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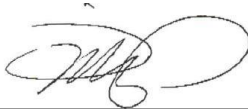
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I certify under penalty of perjury that the foregoing is true and correct.

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(54) [Title of the Invention] PATTERN FORMING METHOD, DEVICE, ELECTRONIC APPARATUS, AND
DEVICE MANUFACTURING METHOD

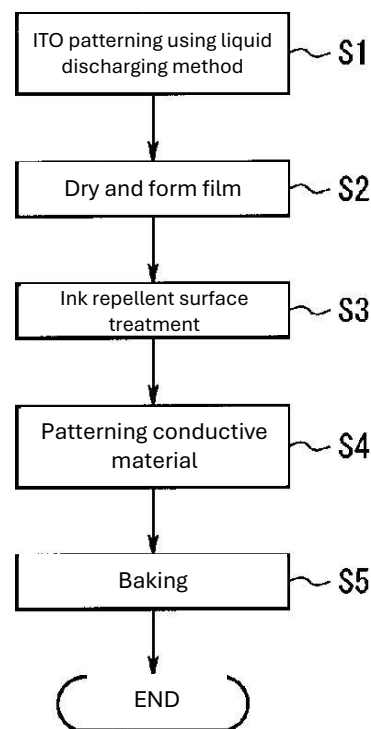
(57) ABSTRACT

[PROBLEM]

To provide a pattern forming method, a device, an
electronic apparatus, and a method for manufacturing a
device, which are capable of reducing waste in the
manufacturing process.

[RESOLUTION MEANS]

A liquid or fluid containing indium tin oxide (ITO) is
discharged from an inkjet head of a droplet discharging
device onto a desired position on a substrate, thereby
patterning the indium tin oxide on the substrate (step S1).



What is claimed is:

[Claim 1] A pattern forming method for forming a wiring pattern at a prescribed location on a substrate, the pattern forming method comprising: forming a wiring pattern by discharging a liquid containing a conductive material by a droplet discharging device.

[Claim 2] The pattern forming method according to claim 1, wherein the conductive material includes indium tin oxide.

[Claim 3] A method for manufacturing a device in which a wiring pattern made of a conductive material is formed at a prescribed location on a substrate, comprising: a transparent conductive film forming step of forming a transparent conductive film at a prescribed location on the substrate by a droplet discharging device; a liquid repellency treatment step of subjecting a transparent conductive film surface to a liquid repellency treatment; a wiring pattern forming step of forming a wiring pattern on the transparent conductive film; and a baking step of baking the wiring pattern and the transparent conductive film.

[Claim 4] The method for manufacturing a device according to claim 3, wherein the liquid repellency treatment step includes subjecting the surface of the transparent conductive film to a liquid repellency treatment using a fluororesin polymer film.

[Claim 5] The method for manufacturing a device according to claim 3 or 4, wherein the wiring pattern is formed by discharging a liquid material containing metal fine particles using a droplet discharging device in the wiring pattern forming step.

[Claim 6] The method for manufacturing a device according to claims 3 to 5, wherein, before the wiring pattern forming step, a region of the transparent conductive film where the wiring pattern is formed is subjected to a lyophilic treatment.

[Claim 7] The method for manufacturing a device according to any one of claims 3 to 6, wherein the width of the transparent conductive film is wider than the width of the wiring pattern.

[Claim 8] A device, comprising: a substrate on which wiring is formed using the pattern forming method according to claim 1 or 2.

[Claim 9] An electronic apparatus, comprising: the device according to claim 8.

DETAILED DESCRIPTION OF THE INVENTION

[0001]

TECHNICAL FIELD

The present invention relates to a pattern forming method having a step of forming a prescribed conductive pattern on a substrate, a device, electronic apparatus, and a method for manufacturing a device, and in particular to a method for manufacturing using a droplet discharging system.

[0002]

CONVENTIONAL TECHNOLOGY

Conventionally, a method for providing a conductive pattern forming an electrode or wiring pattern on a substrate directly forms a conductive pattern on the substrate by photolithography and etching. In this conventional method, first, a thin film made of a conductive material such as copper foil or the like is formed over the entire surface of the substrate. Next, a photosensitive film (photoresist film) is

applied and formed over the entire thin film of the conductive material, and a desired electrode or wiring pattern is transferred onto the photosensitive film by photolithography. Next, the photosensitive film and the thin film are removed except for the exposed pattern portion using an etching solution (such as an aqueous solution of ferric oxide), thereby forming a conductive pattern with a desired shape on the substrate.

[0003]

PROBLEMS TO BE SOLVED BY THE INVENTION

However, with the conventional method of providing a conductive pattern, most of the conductive material formed over the entire surface of the substrate (other than the conductive pattern portion) must be removed by etching, and the removed conductive material is wasted in the manufacturing process. Furthermore, the conventional method of providing a conductive pattern requires a photomask to be used in the photolithography process, which lengthens the manufacturing process and requires that a photomask be made each time the model of the conductive pattern is changed, resulting in increased manufacturing costs and a longer manufacturing period. Furthermore, conventional conductive patterns have the problem that even a single break in the wiring of the conductive pattern provided on the substrate means that the prescribed function cannot be achieved.

