

CERTIFICATE OF TRANSLATION ACCURACY

I, Peter Niederlohner, declare:

1. I am a native speaker of German and am well versed in both the German and English languages and have over 25 years of experience translating German technical documents into English on a full-time basis.
2. The following translation of the corresponding source text from German into English is accurate and complete to the best of my knowledge.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and accurate.

Statements made herein are to the best of my knowledge true and are based on information that I believe to be true and further these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the patent application in the United States of America or any patent issuing thereon.

Executed this 22nd day of May 2024, at Brooklyn, NY.

A handwritten signature in black ink, appearing to read "Peter Niederlohner", with a stylized flourish at the end.

Peter Niederlohner

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(54) Title: METHOD FOR PRODUCING AN ELECTRONIC COMPONENT AND ELECTRONIC COMPONENT

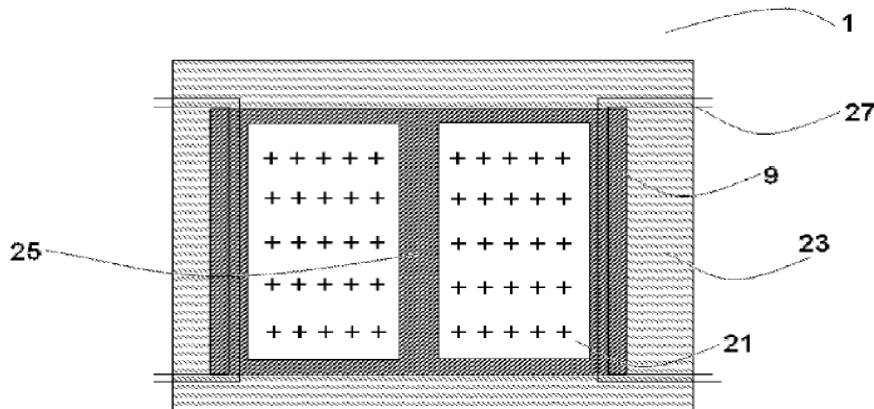


Fig. 3

(57) Abstract: The present invention relates to a method for producing an electronic component having at least one first electrode region (21) and a second electrode region (23), said regions being separated from each other by an insulator (9) and each comprising at least one partial layer of a first electrically conductive material. The present invention further relates to an electronic component that can be produced by means of the method according to the invention.

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The present invention relates to a method for producing an electronic component having at least one first electrode region (21) and a second electrode region (23), said regions being separated from each other by an insulator (9) and each comprising at least one partial layer of a first electrically conductive material. The present invention further relates to an electronic component that can be produced by means of the method according to the invention.

Description

Method for producing an electronic component and electronic
component

The present invention relates to a method for producing an
electronic component and an electronic component.

This patent application claims the priorities of German
patent application 10 2009 060 066.3 and German patent
application 10 2009 043 066.0, the disclosure contents of
which are hereby incorporated by reference.

In electronic components such as organic light-emitting
diodes, insulators are used, among other things, to separate
two electrode regions from each other. Suitable insulators
such as light-sensitive lacquers are usually very expensive
and time-consuming to apply.

One task of the present invention is to provide an improved
method of producing an electronic component compared to the
prior art, in which the insulator is only applied to certain
areas of an electrically conductive layer.

The task according to the invention is solved by a method
having the features of independent claim 1 and an electronic
component having the features of independent claim 15.

Subclaims indicate further developments of the method
according to the invention.

5 The method according to the invention is suitable for producing an electronic component having at least one first electrode region and a second electrode region, which are separated from one another by an insulator and each have at least a partial layer of a first electrically conductive material.

10 The method according to the invention comprises the following steps:

A) Providing a substrate layer and at least one first electrically conductive layer of the first electrically conductive material arranged on the substrate layer;

15 B) Arranging at least one second electrically conductive layer of a second electrically conductive material on the first electrically conductive layer;

20 C) Arranging at least one first insulator on the substrate so that the second electrically conductive layer comprises at least a first portion covered with the insulator and a second portion not covered with the insulator, and wherein the insulator is arranged so that it can serve to separate the first electrode portion and the second electrode portion from each other; and

25 D) Arranging at least one functional layer and at least one second electrode layer on the second electrically conductive layer obtained in the preceding step, which is covered in portions with the insulator.

30 The term "electrode region," as used herein, refers to a region or portion of the electronic component or an electrode layer thereof functioning as an electrode. The electrode layer may be an anode layer or a cathode layer.

35 The first and second electrode regions each have at least one partial layer of a first electrically conductive material.

5 The term "electrically conductive material," as used herein, refers to a material or substance with the ability to conduct electric current. The term "partial layer of a first electrically conductive material," as used herein, means that the electrode regions each comprise or consist of a section formed as a layer of the first electrically conductive material. The partial layer formed from the first electrically conductive material is clearly separated from possible further layers, so that, for example, the formation of an alloy between the first electrically conductive material and any further material applied in the respective electrode region is excluded.

15 The term "insulator," as used herein, refers to an insulating substance which is applied in such a way that it prevents a current flow between the first electrode region and the second electrode region. The insulator may be a coating or a coating agent, such as a polymer and in particular a lacquer, and the like.

20 The term "lacquer" is understood here to mean a coating material that can be applied in liquid or powder form.

25 The term "first electrically conductive layer," as used herein, means a layer comprising the first electrically conductive material or a layer consisting of the first electrically conductive material which is deposited directly on the substrate layer. The first electrically conductive layer may be a transparent conductive layer. It may be formed of, but is not limited to, a transparent conductive oxide (TCO), e.g. indium-doped tin oxide (ITO) or ZnO, In/ZnO, SnZnO, Al-ZnO and the like.

30

35

The first electrically conductive layer can be applied to the substrate layer by sputtering, for example.

