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(54) **ORGANIC LIGHT-EMITTING DIODE ARRAY SUBSTRATE, MANUFACTURING METHOD THEREFOR, AND DISPLAY DEVICE**

ORGANISCHES LED-ARRAYSUBSTRAT, HERSTELLUNGSVERFAHREN DAFÜR UND ANZEIGEVORRICHTUNG

SUBSTRAT DE MATRICE DE DIODES ÉLECTROLUMINESCENTES ORGANIQUES, PROCÉDÉ DE FABRICATION CORRESPONDANT, ET DISPOSITIF D'AFFICHAGE

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- **None**

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Description

TECHNICAL FIELD

[0001] The present invention relates to the field of display technology, and particularly relates to an organic light emitting diode array substrate, an organic light emitting diode display apparatus, and a manufacturing method of the organic light emitting diode array substrate.

BACKGROUND

[0002] Organic light emitting diodes (OLEDs), due to their characteristics such as self-luminous property, quick response, rich colors and the like, have gradually become important display devices. In the prior art, an OLED array substrate has a complicated structure, and generally includes structures of thin film transistors and OLEDs, wherein various structures, such as gates, sources and drains of the thin film transistors and cathodes and anodes of the OLEDs, need to be formed by many patterning processes. As a result, manufacturing process of the OLED array substrate is complicated.

[0003] In addition, it is extraordinarily important to form an even and stable organic light emitting material layer in an OLED. Especially in the case of using an inkjet printing technique, defects such as Mura may occur once an ink droplet of the organic light emitting material fails to spread evenly in an ink droplet accommodation unit. This may decrease yield of OLED array substrate products.

[0004] US patent application US20030146695A1 discloses a display apparatus that prevents shortening of the life of the luminescent elements and has a superior contrast ratio. The display apparatus is composed by forming a plurality of luminescent elements on a substrate and providing bank sections between each of the luminescent elements. The bank sections are formed from a first bank layer located on the side of the substrate and a second bank layer formed on the first bank layer. A light blocking layer is then provided between the first bank layer and the second bank layer.

[0005] Chinese patent application CN103681773A discloses an organic electroluminescent display device, a preparation method thereof and a display device. The display device comprises a substrate, a thin film transistor and an organic electroluminescent structure, wherein the thin film transistor and the organic electroluminescent structure are located on the substrate. An active layer of the thin film transistor and an anode of the organic electroluminescent structure are arranged on the same layer. Due to the fact that in the organic electroluminescent display (OLED) device, the active layer is made of a transparent oxide semiconductor material and the concentration of a carrier in the oxide semiconductor material can be improved by performing plasma treatment on the oxide semiconductor material, the oxide semiconductor material of the active layer can be adopted to prepare the anode, and the anode and the active layer are arranged on the same layer; when the OLED device is prepared, a novel composition process for preparing the anode is not needed, simultaneous preparation of the active layer and the anode can be achieved only by changing composition of a corresponding film layer, process steps can be simplified, the production cost is reduced, production efficiency is improved, and production time is shortened.

[0006] US patent application US20070269621A1 discloses a device including a bank, a film disposed in a region surrounded by the bank, and a groove extending along the periphery of the region. A method for forming a film by providing a liquid containing a functional material in a region surrounded by a bank includes forming a groove extending along the periphery of the region, providing the liquid in the region, and drying the liquid to form the film. The film is made of the functional material and is disposed over the groove. A method for manufacturing a device includes forming a film by providing a liquid in a region surrounded by a bank, the film being formed by the film-forming method.

SUMMARY

[0007] An object of the present invention is to provide an organic light emitting diode array substrate which is manufactured easily and has higher yield.

[0008] An object of the present invention also includes providing a manufacturing method of the organic light emitting diode array substrate and an organic light emitting diode display apparatus including the organic light emitting diode array substrate.

[0009] To achieve the above objects, technical solutions of the present invention are implemented by the following implementations.

[0010] Embodiments of the present invention provides a manufacturing method of an organic light emitting diode array substrate as set forth in appended claim 1.

[0011] In an embodiment, after forming an accommodation cavity, and before the step of injecting a solution containing an organic light emitting material into the accommodation cavity; and performing a drying process to form an organic light emitting material layer, the manufacturing method further includes a step of:
performing an overexposure treatment on the first electrode formed in the same layer as the active layer through the accommodation cavity to improve conductivity thereof.

[0012] In an embodiment, wavelength of light used in the overexposure treatment is in the range of 200nm to 400nm, and time for the overexposure treatment is between 0.5 minutes to 2 minutes.

[0013] In an embodiment, a surface of the first electrode subjected to the overexposure treatment is lyophilic.

[0014] In an embodiment, the first insulating layer is an etch stop layer.

[0015] In an embodiment, an angle between liquid level of the solution containing the organic light emitting material and a plane in which a surface of the etch stop layer is located is smaller than 0 degree.

[0016] In an embodiment, material of the etch stop layer is silicon oxide or aluminum oxide.

[0017] In an embodiment, the second insulating layer is a pixel define layer.

[0018] In an embodiment, an angle between liquid level of the solution containing the organic light emitting material and a plane in which a surface of the pixel define layer is located is larger than 30 degrees.

[0019] In an embodiment, the pixel define layer is made of an organic fluoride material.

[0020] In an embodiment, thickness of the second insulating layer is smaller than 1/4 of thickness of the first insulating layer.

[0021] An embodiment of the present invention provides an organic light emitting diode array substrate as set forth in appended claim 10.

[0022] Embodiments of the present invention further provide an organic light emitting diode display apparatus as set forth in appended claim 15.

[0023] For the above technical solutions of the present invention, in at least one aspect, the process can be simplified by forming one electrode of the organic light emitting diode and the active layer of the thin film transistor in the same layer, and flatness of the organic light emitting material layer can be improved by combining the lyophilic layer and the lyophobic layer, which can in turn improve manufacturing yield of organic light emitting diode array substrates.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024]

Fig. 1 is a schematic diagram of a manufacturing method of an OLED array substrate according to an embodiment of the present invention;

Fig. 2 is a schematic diagram illustrating influences of a lyophilic first insulating layer and a lyophobic second insulating layer on solution containing an organic light emitting material;

Fig. 3 is a schematic diagram of a part of an OLED array substrate including a bottom-gate thin film transistor and an OLED according to an example not forming part of the present invention;

Fig. 4 is a schematic diagram of a part of an OLED array substrate including a top-gate thin film transistor and an OLED according to an embodiment of the present invention;

Fig. 5 is a schematic diagram of a top-emission OLED display unit according to an example not forming part of the present invention; and

Fig. 6 is a flowchart schematically illustrating a manufacturing method of an OLED display unit according to an embodiment of the present invention.

DETAILED DESCRIPTION

[0025] Technical solutions of the present invention will be described in detail below in conjunction with the embodiments and accompanying drawings. Throughout the description, same or similar reference numerals represent same or similar parts. The following description of implementations of the present invention with reference to the accompanying drawings is intended to explain the general inventive concept of the present invention, and shall not be constructed as a limitation to the present invention.

[0026] Embodiments of the present invention provide a manufacturing method of an OLED array substrate including a thin film transistor and an OLED. In the manufacturing method, first, an oxide semiconductor layer is formed by a film forming process, and one patterning process is performed on the oxide semiconductor layer to form an active layer 108 of the thin film transistor and a first electrode 101 of the OLED, as shown in Fig. 1 (a). Then, a first insulating layer 102 and a second insulating layer 103 are sequentially formed on the active layer 108 and the first electrode 101 of the OLED, as shown in Fig. 1(b), the first insulating layer 102 is a lyophilic layer, and the second insulating layer 103 is a lyophobic layer. Subsequently, a patterning process is performed on the first insulating layer 102 and the second insulating layer 103 to form an accommodation cavity 104 exposing the first electrode 101, as shown in Fig. 1(c). Thereinafter, a solution containing an organic light emitting material is injected into the accommodation cavity 104 and dried to form an organic light emitting material layer 201, as shown in Fig. 1(d).

[0027] As the active layer 108 and the first electrode 101 are formed in a same layer by one patterning process, which includes, for example, deposition, photolithography, development, etch, etc., the manufacturing process of the OLED array substrate is obviously simplified. In the prior art, however, the active layer 108 and the first electrode 101 are formed in two patterning processes, and by contrast, the manufacturing method according to embodiments of the present invention can decrease the number of patterning processes during the whole manufacturing process of the OLED array substrate, and improve manufacturing efficiency and yield as well.