[0004] An object of the present invention is to provide a pattern forming method, a device, electronic apparatus, and a method for manufacturing a device, which can reduce waste and eliminate disconnections in the manufacturing process related to a substrate.

[0005]

MEANS FOR SOLVING THE PROBLEM

In order to achieve the aforementioned object, the pattern forming method of the present invention is a pattern forming method for forming a wiring pattern at a prescribed location on a substrate, wherein the wiring pattern is formed by discharging a liquid containing a conductive material using a droplet discharging device. With this method, the transparent electrode material is discharged only onto the portion of the substrate where the conductive pattern is to be formed. On the other hand, when a conductive pattern is formed by photolithography, etching, or the like, a transparent electrode material must first be provided over the entire surface of the substrate. Therefore, with the method of the present invention, the amount of transparent electrode material wasted in the manufacturing process can be significantly reduced compared to a conventional method. Furthermore, with this method, there is no need to create a photomask, so the manufacturing time required for forming a conductive pattern of a transparent electrode or the like can be shortened, and manufacturing costs can be reduced.

[0006] Furthermore, in the pattern forming method of the present invention, the conductive material preferably contains indium tin oxide. With this method, indium tin oxide is discharged only in the area of the substrate where a conductive pattern is to be formed, so it is possible to significantly reduce the amount of indium tin oxide wasted in the manufacturing process as compared to the conventional method.

Furthermore, with this method, there is no need to create a photomask, so the manufacturing time required for forming a conductive pattern of a transparent electrode or the like can be shortened, and manufacturing costs can be reduced.

[0007] Furthermore, the method for manufacturing a device of the present invention in which a wiring pattern made of a conductive material is formed at a prescribed location on a substrate, includes: a transparent conductive film forming step of forming a transparent conductive film at a prescribed location on the substrate by a droplet discharging device; a liquid repellency treatment step of subjecting a transparent conductive film surface to a liquid repellency treatment; a wiring pattern forming step of forming a wiring pattern on the transparent conductive film; and a baking step of baking the wiring pattern and the transparent conductive film. With this method, the transparent electrode material is discharged only onto the portion of the substrate where a conductive pattern that will become a structural element of the device is to be formed. On the other hand, when a conductive pattern is formed by photolithography, etching, or the like, a transparent electrode material must first be provided over the entire surface of the substrate. Therefore, with the method of the present invention, the amount of transparent electrode material wasted in the device manufacturing process can be significantly reduced as compared to a conventional method. Furthermore, with this method, there is no need to create a photomask, so the manufacturing time required for forming a conductive pattern of a transparent electrode or the like in a device can be shortened, and manufacturing costs can be reduced.

[0008] In the device manufacturing method of the present invention, the liquid repellency treatment step preferably includes performing a liquid repellency treatment on the surface of the transparent conductive film using a fluororesin polymer film.

[0009] In the device manufacturing method of the present invention, the wiring pattern in the wiring pattern forming step is preferably formed by discharging a liquid material containing metal fine particles using a droplet discharging device. With this method, a liquid containing metal fine particles is only discharged onto the area of the substrate where a wiring pattern is to be formed, which will become a structural element part of the device, thereby significantly reducing waste of metal fine particles during the manufacturing process.

[0010] Furthermore, during manufacturing of the device of the present invention, a portion of the transparent conductive film where the wiring pattern is to be formed is preferably subjected to a lyophilic treatment, prior to the wiring pattern forming step. With this method, a more precise wiring pattern can be easily produced.

[0011] With the device manufacturing method of the present invention, the width of the transparent conductive film is preferably wider than the width of the wiring pattern. With this method, disconnection of the conductive pattern can be easily prevented.

[0012] Furthermore, the device according to the present invention has a substrate on which wiring is formed using the pattern forming method. With the present invention, the device manufacturing period and manufacturing costs can be reduced.

[0013] Moreover, an electronic apparatus according to the present invention includes the aforementioned device. With the present invention, manufacturing defects can be reduced while reducing the manufacturing costs of the electronic apparatus.

