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(54) **ORGANIC LIGHT EMITTING DISPLAY DEVICE**
ORGANISCHE LICHTEMITTIERENDE ANZEIGEVORRICHTUNG
DISPOSITIF ÉLECTROLUMINESCENT ORGANIQUE

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Description

BACKGROUND

1. FIELD OF THE DISCLOSURE

[0001] The present disclosure relates to an organic light emitting display (OLED) device, and more particularly, to an OLED being capable of preventing a brightness non-uniformity problem.

2. DISCUSSION OF THE RELATED ART

[0002] Recently, flat panel display devices, such as a plasma display panel (PDP), a liquid crystal display (LCD) device, and an OLED device, are widely researched and used.

[0003] Among these flat panel display devices, since the OLED device as a self-emission type display device does not implement a backlight unit, the OLED device may have advantages of light weight and thin profile.

[0004] In addition, the OLED device has excellent characteristics of a viewing angle, a contrast ratio, power consumption, a response time, production costs, production yield, and so on.

[0005] The OLED device may include a switching thin film transistor (TFT), which is connected to gate and data lines, a driving TFT, which is connected to the switching TFT, and an organic emitting diode. The organic emitting diode is connected to the driving TFT and includes a first electrode, an organic emitting layer and a second electrode.

[0006] The first electrode may serve as an anode and may include a transparent conductive material having a relatively high work function. The second electrode may serve as a cathode and may include a metallic material having a relatively low work function. The metallic material may have an opaque property.

[0007] In a top emission type OLED device, the light from the organic emitting layer passes through the second electrode being opaque. Accordingly, a thickness of the second electrode should be controlled to have a light-transmissive property.

[0008] However, when the thickness of the second electrode is lowered, the resistance of the second electrode is increased such that a voltage drop in the second electrode becomes significant, and causes non-uniformity in brightness.

[0009] Particularly, the above brightness non-uniformity problem is serious in a large-size OLED device.

[0010] To prevent the above brightness non-uniformity problem, an auxiliary line, which is connected to the second electrode, may be formed to reduce the resistance of the second electrode.

[0011] FIG. 1 is a schematic cross-sectional view of the related art OLED device including an auxiliary line.

[0012] Referring to FIG. 1, in the related art OLED device 10, a semiconductor layer 13 including a first region 13a and second region 13b at both sides of the first region 13a is formed on a substrate 11. The first region 13a is formed of intrinsic poly-silicon, and the second region 13b is formed of impurity-doped poly-silicon.

[0013] A gate insulating layer 15 is formed on the semiconductor layer 13, and a gate electrode 25 corresponding to the first region 13a of the semiconductor layer 13 is formed on the gate insulating layer 15. An interlayer insulating layer 17 is formed on the gate electrode 25.

[0014] In this instance, semiconductor contact holes 21 are formed through the gate insulating layer 15 and the interlayer insulating layer 17 to expose the second regions 13b of the semiconductor layer 13.

[0015] A source electrode 33 and a drain electrode 36, which are spaced apart from each other, are formed on the interlayer insulating layer 17. The source and drain electrodes 33 and 36 are electrically connected to the second regions 13b of the semiconductor layer 13 through the semiconductor contact holes 21, respectively.

[0016] The semiconductor layer 13, the gate electrode 25, the source electrode 33 and the drain electrode 36 constitute a driving TFT DTr.

[0017] A first passivation layer 19, which may include a flat top surface, is formed on or over the driving TFT DTr, and an auxiliary line 50 is formed on the first passivation layer 19 at a boundary of a pixel region P.

[0018] A second passivation layer 41, which may include a flat top surface, is formed on the auxiliary line 50.

[0019] In this instance, a drain contact hole 43, which exposes the drain electrode 36 of the driving TFT DTr, is formed through the first and second passivation layers 19 and 41, and a first auxiliary contact hole 53, which exposes the auxiliary line 50, is formed through the second passivation layer 41.

[0020] A first electrode 70, which is electrically connected to the drain electrode 36 through the drain contact hole 43, is formed on the second passivation layer 41 in the pixel region P. In addition, an auxiliary electrode 71, which is electrically connected to the auxiliary line 50 through the first auxiliary contact hole 53, is formed on the second passivation layer 41 at a boundary of the pixel region P.

[0021] A bank 73 is formed at a boundary of the pixel region P. The bank 73 covers edges of the first electrode 70 and the auxiliary electrode 71.

[0022] In this instance, the bank 73 has a lattice shape to surround the pixel region P and includes a second auxiliary contact hole 77 exposing the auxiliary electrode 71.

[0023] An organic emitting layer 75 is formed on the first electrode 70 in the pixel region P, and a second electrode 80 is formed over an entire surface of the substrate 11 including the bank 73 and the organic emitting layer 75. As a result, the second electrode 80 is electrically connected to auxiliary electrode 71 through the second auxiliary contact hole 77.

[0024] The first and second electrodes 70 and 80 and the organic emitting layer 75 therebetween constitute an organic emitting diode E.

[0025] Since the auxiliary line 50 is electrically connected to the second electrode 80 through the auxiliary electrode 71, the resistance of the second electrode 80 is lowered. As a result, the brightness non-uniformity problem can be prevented or minimized.

[0026] However, fabricating the OLED device 10 including the auxiliary line 50, the second passivation layer 41 and the first auxiliary contact hole 53, involves complicated process and increases the production cost of the OLED device 10.

[0027] In addition, in order to sufficiently reduce the resistance of the second electrode 80, a width and/or a thickness of the auxiliary line 50 and the auxiliary electrode 71 should be increased. However, since the auxiliary electrode 71 is positioned at the boundary of the pixel region P to be spaced part from the first electrode 70 and the boundary of the pixel region P has a narrow width for the aperture ratio, there is limit to how much the width of the auxiliary electrode 71 can be increased.

[0028] In addition, an overlapping area between the auxiliary line 50 and the first electrode 70 should be minimized to reduce a parasitic capacitance between the auxiliary line 50 and the first electrode 70, hence increasing the width of the auxiliary line 50 is limited.

[0029] Moreover, there is limit to increasing the thickness of the auxiliary line 50 and the auxiliary electrode 71, because a thin profile OLED device 10 is desirable.

[0030] US 2010/0309101 describes a display device including: a substrate; a pair of partition walls above the substrate; a light-emitting portion above the substrate that includes a first electrode, a second electrode, and a light-emitting layer located between the first electrode and the second electrode, the second electrode and the light-emitting layer located between the pair of partition walls; and a pixel circuit for applying a voltage to the first electrode. Each of the pair of partition walls includes a conductive portion and an insulating portion that covers side surfaces of the conductive portion for insulating the first electrode and the light-emitting layer from the conductive portion. The second electrode covers an upper surface of the conductive portion of each of the pair of partition walls and is electrically connected to the pixel circuit via the conductive portion.

[0031] US 2005/0253508 describes an organic electroluminescent display element including a substrate, a plurality of first electrodes, an auxiliary electrode, an insulating layer, an organic layer, a second electrode, and a conductive material. The auxiliary electrode is provided between the plurality of first electrodes on the substrate and separated from the plurality of first electrodes. The insulating layer covers the auxiliary electrode, separates and isolates the plurality of first electrodes from each other, and has through holes extending to the auxiliary electrode. The organic layer is provided on each of the plurality of first electrodes. The second electrode covers a whole surface of the insulating layer and the organic layers and allowing light emitted in the organic layers to transmit therethrough. The conductive material is provided in the through holes, for electrically connecting the auxiliary electrode to the second electrode.

[0032] US 2009/0215350 describes a method of manufacturing an organic electroluminescence device including a plurality of light-emitting elements. The partition wall layer includes a first partition wall layer having openings corresponding to the light-emitting elements and a second partition wall layer which is disposed on the first partition wall layer, and extending so as to follow the gap of the light-emitting elements, and has the groove on the top thereof; the forming the partition wall layer includes forming the first partition wall layer and forming the second partition wall layer on the first partition wall layer such that the first partition wall layer is exposed at the bottom of the groove; and the first partition wall layer is composed of an inorganic material, and the second partition wall layer is composed of an organic material.