[0028] As described above, the first insulating layer 102 is a lyophilic layer, and the second insulating layer 103 is a lyophobic layer, which facilitate improving flatness of the organic light emitting material layer 201, especially in the case of using inkjet printing to form the organic light emitting material layer 201. Lyophilic and lyophobic properties of the first insulating layer 102 and the second insulating layer 103 for forming the accommodation cavity 104 have a significant influence on the flatness of a surface of the solution containing the organic light emitting material that is injected into the accommodation cavity 104. As shown in Fig. 2, in a case where the entire wall of the accommodation cavity 104 is formed by a lyophobic layer having a lyophobic surface, upper surface of the solution (e.g., in the form of an ink droplet) containing the organic light emitting material in the accommodation cavity 104 presents a convex shape (as shown in the top left figure in Fig. 2), and in a case where the entire wall of the accommodation cavity 104 is formed by a lyophilic layer having a lyophilic surface, the upper surface of the solution containing the organic light emitting material in the accommodation cavity 104 presents a concave shape (as shown in the lower left figure in Fig. 2). The obvious convex or concave shape may result in Mura during display. In the embodiments of the present invention, the wall of the accommodation cavity 104 is in the form of a combination of the lyophobic second insulating layer 103 and the lyophilic first insulating layer 102, in this manner, effects of the lyophilic layer and the lyophobic layer can be at least partially counteracted so that the upper surface of the droplet of the organic light emitting material in the accommodation cavity 104 tends to be flat, as shown in the right figure in Fig. 2. To achieve better effect, the second insulating layer 103 may be formed to have a thickness much smaller than that of the first insulating layer 102. For example, the thickness of the second insulating layer 103 does not exceed 1/4 of the thickness of the first insulating layer 102. As an example, the thickness of the lyophobic second insulating layer 103 may be in the range of 200nm to 500nm, and the thickness of the lyophilic first insulating layer 102 may be in the range of 800nm to 2000nm.

[0029] Compared to a solution adopting either a single lyophilic layer or a single lyophobic layer, the structure combining a lyophilic layer and a lyophobic layer can improve flatness of the organic light emitting material layer in an OLED display apparatus, and allow the injected solution containing the organic light emitting material (e.g., droplets of organic light emitting material jetted from an inkjet printing apparatus) to uniformly spread in the accommodation cavity 104, so as to avoid Mura defect during display.

[0030] As an example, the solution containing the organic light emitting material may be aqueous liquid, the second insulating layer 103 may be a hydrophobic layer, and the first insulating layer 102 may be a hydrophilic layer.

[0031] Those skilled in the art should understand that a lyophilic layer is a layer whose surface has a strong affinity for liquid (the solution containing the organic light emitting material in the present application), or is apt to be wetted by the liquid. Accordingly, a lyophobic layer is a layer whose surface lacks affinity for liquid (the solution containing the organic light emitting material in the present application), or can hardly be wetted by the liquid. Lyophilic and lyophobic property of a layer may depend on material and surface treatment.

[0032] In the context, the lyophilic and lyophobic property of a layer may be represented by an angle between a plane in which a surface of the layer is located and liquid level of the liquid in the accommodation cavity. As an example, the angle between the liquid level of the solution containing the organic light emitting material and a plane in which the surface of the second insulating layer 103 is located may be larger than 30 degrees. As an example, the angle between the liquid level of the solution containing the organic light emitting material and a plane in which the surface of the first insulating layer 102 is located may be smaller than 0 degree.

[0033] For example, the second insulating layer 103 may be made of an organic fluorine material, an organic silicon material, an inorganic nano-material or a photosensitive material. The first insulating layer 102 may be made of, for example, silicon oxide, aluminum oxide, or an inorganic insulating layer. As an example, the second insulating layer 103 may be a pixel define layer. As an example, the first insulating layer 102 may be an etch stop layer.

[0034] In an embodiment, the oxide semiconductor layer may be a metal oxide layer, such as indium gallium zinc oxide (IGZO), gallium zinc oxide (GZO), indium zinc oxide (IZO), or the like. As an example, after forming the accommodation cavity 104, and before the solution containing the organic light emitting material is injected into the accommodation cavity 104 and dried to form the organic light emitting material layer 201, an overexposure treatment may be performed, through the accommodation cavity 104, on the first electrode 101 formed in the same layer as the active layer 108 to improve its conductivity, for example, to better match work functions of other materials in the OLED. The first electrode 101 not only may be formed in the same layer as the active layer 108 but also may be formed in the same layer as other functional layer(s) that can be formed from the oxide semiconductor layer to further simplify the process.

[0035] As an example, wavelength of light used in the above overexposure treatment may be in the range of 200nm to 400nm, and treating time may be between 0.5 minutes to 2 minutes. As an example, the surface of the first electrode 101 subjected to the overexposure treatment may have lyophilic property. As an example, the second insulating layer 103 may be a pixel define layer. The pixel define layer 103 may be made of, for example, an organic fluorine material, an organic silicon material, an inorganic nano-material or a photosensitive material. As an example, the first insulating layer 102 may be an etch stop layer. The etch stop layer 102 may be made of, for example, silicon oxide, aluminum oxide, or an inorganic insulating layer.

[0036] As an example, after forming the first insulating layer (e.g., the etch stop layer) 102, and before forming the second insulating layer 103, the manufacturing method of an OLED array substrate according to an embodiment of the present invention further includes: forming a source 109 and a drain 110 on the first insulating layer 102, the source 109 and the drain 110 are respectively electrically connected to the active layer 108 through a first via hole 139 and a second via hole 140 both penetrating through the first insulating layer 102, and the drain 110 is also electrically connected to the first electrode 101 through a third via hole 141 penetrating through the first insulating layer 102. Thus, parts of the thin film transistor other than the active layer 108 can be formed conveniently.

[0037] Before forming the active layer 108 of the thin film transistor and the first electrode 101 of the OLED, the manufacturing method of an OLED array substrate according to an embodiment of the present invention further includes: forming a gate 107 of the thin film transistor on a base substrate 106; and forming a gate insulating layer 105 on the gate 107 and a part of the base substrate 106 without the gate 107 covering thereon, the active layer 108 and the first electrode 101 being formed on the gate insulating layer 105. An OLED array substrate (not forming part of the invention) thus manufactured is a bottom-gate OLED array substrate 200, as shown in Fig. 3. As an example, a reflective layer 120 may be formed at a position on the base substrate 106 corresponding to the accommodation cavity 104 while forming the gate 107 on the base substrate 106, that is, the reflective layer 120 may be formed in the same layer as the gate 107, so that a top-emission OLED array substrate 200 is formed without increasing the number of patterning processes, as shown in Fig. 5.

[0038] Alternatively, as an example, after forming the active layer 108 of the thin film transistor and the first electrode 101 of the OLED, and before forming the first insulating layer (e.g., the etch stop layer) 102, the manufacturing method of an OLED array substrate according to an embodiment of the present invention further includes: forming a gate insulating layer 105 on the active layer 108 of the thin film transistor, the first electrode 101 of the OLED, and a part of the base substrate without the active layer 108 of the thin film transistor and the first electrode 101 of the OLED covering thereon; forming a gate 107 on the gate insulating layer 105; the source and the drain are respectively electrically connected to the active layer 108 through a first via hole 139 and a second via hole 140 both penetrating through the first insulating layer 102 and the gate insulating layer 105, and the drain is also electrically connected to the first electrode 101 of the OLED through a third via hole 141 penetrating through the first insulating layer 102 and the gate insulating layer 105. In the step of performing a patterning process on the first insulating layer 102 and the second insulating layer 103 to form an accommodation cavity 104 exposing the first electrode, the patterning process is performed on the gate insulating layer 105, the first insulating layer 102 and the second insulating layer 103 to form the accommodation cavity 104 exposing the first electrode. The manufactured OLED array substrate is a top-gate OLED array substrate 200', as shown in Fig. 4. The gate insulating layer 105 is a lyophilic layer.

[0039] Fig. 6 illustrates a schematic flowchart of a manufacturing method of an OLED display unit according to an embodiment of the present invention. As described above, the manufacturing method 300 of an OLED display unit includes:

step 301 of forming an oxide semiconductor layer by a film forming process, and performing one patterning process on the oxide semiconductor layer to form an active layer of the thin film transistor and a first electrode of the organic light emitting diode;

step 302 of sequentially forming a first insulating layer and a second insulating layer on the active layer and the first electrode of the OLED, the first insulating layer being a lyophilic layer, and the second insulating layer being a lyophobic layer;

step 303 of performing a patterning process on the first insulating layer and the second insulating layer to form an accommodation cavity exposing the first electrode; and

step 305 of injecting a solution containing an organic light emitting material into the accommodation cavity; and performing a drying process to form an organic light emitting material layer.