[0014]

EMBODIMENTS OF THE INVENTION

Hereinafter, a method for manufacturing an electrode wiring pattern according to the present invention will be described with reference to the drawings. With the present invention, transparent electrodes and the like are provided by applying indium tin oxide (ITO) or the like to a substrate using a droplet discharging method, but the present invention is not limited to this, and transparent electrodes and the like may also be provided by applying a material other than indium tin oxide to a substrate using the droplet discharging method. Moreover, examples of wiring pattern materials for components other than transparent electrodes include liquids containing conductive fine particles. Examples of conductive fine particles include metal fine particles containing any of gold, silver, copper, palladium, and nickel, as well as conductive polymers, superconductor fine particles, and the like. The conductive fine particles can be used by coating the surface with an organic material or the like in order to improve dispersibility. Examples of the coating material that is applied to the surface of the conductive fine particles include organic solvents such as xylene, toluene, citric acid, or the like. The dispersion medium for the liquid containing the conductive fine particles is not particularly limited as long as dispersion of the conductive fine particles is possible, and aggregation is not induced. Examples of the solvent include, in addition to water, alcohols such as methanol, ethanol, propanol, and butanol; hydrocarbon compounds such as n-heptane, n-octane, decane, toluene, xylene, cymene, durene, indene, dipentene, tetrahydronaphthalene, decahydronaphthalene, and cyclohexylbenzene; ether compounds such as ethylene glycol dimethyl ether, ethylene glycol diethyl ether, ethylene glycol methyl ethyl ether, diethylene glycol dimethyl ether, diethylene glycol diethyl ether, diethylene glycol methyl ethyl ether, 1,2-dimethoxyethane, bis(2-methoxyethyl)ether, and p-dioxane; and polar compounds such as propylene carbonate, γ -butyrolactone, N-methyl-2-pyrrolidone, dimethylformamide, dimethylsulfoxide, and cyclohexanone, and the like. Of these, water, alcohols, hydrocarbon-based compounds, and ether-based compounds are preferred from the perspective of the dispersibility of the microparticles, the stability of the dispersion liquid, and the ease of application to the droplet discharging device of the present invention, and more preferred dispersion media include water and hydrocarbon-based compounds. These dispersion media may be used alone or in combination of two or more.

[0015] FIG. 1 is a process diagram depicting a method for manufacturing an electrode wiring pattern according to the present embodiment. First, a liquid, such as a liquid containing indium tin oxide (ITO), is discharged from an inkjet head of a droplet discharging device (inkjet device, not depicted) onto a desired location on a substrate, thereby patterning the indium tin oxide on the substrate (step S1).

The indium tin oxide patterned on this substrate may be used to form, for example, a transparent electrode in an electro-optical device such as a plasma display panel (PDP), an organic EL device (organic electroluminescence device), or a liquid crystal display (LCD), or may be used to form an electrode, wiring, or conductive film in other devices.

[0016] In the manufacturing method of the electrode wiring pattern in step S1, indium tin oxide is discharged only onto the portions of the substrate where transparent electrodes or the like are to be formed, so there is no need to remove indium tin oxide by photolithography or etching, and waste of indium tin oxide and the like in the manufacturing process can be significantly reduced compared to conventional methods. Furthermore, with the above method, there is no need to prepare a photomask, so the manufacturing time required for forming a transparent electrode or the like can be shortened, and manufacturing costs can be reduced. These effects can be achieved without performing steps S3 to S5 below.

[0017] Next, the indium tin oxide is left in a patterned state on the substrate for a prescribed period of time, whereby the patterned indium tin oxide is dried to form a film on the substrate (step S2). If necessary, the drying may be performed by heating.

[0018] Next, a liquid repellency treatment is applied to the surface of the substrate including the indium tin oxide film formed in step S2 (step S3). This liquid repellency treatment is a treatment for controlling the liquid repellency of the surface of a substrate containing indium tin oxide so that a conductive material will not wet and spread when the material is applied in a later process. Note that instead of carrying out the liquid repellency treatment in step S3, the liquid repellency of the indium tin oxide droplets discharged in step S1 may be enhanced. Moreover, instead of the indium tin oxide droplets discharged in step S1, a transparent electrode material having strong liquid repellency may be used without performing the liquid repellency treatment in step S3. Here, the liquid repellency treatment in step S3 uses a liquid organic substance containing a linear PFC such as C_6F_{10} , C_8F_{18} , or the like as a raw material liquid for the liquid repellency treatment, and forms a fluororesin polymer film having liquid repellency on the surface of the indium tin oxide film. In other words, the liquid organic matter of the linear PFC is heated by a heater or the like and gasified. When the gas is turned into plasma, the linear PFC becomes active, and the active PFC gas that reaches the surface of the indium tin oxide film polymerizes, forming a fluororesin polymerized film on the surface of the indium tin oxide film. The processing gas is not limited to this, and other fluorocarbon gases and fluorine-containing gases can be used. Furthermore, prior to the liquid repellency treatment, a plasma treatment using a fluorine-containing gas or oxygen gas as a treatment gas may be performed when discharging indium tin oxide. Lower electrical resistance and higher light transmittance of the indium tin oxide coating are more preferable. The electrical resistance and light transmittance can be adjusted by adjusting the proportion of the oxide contained therein. In general, a higher oxide ratio results in a higher light transmittance, and a lower oxide ratio results in a lower electrical resistance. Furthermore, if fluorine