SUMMARY

[0033] Aspects of an invention are defined in the appended independent claims.

[0034] There is provided an organic light emitting display device including a transparent electrode with low resistivity.

[0035] In one or more embodiments, an organic light emitting display device comprises: a substrate including a pixel region and a non-pixel region; a first electrode over the substrate in the pixel region; an organic emitting layer over the first electrode in the pixel region; a bank over the substrate in the non-pixel region; an auxiliary conductive line covered by the bank in the non-pixel region, a thickness of the auxiliary line larger than a thickness of the first electrode; and a second electrode on the organic emitting layer in the pixel region and on the bank in the non-pixel region, the second electrode electrically connected to the auxiliary conductive line.

[0036] In one or more embodiments, the bank surrounds the organic emitting layer to define the pixel region.

[0037] In one or more embodiments, the bank includes a hydrophobic property material.

[0038] In one or more embodiments, the bank includes a contact hole, the second electrode electrically connected to the auxiliary conductive line though the contact hole to reduce a resistance of the second electrode.

[0039] In one or more embodiments, an auxiliary electrode in the non-pixel region, the auxiliary electrode in a same layer as the first electrode but separated from the first electrode by the bank, the auxiliary electrode electrically coupled to the auxiliary conductive line.

[0040] In one or more embodiments, the organic light emitting display further comprises: a thin film transistor over the substrate; and a passivation layer over the thin film transistor. The auxiliary conductive line and the first electrode may be both formed above the passivation layer.

[0041] In one or more embodiments, a side surface of the bank has a stair shape (or 'stepped shape') where the side surface of the bank adjoins the first electrode between the pixel region and the non-pixel region.

[0042] In one or more embodiments, the bank covers a top surface and side surfaces of the auxiliary conductive line.

[0043] In one or more embodiments, the auxiliary conductive line has the thickness greater than a sum of thicknesses of the first electrode, the organic emitting layer and the second electrode.

[0044] In one or more embodiments, the auxiliary conductive line faces the substrate in a direction, a portion of the bank on the auxiliary conductive line has a thickness in the direction smaller than the thickness of the auxiliary conductive line in the direction.

[0045] In one or more embodiments, the auxiliary conductive line has a sheet resistance smaller than a sheet resistance of the second electrode.

[0046] In one or more embodiments, the second electrode has a thickness such that a light transmittance of the second electrode is 10 % or more or a sheet resistance of the second electrode is 100 Ω/sq or less.

[0047] In one or more embodiments, the bank covers side surfaces of the auxiliary conductive line and has a height being same as the auxiliary conductive line such that the second electrode contacts an entire top surface of the auxiliary conductive line.

[0048] There is provided a method of manufacturing an organic light emitting display device. In one or more embodiments, the method comprises: forming a substrate including a pixel region and a non-pixel region; forming a first electrode over the substrate in the pixel region; forming an auxiliary conductive line over the substrate in the non-pixel region, a thickness of the auxiliary conductive line greater than a thickness of the first electrode; forming a bank to cover the auxiliary conductive line; forming an organic emitting layer over the first electrode in the pixel region through an opening of the bank in the pixel region; and forming a second electrode on the organic emitting layer in the pixel region and on the bank in the non-pixel region, the second electrode connected to the auxiliary conductive line.

[0049] In one or more embodiments, the organic emitting layer is formed by a soluble process.

[0050] In one or more embodiments, the method further comprises forming a contact hole in the bank prior to forming the second electrode, wherein the second electrode is formed on the bank in the non-pixel region and is electrically connected to the auxiliary conductive line through the contact hole to reduce a resistance of the second electrode.

[0051] In one or more embodiments, the method further comprises forming an auxiliary electrode in the non-pixel region, the auxiliary electrode in a same layer as the first electrode, the auxiliary electrode in the non-pixel region and the first electrode simultaneously formed together. The auxiliary conductive line may be electrically coupled to the auxiliary electrode.

[0052] In one or more embodiments, the bank including a hydrophobic property material is formed by a soluble process to fill a space between the auxiliary electrode and the first electrode to separate the auxiliary electrode and the first electrode.

[0053] In one or more embodiments, a side surface of the bank has a stair shape where the side surface of the bank adjoins the first electrode between the pixel region and the non-pixel region.

[0054] In one or more embodiments, the method further comprises: forming a thin film transistor over the substrate prior to forming the first electrode and the auxiliary conductive line; and forming a passivation layer over the thin film transistor prior to forming the first electrode and the auxiliary conductive line. The auxiliary conductive line and the first electrode may be both formed above the passivation layer.

[0055] In one or more embodiments, the bank covers a top surface and side surfaces of the auxiliary conductive line.

[0056] In one or more embodiments, the bank covers side surfaces of the auxiliary conductive line and has a height being same as the auxiliary conductive line such that the second electrode contacts an entire top surface of the auxiliary conductive line.

[0057] It is to be understood that both the foregoing general description and the following detailed description are by example and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0058] The accompanying drawings, which are included to provide a further understanding of the present disclosure and are incorporated in and constitute a part of this specification, illustrate embodiments and together with the description serve to explain the principles of the present disclosure.

FIG. 1 is a schematic cross-sectional view of the related art OLED device including an auxiliary line.

FIG. 2 is a schematic plane view of an OLED device according to a first embodiment.

FIG. 3 is a schematic cross-sectional view taken along the line III-III in FIG. 2.

FIGs. 4A through 4F are schematic cross-sectional views illustrating a fabricating process of an OLED device according to the first embodiment.

FIG. 5 is a schematic plane view of an OLED device according to a second embodiment.

FIG. 6 is a schematic cross-sectional view taken along the line VI-VI in FIG. 5.

FIGs. 7A through 7F are schematic cross-sectional views illustrating a fabricating process of an OLED device according to the second embodiment.

FIG. 8 is a schematic plane view of an OLED device according to a third embodiment.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0059] Reference will now be made in detail to embodiments, examples of which are illustrated in the accompanying drawings.

[0060] FIG. 2 is a schematic plane view of an OLED device according to a first embodiment.

[0061] Referring to FIG. 2, an OLED device 100 according to the first embodiment includes a bank 173 having a lattice shape to surround a pixel region P and an auxiliary line 150 (herein also referred to as "an auxiliary conductive line") under the bank 173.

[0062] The bank 173 includes an auxiliary contact hole 177 exposing the auxiliary line 150. The auxiliary line 150 and the auxiliary contact hole 177 have a lattice shape to surround the pixel region P.

[0063] Although not shown in FIG. 2, a first electrode 170 (of FIG. 3) of an organic emitting diode E is disposed in each pixel region P, and a second electrode 180 (of FIG. 3) of the organic emitting diode E is disposed on an entire surface of a substrate 101 (of FIG. 3) and on an upper side of the bank 173. As a result, the second electrode 180 is electrically connected to the auxiliary line 150 through the auxiliary contact hole 177 of the bank 173.

[0064] FIG. 3 is a schematic cross-sectional view taken along the line III-III in FIG. 2.

[0065] Referring to FIG. 3, the OLED device 100 includes the substrate 101 having the pixel region P and non-pixel region NP, the first and second electrodes 170 and 180, an organic emitting layer 175 (also referred to as "an organic light emitting layer 175") between the first and second electrodes 170 and 180, the bank 173 in a non-pixel region NP and the auxiliary line 150 in the non-pixel region NP and being spaced apart from the first electrode 170.

[0066] In this instance, the first and second electrodes 170 and 180 and the organic emitting layer 175 therebetween constitute the organic emitting diode E in a pixel region P.