5 A second electrically conductive layer made of a "second electrically conductive material," which is usually different from the first electrically conductive material, is deposited on the first electrically conductive layer. For example, the
10 first electrically conductive material may be provided in particular for the anode of the finished device, the second electrically conductive material may be provided for the cathode and vice versa. Examples of the second electrically conductive material include but are not limited to metals
15 such as aluminum, barium, indium, copper, silver, gold, magnesium, calcium and lithium and the like, as well as mixtures or combinations thereof, particularly in the form of alloys with each other or with other metals. The second
20 electrically conductive layer can comprise only one but also several sub-layers. The individual sub-layers can then consist of or contain the aforementioned materials independently of each other; in addition to the metals explicitly listed above, they can also contain or consist of
25 the metals chromium and molybdenum. Examples of layer sequences in a second electrically conductive layer comprising several partial layers are Mo/Al/Mo, Cr/Al/Cr, Cu/Cr and Cr/Cu.

30 The second electrically conductive layer can be applied to the first electrically conductive layer by means of sputtering, physical vapor deposition (PVD) or the like.

35 The term "substrate layer," as used herein, refers to a layer of a substrate as conventionally used, for example, in the prior art for an electronic component.

5 The substrate may be a transparent or a non-transparent substrate. For example, the substrate may comprise glass, quartz, sapphire, plastic foils, coated plastic foils, metal, metal foils, metal foils, foils coated with an electrically insulating layer, silicon wafers or another suitable substrate material. According to the invention, the substrate layer is understood in particular to be the layer to which all other layers are subsequently applied during the production of the electronic component. Such subsequent layers may, for example, be layers required for radiation emission in the case of an optical electronic component, for example a radiation-emitting device.

15 The "second electrode layer" may comprise a material or be formed from a material selected from metals such as aluminum, barium, indium, silver, gold, magnesium, calcium and lithium, as well as combinations thereof or a compound thereof, in particular an alloy, as well as transparent conductive oxides, such as metal oxides such as zinc oxide, tin oxide, cadmium oxide, titanium oxide, indium oxide or indium-doped tin oxide (ITO), aluminum-doped zinc oxide (AZO), Zn_2SnO_4 , CdSnO_3 , MgIn_2O_4 , GaInO_3 , $\text{Zn}_2\text{In}_2\text{O}_5$ or $\text{In}_4\text{Sn}_3\text{O}_{12}$ or mixtures of different transparent conductive oxides. The second electrode layer is preferably made of a metal. The second electrode layer of the electronic component can be a cathode layer.

25 A "functional layer" of the electronic component performs a function characteristic of the electronic component. For example, functional layers can be radiation-emitting layers, such as fluorescent and/or phosphorescent emitter layers of an organic light-emitting diode.

5 An "electronic component" which can be produced by the method according to the invention can be, but is not limited to, a transistor, a capacitor, a thermistor, an organic electronic component, such as an organic light-emitting diode, a solar cell, and the like.

10 With the method according to the invention, it is possible to separate two electrode regions from one another, wherein the electrode regions are structured at a preselected position already during the application of the layers of the electrode regions or later and the insulator applied to the second electrically conductive layer is arranged in the
15 region formed by the structuring. The structuring is usually applied later.

20 If the structuring is already present (i.e. is applied "earlier"), this can be done by applying the first and second electrically conductive layers or parts thereof to the substrate, for example by printing, by deposition with the aid of SAMs (self-assembling monolayers) and the like.

25 The insulator is applied (usually exclusively) to the second electrically conductive layer.

According to the invention, it is provided that the insulator is applied to the second electrically conductive
30 layer only in predetermined areas or sections.

Depending on the composition of the insulator, the insulator can be placed only in the first section of the second electrically conductive layer using a pressure process, a
35 syringe, a nozzle, a grommet and the like.

After completion of the electronic component, the first partial area can serve as a bond pad or bus bar for subsequent contacting of the electronic component.

The second electrically conductive layer is divided into at least two partial areas by means of the insulator applied to the substrate, one of which is covered with insulator and the other is not covered. At the same time, the insulator is arranged in such a way that it can serve to separate the first and second electrode areas of the first electrically conductive layer from one another. In particular, this also means that in a later process step the insulator is brought into a formable state which allows the insulator to be arranged in such a way that the electrode regions are separated from one another by the insulator.

The method according to the invention for producing an electronic component can be used to produce electronic components with cost and time savings. Since each layer of the component can be applied individually and, if necessary, structured according to desire or purpose (as can be seen from the following further developments of the method), time-consuming coating or application steps can thus be avoided and (often expensive) material can also be saved.

By applying the second electrically conductive layer over the entire surface of the first electrically conductive layer in accordance with the invention, it is also possible to prevent the first electrically conductive layer, such as a sensitive ITO layer, from coming into contact with the insulator to be printed and/or the protective material and possibly being damaged or impaired.

Furthermore, the first electrically conductive layer does not come into direct contact with the equipment.

Furthermore, the first electrically conductive layer can in particular be kept free of particles, such as impurities, since during etching of the second electrically conductive layer, any impurities on top, such as residues that may arise due to the redeposition of any laser ablation process that may have been carried out, are removed.

Using the method according to the invention, it is possible to achieve "self-aligning" of the second electrically conductive material and the insulator. In this way, it is possible, for example, to easily provide conductive tracks or bond pads in the electronic component produced according to the invention.

In a further development of the method according to the invention, the method comprises the following step:

E) Removing first electrically conductive material of the first electrically conductive layer at least along a predetermined separation region between the first electrode region and the second electrode region.

This step of removal is usually performed after step A) and before step B).

The predetermined separation region may be a kind of trench or gap between the first and second and any further electrode region of the first electrically conductive layer formed by removing the first electrically conductive material.

Alternatively, it is possible to remove both the first electrically conductive material of the first electrically conductive layer

and the second electrically conductive material of the second electrically conductive layer located above the first electrically conductive material at least along a
5 predetermined separation region between the first electrode region and the second electrode region (step F)).
This step is usually carried out after step B) and before step C).

10 Removal of both the first and the second electrically conductive material can preferably be carried out simultaneously, i.e. in one step.

15 In a further development of the method according to the invention, the method according to the two preceding alternatives comprises removing the first electrically conductive material (step E)) or removing the first
20 electrically conductive material and the second electrically conductive material (step F)) by laser ablation.

25 The term "laser ablation," as used herein, includes ablation of the first electrically conductive material or ablation of the first and second electrically conductive materials from the surface of the substrate layer by bombardment with pulsed laser radiation.