radicals are introduced during the formation of the indium tin oxide film by a droplet discharging device, the proportion of oxide decreases, and the electrical resistance value decreases. Furthermore, if ozone radicals are introduced, the proportion of oxides increases, and the light transmittance increases. More specifically, for example, carbon tetrafluoride (CF_4) gas or oxygen gas is activated by gas discharge to generate activated species such as fluorine radicals or ozone radicals. Furthermore, the generated fluorine radicals or ozone radicals are then made to flow out from active species introducing means provided in liquid discharging means through an introduction pipe toward the discharge region of indium tin oxide. Thereby, the film quality can be improved, such as by lowering the resistance of the indium tin oxide film, by using carbon tetrafluoride gas and oxygen gas, or the like, as reactive gases. Incidentally, the gas injecting means has been described as being provided in the droplet discharging device, but a configuration with separate entities is possible, and operations thereof may be controlled separately. Furthermore, before applying the fluororesin polymer film to the surface of the indium tin oxide film formed in step S2, the surface of the indium tin oxide film may be modified in advance by means of, for example, ultraviolet light or electron beams. Thereby, adhesion to the fluororesin polymer film can be improved.

[0019] Next, a conductive material such as a metal is patterned on the indium tin oxide film that has been subjected to the liquid repellency treatment in step S3 (step S4). Here, the width of the conductive material is made smaller than the width of the indium tin oxide. In other words, a film of indium tin oxide is used as a base, and a conductive material is provided on the base and patterned. Furthermore, patterning of a conductive material on the indium tin oxide is performed using a method in which a liquid or fluid containing a conductive material is discharged onto the indium tin oxide from an inkjet head of a droplet discharging device. The portion of the liquid repellent indium tin oxide film where the conductive material is to be patterned may be subjected to a lyophilic treatment beforehand. Specifically, in step S3, the portion of the fluororesin polymer film formed on the indium tin oxide film where the conductive material is to be patterned is irradiated with ultraviolet light in advance. Therefore, the ultraviolet light breaks the bonds of the polymer film, and the polymer film formed in the pattern forming portion is removed, thereby imparting lyophilicity. The means for imparting lyophilicity is not limited to ultraviolet light. For example, ozone radicals may be used as the active species introducing means used in step S3.

[0020] As a result, similar to the effect achieved in step S1 above, the conductive material needs to be discharged only onto the desired areas on the indium tin oxide, eliminating the need to remove the conductive material by photolithography or etching, and making it possible to significantly reduce waste of conductive material in the manufacturing process compared to conventional methods. Furthermore, with the above method, there is no need to prepare a photomask, so the manufacturing process can be shortened and manufacturing costs can be reduced.

[0021] Next, in step S4, the conductive material is patterned on the indium tin oxide film, and in that state, a high temperature heat treatment, referred to as “baking”, is performed (step S5).

[0022] As a result, a conductive pattern is formed on the indium tin oxide film as an underlayer. Therefore, even if there is a disconnection in the conductive pattern, a transparent conductive film made of indium tin oxide is formed underneath the conductive pattern, so the pattern remains connected as wiring on the substrate and can perform the prescribed function on the substrate. Furthermore, even if the electrical resistance value becomes higher than desired when using only a transparent conductive film made of indium tin oxide, the electrical resistance value can be sufficiently reduced and the transmittable power can be sufficiently increased by forming a conductive pattern on the indium tin oxide.

[0023] (Electro-optical device) Next, a method for manufacturing an electro-optical device using the method for manufacturing an electrode wiring pattern according to the present embodiment will be described. Examples of electro-optical devices include plasma display panels, organic EL devices, and liquid crystal display devices. FIG. 2 is a cross-sectional view depicting an example of a plasma display panel manufactured using the method for manufacturing an electrode wiring pattern according to the present embodiment.

[0024] In FIG. 2, the plasma display panel 20 is made by bonding two glass substrates 21, 29 together, and the space formed between both substrates is filled with an inert gas. The glass substrates 21, 29 are both provided with electrodes (transparent electrodes 22, bus electrodes 23, address electrodes 27) and the like which are formed by the manufacturing method of an electrode wiring pattern according to the present embodiment. Next, the configuration of the plasma display panel 20 will be specifically described.

[0025] In the plasma display panel 20, of the pair of substrates sandwiching a discharge space 25, on the inner surface of the glass substrate 21 on the observation side, sustain electrodes are provided for each line, which is a row of cells in the horizontal direction of the screen. The sustain electrode is made of a transparent electrode 22 which is a transparent conductive film, and a bus electrode 23 which is a metal film for reducing the resistance value. The transparent electrode 22 and the bus electrode 23 are provided by the manufacturing method depicted in FIG. 1. In other words, the transparent electrode 22 is made of indium tin oxide and is formed by the droplet discharging method, and the bus electrode 23 is also formed by the droplet discharging method.