[0040] By using the manufacturing method in the embodiment of the present invention, not only can the first electrode and the active layer be formed by one patterning process, but also compared to a case in which the first electrode and the active layer are formed in two different layers, an insulating layer for separating the two layers can be omitted, which further simplifies the process. In addition, when forming the accommodation cavity, the first insulating layer and the second insulating layer may be etched together to further simplify the process.

[0041] As an example, between step 303 and step 305, optional step 304 (shown by the dashed box in Fig. 6) of performing an overexposure treatment on the first electrode formed in the same layer as the active layer through the accommodation cavity to improve conductivity thereof may be further included.

[0042] Embodiments of the present invention further provide an OLED array substrate, and the OLED array substrate 200 includes: a thin film transistor 211 having an active layer 108; an OLED 212 including a first electrode 101, a second electrode 202 and an organic light emitting material layer 201 disposed between the first electrode 101 and the second electrode 202; and a first insulating layer 102 and a second insulating layer 103 sequentially formed from bottom to top above the active layer 108 and the first electrode 101 of the OLED. The first insulating layer 102 is a lyophilic layer, and the second insulating layer 103 is a lyophobic layer. The active layer 108 and the first electrode 101 of the OLED are in a same layer and made of a same material. An accommodation cavity 104 exposing the first electrode to the organic light emitting material layer 201 is formed in the first insulating layer 102 and the second insulating layer 103, and the accommodation cavity 104 is used for accommodating the organic light emitting material layer 201.

[0043] Because the active layer 108 and the first electrode 101 are in the same layer and made of the same material, they may be formed in one patterning process, which can decrease the number of patterning processes in the process of manufacturing the OLED array substrate 200, and improve manufacturing efficiency and yield.

[0044] In addition, because a composite structure of a lyophilic layer and a lyophobic layer formed by the first insulating layer 102 and the second insulating layer 103 is used, the flatness of the organic light emitting material layer in the OLED array substrate 200 according to the embodiment of the present invention can be improved, and the solution containing the organic light emitting material (e.g., droplets of the organic light emitting material jetted from an inkjet printing apparatus), which is injected into the accommodation cavity to form the organic light emitting material layer, can uniformly spread in the accommodation cavity 104, so as to alleviate defects such as Mura, coffee ring or the like. To achieve better effect, the second insulating layer 103 may be formed to have a thickness much smaller than that of the first insulating layer 102. For example, the thickness of the second insulating layer 103 does not exceed 1/4 of the thickness of the first insulating layer 102.

[0045] As an example, the first insulating layer 102 may be an etch stop layer, and the second insulating layer 103 may be a pixel define layer. In an example, an angle between liquid level of the solution containing the organic light emitting material, which is injected into the accommodation cavity to form the organic light emitting material layer, and the plane in which the surface of the etch stop layer is located is smaller than 0 degree, and an angle between the liquid level of the solution containing the organic light emitting material, which is injected into the accommodation cavity to form the organic light emitting material layer, and the plane in which the surface of the pixel define layer is larger than 30 degrees.

[0046] The thin film transistor 211 further includes: a source 109 and a drain 110 above the first insulating layer (e.g., the etch stop layer) 102, wherein, the source and the drain are respectively electrically connected to the active layer 108 through a first via hole 139 and a second via hole 140 penetrating through the first insulating layer 102, and the drain 110 is also electrically connected to the first electrode 101 of the OLED through a third via hole 141 penetrating through the first insulating layer 102; a gate 107 above or below the active layer 108; and a gate insulating layer 105 between the active layer 108 and the gate 107. Thus, parts of the thin film transistor 211 other than the active layer 108 can be formed conveniently. The thin film transistor 211 can be used to control a voltage of an electrode layer of the OLED when a display element operates, for example, to drive the organic light emitting material to emit light or stop light-emission.

[0047] In an example, as shown in Figs. 3 and 5 (not forming part of the invention), the OLED array substrate 200 may further include a base substrate 106, the gate 107 is on the base substrate 106, and the gate insulating layer 105 is arranged to separate the gate 107 and a part of the base substrate 106 without the gate 107 covering thereon from the active layer 108 and the first electrode 101.

[0048] As shown in Fig. 4, the OLED array substrate 200' includes a base substrate 106, the active layer 108 and the first electrode 101 are on the base substrate 106, and the gate insulating layer 105 is above the active layer 108 and the first electrode 101 and forms the accommodation cavity 104 together with the first insulating layer 102 and the second insulating layer 103. Thus, the accommodation cavity 104 is formed by etching the first insulating layer 102, the second insulating layer 103 and the gate insulating layer 105, and the process is simplified.

[0049] In an example, the OLED array substrate 200 may further include an upper-lower electrode connection structure 111, as shown in Figs. 3, 4 and 5. The upper-lower electrode connection structure 111 includes a lower electrode 1111, an upper electrode 1112 and a contact hole 1113 connecting the two electrodes 1111 and 1112. The lower electrode 1111 may be arranged in the same layer as the gate 107. The upper-lower electrode connection structure 111 may be used for providing power to each electrode in the OLED array substrate.

[0050] As an example, the first electrode 101, the gate insulating layer 105 and the base substrate 106 may all be light-transmissive, so as to allow light emitted, under the effect of a voltage, from the organic light emitting material accommodating in the accommodation cavity 104 to be emitted out from the first electrode 101.

[0051] As an example (not forming part of the invention), as shown in Fig. 5, a reflective layer 120 is provided on the base substrate 106 below the gate insulating layer 105, and the reflective layer 120 is opposite to the bottom of the accommodation cavity 104. The reflective layer 120 can reflect light emitted from the organic light emitting material to the bottom (for example, passing through the first electrode 101 of the OLED) towards the top of the OLED. As an example, the reflective layer 120 may be made of a metal material, such as aluminum, an aluminum silver alloy, molybdenum, a molybdenum alloy, or the like. Arrows in Figs. 3 to 5 indicate light emitting directions. To simplify the process, in an example, the reflective layer 120 and the gate 107 may be formed in a same layer and made of a same material.

[0052] As an example, an angle between the wall of the accommodation cavity 104 and a direction perpendicular to the first electrode 101 of the OLED may be smaller than 30 degrees. In this way, an ink droplet accommodation unit such as the accommodation cavity can be easily manufactured, and short-circuit can hardly occur.

[0053] It should be noted that in order to meet the operating requirement of the OLED better, a hole transport layer and a hole injection layer may further be provided between the first electrode 101 and the organic light emitting material layer 201 of the OLED, and an electron transport layer and an electron injection layer may further be provided between the organic light emitting material layer 201 and the second electrode 202.

[0054] In the embodiments of the present invention, the first electrode 101 may be the anode of the OLED, and the second electrode 202 may be the cathode of the OLED, and vice versa.

[0055] In order to meet the function requirements of the OLED array substrate 200, an element such as a capacitor 119 (as shown by the left dashed box in Figs. 3, 4, or 5) may also be provided in the OLED array substrate 200.

[0056] In the embodiments of the present invention, the accommodation cavity 104 may accommodate an organic light emitting material, required by the OLED display apparatus to work, of any color such as red, blue, green, or the like.

[0057] Embodiments of the present invention further provide an OLED display apparatus including the OLED array substrate 200 described in any one of the above embodiments.

[0058] It should be noted that the OLED display apparatus provided by the embodiments of the present invention may be a WOLED (white organic light emitting diode) display apparatus, a POLED (polymer organic light emitting diode) display apparatus, or the like.

[0059] In addition, the OLED display apparatus in the embodiments may be any product or component having a display function such as an OLED display panel, a mobile phone, a tablet computer, a television, a monitor, a notebook computer, a digital photo frame, a navigator, or the like.

[0060] The present invention is described in conjunction with the accompanying drawings, but the embodiments disclosed in the accompanying drawings are intended to exemplarily illustrate the preferred implementations of the present invention and shall not be constructed as a limitation to the present invention.

[0061] Some embodiments of the general concept of the present invention has been illustrated and described, but those of ordinary skill in the art shall understand that these embodiments can be changed without departing from the scope of the present invention as defined by the appended claims.

