(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 157 610 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
24.02.2010 Bulletin 2010/08

(51) Int Cl.:
H01L 27/32 *(2006.01)*

(21) Application number: **09167904.3**

(22) Date of filing: **14.08.2009**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR
Designated Extension States:
AL BA RS

(30) Priority: **20.08.2008 KR 20080081235**

(71) Applicant: **Samsung Mobile Display Co., Ltd.**
Yongin-City
Gyunggi-do (KR)

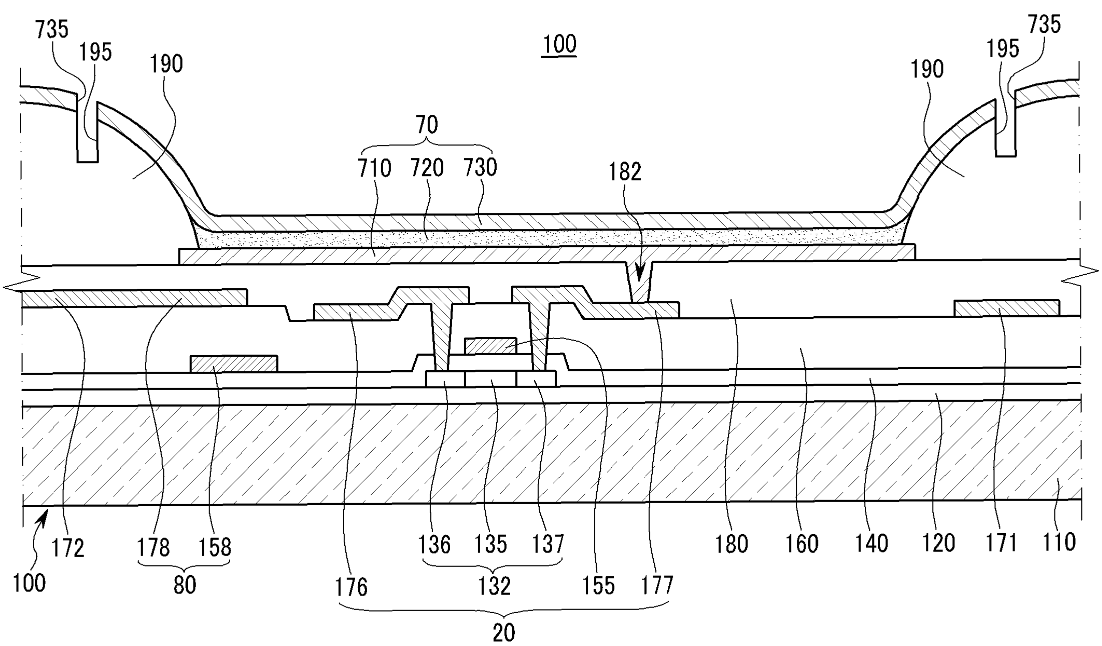
(72) Inventors:
- **Hong, Sang-Mok**
  Gyunggi-do (KR)
- **Lee, Za-Il**
  Gyunggi-do (KR)
- **Lee, Keun-Soo**
  Gyunggi-do (KR)

(74) Representative: **Rasch, Dorit**
Anwaltskanzlei
Gulde Hengelhaupt Ziebig & Schneider
Wallstrasse 58/59
10179 Berlin (DE)

(54) Organic light emitting diode display and method for manufacturing the same

(57) Aspects of the present invention relate to an organic light emitting diode (OLED) display and a manufacturing method thereof. The OLED display includes: a substrate ; pixel electrodes disposed on the substrate; a pixel defining layer disposed on the substrate, having a plurality of openings that expose the pixel electrodes; an organic emission layer formed on the pixel electrodes; and a common electrode formed on the organic emission layer and the pixel defining layer. An electrode cut is formed in the common electrode, around one of the openings of the pixel defining layer, to electrically isolate a portion of the common electrode.

FIG. 2



EP 2 157 610 A1

Description

1. Field of the Invention

[0001] Aspects of the present invention relate to an organic light emitting diode (OLED) display and a method of manufacturing the same.

2. Description of the Related Art

[0002] An OLED display includes organic light emitting diodes (OLEDs) that emit light. Light is emitted when excitons, which are generated when electrons and holes are combined, drop from an excited state to a ground state. An OLED display produces an image using the generated light.

[0003] Accordingly, an OLED display has self-luminance characteristics, and compared to a liquid crystal display (LCD), the thickness and a weight thereof can be reduced, since a separate light resource is not required. Further, because an OLED display has a low power consumption, a high luminance, and a high reaction speed, it is ideally suited for use in a mobile electronic device.

[0004] An OLED display displays an image using a plurality of pixels, and an OLED is included in each pixel. In general, an OLED includes an organic emission layer, a hole injection electrode, and an electron injection electrode. When a current is supplied to the hole injection electrode and the electron injection, the organic emission layer emits light.

[0005] However, a bright spot failure may occur in some pixels, during manufacturing. A bright spot failure refers to a state in which an OLED continuously emits light, without regard to a data signal and a gate signal. As described, a pixel that always emits light, due to a bright spot failure, can be easily detected by a user, as a bright spot in an image. That is, the occurrence of a bright spot failure reduces the quality of an OLED display.

[0006] Conventionally, when an OLED display is manufactured with a pixel having a bright spot failure, the pixel is deactivated using a laser. However, such repair process may damage peripheral data lines, common lines, and/or other electrodes.

SUMMARY OF THE INVENTION

[0007] Aspects of the present invention provide an organic light emitting diode (OLED) display that facilitates the repair of a bright spot failure, and a method of manufacturing the OLED display.

[0008] An OLED display, according to an exemplary embodiment of the present invention, includes: a substrate including a plurality of pixel areas; a pixel electrode disposed in each pixel area (the plurality of pixel electrodes being separated from each other); a pixel defining layer formed on the substrate, having a plurality of openings that respectively expose the pixel electrodes; an organic emission layer formed on the pixel electrodes; and a common electrode formed on the organic emission layer and the pixel defining layer. An electrode cut is formed in the common electrode, around one of the openings of the pixel defining layer, to electrically isolate a portion of the common electrode. That is, preferably the electrode cut forms a closed curve, i.e. a curve with no endpoints and which completely encloses an area, i.e. an opening of the pixel defining layer.

[0009] Preferably, the pixel defining layer has a convex upper cross section, more preferably the pixel defining layer comprises a curved upper surface, still more preferably the pixel defining layer comprises an upper surface having a circular cross section. Preferably, the pixel defining layer comprises an elevating (step) portion in which the elevation of the pixel defining layer increases from a contact portion of the pixel defining layer and the pixel electrode to a direction facing away from said contact portion.