[0067] The first electrode 170 is positioned in the pixel region P and includes a conductive material having a relative high work function to serve as an anode. For example, the first electrode 170 may include a transparent conductive material, e.g., indium-tin-oxide (ITO) and indium-zinc-oxide (IZO).

[0068] The auxiliary line 150 is formed of a different material than a material of the first electrode 170 and has a resistance smaller than a resistance of the second electrode 180. If the auxiliary line 150 and the first electrode are formed of the same material, there is limitation of increasing a width of the auxiliary line 150. For example, the auxiliary line 150 may include a low resistance metallic material, e.g., copper (Cu), molybdenum (Mo) and aluminum (Al), and may have single or multi-layered structure. The auxiliary line 150 faces the substrate 101 in a vertical direction 112 and has a first thickness t1 between a bottom surface of the auxiliary line 150 and a top surface of the auxiliary line 150 in the vertical direction 112.

[0069] The bank 173 covers the auxiliary line 150 and edges of the first electrode 170. The bank 173 may include an organic material or an inorganic material. In one embodiment, a portion of the bank 173 on the auxiliary line 150 has a second thickness t2 between the top surface of the bank 173 and a top surface of the auxiliary line 150, where second thickness t2 is smaller than the first thickness t1. When the organic material is formed by a soluble process, the bank 173 may have a hydrophobic property. In one or more embodiments, the bank 173 covers a top surface and side surfaces of the auxiliary line 150 in the non-pixel region NP as shown in FIG. 3.

[0070] The organic emitting layer 175 is disposed on a portion (e.g., center) of the first electrode 170 exposed through an opening of the bank 173. The organic emitting layer 175 may include a red emitting pattern, a green emitting pattern, a blue emitting pattern, or a white emitting pattern, or some other color light emitting pattern. The organic emitting layer 175 may be formed by a deposition process or a soluble process, e.g., an inkjet printing and a nozzle printing.

[0071] The bank 173 includes the auxiliary contact hole 177 exposing the auxiliary line 150, and the second electrode 180 is disposed on the bank 173 and the organic emitting layer 175. As a result, the second electrode 180 is electrically connected to the auxiliary line 150 through the auxiliary contact hole 177.

[0072] The second electrode 180 may include a metallic material having a relatively low work function to serve as a cathode. For example, the metallic material for the second electrode 180 may be silver, magnesium or their alloy.

[0073] In other embodiments, the first electrode 170 may be a cathode and the second electrode 180 may be an anode.

[0074] Since the above metallic material generally has an opaque property, a third thickness t3 of the second electrode 180 should be controlled or adjusted to be semi-transparent. For example, the third thickness t3 of the second electrode 180 between a top surface of the second electrode 180 and a bottom surface of the second electrode 180 in the pixel region P may be controlled such that the transmittance of the second electrode 180 is about 10 % or more or the sheet resistance or the resistance of the second electrode 180 is about 100 Ω/sq or less. The third thickness t3 of the second electrode 180 is varied according to the metallic material.

[0075] In the present disclosure, the sheet resistance of the second electrode 180 is reduced because of the auxiliary line 150.

[0076] The auxiliary line 150 is positioned inside the bank 173, and the auxiliary line 150 and the first electrode 170 are formed of different material. The bank 173 has sufficient thickness to define the pixel region P. Accordingly, sufficient space for increasing the first thickness t1 of the auxiliary line 150 is provided such that the voltage drop in the second electrode 180 can be reduced. In addition, even if the first thickness t1 of the auxiliary line 150 is increased, a thickness of the OLED device 100 does not need to be increased.

[0077] In one example, the first thickness t1 of the auxiliary line 150 is greater than the first electrode 170. For example, the first thickness t1 may be about 5000 Å or more such that the second electrode 180 has the sheet resistance of about 1.0 Ω/sq or less.

[0078] In one example, the second thickness t2 of the bank 173 on the auxiliary line 150 may be 3 μm or less. The second thickness t2 may be between 1 μm and 2 μm.

[0079] In this instance, despite the third thickness t3 of the second electrode 180 being reduced to have the semi-transparent property or transmissive property, the sheet resistance of the second electrode 180 is sufficiently lowered thanks to the auxiliary line 150. Accordingly, the voltage drop problem in the second electrode 180 and the non-uniform brightness problem in the OLED device 100 may be prevented.

[0080] The first thickness t1 of the auxiliary line 150 may be greater than a total thickness of the organic emitting diode E, i.e., a thickness summation of the first electrode 170, the organic emitting layer 175 and the second electrode 180.

[0081] A driving TFT DTr, which is positioned between the substrate 101 and the first electrode 170 and is connected to the first electrode 170, is formed on the substrate 101.

[0082] For example, a semiconductor layer 113 including a first region 113a and second regions 113b at both sides of the first region 113a is formed on a substrate 101. The first region 113a is formed of intrinsic poly-silicon, and the second region 113b is formed of impurity-doped poly-silicon.

[0083] A gate insulating layer 115 is formed on the semiconductor layer 113, and a gate electrode 125 corresponding to the first region 113a of the semiconductor layer 113 is formed on the gate insulating layer 115. An interlayer insulating layer 117 is formed on the gate electrode 125.

[0084] In this instance, semiconductor contact holes 121 are formed through the gate insulating layer 115 and the interlayer insulating layer 117 to expose the second regions 113b of the semiconductor layer 113.

[0085] A source electrode 133 and a drain electrode 136, which are spaced apart from each other, are formed on the interlayer insulating layer 117. The source and drain electrodes 133 and 136 are electrically connected to the second regions 113b of the semiconductor layer 113 through the semiconductor contact holes 121, respectively.

[0086] The semiconductor layer 113, the gate electrode 125, the source electrode 133 and the drain electrode 136 constitute a driving TFT DTr.

[0087] A passivation layer 119, which may include a flat top surface, is formed on or over the driving TFT DTr. In this instance, a drain contact hole 143, which exposes the drain electrode 136 of the driving TFT DTr, is formed through the passivation layer 119.

[0088] The first electrode 170 is disposed on the passivation layer 119 and in the pixel region P. The first electrode 170 is electrically connected to the drain electrode 136 through the drain contact hole 143.

[0089] The auxiliary line 150 is disposed on the passivation layer 119 and is positioned in the non-pixel region NP to be spaced apart from the first electrode 170.

[0090] FIGs. 4A through 4F are schematic cross-sectional views illustrating a fabricating process of an OLED device according to the first embodiment.

[0091] Since a fabricating process of the driving TFT in the present disclosure is similar to the general fabricating process, the description thereof is omitted.

[0092] As shown in FIG. 4A, an organic material, e.g., photo-acryl, is coated over the substrate 101, where the driving TFT DTr is formed, to form the passivation layer 119, and a mask process is performed to form the drain contact hole 143 in the passivation layer 119. The drain electrode 136 of the driving TFT DTr is exposed through the drain contact hole 143.

[0093] Next, as shown in FIG. 4B, the first electrode 170 is formed on the passivation layer 119 and in the pixel region P. The first electrode 170 is electrically connected to the drain electrode 136 through the drain contact hole 143. For example, the first electrode 170 may be formed of a transparent conductive material, e.g., ITO or IZO.

[0094] Next, as shown in FIG. 4C, the auxiliary line 150 is formed in the non-pixel region NP to be spaced apart from the first electrode 170. The auxiliary line 150 includes a low resistance metallic material. For example, the auxiliary line 150 may include at least one of Cu, Mo and Al and may have single or multi-layered structure.

[0095] Next, as shown in FIG. 4D, the bank 173 covering the auxiliary line 150 and edges of the first electrode 170 is formed. A mask process is performed to form the auxiliary contact hole 177 exposing the auxiliary line 150. The bank 173 may include an organic material or an inorganic material. When the organic emitting layer 175 is formed by a soluble process, the bank 173 may have a hydrophobic property.