Claims

1. A manufacturing method of an organic light emitting diode array substrate (200), the organic light emitting diode array substrate (200) comprising a thin film transistor and an organic light emitting diode, the method comprising steps of:

   forming an oxide semiconductor layer by a film forming process, and performing one patterning process on the oxide semiconductor layer to form an active layer (108) of the thin film transistor and a first electrode (101) of the organic light emitting diode;
   forming a gate insulating layer (105) on the active layer (108) of the thin film transistor, the first electrode (101) of the organic light emitting diode, and a part of a base substrate (106) that is not covered by the active layer (108) of the thin film transistor and the first electrode (101) of the organic light emitting diode;
   forming a gate (107) on the gate insulating layer (105);
   sequentially forming a first insulating layer (102) and a second insulating layer (103) on the active layer (108) and the first electrode (101) of the organic light emitting diode, the first insulating layer (102) being a lyophilic layer, and the second insulating layer (103) being a lyophobic layer;
   forming an accommodation cavity (104) exposing the first electrode (101) by performing a patterning process on the first insulating layer (102) and the second insulating layer (103); and
   injecting a solution containing an organic light emitting material into the accommodation cavity (104) and performing a drying process to form an organic light emitting material layer (201),
   wherein after forming the first insulating layer (102) and before forming the second insulating layer (103), the method further comprises a step of:

      forming a source (109) and a drain (110) on the first insulating layer (102) such that the source (109) and the drain (110) are respectively electrically connected to the active layer (108) through a first via hole (139) and a second via hole (140) penetrating through the first insulating layer (102) and the gate insulating layer (105), and the drain (110) is further electrically connected to the first electrode (101) of the organic light emitting diode through a third via hole (141) penetrating through the first insulating layer (102) and the gate insulating layer (105), and
      wherein in the step of forming an accommodation cavity (104) exposing the first electrode (101) by performing a patterning process on the first insulating layer (102) and the second insulating layer (103), the patterning process is performed on the first insulating layer (102), the second insulating layer (103) and the gate insulating layer (105) to form the accommodation cavity (104) exposing the first electrode (101), the gate insulating layer (105) has lyophilic property.

2. The manufacturing method of claim 1, further comprising, after the step of forming an accommodation cavity (104), and before the step of injecting a solution containing an organic light emitting material into the accommodation cavity (104) and performing a drying process to form an organic light emitting material layer (201), a step of:
performing an overexposure treatment on the first electrode (101) formed in the same layer as the active layer (108) through the accommodation cavity (104) to improve conductivity thereof.

3. The manufacturing method of claim 2, wherein wavelength of light used in the overexposure treatment is in the range of 200nm to 400nm, and time for performing the overexposure treatment is between 0.5 minutes to 2 minutes.

4. The manufacturing method of claim 2, wherein a surface of the first electrode (101) subjected to the overexposure treatment has lyophilic property.

5. The manufacturing method of claim 1, wherein an angle between liquid level of the solution containing the organic light emitting material and a plane in which a surface of the first insulating layer (102) is located is smaller than 0 degree; and preferably, the first insulating layer (102) is made of silicon oxide or aluminum oxide.

6. The manufacturing method of claim 1, wherein an angle between liquid level of the solution containing the organic light emitting material and a plane in which a surface of the second insulating layer (103) is located is larger than 30 degrees.

7. The manufacturing method of claim 6, wherein the second insulating layer (103) is made of an organic fluoride material.

8. The manufacturing method of any one of claims 1 to 7, wherein thickness of the second insulating layer (103) is no larger than 1/4 of thickness of the first insulating layer (102).

9. The manufacturing method of any one of claims 1 to 8, wherein the first insulating layer (102) is an etch stop layer, and the second insulating layer (103) is a pixel define layer.

10. An organic light emitting diode array substrate (200), comprising:

a base substrate (106);
a thin film transistor having an active layer (108);
an organic light emitting diode comprising a first electrode (101), a second electrode and an organic light emitting material layer (201) disposed between the first electrode (101) and the second electrode; and
a first insulating layer (102) and a second insulating layer (103) sequentially formed from bottom to top above the active layer (108) and the first electrode (101) of the organic light emitting diode, the first insulating layer (102) being a lyophilic layer, and the second insulating layer (103) being a lyophobic layer, wherein,
the active layer (108) and the first electrode (101) of the organic light emitting diode are in a same layer, made of a same material and on the base substrate (106), the thin film transistor further comprises a gate insulating layer (105) on the active layer (108), the first electrode (101) of the organic light emitting diode and a part of the base substrate (106) that is not covered by the active layer (108) and the first electrode (101) of the organic light emitting diode, a gate (107) on the gate insulating layer (105), and a source (109) and a drain (110) above the first insulating layer (102) and below the second insulating layer (103), the first insulating layer (102) is formed above the gate (107) and the gate insulating layer (105), the source (109) and the drain (110) are respectively electrically connected to the active layer (108) through a first via hole (139) and a second via hole (140) penetrating through the first insulating layer (102) and the gate insulating layer (105), and the drain (110) is further electrically connected to the first electrode (101) of the organic light emitting diode through a third via hole (141) penetrating through the first insulating layer (102) and the gate insulating layer (105), and an accommodation cavity (104) exposing the first electrode (101) to the organic light emitting material layer (201) is formed in the first insulating layer (102), the second insulating layer (103) and the gate insulating layer (105), the accommodation cavity (104) is used for accommodating the organic light emitting material layer (201), and the gate insulating layer (105) has lyophilic property.

11. The organic light emitting diode array substrate of claim 10, wherein the first insulating layer (102) is made of silicon oxide or aluminum oxide.

12. The organic light emitting diode array substrate of claim 10, wherein the second insulating layer (103) is made of an organic fluoride material.

13. The organic light emitting diode array substrate of any one of claims 10 to 12, wherein thickness of the second insulating layer (103) is no larger than 1/4 of thickness of the first insulating layer (102).

14. The organic light emitting diode array substrate of

any one of claims 10 to 13, wherein the first insulating layer (102) is an etch stop layer, and the second insulating layer (103) is a pixel define layer.

15. An organic light emitting diode display apparatus, comprising:
the organic light emitting diode array substrate (200) of claim 10.

Patentansprüche

1. Herstellungsverfahren eines organischen LED-Arraysubstrats (200), wobei das organische LED-Arraysubstrat (200) einen Dünnfilmtransistor und eine organische lichtemittierende Diode (Light Emitting Diode, LED) aufweist, wobei das Verfahren die folgenden Schritte umfasst:

Bilden einer Oxid-Halbleiterschicht durch einen Filmbildungsvorgang, und Durchführen eines Strukturierungsvorgangs auf der Oxid-Halbleiterschicht, um eine aktive Schicht (108) des Dünnfilmtransistors und eine erste Elektrode (101) der organischen LED zu bilden;
Bilden einer Gate-Isolierschicht (105) auf der aktiven Schicht (108) des Dünnfilmtransistors, der ersten Elektrode (101) der organischen LED und einem Teil eines Basissubstrats (106), der nicht von der aktiven Schicht (108) des Dünnfilmtransistors und der ersten Elektrode (101) der organischen LED bedeckt ist;
Bilden eines Gates (107) auf der Gate-Isolierschicht (105);
sequentielles Bilden einer ersten Isolierschicht (102) und einer zweiten Isolierschicht (103) auf der aktiven Schicht (108) und der ersten Elektrode (101) der organischen LED, wobei die erste Isolierschicht (102) eine lyophile Schicht ist und die zweite Isolierschicht (103) eine lyophobe Schicht ist;
Bilden eines Aufnahmehohlraums (104), der die erste Elektrode (101) durch Durchführen eines Strukturierungsvorgangs auf der ersten Isolierschicht (102) und der zweiten Isolierschicht (103) freilegt; und
Einspritzen einer Lösung, die ein organisches lichtemittierendes Material enthält, in den Aufnahmehohlraum (104) und Durchführen eines Trocknungsvorgangs, um eine Schicht aus einem organischen lichtemittierenden Material (201) zu bilden,
wobei das Verfahren nach dem Bilden der ersten Isolierschicht (102) und vor dem Bilden der zweiten Isolierschicht (103) ferner folgenden Schritt aufweist:

Bilden einer Source (109) und eines Drains (110) auf der ersten Isolierschicht (102), so dass die Source (109) und der Drain (110) jeweils durch ein erstes Durchkontaktierungsloch (139) und ein zweites Durchkontaktierungsloch (140), die durch die erste Isolierschicht (102) und die Gate-Isolierschicht (105) hindurchgehen, mit der aktiven Schicht (108) elektrisch verbunden sind, und der Drain (110) weiter elektrisch mit der ersten Elektrode (101) der organischen LED durch ein drittes Durchkontaktierungsloch (141) verbunden ist, das durch die erste Isolierschicht (102) und die Gate-Isolierschicht (105) hindurchgeht, und
wobei in dem Schritt des Bildens eines Aufnahmehohlraums (104), der die erste Elektrode (101) freilegt, durch Durchführen eines Strukturierungsvorgangs auf der ersten Isolierschicht (102) und der zweiten Isolierschicht (103) der Strukturierungsvorgang auf der ersten Isolierschicht (102), der zweiten Isolierschicht (103) und der Gate-Isolierschicht (105) durchgeführt wird, um den Aufnahmehohlraum (104) zu bilden, der die erste Elektrode (101) freilegt, wobei die Gate-Isolierschicht (105) eine lyophile Eigenschaft hat.