[0010] According to an exemplary embodiment of the present invention, the electrode cut may be formed on the pixel defining layer. The pixel defining layer may include a channel formed along the electrode cut. That is, the channel and the electrode cut completely overlap each other along an axis which extends parallel to the normal vector of the substrate which preferably comprises a planar upper surface in the pixel area.

[0011] The pixel defining layer may be interposed between the electrode cut and the pixel electrode. Preferably the pixel defining layer extends between the electrode cut and the pixel electrode. That is, the pixel defining layer is arranged in a portion which is defined by a connecting line between a point of the electrode cut and the closest part of the corresponding (i.e. closest or adjacent) pixel electrode.

[0012] According to an exemplary embodiment of the present invention, the OLED display may further include a data line, a common power line, a source electrode, and a drain electrode. At least one of the data line, the common power line, the source electrode, and the drain electrode may be disposed under the electrode cut.

[0013] According to an exemplary embodiment of the present invention, an organic emission layer, arranged in the pixel area where the electrode cut is formed, may not emit light. The organic emission layer may be formed between the pixel defining layer and the common electrode, and an organic layer cut may be formed by cutting the organic emission layer along the electrode cut. That is, the organic layer cut and the electrode cut completely overlap each other along an axis which extends parallel to the normal vector of the substrate which preferably comprises a planar upper surface in the pixel area.

[0014] Preferably, a projection of the organic layer cut and/or the electrode cut onto the substrate along a first axis has the shape of an rectangle, wherein the first axis extends parallel to the normal vector of the substrate.

[0015] Preferably, the cross section of the channel has planar sides and a planar lower portion. The cross section is a sectional view along a cutting surface which has a normal vector extending parallel to the longitudinal axis of the channel. Preferably, the lateral extension of the cross section of the channel (extending parallel to the surface of the substrate) is smaller than the vertical extension of the cross section of the channel (extending parallel to the normal vector of the substrate). Preferably, the lateral extension of the cross section of the channel is at least two times smaller than the vertical extension of the cross section of the channel.

[0016] Preferably, the (maximal) lateral extension (of the cross section) of the channel ranges between 3 and 30% of the thickness of the pixel defining layer, wherein the thickness of the pixel defining layer is understood as the maximal thickness of the pixel defining layer, that is, the part of the pixel defining layer outside the convex/concave portion. More specifically, the pixel defining layer has a homogeneous (maximal) thickness and only in areas adjacent to pixel electrodes (where openings are formed in the pixel defining layer so as expose the pixel electrodes), the thickness of the pixel defining layer gradually decreases such to comprise a convex cross section.

[0017] More preferably, the lateral extension of the cross section of the channel ranges between 5 and 20% of the thickness of the pixel defining layer and still more preferably, the lateral extension of the cross section of the channel ranges between 8 and 15% of the thickness of the pixel defining layer.

[0018] Preferably, the (maximal) vertical extension (of the cross section) of the channel ranges between 10 and 50% of the thickness of the pixel defining layer, more preferably, the vertical extension of the channel ranges between 20 and 30% of the thickness of the pixel defining layer.

[0019] A manufacturing method of an OLED display, according to another exemplary embodiment of the present invention, includes: forming a pixel electrode in each pixel area of a substrate; forming a pixel defining layer on the substrate, having a plurality of openings that respectively expose the pixel electrodes; forming an organic emission layer on the pixel electrode; completing a plurality of OLEDs, by forming a common electrode on the organic emission layer; searching for a defective OLED (i.e. detecting a defective one of the OLEDs); and forming an electrode cut in the common electrode, which surrounds one of the openings that corresponds to the defective OLED, to electrically isolate a portion of the common electrode.

[0020] Preferably the plurality of organic light emitting diodes are arranged in a matrix.

[0021] According to an exemplary embodiment of the present invention, the electrode cut may be formed on the pixel defining layer. The forming of the electrode cut may include forming a channel in the pixel defining layer, which is disposed under the electrode cut. The pixel defining layer may be interposed between the electrode cut and the pixel electrode. The step of forming of the electrode cut preferably includes forming a channel together with the electrode cut by concaving the pixel defining layer disposed under the electrode cut. That is, the pixel defining layer which is formed with a convex shape (cross section) before forming the electrode cut, will be made concave in a portion which is disposed under the electrode cut. That is, after the step of concaving, the pixel defining layer comprises a convex portion (cross section) adjacent to the pixel area and the convex portion comprises smaller concave portion in a portion which is disposed under the electrode cut. In more particular, the pixel defining layer comprises a convex portion (cross section) except for a concave portion which is disposed under the electrode cut.

[0022] According to an exemplary embodiment of the present invention, the manufacturing method further include forming a data line, a common power line, a source electrode, and a drain electrode. At least one of the data line, the common power line, the source electrode, and the drain electrode may be disposed under the electrode cut.

[0023] According to an exemplary embodiment of the present invention, an organic emission layer is formed in a pixel area corresponding to the electrode cut. Furthermore, the organic emission layer is formed between the pixel defining layer and the common electrode in the elevating portion of the pixel defining layer.

[0024] The organic emission layer may not emit light, i.e. the defective OLED does not emit light.

[0025] According to an exemplary embodiment of the present invention, the manufacturing method further include forming the organic emission layer between the pixel defining layer and the common electrode. The forming of the electrode cut may include forming an organic layer cut, together with the electrode cut, by cutting the organic emission layer along the electrode cut.

[0026] According to an exemplary embodiment of the present invention, an organic light emitting diode (OLED) display comprises: a substrate; pixel electrodes disposed on the substrate; a pixel defining layer disposed on the substrate, having openings that expose the pixel electrodes; an organic emission layer disposed on the pixel electrodes; and a common electrode disposed on the organic emission layer and the pixel defining layer, wherein a cut is formed in the common electrode and the organic emission layer, to electrically isolate a portion of the common electrode and a corresponding portion of the organic emission layer, so as to deactivate an OLED of the display.

[0027] Preferably a channel corresponding to the cut is formed in the pixel defining layer.

[0028] According to an exemplary embodiment of the present invention, a manufacturing method of an organic light emitting diode (OLED) display including OLEDs and a common electrode that is electrically connected to the OLEDs, the method comprises: detecting a defective one of the OLEDs; and forming an electrode cut in the common electrode to deactivate the defective OLED, by electrically isolating a portion of the common electrode.

[0029] Preferably the method further comprises: forming an organic emission layer cut through an organic emission layer of the display, which is adjacent to the electrode cut. Preferably the method further comprises: forming a channel in a pixel defining layer of the display, which is adjacent to the organic emission layer cut.