[0096] Next, as shown in FIG. 4E, the organic emitting layer 175 is formed on the first electrode 170 in the pixel region P. The organic emitting layer 175 may include a red emitting pattern, a green emitting pattern, a blue emitting pattern, and a white emitting pattern, or some other color light emitting pattern. The organic emitting layer 175 may be formed by a deposition process or a soluble process, e.g., an inkjet printing and a nozzle printing.

[0097] Next, as shown in FIG. 4F, the second electrode 180 is formed over an entire surface of the substrate 101. As a result, the second electrode 180 is formed on the bank 173 and the organic emitting layer 175 and is electrically connected to the auxiliary line 150 through the auxiliary contact hole 177.

[0098] The second electrode 180 may include a metallic material having a relatively low work function to serve as a cathode. For example, the metallic material for the second electrode 180 may be silver, magnesium or their alloy.

[0099] In the OLED device 100 of the present disclosure, the voltage drop problem can be prevented without the second passivation layer 41 (of FIG. 1) and the first auxiliary contact hole 53 (of FIG. 1).

[0100] In addition, since the auxiliary line 150 having a relatively large thickness is positioned inside the bank 173, a total thickness of the OLED device 100 is not increased by the auxiliary line 150.

[0101] As a result, the fabricating process of the OLED device 100 is simplified, and the production cost of the OLED device 100 is reduced.

[0102] FIG. 5 is a schematic plane view of an OLED device according to a second embodiment.

[0103] Referring to FIG. 5, an OLED device 200 according to the second embodiment includes a bank 273 having a lattice shape to surround a pixel region P and an auxiliary line 250 under the bank 273.

[0104] The bank 273 includes an auxiliary contact hole 277 exposing the auxiliary line 250. The auxiliary line 250 and the auxiliary contact hole 277 have a lattice shape to surround the pixel region P.

[0105] Although not shown, a first electrode 270 (of FIG. 6) of an organic emitting diode E is disposed in each pixel region P, and an auxiliary electrode 271 (of FIG. 6) under the auxiliary line 250 is electrically connected to the auxiliary line 250. The second electrode 280 (of FIG. 6) of the organic emitting diode E is disposed on an entire surface of a substrate 201 (of FIG. 6) and on an upper side of the bank 273. As a result, the second electrode 280 is electrically connected to the auxiliary electrode 271 and the auxiliary line 250 through the auxiliary contact hole 277 of the bank 273.

[0106] FIG. 6 is a schematic cross-sectional view taken along the line VI-VI in FIG. 5.

[0107] Referring to FIG. 6, the OLED device 200 includes the substrate 201 having the pixel region P and the non-pixel region NP, the first and second electrodes 270 and 280, an organic emitting layer 275 (also referred to as "an organic light emitting layer 275") between the first and second electrodes 270 and 280, the bank 273 in the non-pixel region NP, the auxiliary electrode 271, which is spaced apart from the first electrode 270, and the auxiliary line 250 on the auxiliary electrode 271.

[0108] In this instance, the first and second electrodes 270 and 280 and the organic emitting layer 275 therebetween constitute the organic emitting diode E.

[0109] The first electrode 270 is positioned in the pixel region P and includes a conductive material having a relative high work function to serve as an anode. For example, the first electrode 270 may include a transparent conductive material, e.g., indium-tin-oxide (ITO) and indium-zinc-oxide (IZO).

[0110] The auxiliary electrode 271 is disposed in the non-pixel region NP. The auxiliary electrode 271 is formed of the same material and disposed at the same layer as the first electrode 270.

[0111] The auxiliary line 250 is formed of a different material than a material of the first electrode 270 and has a resistance smaller than a resistance of the second electrode 280. For example, the auxiliary line 250 may include a low resistance metallic material, e.g., copper (Cu), molybdenum (Mo) and aluminum (Al), and may have single or multi-layered structure. The auxiliary line 250 has a first thickness t1.

[0112] In FIG. 6, the auxiliary line 250 has a width in a horizontal direction 114 smaller than a width of the auxiliary electrode 271 in the horizontal direction 114 such that opposite edges of the auxiliary electrode 271 are exposed. Alternatively, the auxiliary line 250 may have the same width as the auxiliary electrode 271.

[0113] The bank 273 covers the auxiliary line 250, the edges of the auxiliary electrode 271 and an edge of the first electrode 270.

[0114] When the auxiliary line 250 has the width smaller than a width of the auxiliary electrode 271 to expose the edges of the auxiliary electrode 271, a side surface of the bank 273 has a stair shape 295. Namely, the bank 273 has a protruding portion at a lower part to form the stair shape.

[0115] In this instance, a bent portion of the stair shape 295 is positioned between the auxiliary electrode 271 and the first electrode 270. When the bent portion of the stair shape 295 is positioned on the auxiliary electrode 271, an amount of an organic material on the protruding portion of the bank 273 is increased. On the other hand, when the bent portion of the stair shape 295 is positioned on the first electrode 270, the protruding portion becomes too short such that a pile-up problem, i.e., a coffee ring effect problem, is insufficiently prevented. Specifically, a thickness of an edge portion of the organic emitting layer 275 in contact with the bank 273 can be greater than a thickness of a center portion of the organic emitting layer 275 in the drying process due to surface tension, if the bent portion of the stair shape 295 is positioned on the first electrode 270. Such pile-up problem can cause non-uniformity of brightness. On the other hand, to prevent this problem, the stair shape 295 of the bank 273 should extend to a center of the first electrode 270. However, in this case, an emitting area is decreased.

[0116] The bank 273 may include an organic material or an inorganic material. A portion of the bank 273 on the auxiliary line 250 has a second thickness t2 being smaller than the first thickness t1. When the organic emitting layer 275 is formed by a soluble process, the bank 273 may have a hydrophobic property.

[0117] The organic emitting layer 275 is disposed on a center of the first electrode 270 exposed through an opening of the bank 273. The organic emitting layer 275 may include a red emitting pattern, a green emitting pattern, a blue emitting pattern, and a white emitting pattern.

The organic emitting layer 275 may be formed by a deposition process or a soluble process, e.g., an inkjet printing and a nozzle printing.

[0118] Since the bank 273 has the stair shape 295 due to the auxiliary electrode 271 and the auxiliary line 250 and the bank 273 includes a hydrophobic property material, a pile-up problem generated during a drying process of the organic emitting layer 275, which is formed by a soluble process, is decreased. As a result, the thickness uniformity of the organic emitting layer 275 is improved.

[0119] The bank 273 includes the auxiliary contact hole 277 exposing the auxiliary line 250. The second electrode 280 is disposed on the bank 273 and the organic emitting layer 275. As a result, the second electrode 280 is electrically connected to the auxiliary line 250 through the auxiliary contact hole 277.

[0120] The second electrode 280 may include a metallic material having a relatively low work function to serve as a cathode. For example, the metallic material for the second electrode 280 may be silver, magnesium or their alloy.

[0121] Since the above metallic material generally has an opaque property, a third thickness t3 of the second electrode 280 should be controlled or adjusted to be semi-transparent. For example, the third thickness of the second electrode 280 may be controlled such that the transmittance of the second electrode 280 is about 10 % or more or the sheet resistance or the resistance of the second electrode 280 is about 100 Ω/sq or less. The third thickness t3 of the second electrode 280 is varied according to the metallic material.

[0122] On the other hand, since the second electrode 280 is formed to cover an entire surface of the substrate 201, there is a voltage drop problem.

[0123] In the present disclosure, the sheet resistance of the second electrode 280 is reduced because of the auxiliary line 250 and the auxiliary electrode 271.

[0124] The auxiliary line 250 and the auxiliary electrode are positioned inside the bank 273, and the auxiliary line 250 and the first electrode 270 are formed of different materials. The bank 273 has sufficient thickness to define the pixel region P. Accordingly, sufficient space for increasing the first thickness t1 of the auxiliary line 250 is provided such that the voltage drop in the second electrode 280 can be reduced. In addition, even if the first thickness t1 of the auxiliary line 250 is increased, a thickness of the OLED device 200 does not need to be increased.