30 During the essentially sectional removal or ablation of the second electrically conductive layer and the first electrically conductive layer by means of laser ablation, only the uppermost, i.e. the second electrically conductive
35 layer, heats up in particular. This can be particularly advantageous in order to protect the first electrically conductive layer, for example an ITO layer, which is generally a very sensitive layer.

In a further development of the method according to the invention, the method further comprises the step G) of arranging at least one protective material in at least a third sub-region of the second electrically conductive layer arranged in the second sub-region.

The term "protective material," as used herein, refers to a material or substance which serves to protect the second electrically conductive material of the second electrically conductive layer in the partial areas to which it has been applied on the second electrically conductive layer, in particular in the further process sequence of producing the electronic component, i.e. in further process steps.

The protective material can be a coating such as a lacquer and the like. In particular, the protective material can be an alkali-soluble etch-stop lacquer, for example an etch-stop lacquer such as is used in the production of printed circuit boards (PCBs). This etch-stop lacquer can be cross-linked or hardened thermally or by means of UV radiation. The protective material is preferably soluble in a solvent in which the insulator is not soluble. Examples include alkaline solutions such as weakly alkaline aqueous solutions of salts, etc. (e.g. NaOH, KOH, NH₄OH, or quaternary ammonium salts such as N(CH₃)₄OH).

The protective material can be applied either after the second electrically conductive layer has been applied to the first electrically conductive layer and before the insulator has been applied to the second electrically conductive layer, or after the insulator has been applied to the second electrically conductive layer and before a functional layer has been applied to the second electrically conductive layer.

5 The protective material is applied in such a way that the second electrically conductive layer is covered with protective material in the third partial area and is not covered with the protective material and not with the insulator in at least one fourth partial area, which is arranged in the second partial area.

10 The protective material can be arranged—at least in sections—over or on the insulator.

15 In a further development of the method according to the invention, the protective material is arranged on the second partial area at a distance from the insulator so that a gap remains between the first partial area and the third partial area. In this embodiment, the protective material is not arranged on the insulator.

20 A "distance" at which the protective material is arranged in relation to the insulator can be a predetermined distance. The "gap," which is created by arranging the protective material at a distance from the insulator, can be an area that corresponds to the separation area or the separation line between the first and second electrode areas.

25 According to this further development of the method according to the invention, it is provided that at least a part of the first electrically conductive material of the first electrically conductive layer and of the second electrically conductive material of the second electrically conductive layer, which are located in the region of the gap as described above, are removed. The first electrically conductive material of the first electrically conductive layer to be removed and the second electrically conductive material of the second electrically conductive layer are generally located below the gap.

In a further development of the method according to the invention for producing the electronic component, the method comprises the following step:
5 H) at least partially removing the second electrically conductive layer in at least the fourth partial area.

10 This step H) can take place either after step C) and before step D) or after step G) and before step D).

The second electrically conductive material is essentially removed in the fourth partial area of the second partial area, i.e. in the area which is neither covered by protective material nor by insulator. By removing the second electrically conductive material, the first electrically conductive layer lying under the second electrically conductive layer is exposed (and not removed) in the area of
15 the fourth partial area of the second electrically conductive layer. The removal is thus carried out using a technique that selectively removes only one layer, e.g. a metal layer.
20

25 In a further development of the method according to the invention for producing the electronic component, the second electrically conductive layer is removed by etching.

30 The etching of the second electrically conductive material can be carried out by means of an etching bath.

The term "etching," as used herein, refers to the removal of the second electrically conductive material on the surface of the first electrically conductive layer by applying suitable etching substances; these may be chemical substances that modify
35

(usually oxidize) the material to be removed in a chemical reaction and thus generally dissolve it. Etchants are usually acids or strong oxidizing agents. Examples include HNO_3 , HCl , H_3PO_4 , acetic acid, H_2SO_4 , ceric ammonium nitrate (CAN) and H_2O_2 .

In one such embodiment, both the insulator and the protective material are resistant to the chemicals, such as acids, used for etching the second electrically conductive material. The insulator and the protective material provide an etch-stop function for the second electrically conductive layer or the second electrically conductive material in the corresponding areas of the second electrically conductive layer in the areas of the second electrically conductive layer to which they are applied.

Furthermore, the etching bath is selected in such a way that the first electrically conductive layer, for example a sensitive ITO layer, is not attacked or impaired by the etchants used.

By etching the second electrically conductive material, the structures of the first electrically conductive layer and the second electrically conductive layer located under the insulator layer and/or under the protective material layer are maintained.

An advantage of the method according to the invention may be that only a single etching step is required to remove the second electrically conductive material in the fourth subregion of the second electrically conductive layer arranged in the second subregion of the second electrically conductive layer, thus exposing parts of the first electrically conductive layer as first and second electrode regions.

In a further development of the method according to the invention, the method comprises the following step:

I) Removing the protective material from the second
5 electrically conductive layer.

The protective material is removed from the second electrically conductive layer after step H).

10 Since the insulator is only applied to the second electrically conductive layer at specific, predetermined points, a non-electrically conductive material, the protective material, may only have to be removed once in the method according to the invention. The protective material used can generally be
15 removed with the aid of a suitable solvent instead of being removed by means of etching, as may be common in the prior art.

20 The protective material can also be removed by stripping, for example. The term "stripping" refers to the ashing or removal of protective material, such as a (photo)lacquer. As a rule, an oxygen plasma is used in the so-called stripper or asher to burn off the (photo)lacquer.

25 By removing the protective material from the second electrically conductive layer, the second electrically conductive material is completely exposed. The exposed areas of the second electrically conductive layer can be used as the
30 second electrode of the electronic component. They can form part of the second electrode or serve completely as the second electrode.

35 In a further development of the method according to the invention, the insulator is applied directly to the second electrically conductive layer and arranged on the second electrically conductive layer in such a way that it is located in the immediate vicinity of the separation region between the first electrode region and the second electrode region. The term "in the immediate vicinity" means that the

insulator is spatially applied to the second electrically
conductive layer in such a way that it is able to flow into
the separation region between the first electrode region and
the second electrode region by a subsequent treatment such
as softening. For example, the insulator may be arranged
such that its distance from the separation region is not
greater than the width of the separation region.