[0026] The transparent electrode 22 and the bus electrode 23 are covered with a dielectric layer 24 for alternating current driving. The dielectric layer 24 has light transmitting properties. An address electrode 27, barrier rib 28, and phosphors 26R, 26G, 26B of three colors (red R, green G, and blue B) for color display are provided on the inner side of the glass substrate 29 on the rear side. The discharge space 25 is divided into unit light emitting regions in the line direction by the barrier ribs 28. The discharge space 25 is filled with a discharge gas such as argon, neon, or the like. The phosphors 26R, 26G, and 26B are locally excited by

ultraviolet light generated by discharging and emit visible light of a prescribed color. One unit of the light emitting region in the display is made of three unit light emitting regions aligned in the line direction. The structure within the range of each unit light emitting region is called a cell.

[0027] Next, a manufacturing process for the plasma display panel 20 having the above structure will be described. Of the two glass substrates 21, 29, the glass substrate 21 on the observation side (display surface side) is called an observation surface side substrate structure, and the glass substrate 29 on the opposite side (rear surface side) as the glass substrate 21 is called a rear surface side substrate structure. First, a transparent electrode 22 is formed on a light transmitting glass substrate 21 as the observation surface side substrate structure. The transparent electrode 22 is formed by discharging indium tin oxide from the droplet discharging device as described above. Next, the bus electrode 23 is formed on the transparent electrode 22. The bus electrode 23 is also formed by discharging a conductive material from the droplet discharging device. Next, a dielectric layer 24 is formed to cover the transparent electrode 22 and the bus electrode, completing the observation surface side substrate structure.

[0028] On the other hand, for the rear surface side substrate structure, first, the address electrode 27 is formed on the glass substrate 29. The address electrode 27 is also formed by discharging a conductive material from a droplet discharging device. Next, partition walls 28 are formed, and then the phosphors 26R, 26G, and 26B are formed in the spaces partitioned by the partition walls 28 by screen printing or the like. The phosphors 26R, 26G, and 26B are formed by screen printing a phosphor paste made by mixing phosphor powder of a prescribed luminescent color with a vehicle containing a cellulose-based or acrylic-based thickener resin and an organic solvent such as an alcohol-based or ester-based solvent. The phosphor 26R emitting red light, the phosphor 26G emitting green light, and the phosphor 26B emitting blue light are alternately formed in the direction of the address electrode 27. Next, the phosphors 26R, 26G, and 26B are subjected to a heat treatment in an air atmosphere at atmospheric pressure to evaporate the volatile components of the vehicle. This heat treatment is called the phosphor baking process. After the phosphors 26R, 26G, and 26B have been baked, the observation surface side substrate structure and the rear surface side substrate structure are bonded together, and the inside is evacuated to a vacuum, and then filled with an inert gas, thereby completing the plasma display panel 20.

[0029] As a result, in the manufacturing method of the plasma display panel 20 of the present embodiment, a droplet discharging method is used to form the transparent electrode 22, the bus electrode 23, and the address electrode 27, thereby enabling a significant reduction in the amount of indium tin oxide and conductive material that is wasted, as compared to manufacturing methods using photolithography or etching. Furthermore, in the manufacturing method of the plasma display panel 20 of the present embodiment, there is no need to create a photomask when forming the bus electrodes 23 and the address electrodes 27, so the manufacturing period can be shortened and manufacturing costs can be reduced.

[0030] Furthermore, in the plasma display panel 20 of the present embodiment, even if the bus electrode 23 is disconnected, the transparent electrode 23 made of indium tin oxide is formed under the conductive pattern, so the wiring on the substrate will stay connected, and the plasma display panel 20 can perform the prescribed function.

[0031] Next, a method for manufacturing an organic EL device using the method for manufacturing an electrode wiring pattern according to the present embodiment will be described with reference to FIG. 3. FIG. 3 is a cross-sectional view depicting an example of an organic EL device manufactured using the method for manufacturing an electrode wiring pattern according to the present embodiment.

[0032] In FIG. 3, the organic EL device 40 includes a substrate (light transmitting layer) 41 capable of transmitting light, an organic EL element (light emitting element) 60 formed on one surface of the substrate 41, sandwiched between a pair of a negative electrode (electrode) 50 and a positive electrode (transparent electrode) 42, and which includes light emitting layers 46, 47, 48 made of an organic electroluminescent material and a hole injection layer 44, and a protective layer 51 for protecting the organic EL element 60. If necessary, a fluorine compound layer 45 is provided between the hole injection layer 44 and the light emitting layers 46, 47, 48. In addition, a thin film 49 is provided between the light emitting layer 48 and the negative electrode 50.