[0125] The first thickness t1 of the auxiliary line 250 may be larger than the first electrode 270. In addition, the first thickness t1 of the auxiliary line 250 may be larger than the auxiliary electrode 271. For example, the first thickness t1 may be about 5000 Å or more such that the second electrode 280 has the sheet resistance of about 1.0 Ω/sq or less.

[0126] In one example, the second thickness t2 of the bank 273 on the auxiliary line 250 may be 3 μm or less. The second thickness t2 may be between 1 μm and 2 μm.

[0127] In this instance, when the third thickness t3 of the second electrode 280 is reduced to have the semi-transparent property or transmissive property, the sheet resistance of the second electrode 280 is sufficiently lowered due to the auxiliary line 250 and the auxiliary electrode 271. Accordingly, the voltage drop problem in the second electrode 280 and the non-uniform brightness problem in the OLED device 200 may be prevented.

[0128] The first thickness t1 of the auxiliary line 250 may be larger than a total thickness of the organic emitting diode E, i.e., a thickness summation of the first electrode 270, the organic emitting layer 275 and the second electrode 280.

[0129] A driving TFT DTr, which is positioned between the substrate 201 and the first electrode 270 and is connected to the first electrode 270, is formed on the substrate 201.

[0130] For example, a semiconductor layer 213 including a first region 213a and second regions 213b at both sides of the first region 213a is formed on a substrate 201. The first region 213a is formed of intrinsic poly-silicon, and the second region 213b is formed of impurity-doped poly-silicon.

[0131] A gate insulating layer 215 is formed on the semiconductor layer 213, and a gate electrode 225 corresponding to the first region 213a of the semiconductor layer 213 is formed on the gate insulating layer 215. An interlayer insulating layer 217 is formed on the gate electrode 225.

[0132] In this instance, semiconductor contact holes 221 are formed through the gate insulating layer 215 and the interlayer insulating layer 217 to expose the second regions 213b of the semiconductor layer 213.

[0133] A source electrode 233 and a drain electrode 236, which are spaced apart from each other, are formed on the interlayer insulating layer 217. The source and drain electrodes 233 and 236 are electrically connected to the second regions 213b of the semiconductor layer 213 through the semiconductor contact holes 221, respectively.

[0134] The semiconductor layer 213, the gate electrode 225, the source electrode 233 and the drain electrode 236 constitute a driving TFT DTr.

[0135] A passivation layer 219, which may include a flat top surface, is formed on or over the driving TFT DTr. In this instance, a drain contact hole 243, which exposes the drain electrode 236 of the driving TFT DTr, is formed through the passivation layer 219.

[0136] The first electrode 270 is disposed on the passivation layer 219 and in the pixel region P. The first electrode 270 is electrically connected to the drain electrode 236 through the drain contact hole 243. In addition, the auxiliary electrode 271 is disposed on the passivation layer 219 and in the non-pixel region NP to be spaced apart from the first electrode 270. In other embodiments, the first electrode 270 is electrically connected to the source electrode 233, instead of the drain electrode 236, through the contact hole 243.

[0137] The auxiliary line 250 is disposed on the auxiliary electrode 271 and is also spaced part from the first electrode 270.

[0138] FIGs. 7A through 7F are schematic cross-sectional views illustrating a fabricating process of an OLED device according to the second embodiment.

[0139] As shown in FIG. 7A, an organic material, e.g., photo-acryl, is coated over the substrate 201, where the driving TFT DTr is formed, to form the passivation layer 219, and a mask process is performed to form the drain contact hole 243 in the passivation layer 219. The drain electrode 236 of the driving TFT DTr is exposed through the drain contact hole 243.

[0140] Next, as shown in FIG. 7B, the first electrode 270 and the auxiliary electrode 271 are formed on the passivation layer 219. The first electrode 270 and the auxiliary electrode 271 may be simultaneously formed together. The first electrode 270 is formed in the pixel region P, and the auxiliary electrode 271 is formed in the non-pixel region NP. The first electrode 270 is electrically connected to the drain electrode 136 through the drain contact hole 243. For example, each of the first electrode 170 and the auxiliary electrode 271 may be formed of a transparent conductive material, e.g., ITO or IZO.

[0141] Next, as shown in FIG. 7C, the auxiliary line 250 is formed on the auxiliary electrode 271. The auxiliary line 250 may have a width smaller than a width of the auxiliary electrode 271 to expose the opposite edges of the auxiliary electrode 271.

[0142] The auxiliary line 250 includes a low resistance metallic material. For example, the auxiliary line 250 may include at least one of Cu, Mo and Al and may have single or multi-layered structure.

[0143] Next, as shown in FIG. 7D, the bank 273 covering the auxiliary line 250 and an edge of the first electrode 270 is formed. The bank 273 may cover the opposite edges of the auxiliary electrode 271 protruding from the auxiliary line 250. The bank 273 may have a stair shape 295 side surface. Namely, a lower part of the bank 273 protrudes toward the pixel region P.

[0144] A mask process is performed to form the auxiliary contact hole 277 exposing the auxiliary line 250. The bank 273 may include an organic material or an inorganic material. When the organic emitting layer 275 may be formed by a soluble process, the bank 273 may have a hydrophobic property.

[0145] Next, as shown in FIG. 7E, the organic emitting layer 275 is formed on the first electrode 270 in the pixel region P. The organic emitting layer 275 may include a red emitting pattern, a green emitting pattern, a blue emitting pattern, and a white emitting pattern or some other color light emitting pattern. The organic emitting layer 275 may be formed by a deposition process or a soluble process, e.g., an inkjet printing and a nozzle printing.

[0146] Since the bank 273 has the stair shape 295 due to the auxiliary electrode 271 and the auxiliary line 250, a pile-up problem generated during a drying process of the organic emitting layer 275, which is formed by a soluble process, is decreased. As a result, the thickness uniformity of the organic emitting layer 275 is improved.

[0147] Next, as shown in FIG. 7F, the second electrode 280 is formed over an entire surface of the substrate 201. As a result, the second electrode 280 is formed on the bank 273 and the organic emitting layer 275, and is electrically connected to the auxiliary line 250 through the auxiliary contact hole 277.

[0148] The second electrode 280 may include a metallic material having a relatively low work function to serve as a cathode. For example, the metallic material for the second electrode 280 may be silver, magnesium or their alloy.

[0149] In the OLED device 200 of the present disclosure, the voltage drop problem can be prevented without the second passivation layer 41 (of FIG. 1) and the first auxiliary contact hole 53 (of FIG. 1).

[0150] In addition, since the auxiliary line 250 having a relatively large thickness is positioned inside the bank 273, a total thickness of the OLED device 200 is not increased by the auxiliary line 250.

[0151] As a result, the fabricating process of the OLED device 200 is simplified, and the production cost of the OLED device 200 is reduced.

[0152] Moreover, since the auxiliary electrode 271, which is disposed under the auxiliary line 250 and contacts a lower surface of the auxiliary line 250, is formed in a process for the first electrode 270, the voltage drop problem in the second electrode 280 is further prevented without an additional process.

[0153] Furthermore, since the bank 273 has a side surface of a stair shape 295, the thickness uniformity of the organic emitting layer 275, which is formed by a soluble process, is improved.

[0154] Accordingly, the OLED device 200 having uniform brightness, thin profile and high display quality is provided without an additional process or thickness increase.

[0155] FIG. 8 is a schematic cross-sectional view of an OLED device according to a third embodiment.

[0156] Referring to FIG. 8, the OLED device 300 includes the substrate 301 having the pixel region P and the non-pixel region NP, the driving TFT DTr, the first and second electrodes 370 and 380, an organic emitting layer 375 (also referred to as "an organic light emitting layer 375") between the first and second electrodes 370 and 380, the bank 373 in the non-pixel region NP, the auxiliary electrode 371, which is spaced apart from the first electrode 370, and the auxiliary line 350 on the auxiliary electrode 371.