The insulator can be applied to the second electrically
conductive layer in a predetermined pattern. For example,
such a pattern can be predetermined by means of coordinates
or the like before the insulator is applied. The insulator
can be applied to the second electrically conductive layer
by means of a mask or a stencil or defined coordinates which
are related to the surface of the second electrically
conductive layer as a reference system.

By applying the insulator and the protective material at
specific points by means of a printing process, it is also
possible to reduce or eliminate the risk of errors caused by
incorrect alignment of the photolithographic system during
the application of the photosensitive lacquers.

In a further development of the method according to the
invention, the insulator is applied to the second
electrically conductive layer by means of a printing
process. Suitable printing processes include planographic,
relief, intaglio and screen-printing processes as well as
combinations thereof. In particular, the insulator can be
printed onto the second electrically conductive layer by
means of screen printing, inkjet printing, flexographic
printing and the like.

Other suitable printing methods include pad printing, stamp printing, pochoir and the like.

5 The protective material can also be printed onto the second electrically conductive layer in the same way as the insulator. The explanations given above regarding suitable printing processes therefore apply equally to the printing of the
10 protective material.

With the method according to the invention, it is advantageously possible to save both material and time and thus costs by printing the insulator and the protective
15 material compared to the methods normally used in the prior art, such as lithographic methods.

In contrast to the conventionally used lithography methods, in which each coating step is applied individually and structured photolithographically, in the methods according
20 to the invention it is intended to apply only as much material of the insulator and the protective material, both of which can generally be expensive materials, as is
25 required for the production of the electronic component. In this way, for example, OLED light tiles, which were complex and expensive to produce using conventional methods, can be advantageously produced in a time- and material-saving
30 manner.

Since simple lacquers can be used as insulator and/or as protective material in the method according to the invention, the use of expensive chemicals, such as
35 photosensitive lacquers, which are generally used in photolithographic processes, can also be advantageously dispensed with. Since no subsequent structuring of the individual layers is required according to the invention, expensive equipment can also be advantageously dispensed with.

5 In a further development of the method according to the invention, the method comprises the step J) of setting conditions in which the insulator may be brought at least partially into a flowable state and the step K) of introducing the insulator or allowing it to flow into at least one section of the separation region between the first electrode region and the second electrode region.

10 The insulator is in particular a liquefiable insulator, such as a polymer or a lacquer. In order to be able to liquefy the insulator, one or more of the following conditions, temperature increase, pressure, light, reagents, vapor and the like can be set as conditions for the liquefaction of the insulator. For example, the insulator can be softened by heating the substrate layer or by direct heat radiation on the second electrically conductive layer if a suitable material is selected. The insulator can flow over the edges of the second electrically conductive layer and/or the first electrically conductive layer. Furthermore, the insulator may be softened by being introduced into a solvent atmosphere, e.g. water, but also a lower-boiling solvent. In this way, the structure of the insulator can be advantageously rounded.

20 25 30 In another further development, the method is carried out in such a way that at least one conductor track made of the second electrically conductive material is arranged on the first electrically conductive layer in the first electrode area.

35 In the finished electronic component, it can be seen both with the naked eye and under a microscope that the insulator has been printed on.

Wavy or jagged structures can be seen at the edges, which do not occur when using a photolithographic process (clear straight line).

The method according to the invention is usually free of photolithographic steps and can therefore be used as a cost-effective method for producing an electronic component, such as an organic light-emitting diode. By means of the method according to the invention, it is possible to produce an electronic component with a robust design. The method according to the invention can therefore also be used for the mass production of electronic components.

All in all, the method according to the invention can thus provide a very cost-effective method, for example for producing OLED light tiles.

The present invention is illustrated below without limiting the generality with reference to the figures. In the drawing, the same reference signs denote the same or identical elements, in which:

Fig. 1 A-I illustrate a method for producing an electronic component according to a first embodiment of the present invention;

Fig. 2 A-I illustrate a method for producing an electronic component according to a second embodiment of the present invention; and

Fig. 3 shows a top view of a substrate template.

Figs. 1A to I show the preparation of a substrate for producing an electronic component using the method according to the present invention in accordance with a first embodiment.

A substrate layer 1 (see Fig. 1A) can, for example, be formed from glass. Alternatively, the substrate layer 1 can also be formed from plastic films, coated plastic films, metal films which are coated, for example, with an electrically insulating layer, and the like.

Processing begins with extensive coating of the substrate layer 1 with a first electrically conductive layer 3 (see Fig. 1B).

The first electrically conductive layer 3 can, for example, be a transparent layer of ITO. Alternatively, the first electrically conductive layer 3 can also be formed from another transparent electrical material, such as ZnO, IN/ZnO, SnZnO, Al-ZnO or another suitable material which is designed to withstand the etching process of the second electrically conductive material.

The coating can be applied by sputtering, for example.

In the next step, the first electrically conductive layer 3 is coated extensively with a second electrically conductive layer 5 (see Fig. 1C). A metal can be used as the second electrically conductive material for the second electrically conductive layer 5. However, many other metals and combinations thereof are possible. The second electrically conductive layer 5 can be deposited by sputtering, PVD and the like.

As shown in Fig. 1D, laser ablation then takes place which produces a separation area 7 or a trench in the second electrically conductive layer 5 and the first electrically conductive layer 3. The separation area 7 represents the subsequent electrical insulation between the cathode and the anode of the electronic component.

In the next step, as shown in Fig. 1E, an insulator 9 is applied to the second electrically conductive layer 5 in a structured manner, so that at least a first partial area 11 is formed, which is covered with the insulator 9, and at least a second partial area 13, which is not covered with the insulator.

The insulator 9 may be a lacquer. It may be applied to the second electrically conductive layer 5 by means of a printing process, such as screen printing, inkjet printing or flexographic printing. The insulator 9 should be selected so that it can be softened by subsequent treatment and brought into a flowable state.

The function of the insulator 9 is primarily the electrical insulation in the subsequent electronic component and the etch-stop function of the second electrically conductive layer 5.

Next, a protective material 15 is applied to the second electrically conductive layer 5 (see Fig. 1F), which may or may not partially cover the insulator 9. The second electrically conductive layer 5 now has a third partial area 17, which is covered with protective material 15, and a fourth partial area 19, which is not covered with protective material.