[0033] Here, the organic EL device 40 depicted in FIG. 3 has a configuration in which light emitted from the light emitting layer 48 is extracted to the outside of the device from the substrate 41 side, and the material forming the substrate 41 may be a transparent or semi-transparent material that can transmit light, such as transparent glass, quartz, sapphire, or a transparent synthetic resin such as polyester, polyacrylate, polycarbonate, or polyether ketone. In particular, the forming material of the substrate 41 is preferably made of inexpensive soda glass. On the other hand, in the case of a configuration in which light is extracted from the opposite side of the substrate 41 (the protective layer 51 side), the substrate 41 may be opaque, and in this case, ceramics such as alumina, metal sheets such as stainless steel that have been subjected to an insulating treatment such as surface oxidation, thermosetting resins, thermoplastic resins, and the like can be used.

[0034] The positive electrode 42 is a transparent electrode made of indium tin oxide or the like and is capable of transmitting light. The positive electrode 42 is formed by the droplet discharging method depicted in the description of step S1 in FIG. 1.

[0035] Examples of materials for forming the hole injection layer 44 include copper phthalocyanine (CuPc), polyphenylene vinylene (polytetrahydrothiophenylphenylene), 1,1-bis-(4-N,N-ditolylaminophenyl)cyclohexane, and tris(8-hydroxyquinolinol)aluminum. In particular, the use of copper phthalocyanine (CuPc) is preferable.

[0036] It should be noted that a positive hole transport layer may be formed in place of the positive hole injection layer 44, and furthermore, both a positive hole injection layer and a positive hole transport layer may be formed. In this case, examples of materials for forming the hole injection layer

include triphenylamine derivatives (TPD), pyrazoline derivatives, arylamine derivatives, stilbene derivatives, triphenyldiamine derivatives, and the like. Specific examples include those described in Japanese Unexamined Patent Application S63-70257, Japanese Unexamined Patent Application S63-175860, Japanese Unexamined Patent Application H2-135359, Japanese Unexamined Patent Application H2-135361, Japanese Unexamined Patent Application H2-209988, Japanese Unexamined Patent Application H3-37992, and Japanese Unexamined Patent Application H3-152184, but triphenyldiamine derivatives are preferred, and among them, 4,4'-bis(N(3-methylphenyl)-N-phenylamino)biphenyl is preferred.

[0037] The light emitting layers 46, 47, and 48 can be formed from small molecule organic light emitting dyes or polymer light emitting bodies, or in other words, light emitting materials such as various fluorescent and phosphorescent materials, and organic electroluminescent materials such as Alq₃ (aluminum chelate complex). Among the conjugate polymers that serve as light emitting substances, those containing an arylenevinylene or polyfluorene structure are particularly preferable. Examples of small molecule light emitting bodies that can be used include naphthalene derivatives, anthracene derivatives, perylene derivatives, dyes such as polymethine, xanthene, coumarin, and cyanine dyes, metal complexes of 8-hydroxyquinoline and its derivatives, aromatic amines, tetraphenylcyclopentadiene derivatives, and known substances described in Japanese Unexamined Patent Application S57-51781 and Japanese Unexamined Patent Application S59-194393. The negative electrode 50 is a metal electrode made of aluminum (Al), magnesium (Mg), gold (Au), silver (Ag), and the like. The negative electrode 50 may be formed by the droplet discharging method depicted in the description of step S1 in FIG. 1, or may be formed by photolithography or etching.

[0038] The thin film 49 provided between the negative electrode 50 and the light emitting layer 48 is an electron transport layer or an electron injection layer. Examples of materials for forming the electron transport layer include, but are not limited to, oxadiazole derivatives, anthraquinodimethane and derivatives thereof, benzoquinone and derivatives thereof, naphthoquinone and derivatives thereof, anthraquinone and derivatives thereof, tetracyanoanthraquinodimethane and derivatives thereof, fluorenone derivatives, diphenyldicyanoethylene and derivatives thereof, diphenoquinone derivatives, and metal complexes of 8-hydroxyquinoline and derivatives thereof. Specifically, similar to the material for forming the positive hole transport layer, those described in Japanese Unexamined Patent Application S63-70257, Japanese Unexamined Patent Application S63-175860, Japanese Unexamined Patent Application H2-135359, Japanese Unexamined Patent Application H2-135361, Japanese Unexamined Patent Application H2-209988, Japanese Unexamined Patent Application H3-37992, and Japanese Unexamined Patent Application H3-152184 can be suggested, and in particular, 2-(4-biphenyl)-5-(4-*t*-butylphenyl)-1,3,4-oxadiazole, benzoquinone, anthraquinone, and tris(8-quinolinol)aluminum are preferable.

[0039] Although not depicted, the organic EL device 40 of the present embodiment is an active matrix type, and actually, a plurality of data lines and a plurality of scanning lines are arranged in a lattice pattern on the substrate 41. An organic EL element 60 is connected to each of the pixels arranged in a matrix and partitioned by the partitions 43 via a driving TFT such as a switching transistor or a driving transistor. When a drive signal is supplied via the data lines and scanning lines, current flows between the electrodes, causing the light emitting layers 46, 47, and 48 of the organic EL element 60 to emit light and be emitted toward the outer surface of the substrate 41, thereby lighting up that pixel. The pixel in which the light emitting layer 46 is provided is a red light emitting pixel 55 that emits red light, the pixel in which the light emitting layer 47 is provided is a green light emitting pixel 56 that emits green light, and the pixel in which the light emitting layer 48 is provided is a blue light emitting pixel 57 that emits blue light.