2. Herstellungsverfahren nach Anspruch 1, ferner nach dem Schritt des Bildens eines Aufnahmehohlraums (104) und vor dem Schritt des Einspritzens einer Lösung, die ein organisches lichtemittierendes Material enthält, in den Aufnahmehohlraum (104) und des Durchführens eines Trocknungsvorgangs, um eine organische lichtemittierende Materialschicht (201) zu bilden, folgenden Schritt umfassend:
Durchführen einer Überbelichtungsbehandlung an der ersten Elektrode (101), die in der gleichen Schicht wie die aktive Schicht (108) durch den Aufnahmehohlraum (104) gebildet ist, um deren Leitfähigkeit zu verbessern.

3. Herstellungsverfahren nach Anspruch 2, wobei eine Wellenlänge des Lichts, die bei der Überbelichtungsbehandlung verwendet wird, im Bereich von 200 nm bis 400 nm liegt und die Zeit zur Durchführung der Überbelichtungsbehandlung zwischen 0,5 Minuten und 2 Minuten beträgt.

4. Herstellungsverfahren nach Anspruch 2, wobei eine Fläche der ersten Elektrode (101), die der Überbelichtungsbehandlung unterzogen wird, eine lyophile Eigenschaft aufweist.

5. Herstellungsverfahren nach Anspruch 1, wobei ein Winkel zwischen dem Flüssigkeitspegel der Lösung, die das organische lichtemittierende Material enthält, und einer Ebene, in der sich eine Fläche der ersten Isolierschicht (102) befindet, kleiner als 0 Grad ist; und die erste Isolierschicht (102) vorzugsweise aus Siliziumoxid oder Aluminiumoxid hergestellt wird.

6. Herstellungsverfahren nach Anspruch 1, wobei ein Winkel zwischen dem Flüssigkeitspegel der Lösung, die das organische lichtemittierende Material enthält, und einer Ebene, in der sich eine Fläche der zweiten Isolierschicht (103) befindet, größer als 30 Grad ist.

7. Herstellungsverfahren nach Anspruch 6, wobei die zweite Isolierschicht (103) aus einem organischen Fluoridmaterial hergestellt wird.

8. Herstellungsverfahren nach einem der Ansprüche 1 bis 7, wobei die Dicke der zweiten Isolierschicht (103) nicht größer als 1/4 der Dicke der ersten Isolierschicht (102) ist.

9. Herstellungsverfahren nach einem der Ansprüche 1 bis 8, wobei die erste Isolierschicht (102) eine Ätzstoppschicht ist und die zweite Isolierschicht (103) eine Pixeldefinitionsschicht ist.

10. Organisches LED-Arraysubstrat (200), aufweisend:

ein Basissubstrat (106);
einen Dünnfilmtransistor mit einer aktiven Schicht (108);
eine organische LED mit einer ersten Elektrode (101), einer zweiten Elektrode und einer organischen lichtemittierenden Materialschicht (201), die zwischen der ersten Elektrode (101) und der zweiten Elektrode angeordnet ist; und
eine erste Isolierschicht (102) und eine zweite Isolierschicht (103), die sequentiell von unten nach oben über der aktiven Schicht (108) und der ersten Elektrode (101) der organischen LED gebildet sind, wobei die erste Isolierschicht (102) eine lyophile Schicht ist und die zweite Isolierschicht (103) eine lyophobe Schicht ist, wobei
die aktive Schicht (108) und die erste Elektrode (101) der organischen LED in derselben Schicht, aus demselben Material und auf dem Basissubstrat (106) sind, der Dünnfilmtransistor ferner eine Gate-Isolierschicht (105) auf der aktiven Schicht (108), der ersten Elektrode (101) der organischen LED und getrennt von dem Basissubstrat (106), das nicht von der aktiven Schicht (108) und der ersten Elektrode (101) der organischen LED bedeckt ist, ein Gate (107) auf der Gate-Isolierschicht (105) und eine Source (109) und ein Drain (110) oberhalb der ersten Isolierschicht (102) und unterhalb der zweiten Isolierschicht (103) aufweist, wobei die erste Isolierschicht (102) oberhalb des Gates (107) und der Gate-Isolierschicht (105) gebildet ist, die Source (109) und der Drain (110) jeweils durch ein erstes Durchkontaktierungsloch (139) und ein zweites Durchkontaktierungsloch (140), die durch die erste Isolierschicht (102) und die Gate-Isolierschicht (105) hindurchgehen, mit der aktiven Schicht (108) elektrisch verbunden sind, und der Drain (110) ferner durch ein drittes Durchkontaktierungsloch (141), das durch die erste Isolierschicht (102) und die Gate-Isolierschicht (105) hindurchgeht, mit der ersten Elektrode (101) der organischen LED elektrisch verbunden ist und ein Aufnahmehohlraum (104), der die erste Elektrode (101) der organischen lichtemittierenden Materialschicht (201) aussetzt, in der ersten Isolierschicht (102), der zweiten Isolierschicht (103) und der Gate-Isolierschicht (105) gebildet ist, wobei der Aufnahmehohlraum (104) zum Aufnehmen der organischen lichtemittierenden Materialschicht (201) verwendet wird und die Gate-Isolierschicht (105) lyophile Eigenschaften aufweist.

11. Organisches LED-Arraysubstrat nach Anspruch 10, wobei die erste Isolierschicht (102) aus Siliziumoxid oder Aluminiumoxid hergestellt ist.

12. Organisches LED-Arraysubstrat nach Anspruch 10, wobei die zweite Isolierschicht (103) aus einem organischen Fluoridmaterial hergestellt ist.

13. Organisches LED-Arraysubstrat nach einem der Ansprüche 10 bis 12, wobei die Dicke der zweiten Isolierschicht (103) nicht größer als 1/4 der Dicke der ersten Isolierschicht (102) beträgt.

14. Organisches LED-Arraysubstrat nach einem der Ansprüche 10 bis 13, wobei die erste Isolierschicht (102) eine Ätzstoppschicht ist und die zweite Isolierschicht (103) eine Pixeldefinitionsschicht ist.

15. Organische LED-Anzeigevorrichtung, das organische LED-Arraysubstrat (200) nach Anspruch 10 aufweisend.

Revendications

1. Procédé de fabrication d'un substrat de réseau de diodes électroluminescentes organiques (200), le substrat de réseau de diodes électroluminescentes (200) comprenant un transistor en couche mince et une diode électroluminescente organique, le procédé comprenant les étapes consistant à :

former une couche semi-conductrice d'oxyde par un processus de formation de film, et réaliser

un processus de formation de motif sur la couche semi-conductrice d'oxyde pour former une couche active (108) du transistor en couche mince et une première électrode (101) de la diode électroluminescente organique ;
former une couche isolante de grille (105) sur la couche active (108) du transistor en couche mince, la première électrode (101) de la diode électroluminescente organique, et une partie d'un substrat de base (106) qui n'est pas recouverte par le couche active (108) du transistor en couche mince et la première électrode (101) de la diode électroluminescente organique ;
former une grille (107) sur la couche isolante de grille (105) ;
former séquentiellement une première couche isolante (102) et une seconde couche isolante (103) sur la couche active (108) et la première électrode (101) de la diode électroluminescente organique, la première couche isolante (102) étant une couche lyophilique, et la seconde couche isolante (103) étant une couchelyophobe ;
former une cavité d'hébergement (104) exposant la première électrode (101) en réalisant un processus de formation de motif sur la première couche isolante (102) et la seconde couche isolante (103) ; et
injecter une solution contenant un matériau électroluminescent organique dans la cavité d'hébergement (104) et réaliser un processus de séchage pour former une couche de matériau électroluminescent organique (201),
dans lequel, après avoir formé la première couche isolante (102) et avant de former la seconde couche isolante (103), le procédé comprend en outre une étape consistant à :