The protective material 15 may be a lacquer. The protective material 15 is preferably soluble in a solvent in which the insulator 9 is not soluble or at least only slightly soluble.

The protective material 15 can be applied to the second electrically conductive layer 5 by means of a printing process, such as screen printing, inkjet printing or flexographic printing.

The function of the protective material 15 is in particular the etch-stop function of the second electrically conductive layer 5.

As shown in Fig. 1G, the next step is to remove the second electrically conductive material from the second electrically conductive layer 5, preferably using etching. An etching bath, such as 3% trichloroacetic acid in water, is used to etch the second electrically conductive layer 5. The metal structures of the second electrically conductive layer 5 of the fourth sub-region 19 are removed, while those of the first sub-region 11 and the third sub-region 17 are essentially retained.

In step I), the protective material 15 (the protective material is therefore no longer shown in Fig. 1H) is removed using a solvent.

The substrate layer 1 or the insulator 9 is then heated directly so that the insulator 9 softens (reflow) and flows over the open edges of the second electrically conductive layer 5 and the first electrically conductive layer 3. As shown in Fig. 1I, the structure of the insulator 9 is rounded.

The electronic component, for example an OLED, can now be produced on the substrate layer prepared in this way using a conventional process.

For this purpose, the semiconducting, light-emitting organic layers and the second electrode layer, for example a cathode layer, are vapor-deposited onto the substrate layer in subsequent processing steps, for example in a vacuum.

Figs. 2A to I show the preparation of a substrate for producing an electronic component using the method according to the invention in accordance with a second embodiment.

The second embodiment essentially corresponds to the first embodiment, except that the laser ablation of the first electrically conductive layer 3 and the second electrically conductive layer 5 takes place after application of the insulator 9 and the protective material 15:

After the two-dimensional application of the second electrically conductive layer 5 to the first electrically conductive layer 3, the insulator 9 is applied to the second electrically conductive layer 5 by means of a printing process (see Fig. 2D), so that a first partial area 11 with insulator 9 is present.

The protective material 15 is then applied to the second electrically conductive layer 5 (see Fig. 2E) so that a third partial area 17 is covered with protective material 15.

Then, as shown in Fig. 2F, laser ablation is performed, which creates the separation area 7 in the second electrically conductive layer 5 and in the first electrically conductive layer 3. Such a separation area 7 can, for example, provide the subsequent electrical insulation between the cathode and anode of the electronic component.

5 In this case, the laser cut should run in a gap between the insulator 9 and the protective material 15. Furthermore, the laser cut should run so close to the edge of the insulator 9 that during the process step of softening the insulator 9, the insulator 9 flows over the edge of the second electrically conductive layer 5 and the first electrically conductive layer 3 produced by the laser.

10 In the further process, the second electrically conductive material is again removed in the fourth partial area 19 of the second electrically conductive layer 5 (see Fig. 2G), the protective material is removed (see Fig. 2H), the insulator 9 is brought into a flowable state and introduced into the separation area 7 (see Fig. 2I) and the remaining layers of the electronic component are deposited on the substrate layer prepared in this way (not shown).

20 Alternatively, it is also possible to structure the first electrically conductive layer by means of laser ablation and then apply second electrically conductive material to the areas of the first electrically conductive layer or over the entire surface of the first electrically conductive layer, so that second electrically conductive material is introduced into the gaps created by the structuring of the first electrically conductive layer. The structuring of the first electrically conductive layer can then be exposed again later by arranging the insulator and the layer material in such a way that, during the etching process, second electrically conductive material is removed in the area in which trenches or the like were introduced in the first electrically conductive layer.

35 If the second electrically conductive layer and the first electrically conductive layer are structured together,

any deposits or impurities resulting from the ablation process can be removed. Such a procedure can be similar to the cleaning of silicon wafers and advantageously represent a very clean process. Alternatively, it may also be advisable for the laser to cut through the insulator, the second electrically conductive layer and the first electrically conductive layer, so that the insulator can fill the separation area from both sides during softening (reflow) of the insulator.

Fig. 3 shows a top view of a prepared substrate layer 1 for producing an electronic component.

The substrate layer 1 has one first electrode area 21 and a second electrode area 23 on its top face, which are insulated from each other by the insulator 9.

A conductor track 25 is provided in the center of the substrate template shown in Fig. 3. Feed lines 27 are arranged for electrical contacting of the component.

Claims

1. Method for producing an electronic component having at least one first electrode region (21) and a second electrode region (23), which are separated from one another by an insulator (9) and each have at least one partial layer of a first electrically conductive material, having the following steps:
- A) providing a substrate layer (1) and at least one first electrically conductive layer (3) of the first electrically conductive material arranged on the substrate layer;
- B) arranging at least one second electrically conductive layer (5) made of a second electrically conductive material on the first electrically conductive layer (3);
- C) arranging at least one first insulator (9) on the substrate so that the second electrically conductive layer (5) comprises at least a first sub-region (11) covered with the insulator (9) and a second sub-region (13) not covered with the insulator, and wherein the insulator (9) is arranged such that it may serve to separate the first electrode region (21) and the second electrode region (23) from each other; and
- D) arranging at least one functional layer and at least one second electrode layer on the second electrically conductive layer (5) obtained in step C), which is covered in sections with the insulator (9).

2. Method according to claim 1, further comprising at least one of the following steps:

5 E) removing first electrically conductive material of the first electrically conductive layer (3) at least along a predetermined separation region between the first electrode region (21) and the second electrode region (23),

10 wherein the step E) is performed between step A) and step B); or

15 F) removing first electrically conductive material of the first electrically conductive layer (3) and second electrically conductive material of the second electrically conductive layer (5) located above the first electrically conductive material at least along a predetermined separation region
20 between the first electrode region (21) and the second electrode region (23),

wherein step F) takes place between step B and step C.

- 25 3. Method according to claim 2, wherein the removal of the first electrically conductive material according to step E) or the removal of the first electrically conductive material and the second electrically
30 conductive material according to step F) takes place by means of laser ablation.