[0157] In this instance, the first and second electrodes 370 and 380 and the organic emitting layer 375 therebetween constitute the organic emitting diode E.

[0158] The first electrode 370 is positioned in the pixel region P and includes a conductive material having a relative high work function to serve as an anode. For example, the first electrode 370 may include a transparent conductive material, e.g., indium-tin-oxide (ITO) and indium-zinc-oxide (IZO).

[0159] The auxiliary electrode 371 is disposed in the non-pixel region NP. The auxiliary electrode 371 is formed of the same material and disposed at the same layer as the first electrode 370.

[0160] The auxiliary line 350 is formed of a different material than a material of the first electrode 370 and has a resistance smaller than a resistance of the second electrode 380. For example, the auxiliary line 350 may include a low resistance metallic material, e.g., copper (Cu), molybdenum (Mo) and aluminum (Al), and may have single or multi-layered structure.

[0161] In FIG. 8, the auxiliary line 350 has a width in a horizontal direction 114 smaller than a width of the auxiliary electrode 371 in the horizontal direction 114 such that opposite edges of the auxiliary electrode 371 are exposed. Alternatively, the auxiliary line 350 may have the same width as the auxiliary electrode 371.

[0162] The bank 373 covers side surfaces of the auxiliary line 350, the edges of the auxiliary electrode 371 and an edge of the first electrode 370. The bank 373 has the same height as the auxiliary line 350 from the substrate 301 or the passivation layer 319 in a vertical direction 112 such that an entire top surface of the auxiliary line 350 is exposed. Namely, a thickness of the bank 373 is equal to a thickness summation of the auxiliary electrode 371 and the auxiliary line 350. As a result, the bank 373 and the auxiliary line 350 may form a flat top surface.

[0163] When the auxiliary line 350 has the width smaller than a width of the auxiliary electrode 371 to expose the edges of the auxiliary electrode 371, a side surface of the bank 373 has a stair shape 395. Namely, the bank 373 has a protruding portion at a lower part to form the stair shape.

[0164] In this instance, a bent portion of the stair shape 395 is positioned between the auxiliary electrode 371 and the first electrode 370. When the bent portion of the stair shape 395 is positioned on the auxiliary electrode 371, an amount of an organic material on the protruding portion of the bank 373 is increased. On the other hand, when the bent portion of the stair shape 395 is positioned on the first electrode 370, the protruding portion becomes too short such that a pile-up problem, i.e., a coffee ring effect problem, is insufficiently prevented. On the other hand, to prevent this problem, the stair shape 395 of the bank 373 should extend to a center of the first electrode 370. However, in this case, an emitting area is decreased.

[0165] The bank 373 may include an organic material or an inorganic material. When the organic emitting layer 375 is formed by a soluble process, the bank 373 may have a hydrophobic property.

[0166] The organic emitting layer 375 is disposed on a center of the first electrode 370 exposed through an opening of the bank 373. The organic emitting layer 375 may include a red emitting pattern, a green emitting pattern, a blue emitting pattern, and a white emitting pattern. The organic emitting layer 375 may be formed by a deposition process or a soluble process, e.g., an inkjet printing and a nozzle printing.

[0167] Since the bank 373 has the stair shape 395 due to the auxiliary electrode 371 and the auxiliary line 350 and the bank 373 includes a hydrophobic property material, a pile-up problem generated during a drying process of the organic emitting layer 375, which is formed by a soluble process, is decreased. As a result, the thickness uniformity of the organic emitting layer 375 is improved.

[0168] The second electrode 380 is disposed on the bank 373, the auxiliary line 350 and the organic emitting layer 375. The second electrode 380 may include a metallic material having a relatively low work function to serve as a cathode. For example, the metallic material for the second electrode 380 may be silver, magnesium or their alloy.

[0169] The second electrode 380 is electrically connected to the auxiliary line 350. The second electrode 380 contacts an entire top surface of the auxiliary line 350 such that a contact area between the second electrode 380 and the auxiliary line 350 is increased. As a result, a contact resistance between the second electrode 380 and the auxiliary line 350 is reduced.

[0170] Namely, the sheet resistance of the second electrode 380 is further lowered due to the increase of the contact area between the second electrode 380 and the auxiliary line 350. Accordingly, the voltage drop problem in the second electrode 380 and the non-uniform brightness problem in the OLED device 300 may be prevented.

[0171] The driving TFT DTr, which is positioned between the substrate 301 and the first electrode 370 and is connected to the first electrode 370, is formed on the substrate 301.

[0172] The driving TFT DTr includes the semiconductor layer 313, the gate electrode 325, the source electrode 333 and the drain electrode 336.

[0173] For example, the semiconductor layer 313 including a first region 313a and second regions 313b at both sides of the first region 313a is formed on a substrate 301. The first region 313a is formed of intrinsic poly-silicon, and the second region 313b is formed of impurity-doped poly-silicon.

[0174] The gate insulating layer 315 is formed on the semiconductor layer 313, and the gate electrode 325 corresponding to the first region 313a of the semiconductor layer 313 is formed on the gate insulating layer 315. The interlayer insulating layer 317 is formed on the gate electrode 325.

[0175] In this instance, the semiconductor contact holes 321 are formed through the gate insulating layer 315 and the interlayer insulating layer 317 to expose the second regions 313b of the semiconductor layer 313.

[0176] The source electrode 333 and the drain electrode 336, which are spaced apart from each other, are formed on the interlayer insulating layer 317. The source and drain electrodes 333 and 336 are electrically connected to the second regions 313b of the semiconductor layer 313 through the semiconductor contact holes 321, respectively.

[0177] The passivation layer 319, which may include a flat top surface, is formed on or over the driving TFT DTr. In this instance, the drain contact hole 343, which exposes the drain electrode 336 of the driving TFT DTr, is formed through the passivation layer 319.

[0178] The first electrode 370 is disposed on the passivation layer 319 and in the pixel region P. The first electrode 370 is electrically connected to the drain electrode 336 through the drain contact hole 343.

[0179] In addition, the auxiliary electrode 371 is disposed on the passivation layer 319 and in the non-pixel region NP to be spaced apart from the first electrode 370. In other embodiments, the first electrode 370 is electrically connected to the source electrode 333, instead of the drain electrode 336.

[0180] The auxiliary line 350 is disposed on the auxiliary electrode 371 and is also spaced part from the first electrode 370.

Claims

1. An organic light emitting display device (100, 200, 300), comprising:

    a substrate (101, 201, 301) defining a pixel region (P) and a non-pixel region (NP);
    a first electrode (170, 270, 370) over the substrate (101, 201, 301) in the pixel region (P);
    an organic emitting layer (175, 275, 375) over the first electrode (170, 270, 370) in the pixel region (P);
    a bank (173, 273, 373) over the substrate (101, 201, 301) in the non-pixel region (NP);
    an auxiliary conductive line (150, 250, 350) covered by the bank (173, 273, 373) in the non-pixel region (NP), a thickness (t1) of the auxiliary conductive line being greater than a thickness of the first electrode (170, 270, 370); and
    a second electrode (180, 280, 380) over the organic emitting layer (175, 275, 375) in the pixel region (P) and over the bank (173, 273, 373) in the non-pixel region (NP), the second electrode (180, 280, 380) being electrically connected to the auxiliary conductive line (150, 250, 350),
    characterised in that the bank (173, 273) covers side surfaces and a portion of the top surface of the auxiliary conductive line (150, 250).

2. The organic light emitting display device according to claim 1, wherein at least one of:

    the bank (173, 273, 373) surrounds the organic emitting layer (175, 275, 375) so as to define the pixel region (P); or
    the bank (173, 273, 373) comprises a hydrophobic material.

3. The organic light emitting display device according to any preceding claim, wherein the bank (173, 273) comprises a contact hole (177, 277), the second electrode (180, 280) being electrically connected to the auxiliary conductive line (150, 250) though the contact hole so as to reduce a resistance of the second electrode (180, 280).