former une source (109) et un drain (110) sur la première couche isolante (102) de telle sorte que la source (109) et le drain (110) sont respectivement connectés électriquement à la couche active (108) au travers d'un premier trou d'interconnexion (139) et d'un second trou d'interconnexion (140) pénétrant au travers de la première couche isolante (102) et de la couche isolante de grille (105), et le drain (110) est en outre connecté électriquement à la première électrode (101) de la diode électroluminescente organique au travers d'un troisième trou d'interconnexion (141) pénétrant au travers de la première couche isolante (102) et de la couche isolante de grille (105), et
dans lequel dans l'étape consistant à former une cavité d'hébergement (104) exposant la première électrode (101) en réalisant un processus de formation de motif sur la première couche isolante (102) et la seconde couche isolante (103), le processus de formation de motif est réalisé sur la première couche isolante (102), la seconde couche isolante (103) et la couche isolante de grille (105) pour former la cavité d'hébergement (104) exposant la première électrode (101), la couche isolante de grille (105) a une propriété lyophilique.

2. Procédé de fabrication selon la revendication 1, comprenant en outre, après l'étape consistant à former une cavité d'hébergement (104) et avant l'étape consistant à injecter une solution contenant un matériau électroluminescent organique dans la cavité d'hébergement (104) et à réaliser un processus de séchage pour former une couche de matériau électroluminescent organique (201), une étape consistant à :
réaliser un traitement de surexposition sur la première électrode (101) formée dans la même couche que la couche active (108) au travers de la cavité d'hébergement (104) pour améliorer sa conductivité.

3. Procédé de fabrication selon la revendication 2, dans lequel la longueur d'onde de la lumière utilisée dans le traitement de surexposition est comprise entre 200 nm et 400 nm, et le temps nécessaire à la réalisation du traitement de surexposition est compris entre 0,5 minute et 2 minutes.

4. Procédé de fabrication selon la revendication 2, dans lequel une surface de la première électrode (101) soumise au traitement de surexposition a une propriété lyophilique.

5. Procédé de fabrication selon la revendication 1, dans lequel un angle entre le niveau de liquide de la solution contenant le matériau électroluminescent organique et un plan dans lequel une surface de la première couche isolante (102) est située est inférieure à 0 degré ; et de préférence, la première couche isolante (102) est constituée d'oxyde de silicium ou d'oxyde d'aluminium.

6. Procédé de fabrication selon la revendication 1, dans lequel un angle entre le niveau de liquide de la solution contenant le matériau électroluminescent organique et un plan dans lequel une surface de la seconde couche isolante (103) est située est supérieure à 30 degrés.

7. Procédé de fabrication selon la revendication 6, dans lequel la seconde couche isolante (103) est constituée d'un matériau fluoré organique.

8. Procédé de fabrication selon l'une quelconque des revendications 1 à 7, dans lequel l'épaisseur de la seconde couche isolante (103) n'est pas supérieure à 1/4 de l'épaisseur de la première couche isolante (102).

9. Procédé de fabrication selon l'une quelconque des revendications 1 à 8, dans lequel la première couche isolante (102) est une couche d'arrêt de gravure et la seconde couche isolante (103) est une couche de définition de pixels.

10. Substrat de réseau de diodes électroluminescentes organiques (200), comprenant :

un substrat de base (106) ;
un transistor en couche mince ayant une couche active (108) ;
une diode électroluminescente organique comprenant une première électrode (101), une seconde électrode et une couche de matériau électroluminescent organique (201) disposée entre la première électrode (101) et la seconde électrode ; et
une première couche isolante (102) et une seconde couche isolante (103) formées séquentiellement de bas en haut au-dessus de la couche active (108) et de la première électrode (101) de la diode électroluminescente organique, la première couche isolante (102) étant une couche lyophilique et la seconde couche isolante (103) étant une couche lyophobe, dans lquel, la couche active (108) et la première électrode (101) de la diode électroluminescente organique sont dans une même couche, constituées d'un même matériau et sur le substrat de base (106), le transistor en couche mince comprend en outre une couche isolante de grille (105) sur la couche active (108), la première électrode (101) de la diode électroluminescente organique et une partie du substrat de base (106) qui n'est pas recouverte par la couche active (108) et la première électrode (101) de la diode électroluminescente organique, une grille (107) sur la couche isolante de grille (105), et une source (109) et un drain (110) au-dessus de la première couche isolante (102) et au-dessous de la seconde couche isolante (103), la première couche isolante (102) est formée au-dessus de la grille (107) et la couche isolante de grille (105), la source (109) et le drain (110) sont respectivement connectées électriquement à la couche active (108) au travers d'un premier trou d'interconnexion (139) et d'un second trou d'interconnexion (140) pénétrant au travers de la première couche isolante (102) et de la couche isolante de grille (105), et le drain (110) est en outre connecté électriquement à la première électrode (101) de la diode électroluminescente organique au travers d'un troisième trou d'interconnexion (141) pénétrant au travers de la première couche isolante (102) et de la couche isolante de grille (105), et une cavité d'hébergement (104) exposant la première électrode (101) à la couche de matériau électroluminescent organique (201) est formée dans la première couche isolante (102), la seconde couche isolante (103) et la couche isolante de grille (105), la cavité d'hébergement (104) est utilisée pour héberger la couche de matériau électroluminescent organique (201), et la couche isolante de grille (105) a une propriété lyophilique.

11. Substrat de réseau de diodes électroluminescentes organiques selon la revendication 10, dans lequel la première couche isolante (102) est constituée d'oxyde de silicium ou d'oxyde d'aluminium.

12. Substrat de réseau de diodes électroluminescentes organiques selon la revendication 10, dans lequel la seconde couche isolante (103) est constituée d'un matériau fluoré organique.

13. Substrat de réseau de diodes électroluminescentes organiques selon l'une quelconque des revendications 10 à 12, dans lequel l'épaisseur de la seconde couche isolante (103) n'est pas supérieure à 1/4 de l'épaisseur de la première couche isolante (102).

14. Substrat de réseaux de diode électroluminescentes organiques selon l'une quelconque des revendications 10 à 13, dans lequel la première couche isolante (102) est une couche d'arrêt de gravure et la seconde couche isolante (103) est une couche de définition de pixels.

15. Appareil d'affichage à diodes électroluminescentes organiques, comprenant : un substrat de réseau de diodes électroluminescentes organiques (200) selon la revendication 10.