[0030] According to the present invention, a bright spot failure of the OLED display can be stably changed to a black spot, thereby improving display quality.

[0031] Additional aspects and/or advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] These and/or other aspects and advantages of the invention will become apparent and more readily appreciated from the following description of the exemplary embodiments, taken in conjunction with the accompanying drawings, of which:

FIG. 1 is a layout view of an organic light emitting diode (OLED) display, according to a first exemplary embodiment of the present invention;
FIG. 2 is a cross-sectional view taken along the line II-II of FIG. 1;
FIG. 3 is a cross-sectional view of an OLED display taken along line III-III of FIG. 1, according to a second exemplary embodiment of the present invention; and
FIG. 4 is a cross-sectional view of a method for manufacturing the OLED of FIG. 3.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

[0033] Reference will now be made in detail to the exemplary embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to the like elements throughout. The exemplary embodiments are described below, in order to explain the aspects of the present invention, by referring to the figures. In the drawings, the thickness of various layers, films, panels, regions, etc., are exaggerated for clarity.

[0034] It will be understood that when an element, such as a layer, film, region, or substrate is referred to as being formed or disposed on another element, it can be directly on the other element, or intervening elements may also be present. In contrast, when an element is referred to as being formed or disposed directly on another element, there are no intervening elements present.

[0035] In the accompanying drawings, an organic light emitting diode (OLED) display is illustrated as an active matrix (AM)-type OLED display having a 2Tr-1 Cap structure, in which two thin film transistors (TFTs) and one capacitor are formed in one pixel, but the present invention is not limited thereto. Therefore, the OLED display can have various structures. For example, three or more TFTs and two or more capacitors can be provided in one pixel of the OLED display, and separate wires can be further provided in the OLED display. Herein, a pixel area refers to an area where a pixel is formed. A pixel refers to a minimum unit for displaying an image, and the OLED display displays an image by using a plurality of pixels.

[0036] With reference to FIG. 1 and FIG. 2, a first exemplary embodiment of the present invention will be described in further detail. As shown in FIG. 1 and FIG. 2, an organic light emitting diode (OLED) display 100 includes a plurality of pixel areas. The OLED display 100 includes a switching thin film transistor 10, a driving thin film transistor 20, a capacitor 80, and an OLED 70, in each pixel area.

[0037] The OLED display 100 further includes gate lines 151, and data lines 171 and a common power line 172 that respectively cross and are insulated from the gate lines 151. Here, the pixel areas are bound by the data lines 151, the data lines 171, and the common power line 172. Although not shown, the OLED display 100 may further include a sealing member to seal the thin film transistors 10 and 20, the capacitors 80, and the OLEDs 70.

[0038] Each OLED 70 includes a pixel electrode 710, an organic emission layer 720 formed on the pixel electrode 710, and a portion of a common (transflective) electrode 730, which is formed on the organic emission layer 720. The pixel electrode 710 becomes a positive electrode (a hole injection electrode), and the transflective common electrode 730 becomes a negative electrode (a electron injection electrode). However, the present invention is not limited thereto and, according to a driving method of the OLED display 100, the pixel electrode 710 may become the negative electrode, and the common electrode 730 may become the positive electrode. Holes and electrons are injected into the organic emission layer 720, from the pixel electrode 710 and the common electrode 730, respectively. Excitons are formed by coupling the injected holes and electrons. When the excitons drop from an excited state to a ground state, light is emitted.

[0039] The switching thin film transistor 10 includes a switching semiconductor layer 131, a switching gate electrode 152, a switching source electrode 173, and a switching drain electrode 174. The driving thin film transistor 20 includes a driving semiconductor layer 132, a driving gate electrode 155, a driving source electrode 176, and a driving drain electrode 177.

[0040] The capacitor 80 includes a first capacitive plate 158, a second capacitive plate 178, and an interlayer insulating layer 160 interposed therebetween. Herein, the interlayer insulating layer 160 becomes a dielectric material. The capacitance of the capacitor 80 is determined by charges accumulated in the capacitor 80, and a voltage between the first and second capacitive plates 158 and 178.

[0041] The switching thin film transistor 10 is used to turn on a corresponding OLED 70. The switching gate electrode 152 is connected to the gate line 151. The switching source electrode 173 is connected to the data line 171. The switching drain electrode 174 is spaced apart from the switching source electrode 173 and is connected to the first capacitive plate 158.

[0042] The driving thin film transistor 20 applies a voltage to the pixel electrode 710, to drive an organic emission layer 720. The driving gate electrode 155 is connected to the first capacitive plate 158. The driving source electrode 176 and the second capacitive plate 178 are connected to the common power line 172. The driving drain electrode 177 is connected to the pixel electrode 710, through a contact hole 182.

[0043] The switching thin film transistor 10 is driven by a gate voltage applied to the gate line 151, so as to transmit a data voltage applied to the data line 171 to the driving thin film transistor 20. A voltage difference, between a common voltage transmitted from the common power line 172 to the driving thin film transistor 20 and the data voltage transmitted from the switching thin film transistor 10, is stored in the capacitor 80. A current corresponding to the voltage stored in the capacitor 80 flows to the OLED 70, through the driving thin film transistor 20, so that the OLED 70 emits light.

[0044] In at least one pixel area an electrode cut 735 is formed, by cutting of the common electrode 730. The electrode cut 735 surrounds an opening of a pixel defining layer 190 of the corresponding pixel area. That is, in a pixel area where the electrode cut 735 is formed, a portion of the common electrode 730 formed on the pixel electrode 710 is electrically disconnected, i.e., is electrically isolated from the rest of the common electrode 730. Accordingly, an organic emission layer 720, in the pixel area where the electrode cut 735 is formed, cannot emit light.

[0045] Hereinafter, the structure of a pixel area having the electrode cut 735, according to the first exemplary embodiment of the present invention, will be described in further detail. The structure of a thin film transistor, particularly, the structure of the driving thin film transistor 20, will also be described. The description of the switching thin film transistor 10 will focus on differences with the driving thin film transistor.

[0046] A substrate 110 is formed of an insulating material, such as glass, quarts, ceramic, plastic, or the like. However, the present invention is not limited thereto. The substrate 110 may be formed of a metallic substrate, such as stainless steel, for example. The substrate 110 includes a plurality of pixel areas.

[0047] A buffer layer 120 is formed on the substrate 110. The buffer layer 120 blocks impurities and planarizes the substrate 110. The buffer layer 120 can be made of various materials, for example, silicon nitride (SiNx), silicon dioxide ($Si0_2$), and/or silicon oxynitride (SiOxNy). However, the buffer layer 120 can be omitted, in accordance with the type and process conditions of the substrate 110.