4. Method according to any one of the preceding claims, further comprising the step of:

35 G) arranging at least one protective material (15) in at least one third sub-region (17), which is arranged at least partially in the second sub-region

(13), between step B) and step C) and/or between step C) and step D), so that the second electrically conductive layer (5) is not covered with the protective material (15) in at least a fourth sub-region (19), which is arranged at least partially in the second sub-region (13).

5. Method according to any one of claims 2 to 4, wherein the protective material (15) is arranged on the second sub-region (13) at a distance from the insulator (9) so that a gap remains between the first sub-region (11) and the third sub-region (13), and wherein at least a part of the first electrically conductive material of the first electrically conductive layer (3) and the second electrically conductive material of the second electrically conductive layer (5) which are located in the region of the gap are removed according to step F).

6. Method according to any one of the preceding claims, further comprising the step of:

H) at least partially removing the second electrically conductive layer (5) in at least the fourth partial region (19) of the second partial region (13),

wherein step H) takes place between step C) and step D) and/or between step G) and step D).

7. Method according to claim 6, wherein the second electrically conductive layer (5) is removed by etching.

8. Method according to any one of claims 6 to 7,
further comprising the step of:

5 I) removing the protective material (15) from the second
electrically conductive layer (5),

with step I) taking place after step H).

- 10 9. Method according to any one of the preceding claims,
wherein the insulator (9) is applied directly to the
second electrically conductive layer (5) in step C) and
arranged on the second electrically conductive layer
15 (5) such that it is located substantially in the
immediate vicinity of the separation region between the
first electrode region (21) and the second electrode
region (23).

- 20 10. Method according to claim 9, wherein the insulator (9) is
applied to the second electrically conductive layer (5)
by means of a printing process.

- 25 11. Method according to any one of the preceding claims,
further comprising the steps of:

J) setting conditions in which the insulator (9) can be brought at
least partially into a flowable state; and

30 K) introducing the insulator (9) into at least one portion of
the separation region between the first electrode region
(21) and the second electrode region (23).

- 5
12. Method according to any one of the preceding claims,
wherein the first electrically conductive material is a
transparent conductive oxide.
13. Method according to any one of the preceding claims,
wherein the second electrically conductive material is a
metal.
- 10
14. Method according to any one of the preceding claims,
which is carried out in such a way that at least one
conductor track made of the second electrically
conductive material is arranged on the first
electrically conductive layer (3) in the first electrode
15 region (21).
- 15
15. Electronic component produced by a method according to any
one of claims 1 to 14.
- 20
- 25
- 30
- 35

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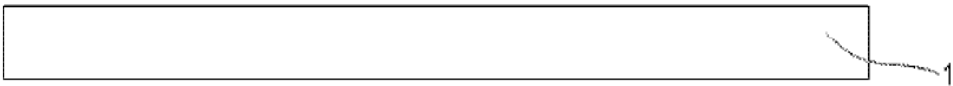


