WF-383698-US_IssueFeeTransmittal-FINAL.pdf	89A6F164B64041E924AA517899890152EB44468A5B7FA1CDC5C97F561BFEBF4F9657F9E8CCB3849E87BDE13BAEE49850501E03570057EC0F758D2FE0889FC242

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via the USPTO patent electronic filing system.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

139780 7590 09/30/2025
Sheppard Mullin Richter & Hampton LLP
Weiguo Chen
650 Town Center Drive, 10th Floor
Costa Mesa, CA 92626

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via the USPTO patent electronic filing system or by facsimile to (571) 273-2885, on the date below.

Chizu Fong	(Typed or printed name)
/Chizu Fong/	(Signature)
November 19, 2025	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/606,980	03/15/2024	Zhao CHEN	50WF-383698-US	9999

TITLE OF INVENTION: ELECTROCHROMIC FILMS WITH EDGE PROTECTION

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$516	$0.00	$0.00	$516	12/30/2025

EXAMINER	ART UNIT	CLASS-SUBCLASS
DINH, JACK	2872	359-265000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Sheppard Mullin Richter & Hampton LLP
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: LannRay Optoelectronics (Zhenjiang) Co. Ltd.

(B) RESIDENCE: (CITY and STATE OR COUNTRY): YANGZHONG CITY, ZHENJIANG CITY, CHINA

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☒ Issue Fee ☐ Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via the USPTO patent electronic filing system ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 504561

5. **Change in Entity Status** (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

☐ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

☐ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature: Pengju Shang — Date: November 19, 2025

Typed or printed name: Pengju Shang — Registration No.: 80050

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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/606,980	**11/19/2025 01:59:40 PM Z ET**	**50WF-383698-US**

Title of Invention

ELECTROCHROMIC FILMS WITH EDGE PROTECTION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9999	FILED BY	Chizu Fong
PATENT CENTER #	73246371	AUTHORIZED BY	PJ Shang
CUSTOMER #	139780	FILING DATE	03/15/2024
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Zhao CHEN

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
DA / 504561	**E2025AID59586612**	**Chizu Fong**

PRE-AUTHORIZED ACCOUNT	PRE-AUTHORIZED CATEGORY
504561	**37 CFR 1.16 (National application filing, search, and examination fees); 37 CFR 1.17 (Patent application and reexamination processing fees); 37 CFR 1.19 (Document supply fees); 37 CFR 1.20 (Post Issuance fees); 37 CFR 1.21 (Miscellaneous fees and charges)**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
2501	UTILITY ISSUE FEE	516.00	1	516.00
			TOTAL AMOUNT:	**$516.00**

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement

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Ambilight v. Lannray PGR2026-00053

Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/606,980	**11/19/2025 01:59:40 PM Z ET**	**50WF-383698-US**

Title of Invention

ELECTROCHROMIC FILMS WITH EDGE PROTECTION

Application Information

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CONFIRMATION #	9999	FILED BY	Chizu Fong
PATENT CENTER #	73246371	FILING DATE	03/15/2024
CUSTOMER #	139780	FIRST NAMED INVENTOR	Zhao CHEN
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	PJ Shang

Documents

TOTAL DOCUMENTS: 0

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)

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New Applications Under 35 U.S.C. 111

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If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage

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Ambilight v. Lannray PGR2026-00053

submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/606,980	12/23/2025	12502870	50WF-383698-US	9999

139780 7590 12/10/2025

Sheppard Mullin Richter & Hampton LLP
Weiguo Chen
650 Town Center Drive, 10th Floor
Costa Mesa, CA 92626

ISSUE NOTIFICATION

The projected patent number and issue date are specified above. The patent will issue electronically. The electronically issued patent is the official patent grant pursuant to 35 U.S.C. § 153. The patent may be accessed on or after the issue date through Patent Center at https://patentcenter.uspto.gov/. The patent will be available in both the public and the private sides of Patent Center. Further assistance in electronically accessing the patent, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-888-217-9197.

The USPTO is implementing electronic patent issuance with a transition period, during which period the USPTO will mail a ceremonial paper copy of the electronic patent grant to the correspondence address of record. Additional copies of the patent (i.e., certified and presentation copies) may be ordered for a fee from the USPTO's Certified Copy Center at https://certifiedcopycenter.uspto.gov/index.html. The Certified Copy Center may be reached at (800)972-6382.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Center (https://patentcenter.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Patents Stakeholder Experience (OPSE), Stakeholder Support Division (SSD) at (571)-272-4200.

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Ambilight v. Lannray PGR2026-00053

INVENTOR(s) (Please see PATENT CENTER site https://patentcenter.uspto.gov for additional inventors):

Zhao CHEN, Camarillo, CA;
Jian WANG, Fremont, CA;
Yan ZHOU, Fremont, CA;

APPLICANT(s) (Please see PATENT CENTER site https://patentcenter.uspto.gov for additional applicants):

LannRay Optoelectronics (Zhenjiang) Co. Ltd., Yangzhong City, CHINA;

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Ambilight v. Lannray PGR2026-00053

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/606,980	03/15/2024	Zhao CHEN	50WF-383698-US	9999

139780 7590 12/23/2025

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Weiguo Chen
650 Town Center Drive, 10th Floor
Costa Mesa, CA 92626

EXAMINER
DINH, JACK

ART UNIT	PAPER NUMBER
2872	

NOTIFICATION DATE	DELIVERY MODE
12/23/2025	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

SheppardMullin_Pair@firsttofile.com
svpatents@sheppardmullin.com
wchen@sheppardmullin.com

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Ambilight v. Lannray PGR2026-00053

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APPLICATION NO.	ISSUE DATE	PATENT NO.
18/606,980	23-Dec-2025	12502870

Sheppard Mullin Richter & Hampton LLP
Weiguo Chen
Costa Mesa, CA 92626

EGRANT NOTIFICATION

Your electronic patent grant (eGrant) is now available, which can be accessed via Patent Center at https://patentcenter.uspto.gov

The electronic patent grant is the official patent grant under 35 U.S.C. 153. For more information, please visit https://www.uspto.gov/electronicgrants

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Ambilight v. Lannray PGR2026-00053