[0048] A driving semiconductor layer 132 is formed on the buffer layer 120. The driving semiconductor layer 132 is generally formed of a polysilicon layer. The driving semiconductor layer 132 includes a channel region 135, in which impurities are not doped. The driving semiconductor layer 132 also includes a source region 136 and a drain region 137, at respective sides of the channel region 135, which are doped with a dopant. The dopant can be a P-type impurity that includes boron (B), such as B_2H_6. Herein, the impurity can be changed, in accordance with the type of the thin film transistor.

[0049] In the first exemplary embodiment of the present invention, a PMOS-structured thin film transistor, using the P-type impurity, is used as the driving thin film transistor 20, but the present invention is not limited thereto. For example, a NMOS-structured thin film transistor, or a CMOS-structured thin film transistor, can be used as the driving thin film transistor 20. In addition, although the driving film transistor 20 of FIG. 2 is a polycrystalline thin film transistor including a polysilicon layer, the switching thin film transistor 10 (not shown in FIG. 2) may be a polycrystalline thin film transistor, or an amorphous thin film transistor including an amorphous silicon layer.

[0050] The gate insulation layer 140, which can be made of silicon nitride (SiNx) or silicon dioxide (SiO_2), is formed on the driving semiconductor layer 132. A gate wire including the driving gate electrode 155 is formed on the gate insulating layer 140. The gate wire further includes the gate line 151, a first capacitive plate 158, and/or other wires. In addition, the driving gate electrode 155 overlaps at least a part of the driving semiconductor layer 132, and particularly, overlaps the channel region 135.

[0051] The interlayer insulation layer 160, which covers the driving gate electrode 155, is formed on the gate insulating layer 140. The gate insulating layer 140 and the interlayer insulating layer 160 have through-holes that expose the source region 136 and the drain region 137 of the driving semiconductor layer 132. The interlayer insulating layer 160 can be made of silicon nitride (SiNx) or silicon dioxide (SiO_2).

[0052] A data wire, including the driving source electrode 176 and the driving drain electrode 177, is formed on the interlayer insulating layer 160. The data wire further includes the data line 171 (FIG. 1), the common power line 172, the second capacitive plate 178, and/or other wires. The driving source electrode 176 and the driving drain electrode 177 are respectively connected to the source region 136 and the drain region 137 of the driving semiconductor layer 132, through the through-holes.

[0053] As described, the driving thin film transistor 20, including the driving semiconductor layer 132, the gate electrode 155, the driving source electrode 176, and the driving drain electrode 177, is formed. The configuration of the driving thin film transistor 20 is not limited to the above-described exemplary embodiment, and can be variously modified.

[0054] A planarization layer 180, which covers the data wires 172, 176, 177, and 178, is formed on the interlayer insulating layer 160. The planarization layer 180 increases the luminous efficiency of the OLED 70. The planarization layer 180 has a contact hole 182, through which the drain electrode 177 is exposed. The planarization layer 180 can be made of at least one of a polyacrylate resin, an epoxy resin, a phenolic resin, a polyamide resin, a polyimide resin, an unsaturated polyester resin, a poly phenylenether resin, a poly phenylenesulfide resin, and benzocyclobutene (BCB). The first exemplary embodiment of the present invention is not limited to the above-described structure, for example, one of the planarization layer 180 and the interlayer insulating layer 160 may be omitted, if necessary.

[0055] The pixel electrode 710 of the OLED 70 is formed on the planarization layer 180. That is, each of the plurality of pixel areas of the OLED display 100 includes a plurality of pixel electrodes 710 that are spaced from each other. The pixel electrode 710 is connected to the drain electrode 177, through the contact hole 182 of the planarization layer 180.

[0056] A pixel defining layer 190, having an opening that exposes the pixel electrode 710, is formed on the planarization layer 180. That is, the pixel electrode 710 is disposed to correspond to the opening of the pixel defining layer 190. However, the pixel electrode 710 may be disposed under the pixel defining layer 190, so as to overlap the pixel defining layer 190. The pixel defining layer 190 can be made of an inorganic material, a resin, or silica-base material, such as a polyacrylate resin, a polyimide, or the like.

[0057] The organic emission layer 720 is formed on the pixel electrode 710, and the common electrode 730 is formed on the organic emission layer 720. Thus, the OLED 70, including the pixel electrode 710, the organic emission layer 720, and the common electrode 730, is completed.

[0058] The organic emission layer 720 can be made of a low molecular weight organic material or a high molecular weight organic material. Such an organic emission layer 720 has a multi-layer structure, including a hole injection layer (HIL), a hole transport layer (HTL), an emission layer, an electron transport layer (ETL), and an electron injection layer (EIL). The HIL is formed on the pixel electrode 710 which is a positive electrode, and the HTL, the ETL, and the EIL are sequentially stacked thereon.

[0059] One of the pixel electrode 710 and the common electrode 730 can be made of a transparent conductive material, and the other can be made of a transflective, or reflective, conductive material. According to materials of the pixel electrode 710 and the common electrode 730, the OLED display 100 can be classified as a top light-emitting type, a bottom light-emitting type, or a dual-side light-emitting type.

[0060] For the transparent conductive material, indium tin oxide (ITO), indium zinc oxide (IZO), zinc oxide (ZnO), or indium oxide (In_2O_3) can be used. For the reflective material, lithium (Li), calcium (Ca), fluorinated lithium /calcium (LiF/Ca), fluorinated lithium/aluminum (LiF/Al), aluminum (Al), silver (Ag), magnesium (Mg), or gold (Au) can be used.

[0061] The electrode cut 735 is formed by cutting the common electrode 730, so as to electrically isolate a portion of the common electrode 730. The electrode cut 735 surrounds the opening of the pixel defining layer 190. That is, the electrode cut 735 is formed in the common electrode 730, on the pixel defining layer 190. Electrode cuts 735 can be form around pixel areas having an abnormal OLED 70.

[0062] As described, a portion of the common electrode 730, which is disposed in the electrode cut 735, is electrically disconnected from the rest of the common electrode 730. Therefore, the electrode cut 735 deactivates the corresponding OLED 70, by electrically isolating the associated emission layer.

[0063] When electrode cut 735 is formed, a channel 195 may also be formed in the pixel defining layer 190, along the electrode cut 735. The electrode cut 735 and/or channel 195 may formed by a laser. The channel 195 can be omitted, however.

[0064] Since the electrode cut 735 is formed on the pixel defining layer 190, the pixel defining layer 190 is interposed between the electrode cut 735 and the pixel electrode 710. Therefore, the pixel defining layer 190 protects the pixel electrode 710 from being damaged, when the electrode cut 735 is formed, by cutting the common electrode 730 with the laser.