Fig. 1A

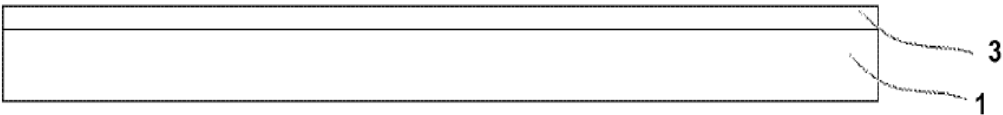


Fig. 1B

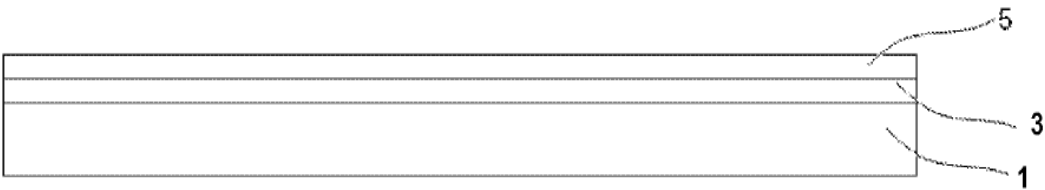


Fig. 1C

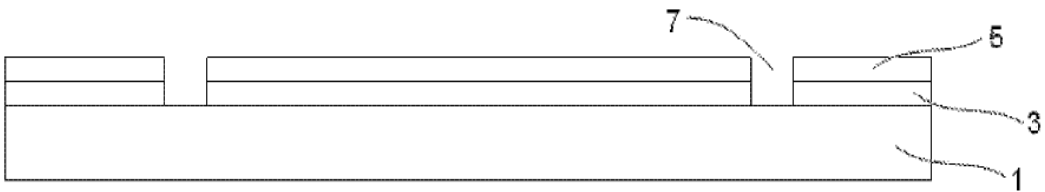


Fig. 1D

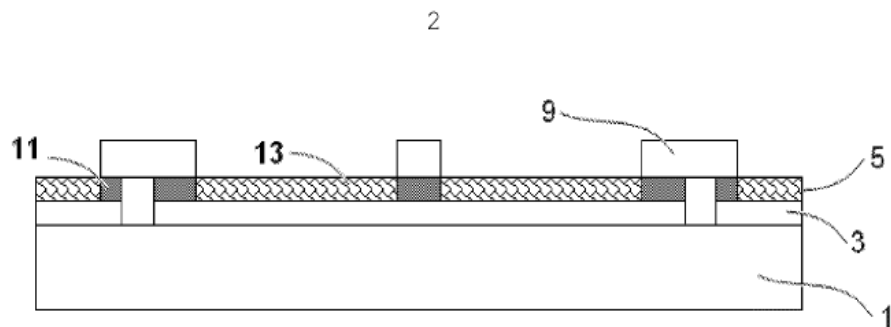


Fig. 1E

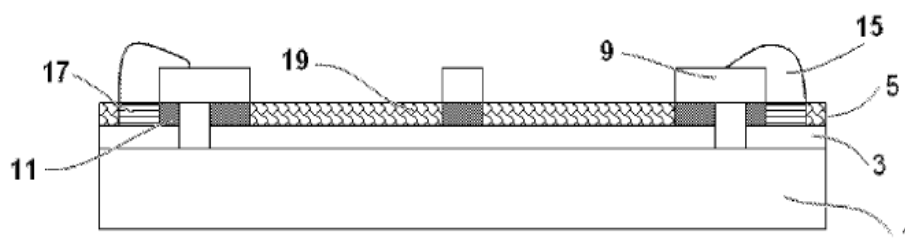


Fig. 1F

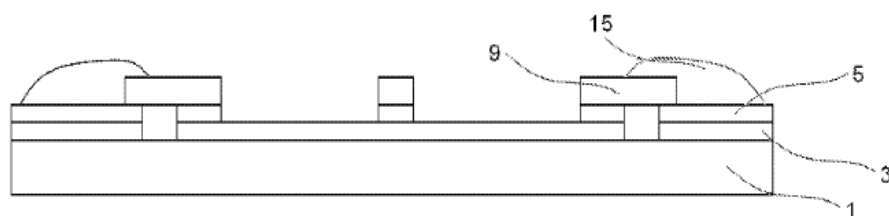


Fig. 1G

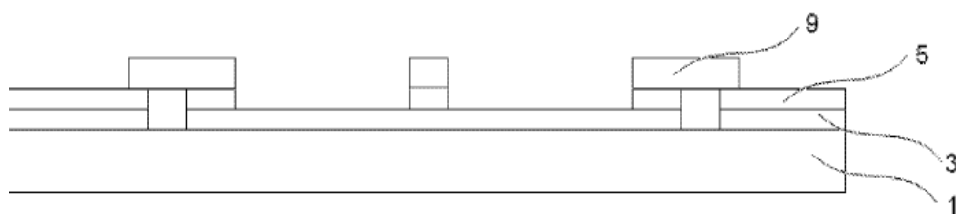


Fig. 1H

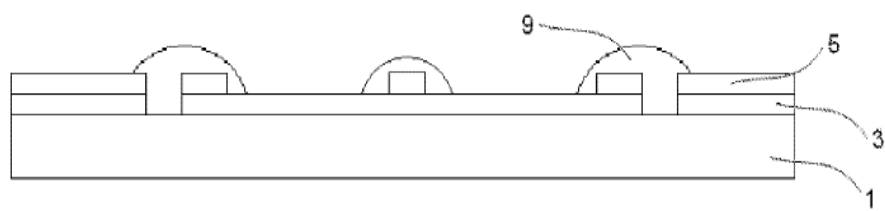


Fig. 1I

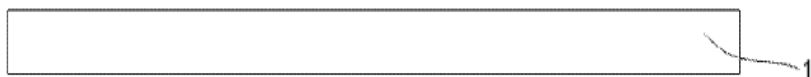


Fig. 2A

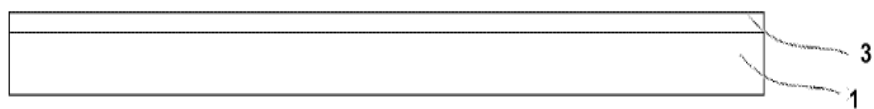


Fig. 2B

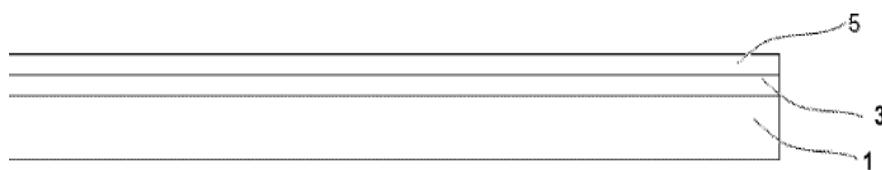


Fig. 2C

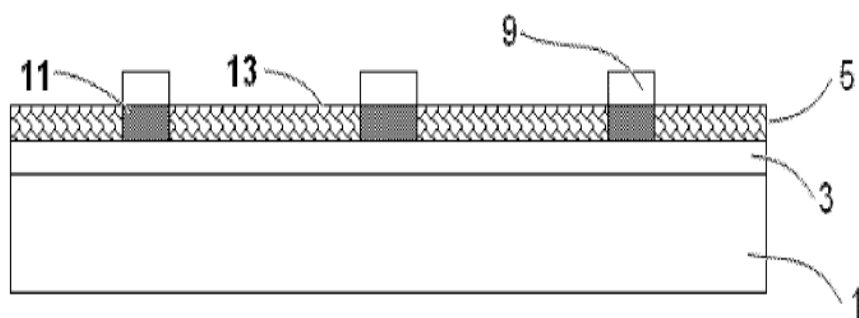


Fig. 2D

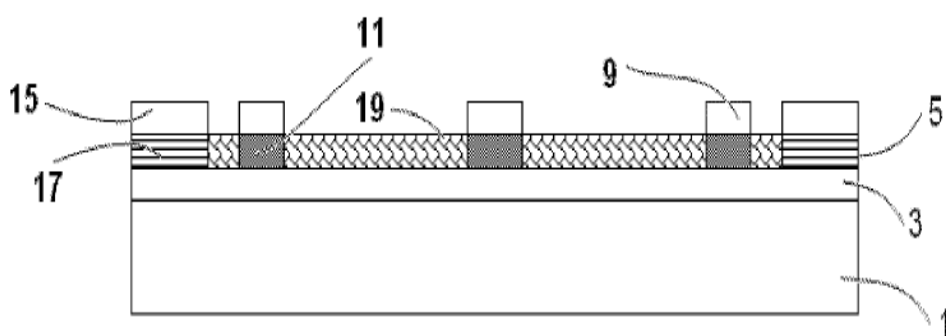


Fig. 2E

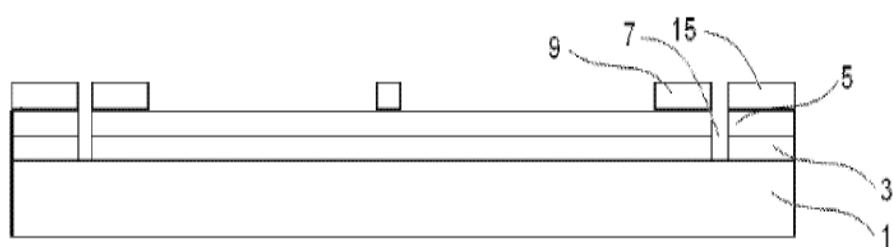


Fig. 2F

5

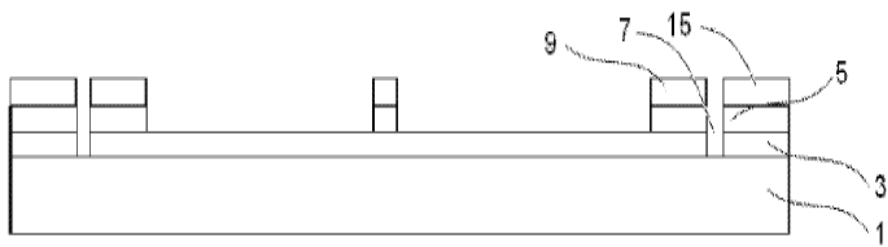


Fig. 2G

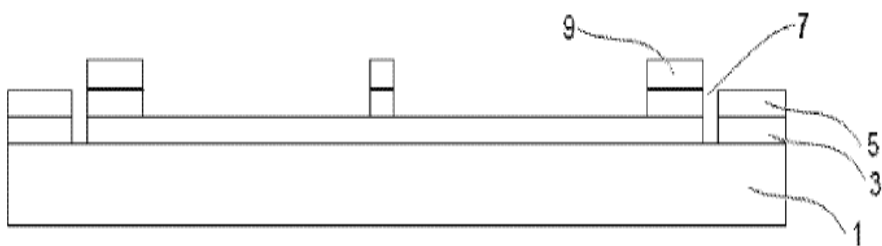


Fig. 2H

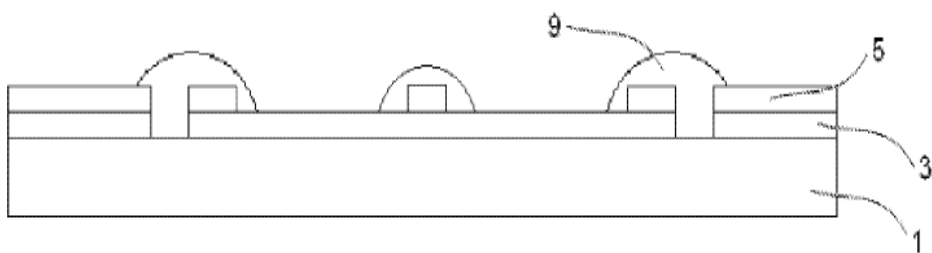
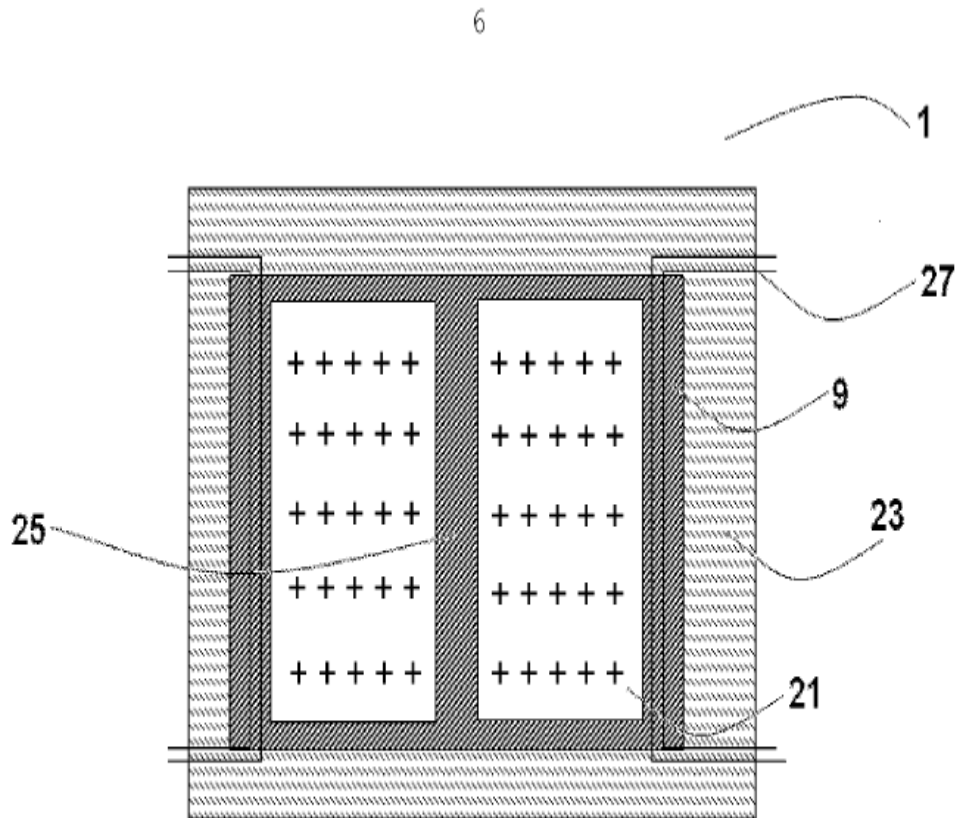


Fig. 2I

**Fig. 3**

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/063623

A. CLASSIFICATION OF SUBJECT MATTER

INV. H01L51/10
ADD.

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)

H01L

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	JP 2009 156913 A (KYOCERA CORP) 16 July 2009 (2009-07-16) paragraph [0040] - paragraph [0051]; figures 5-14	1-15
X	WO 2009/110186 A1 (PANASONIC CORP [JP]; MATSUSUE NORIYUKI; OKUMOTO KENJI) 11 September 2009 (2009-09-11) * abstract -& US 2010/084646 A1 (MATSUSUE NORIYUKI [JP] ET AL) 8 April 2010 (2010-04-08) paragraph [0041] - paragraphs [0045], [0054], [0067]; figure 1	1,2,9,15

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

☒ See patent family annex.

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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.

A document member of the same patent family

Date of the actual completion of the international search

22 December 2010

Date of mailing of the international search report

14/01/2011

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2010/063623

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
JP 2009156913	A	16-07-2009	NONE	
WO 2009110186	A1	11-09-2009	CN 101682957 A US 2010084646 A1	24-03-2010 08-04-2010
US 2010084646	A1	08-04-2010	CN 101682957 A WO 2009110186 A1	24-03-2010 11-09-2009