[0040] As a result, in the manufacturing method of the organic EL device 40 of the present embodiment, the positive electrode (transparent electrode) 42 made of indium tin oxide or the like is formed by a droplet discharging method, which enables a significant reduction in the amount of indium tin oxide that is wasted, compared to manufacturing methods using photolithography or etching. Furthermore, in the method for manufacturing the organic EL device 40 of the present embodiment, since there is no need to create a photomask when forming the positive electrode 42, the manufacturing period can be shortened and manufacturing costs can be reduced.

[0041] Next, a method for manufacturing a liquid crystal device using the method for manufacturing an electrode wiring pattern according to the present embodiment will be described with reference to FIG. 4. FIG. 4 is a cross-sectional view depicting an example of a liquid crystal device 100 manufactured using the method for manufacturing an electrode wiring pattern according to the present embodiment.

[0042] As depicted in FIG. 4, on the surface of the lower substrate 101 facing the liquid crystal layer 103, a color filter 105, a planarizing film 106 made of an organic film or the like, a transparent electrode 107, and an alignment film 109 are sequentially laminated. On the other hand, on the surface of the upper substrate 102 facing the liquid crystal layer 103, a transparent electrode 108 made of indium tin oxide and an alignment film 110 are sequentially laminated. Furthermore, a plurality of spherical spacers 113 are disposed within the liquid crystal layer 103.

[0043] The color filter 105 is composed of red (R), green (G), and blue (B) colored layers 105a formed in a prescribed pattern, and a light shielding layer (black matrix) 105b for blocking light between adjacent colored layers 105a. The alignment films 109, 110 made of an align-able polymer such as polyimide, and surfaces thereof are rubbed in a prescribed direction with a cloth or the like to match the alignment state of the liquid crystal layer 103 when no electric field is applied. The color filter 105 and the planarization film 106 are formed at least in the display region, and are formed only on the inner side of the sealing material 104.

[0044] Next, a method for manufacturing the liquid crystal device 100 having the above structure will be described. First, a color filter 105, a planarizing film 106, a transparent electrode 107, and an alignment film 109 are formed in this order on the surface of the lower substrate 101. Here, the transparent electrode 107 is formed by the manufacturing method depicted in step S1 of FIG. 1, or in other words, by the droplet discharging method.

[0045] Moreover, a transparent electrode 108 and an alignment film 110 are formed in this order on the surface of the upper substrate 102. Here, the transparent electrode 108 is also formed by the droplet discharging method. In other words, the transparent electrode 108 is formed on the surface of the substrate 102 by discharging droplets of indium tin oxide using a droplet discharging device.

[0046] Next, the lower substrate 101, on whose surface a color filter 105, a planarization film 106, a transparent electrode 107, and an alignment film 109 are sequentially laminated, and the upper substrate 102, on whose surface a transparent electrode 108 and an alignment film 110 are sequentially laminated, are attached via an uncured sealant 104. The uncured sealant 104 is then cured to form an injection port for liquid crystal, thereby forming a liquid crystal cell. Next, liquid crystal is drawn into the liquid crystal cell by a vacuum injection method to form the liquid crystal layer 103, thereby completing the liquid crystal device 100 having the above structure.

[0047] As a result, in the manufacturing method of the liquid crystal device 100 of the present embodiment, the transparent electrodes 107, 108 made of indium tin oxide or the like are formed by a droplet discharging method, which enables a significant reduction in the amount of indium tin oxide that is wasted, compared to manufacturing methods using photolithography or etching. Furthermore, in the method for manufacturing the liquid crystal device 100 of the present embodiment, there is no need to create a photomask when forming the transparent electrodes 107, 108, so the manufacturing period can be shortened and manufacturing costs can be reduced.

[0048] (Electronic apparatus) An example of an electronic apparatus including an electro-optical device manufactured by the manufacturing method of the above embodiment will be described. FIG. 5 is a perspective view depicting an example of a mobile phone. In FIG. 5, reference numeral 1000 denotes a mobile phone main body, and reference numeral 1001 denotes a display unit using the above mentioned electro-optical device.

[0049] FIG. 6 is a perspective view depicting an example of a wristwatch type electronic apparatus. In FIG. 6, reference numeral 1100 denotes a watch body, and reference numeral 1101 denotes a display unit using the above mentioned electro-optical device.