[0065] The data wires (the data line 171, the common power line 172, the source electrode 176, and the drain electrode 177) may be disposed under the electrode cut 735. However, the pixel defining layer 190 protects the data wires, during the formation of the electrode cut 735. With the above-described configuration, the OLED display 100 allows for a bright spot failure to be stably changed to a black spot, so that the display quality of the OLED display 100 can be maintained.

[0066] Referring to FIG. 3, a second exemplary embodiment of the present invention will now be described. As shown in FIG. 3, an organic emission layer 720 is interposed between a pixel defining layer 190 and a common electrode 730. The organic emission layer 720 may include an emission layer and several other layers, such as a hole injection layer (HIL), a hole transport layer (HTL), an electron transport layer (ETL), and an electron injection layer (EIL). In this case, the layers excluding the emission layer (HTL, HIL, ETL, and EIL) are formed on the pixel electrode 710 and the pixel defining layer 190, by using an open mask manufacturing process. That is, among the several layers included in the organic emission layer 720, at least one layer is interposed between the pixel electrode 190 and the common electrode 730.

[0067] In addition, in a pixel area where an electrode cut 735 is formed, an organic layer cut 725 is formed by cutting a portion of the organic emission layer 720, which is interposed between the pixel defining layer 190 and the common electrode 730. The organic layer cut 725 extends along an electrode cut 735. The organic layer cut 725 also surrounds an opening of the pixel defining layer 190.

[0068] As described, a portion of the organic emission layer 720 is electrically disconnected from the rest of the organic emission layer 720 disposed in a neighboring pixel areas, by the organic layer cut 725. Therefore, the portion of organic emission layer 720, of an OLED 70 in a pixel area where the electrode cut 735 and the organic layer cut 725 are formed, does not emit light.

[0069] With the above-described configuration, in an OLED display 200, a pixel area where a bright spot failure occurs is more stably changed to a black spot, so as to enhance display quality. When only a portion of the common electrode 730 is disconnected by the electrode cut 735, a small amount of current may flow through the organic emission layer 720. However, current flow through the organic emission layer 720 can be completely blocked, by forming the organic layer cut 725. Accordingly, a pixel having a defective OLED 70 can be reliably changed to a black spot.

[0070] A manufacturing method of the OLED display of FIG. 3 will be described with reference to FIG. 4. The thin film transistor 20 and the capacitor 80 are formed on a substrate 110 including pixel areas, and then the planarization layer 180 is formed thereon. A pixel electrode 710 is formed in each pixel area, on the planarization layer 180.

[0071] A pixel defining layer 190, having openings that expose the pixel electrodes 710, is formed on the planarization layer 180. The organic emission layer 720 and the common electrode 730 are formed on each pixel electrode 710, to complete the OLEDs 70. Herein, the organic emission layers 720 and the common electrodes 730 are formed on the pixel electrodes 710 and the pixel defining layers 190. However, the organic emission layers 720 may be formed only in the openings of the pixel defining layers 190 (i.e., only on the pixel electrode 710).

[0072] A defective OLED 70 is found by examining OLEDs 70. A defective OLED 70 continuously emits light, without regard to the data signal and the gate signal.

[0073] Next, as shown in FIG. 4, the organic emission layer 720 and the organic layer cut 725 are formed, by respectively cutting the common electrode 730 and the organic emission layer 720 with a laser L, in the pixel area where the defective OLED 70 is disposed. Here, the electrode cut 735 and the organic layer cut 725 are formed on the pixel defining layer 190, and surround the opening of the pixel defining layer 190. The channel 195 of the pixel defining layer 190 is formed together with the electrode cut 735 and the organic layer cutting layer 725. However, when the organic emission layer 720 is not disposed on the pixel defining layer 190, only the electrode cut 735 and the channel 195 may be formed.

[0074] As described, a common electrode 730 and an organic emission layer 720 of an OLED 70 are electrically disconnected from a common electrode 730 and an organic emission layer 720 of a neighboring OLED 70, by the electrode cut 735 and the organic layer cut 725. Therefore, an organic emission layer 720 of a defective OLED 70 cannot emit light. Accordingly, the pixel area where the defective OLED 70 is disposed is changed to a black spot.

[0075] According to the above-described manufacturing method, a pixel area where a bright spot failure occurs is stably changed to a black spot, so as to maintain the display quality of the OLED display 200.

Claims

1. An organic light emitting diode (OLED) display comprising:

a substrate (110);
a plurality of pixel electrodes (710) disposed on the substrate (110);
a pixel defining layer (190) disposed on the substrate (110), the pixel defining layer (190) having a plurality of openings that expose the pixel electrodes (710);
an organic emission layer (720) disposed on the pixel electrodes (710); and a common electrode (730) disposed on the organic emission layer (720) and the pixel defining layer (190),
characterized in that
at least one an electrode cut (735) is formed in the common electrode (730), wherein the at least one electrode cut (735) extends around one of the openings of the pixel defining layer (190), to electrically isolate a portion of the common electrode (730).

2. The OLED display of claim 1, wherein the at least one electrode cut (735) is formed in an area where the common electrode (730) directly contacts the pixel defining layer (190).

3. The OLED display according to one of the preceding claims, wherein the pixel defining layer (190) comprises a channel (195) that corresponds to the electrode cut (735).

4. The OLED display according to one of the preceding claims, wherein the pixel defining layer (190) extends between the electrode cut (735) and the pixel electrode (730).

5. The OLED display according to one of the preceding claims, further comprising:

a data line (171), a common power line (172), a source electrode (176), and a drain electrode (177),
wherein a projection of the electrode cut (735) onto the substrate (110) along a first axis overlaps with a projection of at least one of the data line (171), the common power line (172), the

source electrode (176), and the drain electrode (177) onto the substrate (110) along said first axis, wherein the first axis extends parallel to the normal vector of the substrate (110).

6. The OLED display of claim 5, wherein a projection of the electrode cut (735) onto the substrate (110) along the first axis overlaps with a projection of the data line (171) and a projection of the common power line (172) along said first axis.

7. The OLED display according to one of the preceding claims, wherein the organic emission layer (720) is further formed between the pixel defining layer (190) and the common electrode (730), and at least one organic layer cut (725) is formed in the organic emission layer (720), wherein the at least one organic layer cut (725) extends around one of the openings of the pixel defining layer (190), to electrically isolate a portion of the organic emission layer (720), wherein the at least one organic layer cut (725) is formed to extend concurrent with the at least one electrode cut (735).