4. The organic light emitting display device according to any preceding claim, wherein at least one of:

    the organic light emitting display device further comprises an auxiliary electrode (271, 371) in the non-pixel region (NP), the auxiliary electrode being in a same layer as the first electrode (270, 370) but separated from the first electrode (270, 370) by the bank (273, 373), the auxiliary electrode being electrically coupled to the auxiliary conductive line (250, 350);
    the organic light emitting display device further comprises a thin film transistor (DTr) over the substrate (101, 201, 301) and a passivation layer (119, 219, 319) over the thin film transistor, wherein the auxiliary conductive line (150, 250, 350) and the first electrode (170, 270, 370) are both formed over the passivation layer; or
    a side surface of the bank (273, 373) has a stepped shape (295, 395) where the side surface of the bank (273, 373) adjoins the first electrode (270, 370) between the pixel region (P) and the non-pixel region (NP).

5. The organic light emitting display device according to any preceding claim, wherein at least one of:

    the thickness (t1) of the auxiliary conductive line (150, 250, 350) is greater than a sum of thicknesses of the first electrode (170, 270, 370), the organic emitting layer (175, 275, 375) and the second electrode (180, 280, 380); or
    a thickness (t2) of a portion of the bank (173, 273, 373) as measured between a top surface of the portion of the bank (173, 273, 373) and a top surface of the auxiliary conductive line (150, 250, 350) is less than a thickness (t1) of the auxiliary conductive line (150, 250, 350) as measured between a top surface of the substrate (101, 201, 301) and the top surface of the auxiliary conductive line (150, 250, 350).

6. The organic light emitting display device according to any preceding claim, wherein at least one of:

    the auxiliary conductive line (150, 250, 350) has a sheet resistance that is less than a sheet resistance of the second electrode (180, 280, 380); or
    the second electrode (180, 280, 380) has a thick-

ness (t3) that is such that a light transmittance of the second electrode (180, 280, 380) is 10 % or more or a sheet resistance of the second electrode (180, 280, 380) is 100 Ω/sq or less.

7. A method of manufacturing an organic light emitting display device (100, 200, 300), the method comprising:

forming a substrate (101, 201, 301) defining a pixel region (P) and a non-pixel region (NP);
forming a first electrode (170, 270, 370) over the substrate (101, 201, 301) in the pixel region (P);
forming an auxiliary conductive line (150, 250, 350) over the substrate (101, 201, 301) in the non-pixel region (NP), a thickness (t1) of the auxiliary conductive line (150, 250, 350) being greater than a thickness of the first electrode (170, 270, 370);
forming a bank (173, 273, 373) to cover the auxiliary conductive line (150, 250, 350);
forming an organic emitting layer (175, 275, 375) over the first electrode (170, 270, 370) in the pixel region (P) through an opening of the bank (173, 273, 373) in the pixel region (P); and
forming a second electrode (180, 280, 380) over the organic emitting layer (175, 275, 375) in the pixel region (P) and over the bank (173, 273, 373) in the non-pixel region (NP), the second electrode (180, 280, 380) being connected to the auxiliary conductive line (150, 250, 350),
wherein the bank (173, 273) covers side surfaces and a portion of the top surface of the auxiliary conductive line (150, 250).

8. The method of claim 7, wherein the organic emitting layer (175, 275, 375) is formed by a soluble process.

9. The method of any of claims 7 to 8, further comprising:
forming a contact hole (177, 277) in the bank (173, 273) prior to forming the second electrode (180, 280), wherein the second electrode (180, 280) is electrically connected to the auxiliary conductive line (150, 250) through the contact hole so as to reduce a resistance of the second electrode (180, 280).

10. The method of any of claims 7 to 9, further comprising:
forming an auxiliary electrode (271, 371) in the non-pixel region (NP), the auxiliary electrode being in a same layer as the first electrode (270, 370), the auxiliary electrode in the non-pixel region (NP) and the first electrode (270, 370) being formed simultaneously, wherein the auxiliary conductive line (250, 350) is electrically coupled to the auxiliary electrode.

11. The method of claim 10, wherein the bank (173, 273, 373) comprises a hydrophobic material and is formed by a soluble process to fill a space between the auxiliary electrode and the first electrode (170, 270, 370) to separate the auxiliary electrode and the first electrode (170, 270, 370),
optionally wherein a side surface of the bank (273, 373) has a stepped shape (295, 395) where the side surface of the bank (273, 373) adjoins the first electrode (270, 370) between the pixel region (P) and the non-pixel region (NP).

12. The method of any of claims 7 to 11, further comprising:

forming a thin film transistor (DTr) over the substrate (101, 201, 301) prior to forming the first electrode (170, 270, 370) and the auxiliary conductive line (150, 250, 350); and
forming a passivation layer (119, 219, 319) over the thin film transistor prior to forming the first electrode (170, 270, 370) and the auxiliary conductive line (150, 250, 350),
wherein the auxiliary conductive line (150, 250, 350) and the first electrode (170, 270, 370) are both formed over the passivation layer.

Patentansprüche

1. Organische Lichtaussendungsanzeigevorrichtung (100, 200, 300), die Folgendes umfasst:

ein Substrat (101, 201, 301), das einen Pixelbereich (P) und einen Nicht-Pixelbereich (NP) definiert;
eine erste Elektrode (170, 270, 370) über dem Substrat (101, 201, 301) in dem Pixelbereich (P);
eine organische Aussendungsschicht (175, 275, 375) über der ersten Elektrode (170, 270, 370) in dem Pixelbereich (P);
eine Böschung (173, 273, 373) über dem Substrat (101, 201, 301) in dem Nicht-Pixelbereich (NP);
eine leitende Hilfsleitung (150, 250, 350), die durch die Böschung (173, 273, 373) in dem Nicht-Pixelbereich (NP) bedeckt ist, wobei eine Dicke (t1) der leitenden Hilfsleitung größer als eine Dicke der ersten Elektrode (170, 270, 370) ist; und
eine zweite Elektrode (180, 280, 380) über der organischen Aussendungsschicht (175, 275, 375) in dem Pixelbereich (P) und über der Böschung (173, 273, 373) in dem Nicht-Pixelbereich (NP), wobei die zweite Elektrode (180, 280, 380) mit der leitenden Hilfsleitung (150, 250, 350) elektrisch verbunden ist,
dadurch gekennzeichnet, dass die Böschung

(173, 273) Seitenflächen und einen Teil der oberen Fläche der leitenden Hilfsleitung (150, 250) bedeckt.

2. Organische Lichtaussendungsanzeigevorrichtung nach Anspruch 1, wobei
die Böschung (173, 273, 373) die organische Aussendungsschicht (175, 275, 375) umgibt, um den Pixelbereich (P) zu definieren; und/oder
die Böschung (173, 273, 373) ein hydrophobes Material umfasst.

3. Organische Lichtaussendungsanzeigevorrichtung nach einem vorhergehenden Anspruch, wobei die Böschung (173, 273) ein Kontaktloch (177, 277) umfasst, wobei die zweite Elektrode (180, 280) mit der leitenden Hilfsleitung (150, 250) durch das Kontaktloch elektrisch verbunden ist, um einen Widerstand der zweiten Elektrode (180, 280) zu verringern.