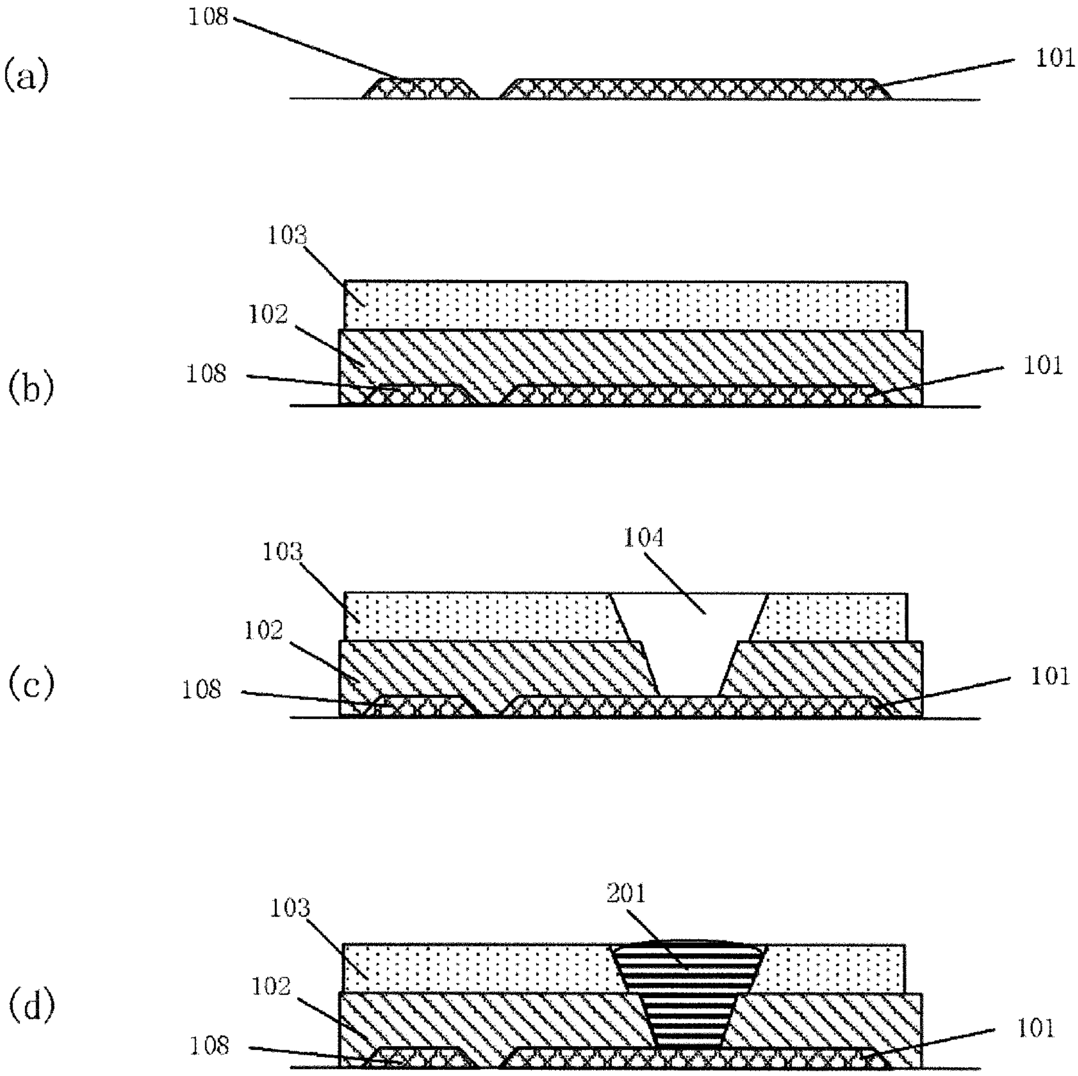
(a)
108
101
(b)
103
102
108
101
(c)
103
104
102
108
101
(d)
103
201
102
108
101

Fig. 1

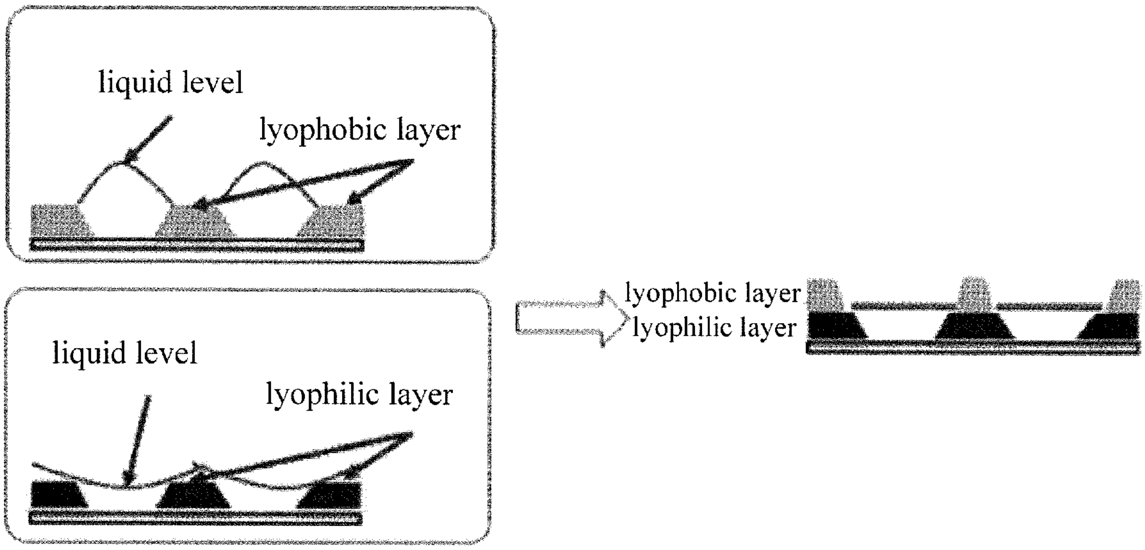

Fig. 2

200

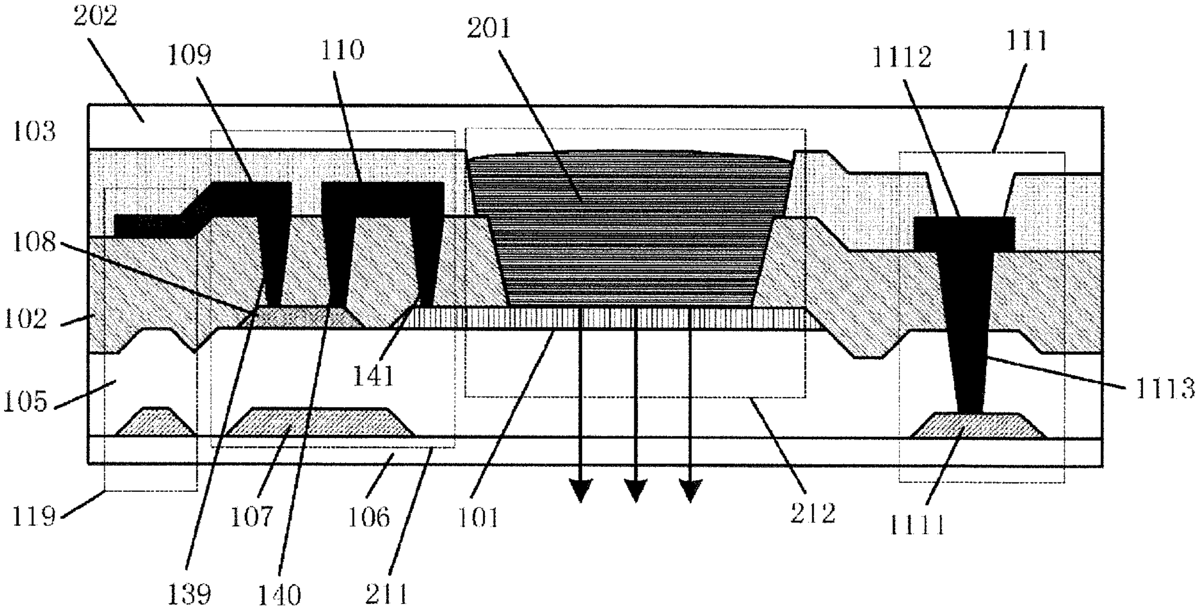

Fig. 3

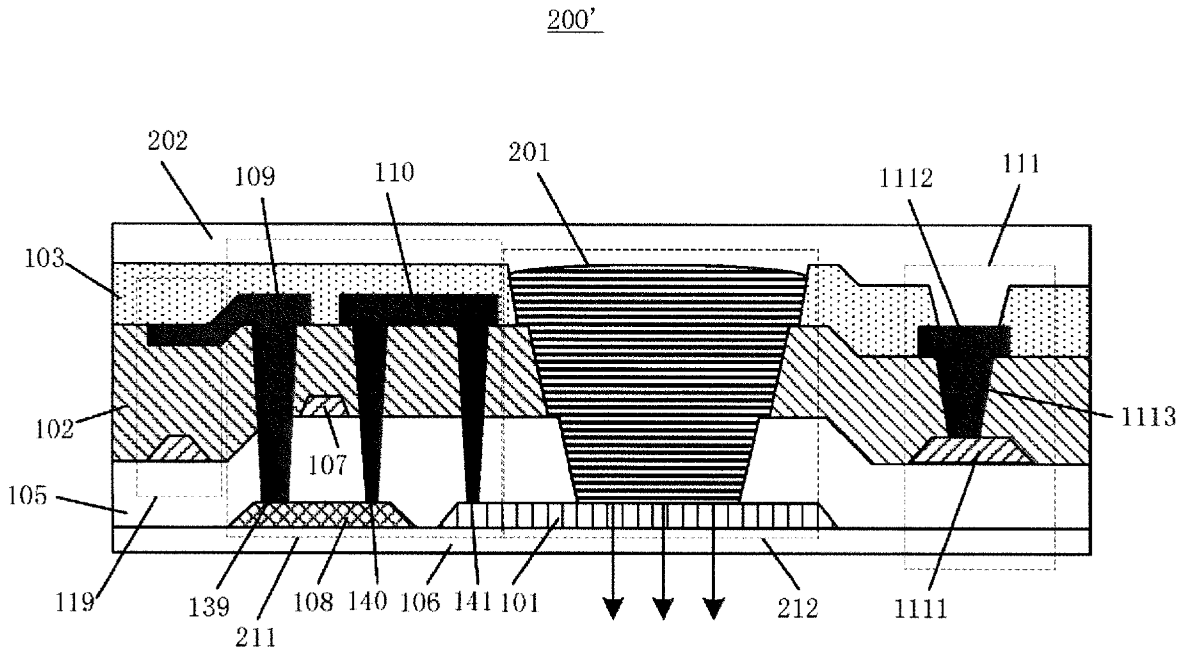
200'
202
109
110
201
1112
111
103
102
1113
107
105
119
139
211
108
140
106
141
101
212
1111