8. A manufacturing method of an organic light emitting diode (OLED) display, comprising:

forming a plurality of pixel electrodes (710) on a substrate (110);
forming a pixel defining layer (190) on the substrate (110), the pixel defining layer (190) having a plurality of openings that respectively expose the pixel electrodes (710);
forming an organic emission layer (720) on the pixel electrodes (710);
forming a common electrode (730) on the organic emission layer (720), so as to form a plurality of organic light emitting diodes;
detecting at least one defective organic light emitting diode among the plurality of the organic light emitting diodes; and
forming an electrode cut (735) in the common electrode (730), which surrounds the at least one of the openings that correspond to the at least one defective organic light emitting diode, to electrically isolate a portion of the common electrode (730).

9. The manufacturing method of claim 8, wherein the electrode cut (735) is formed in an area where the common electrode (730) directly contacts the pixel defining layer (190).

10. The manufacturing method according to one of claims 8 and 9, wherein the step of forming of the electrode cut (735) includes forming a channel (195) simultaneously with the electrode cut (735) by concaving the pixel defining layer (190) disposed under the electrode cut (735).

11. The manufacturing method according to one of claims 8-10, wherein the pixel defining layer (190) is interposed between the electrode cut (735) and the pixel electrode (720).

12. The manufacturing method according to one of claims 8-11, further comprising forming a data line (171), a common power line (172), a source electrode (176), and a drain electrode (177),
wherein at least one of the data line (171), the common power line (172), the source electrode (176), and the drain electrode (177) is disposed between the electrode cut (735) and the substrate (110).

13. The manufacturing method according to one of claims 8-12, wherein the step of forming of the organic emission layer (720) comprises forming the organic emission layer (720) between the pixel defining layer (190) and the common electrode (720); and
the step of forming of the electrode cut (735) comprises forming a cut (725) in the organic emission layer (720) that corresponds to the electrode cut (735).

14. The manufacturing method according to one of claims 8-13, wherein the step of detecting at least one defective organic light emitting diode (70) among the plurality of the organic light emitting diodes comprises: examining the plurality of the organic light emitting diodes (70) by applying a data signal and a gate signal having different states to each of the organic light emitting diodes (70), respectively, wherein an organic light emitting diode (70) is judged to be defective if it continuously emits light without regard to state of the applied data signal and the applied gate signal.