[0050] FIG. 7 is a perspective view depicting an example of a portable information processing device such as a word processor, personal computer, or the like. In FIG. 7, reference numeral 1200 denotes an information processing device, reference numeral 1202 denotes an inputting unit such as a keyboard, reference numeral 1204 denotes the main body of the information processing device, and reference numeral 1206 denotes a display unit using the electro-optical device described above.

[0051] The electronic apparatus depicted in FIG. 5 to FIG. 7 is provided with the electro-optical device of the above embodiment, and therefore can reduce manufacturing costs while shortening the manufacturing period, and can also reduce the incidence of failures, as compared to conventional devices.

[0052] The technical scope of the present invention is not limited to the aforementioned embodiments, and various modifications can be made without departing from the spirit of the present invention. The specific materials, layer structures, and manufacturing methods given in the embodiments are merely examples, and can be modified as appropriate.

[0053]

EFFECT OF THE INVENTION

As is clear from the above description, with the present invention, indium tin oxide or the like is provided on a substrate by using a droplet discharging method, so it is possible to reduce waste in the manufacturing process as compared to the conventional method.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a process diagram depicting a method for manufacturing an electrode wiring pattern according to an embodiment of the present invention.

FIG. 2 is a cross-sectional view depicting an example of a plasma display panel manufactured using the above manufacturing method.

FIG. 3 is a cross-sectional view depicting an example of an organic EL device manufactured by using the above manufacturing method.

FIG. 4 is a cross-sectional view depicting an example of a liquid crystal device manufactured using the above manufacturing method.

FIG. 5 is a diagram depicting an example of an electronic apparatus including the electro-optical device of the present embodiment.

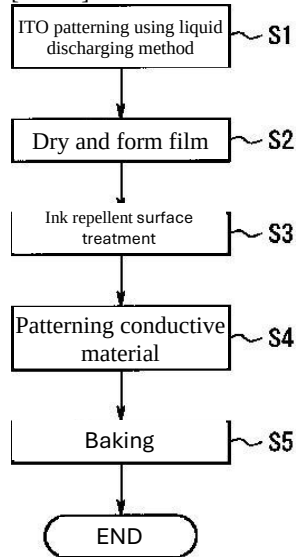
FIG. 6 is a diagram depicting an example of an electronic apparatus including the electro-optical device of the present embodiment.

FIG. 7 is a diagram depicting an example of an electronic apparatus including the electro-optical device of the present embodiment.

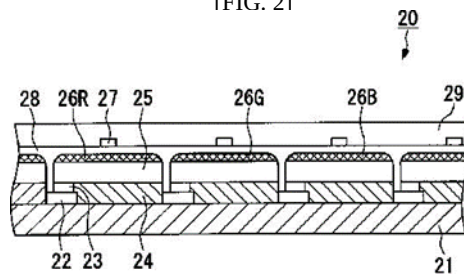
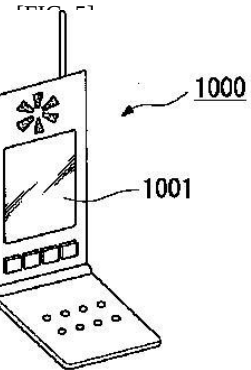
DESCRIPTION OF REFERENTIAL NUMBERS

- 20. Plasma display panel
- 21. Glass substrate
- 22. Transparent electrode
- 23. Bus electrode
- 24. Dielectric layer
- 25. Discharge space
- 26R, 26G, 26B. Phosphor
- 27. Address electrode
- 28. Partition wall
- 29. Glass substrate
- 40. Organic EL device
- 41. Substrate
- 42. Positive electrode
- 43. Partition wall
- 44. Positive hole injecting layer
- 45. Fluorine compound layer
- 46, 47, 48. Light emitting layer
- 49. Thin Film
- 50. Negative electrode
- 51. Protective film
- 55. Red light emitting pixel
- 56. Green light emitting pixel
- 57. Blue light emitting pixel
- 60. Organic EL element

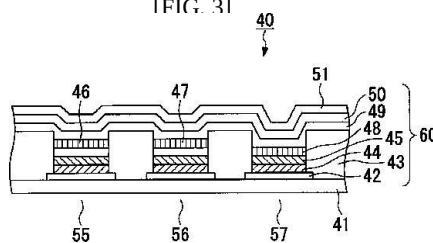
[FIG. 1]



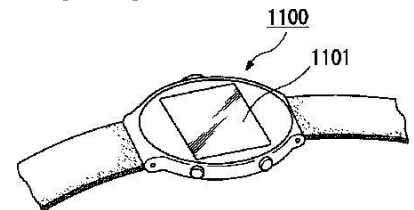
[FIG. 2]



[FIG. 3]



[FIG. 6]



A diagram of a laptop computer, labeled 1200. It features a display screen 1206, a keyboard 1202, and a base 1204. The display screen 1206 shows a stylized drawing of a lightning bolt. The keyboard 1202 is positioned below the display screen. The base 1204 is the bottom part of the laptop.

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