Fig. 4

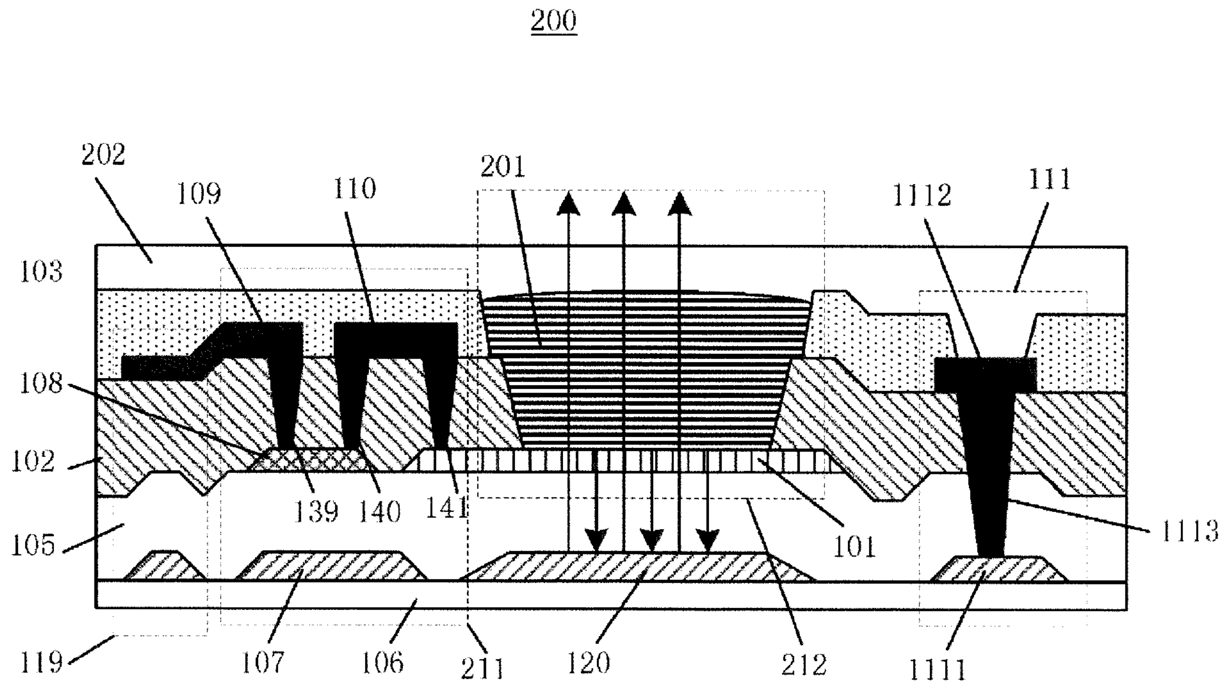
200
202
109
110
201
1112
111
103
108
102
139
140
141
101
1113
105
119
107
106
211
120
212
1111

Fig. 5

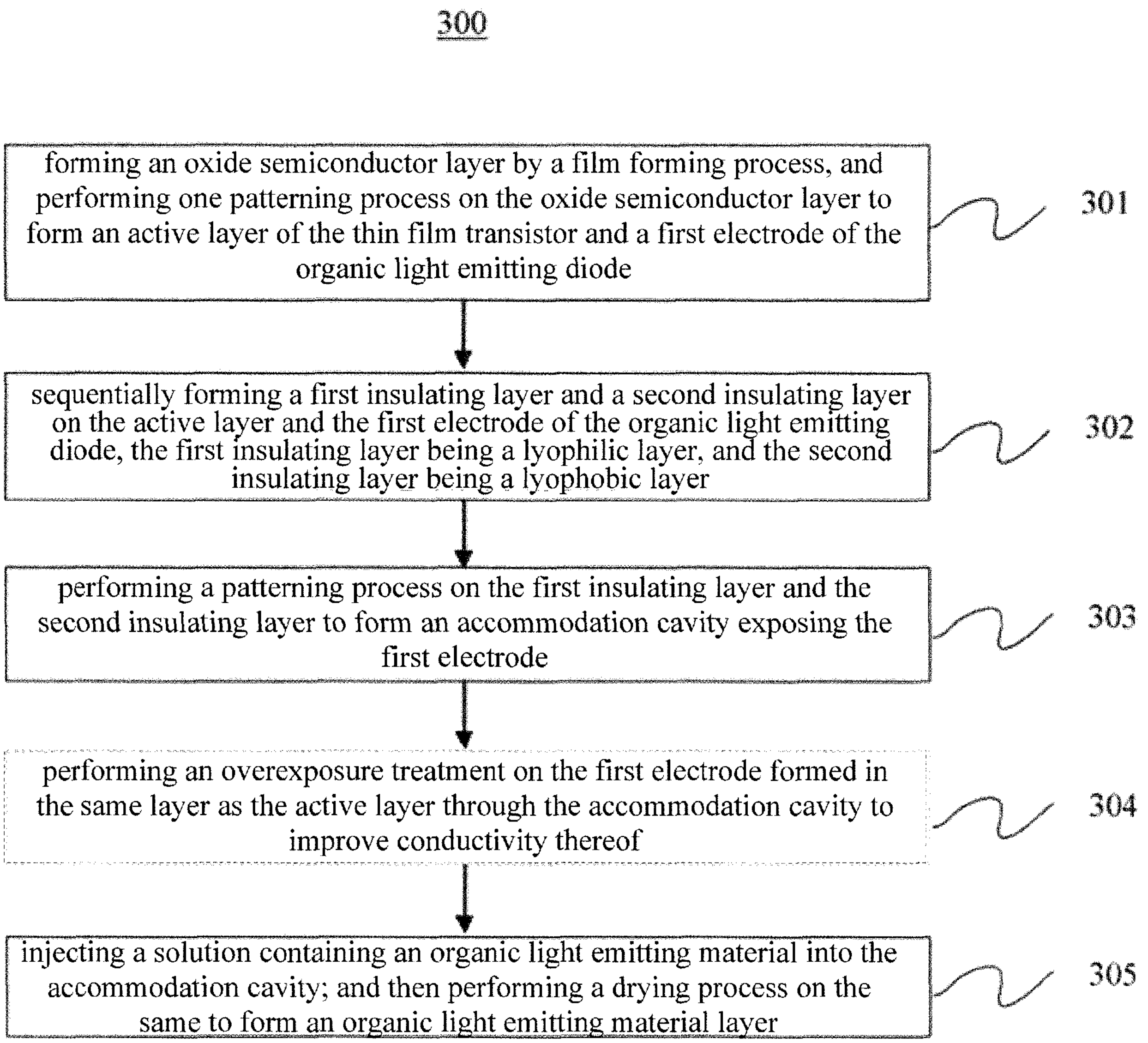
300
forming an oxide semiconductor layer by a film forming process, and performing one patterning process on the oxide semiconductor layer to form an active layer of the thin film transistor and a first electrode of the organic light emitting diode
301
sequentially forming a first insulating layer and a second insulating layer on the active layer and the first electrode of the organic light emitting diode, the first insulating layer being a lyophilic layer, and the second insulating layer being a lyophobic layer
302
performing a patterning process on the first insulating layer and the second insulating layer to form an accommodation cavity exposing the first electrode
303
performing an overexposure treatment on the first electrode formed in the same layer as the active layer through the accommodation cavity to improve conductivity thereof
304
injecting a solution containing an organic light emitting material into the accommodation cavity; and then performing a drying process on the same to form an organic light emitting material layer
305

Fig. 6

REFERENCES CITED IN THE DESCRIPTION

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