FIG. 1

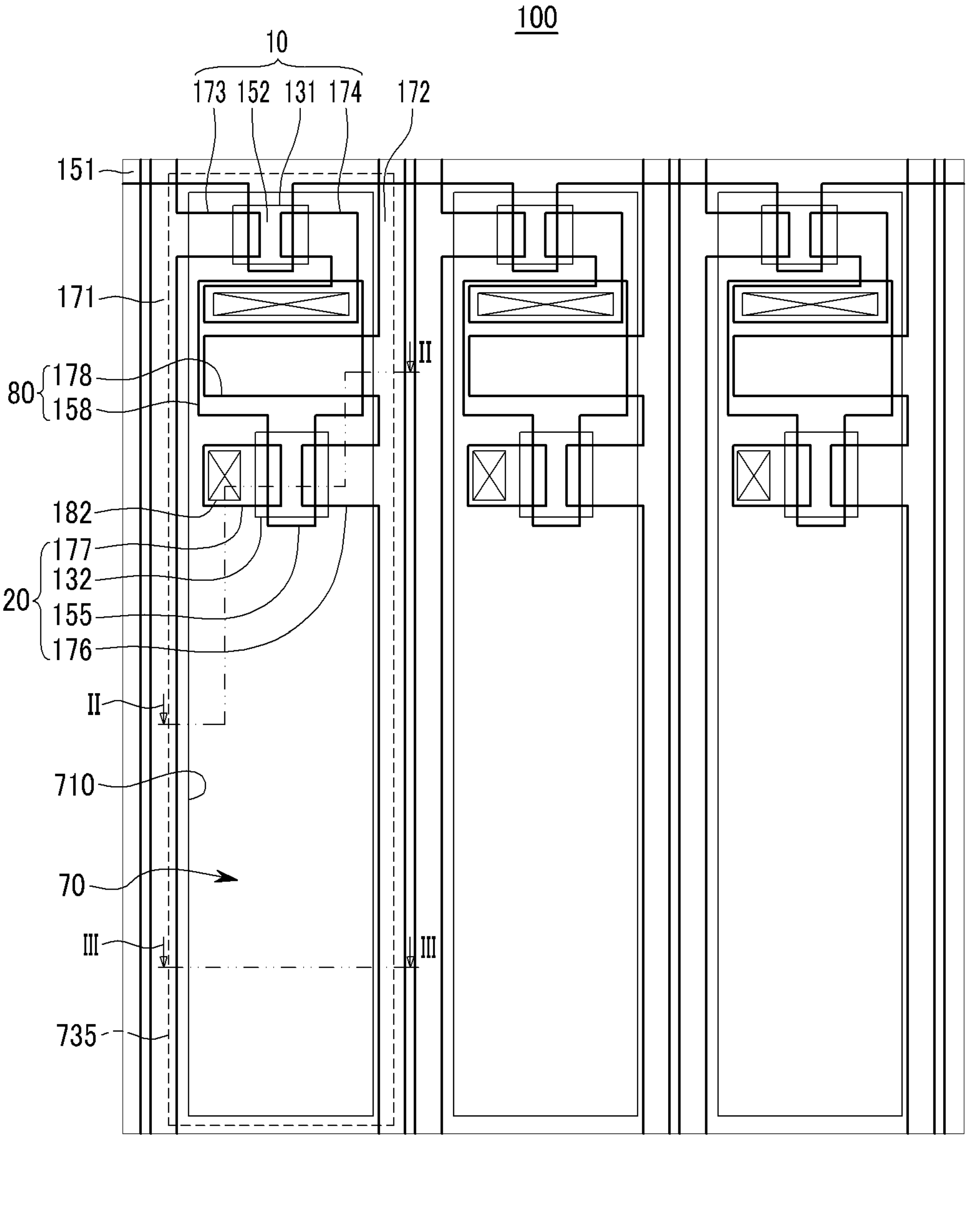

100
10
173
152
131
174
172
151
171
178
80
158
II
182
177
132
20
155
176
II
710
70
III
III
735

FIG. 2

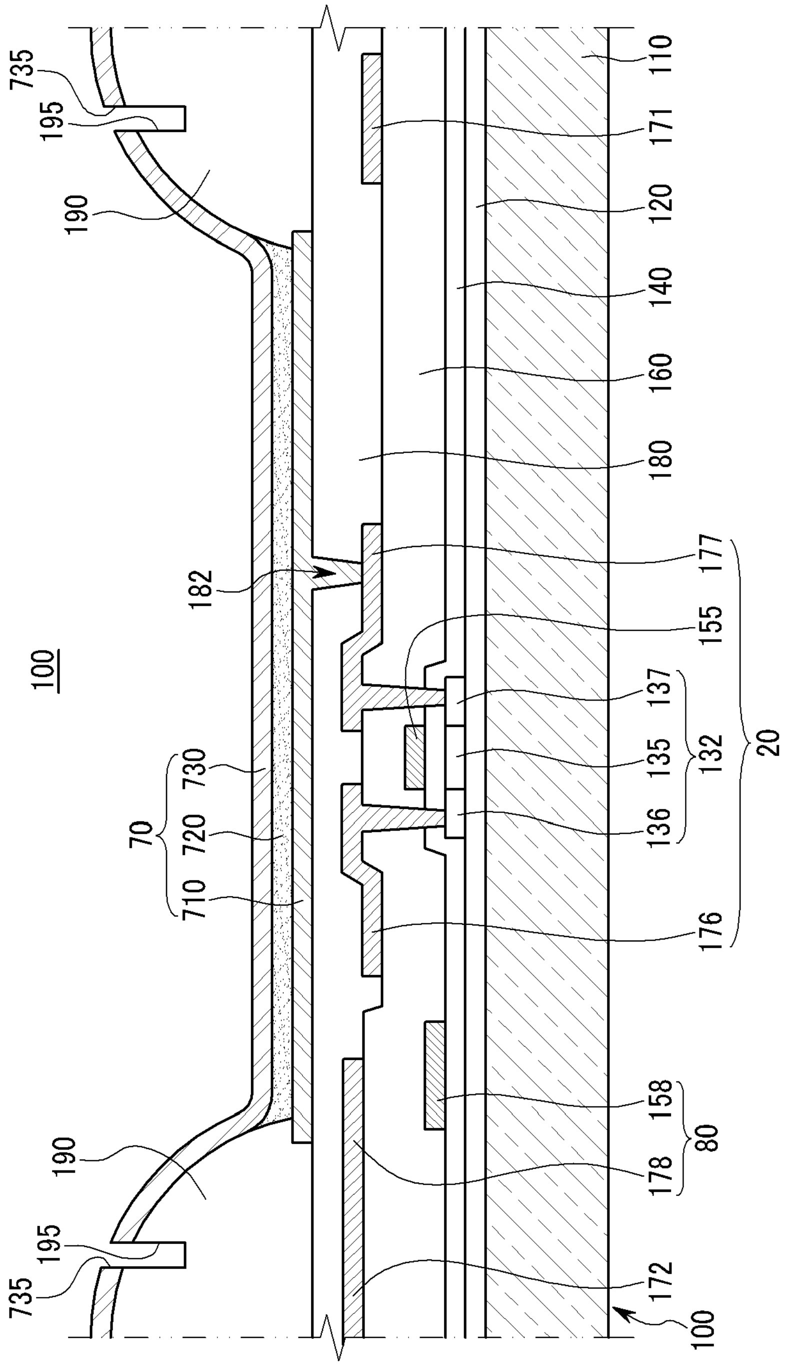

100
735
195
190
110
171
120
140
160
180
182
177
155
137
135
136
132
20
176
70
710
720
730
158
178
80
172
100

FIG. 3

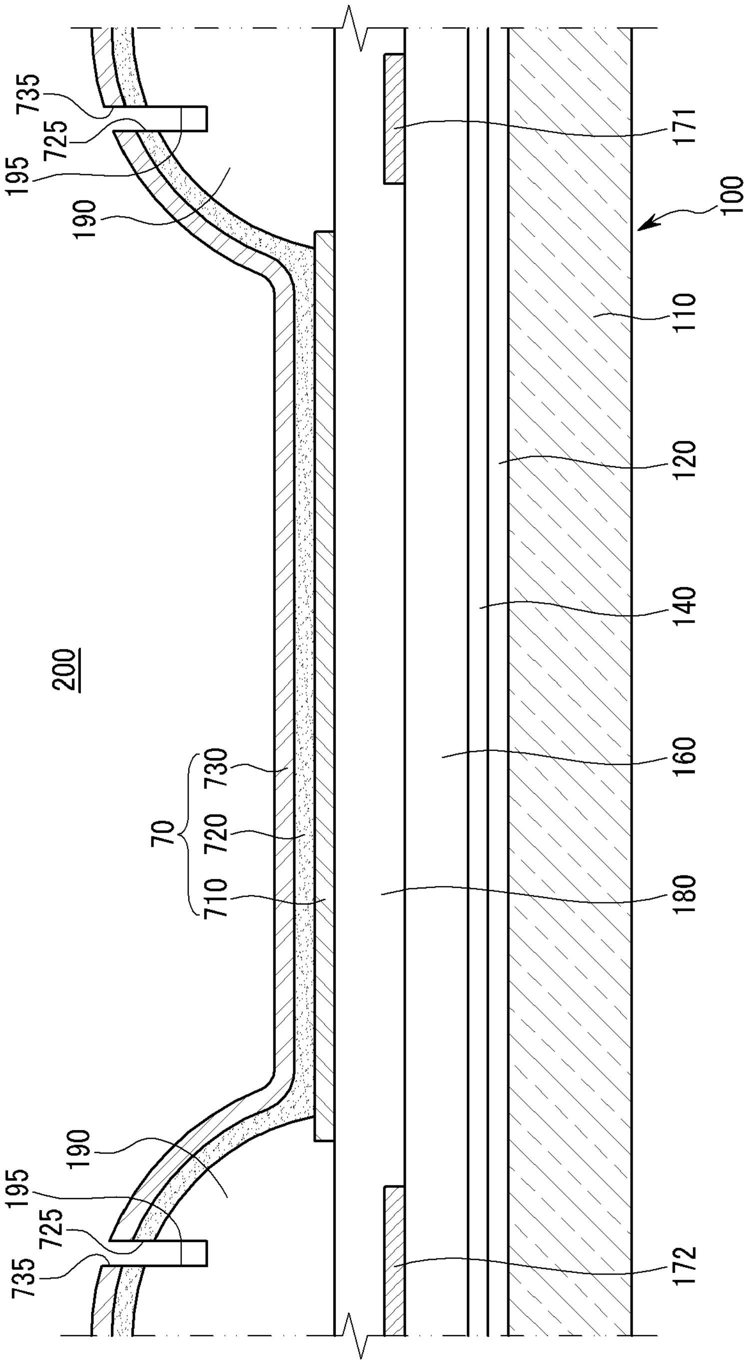
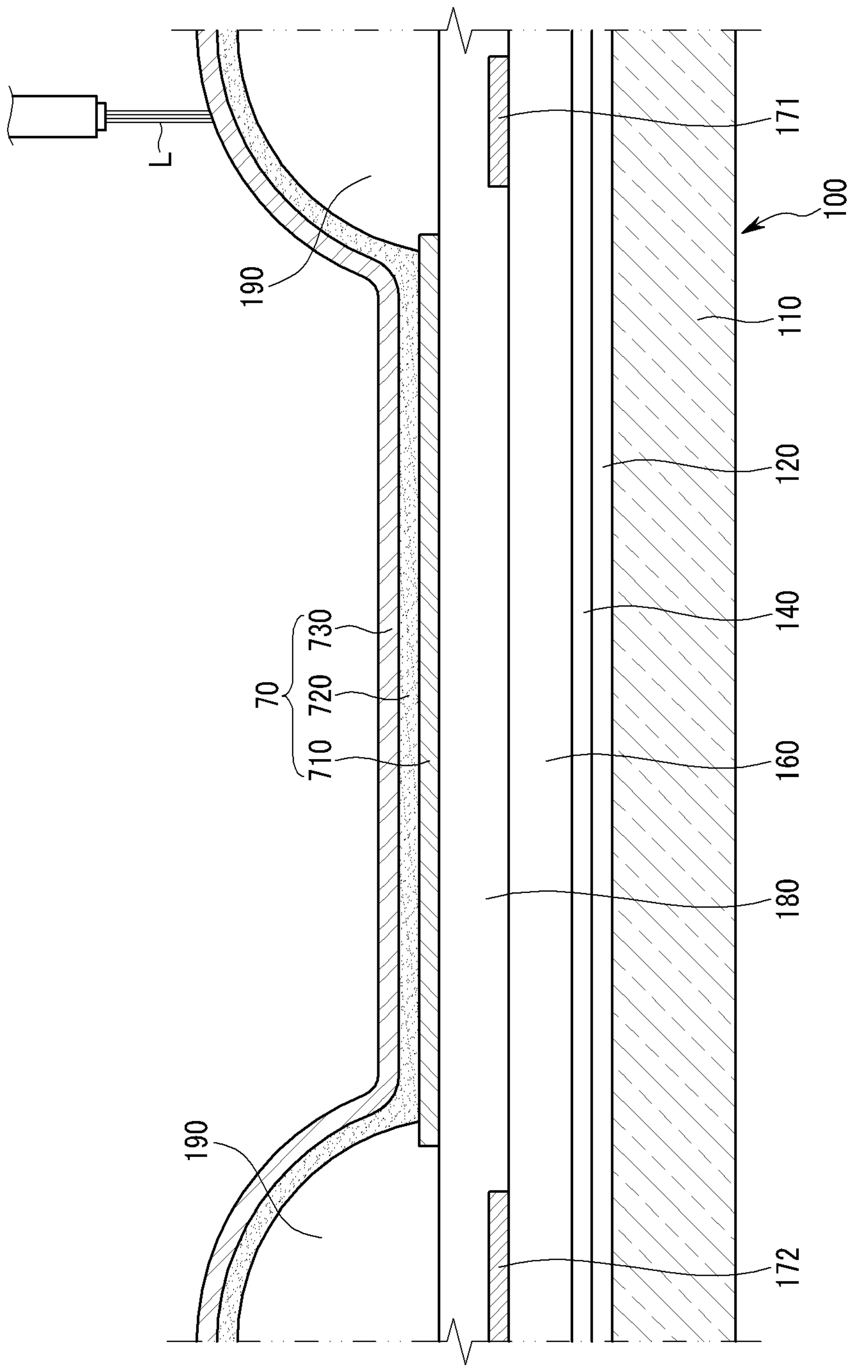

735
725
195
190
200
70
710
720
730
190
195
725
735
171
100
110
120
140
160
180
172

FIG. 4



Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 09 16 7904

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
P,X	US 2009/061720 A1 (FUJIMAKI HIROSHI [JP]) 5 March 2009 (2009-03-05) * paragraph [0006] - paragraph [0012] * * paragraph [0029] - paragraph [0062] * * figures 1-9 *	1,8	INV. H01L27/32
X	JP 2006 323032 A (SONY CORP) 30 November 2006 (2006-11-30) * paragraph [0052] - paragraph [0055] * * figure 6 *	1,8	
X	JP 2003 233329 A (TOSHIBA CORP) 22 August 2003 (2003-08-22) * abstract; figures 5,6 *	1,8	
A	US 2005/269962 A1 (MATSUNAGA IKUO [JP]) 8 December 2005 (2005-12-08) * paragraphs [0052] - [0060]; figures 3,4,6,10 *	1,8	

TECHNICAL FIELDS SEARCHED (IPC)

H01L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	18 November 2009	Bernabé Prieto, A

2

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 09 16 7904

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

18-11-2009

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2009061720 A1	05-03-2009	CN 101384110 A	11-03-2009
		JP 2009064607 A	26-03-2009
		KR 20090025145 A	10-03-2009
JP 2006323032 A	30-11-2006	NONE	
JP 2003233329 A	22-08-2003	NONE	
US 2005269962 A1	08-12-2005	CN 1742302 A	01-03-2006
		WO 2004068446 A1	12-08-2004
		KR 20050094882 A	28-09-2005
		TW 231725 B	21-04-2005

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

专利名称(译)	有机发光二极管显示器及其制造方法		
公开(公告)号	EP2157610A1	公开(公告)日	2010-02-24
申请号	EP2009167904	申请日	2009-08-14
[标]申请(专利权)人(译)	三星显示有限公司		
申请(专利权)人(译)	三星移动显示器有限公司.		
当前申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
[标]发明人	HONG SANG MOK LEE ZA IL LEE KEUN SOO		
发明人	HONG, SANG-MOK LEE, ZA-IL LEE, KEUN-SOO		
IPC分类号	H01L27/32		
CPC分类号	H01L27/3276 H01L27/3246 H01L2251/568		
优先权	1020080081235 2008-08-20 KR		
其他公开文献	EP2157610B1		
外部链接	Espacenet		

摘要(译)

本发明的方面涉及有机发光二极管（OLED）显示器及其制造方法。OLED显示器包括：基板;像素电极设置在基板上;像素限定层，设置在基板上，具有多个暴露像素电极的开口;在像素电极上形成有机发光层;形成在有机发光层和像素限定层上的公共电极。在公共电极中，围绕像素限定层的一个开口形成电极切口，以电隔离公共电极的一部分。

FIG. 2