4. Organische Lichtaussendungsanzeigevorrichtung nach einem vorhergehenden Anspruch, wobei
die organische Lichtaussendungsanzeigevorrichtung ferner eine Hilfselektrode (271, 371) in dem Nicht-Pixelbereich (NP) umfasst, wobei sich die Hilfselektrode in derselben Schicht wie die erste Elektrode (270, 370) befindet, aber von der ersten Elektrode (270, 370) durch die Böschung (273, 373) getrennt ist, wobei die Hilfselektrode an die leitende Hilfsleitung (250, 350) elektrisch gekoppelt ist; und/oder
die organische Lichtaussendungsanzeigevorrichtung ferner einen Dünnschichttransistor (DTr) über dem Substrat (101, 201, 301) und eine Passivierungsschicht (119, 219, 319) über dem Dünnschichttransistor umfasst, wobei sowohl die leitende Hilfsleitung (150, 250, 350) als auch die erste Elektrode (170, 270, 370) über der Passivierungsschicht gebildet sind; und/oder
eine Seitenfläche der Böschung (273, 373) eine gestufte Form (295, 395) besitzt, wobei die Seitenfläche der Böschung (273, 373) an die erste Elektrode (270, 370) zwischen dem Pixelbereich (P) und dem Nicht-Pixelbereich (NP) angrenzt.

5. Organische Lichtaussendungsanzeigevorrichtung nach einem vorhergehenden Anspruch, wobei:

die Dicke (t1) der leitenden Hilfsleitung (150, 250, 350) größer als eine Summe der Dicken der ersten Elektrode (170, 270, 370), der organischen Aussendungsschicht (175, 275, 375) und der zweiten Elektrode (180, 280, 380) ist; und/oder
eine Dicke (t2) eines Teils der Böschung (173, 273, 373), die zwischen einer oberen Fläche des Teils der Böschung (173, 273, 373) und einer oberen Fläche der leitenden Hilfsleitung (150, 250, 350) gemessen wird, kleiner ist als eine Dicke (t1) der leitenden Hilfsleitung (150, 250, 350), die zwischen einer oberen Fläche des Substrats (101, 201, 301) und der oberen Fläche der leitenden Hilfsleitung (150, 250, 350) gemessen wird.

6. Organische Lichtaussendungsanzeigevorrichtung nach einem vorhergehenden Anspruch, wobei:

die leitende Hilfsleitung (150, 250, 350) einen Schichtwiderstand besitzt, der kleiner als ein Schichtwiderstand der zweiten Elektrode (180, 280, 380) ist; und/oder
die zweite Elektrode (180, 280, 380) eine Dicke (t3) besitzt, die derart ist, dass eine Lichtdurchlässigkeit der zweiten Elektrode (180, 280, 380) 10 % oder mehr beträgt oder ein Schichtwiderstand der zweiten Elektrode (180, 280, 380) 100 Ω/sq oder weniger beträgt.

7. Verfahren zum Herstellen einer organischen Lichtaussendungsanzeigevorrichtung (100, 200, 300), wobei das Verfahren Folgendes umfasst:

Bilden eines Substrats (101, 201, 301), das einen Pixelbereich (P) und einen Nicht-Pixelbereich (NP) definiert;
Bilden einer ersten Elektrode (170, 270, 370) über dem Substrat (101, 201, 301) in dem Pixelbereich (P);
Bilden einer leitenden Hilfsleitung (150, 250, 350) über dem Substrat (101, 201, 301) in dem Nicht-Pixelbereich (NP), wobei eine Dicke (t1) der leitenden Hilfsleitung (150, 250, 350) größer als eine Dicke der ersten Elektrode (170, 270, 370) ist;
Bilden einer Böschung (173, 273, 373), um die leitende Hilfsleitung (150, 250, 350) zu bedecken;
Bilden einer organischen Aussendungsschicht (175, 275, 375) über der ersten Elektrode (170, 270, 370) in dem Pixelbereich (P) durch eine Öffnung der Böschung (173, 273, 373) in dem Pixelbereich (P); und
Bilden einer zweiten Elektrode (180, 280, 380) über der organischen Aussendungsschicht (175, 275, 375) in dem Pixelbereich (P) und über der Böschung (173, 273, 373) in dem Nicht-Pixelbereich (NP), wobei die zweite Elektrode (180, 280, 380) mit der leitenden Hilfsleitung (150, 250, 350) verbunden ist,
wobei die Böschung (173, 273) Seitenflächen und einen Teil der oberen Fläche der leitenden Hilfsleitung (150, 250) bedeckt.

8. Verfahren nach Anspruch 7, wobei die organische Aussendungsschicht (175, 275, 375) durch einen löslichen Prozess gebildet wird.

9. Verfahren nach einem der Ansprüche 7 bis 8, das ferner Folgendes umfasst:
Bilden eines Kontaktlochs (177, 277) in der Böschung (173, 273) vor dem Bilden der zweiten Elektrode (180, 280), wobei die zweite Elektrode (180, 280) mit der leitenden Hilfsleitung (150, 250) durch das Kontaktloch elektrisch verbunden ist, um einen Widerstand der zweiten Elektrode (180, 280) zu verringern.

10. Verfahren nach einem der Ansprüche 7 bis 9, das ferner Folgendes umfasst:
Bilden einer Hilfselektrode (271, 371) in dem Nicht-Pixelbereich (NP), wobei die Hilfselektrode in derselben Schicht wie die erste Elektrode (270, 370) ist, wobei die Hilfselektrode in dem Nicht-Pixelbereich (NP) und die erste Elektrode (270, 370) gleichzeitig gebildet werden, wobei die leitende Hilfsleitung (250, 350) an die Hilfselektrode elektrisch gekoppelt ist.

11. Verfahren nach Anspruch 10, wobei die Böschung (173, 273, 373) ein hydrophobes Material umfasst und durch einen löslichen Prozess gebildet wird, um einen Raum zwischen der Hilfselektrode und der ersten Elektrode (170, 270, 370) zu füllen, um die Hilfselektrode und die erste Elektrode (170, 270, 370) zu trennen,
wobei eine Seitenfläche der Böschung (273, 373) optional eine gestufte Form (295, 395) besitzt, wobei die Seitenfläche der Böschung (273, 373) an die erste Elektrode (270, 370) zwischen dem Pixelbereich (P) und dem Nicht-Pixelbereich (NP) angrenzt.

12. Verfahren nach einem der Ansprüche 7 bis 11, das ferner Folgendes umfasst:

Bilden eines Dünnschichttransistors (DTr) über dem Substrat (101, 201, 301) vor dem Bilden der ersten Elektrode (170, 270, 370) und der leitenden Hilfsleitung (150, 250, 350); und
Bilden einer Passivierungsschicht (119, 219, 319) über dem Dünnschichttransistor vor dem Bilden der ersten Elektrode (170, 270, 370) und der leitenden Hilfsleitung (150, 250, 350),
wobei sowohl die leitende Hilfsleitung (150, 250, 350) als auch die erste Elektrode (170, 270, 370) über der Passivierungsschicht gebildet werden.

Revendications

1. Dispositif d'affichage électroluminescent organique (100, 200, 300), comprenant :

un substrat (101, 201, 301) définissant une région de pixels (P) et une région non de pixels (NP) ;
une première électrode (170, 270, 370) par-dessus le substrat (101, 201, 301) dans la région de pixels (P);
une couche émettrice organique (175, 275, 375) par-dessus la première électrode (170, 270, 370) dans la région de pixels (P) ;
un bloc (173, 273, 373) par-dessus le substrat (101, 201, 301) dans la région non de pixels (NP) ;
une ligne conductrice auxiliaire (150, 250, 350) couverte par le bloc (173, 273, 373) dans la région non de pixels (NP), une épaisseur (t1) de la ligne conductrice auxiliaire étant supérieure à une épaisseur de la première électrode (170, 270, 370); et
une seconde électrode (180, 280, 380) par-dessus la couche émettrice organique (175, 275, 375) dans la région de pixels (P) et par-dessus le bloc (173, 273, 373) dans la région non de pixels (NP), la seconde électrode (180, 280, 380) étant connectée électriquement à la ligne conductrice auxiliaire (150, 250, 350),
caractérisé en ce que le bloc (173, 273) couvre des surfaces latérales et une partie de la surface supérieure de la ligne conductrice auxiliaire (150, 250).

2. Dispositif d'affichage électroluminescent organique selon la revendication 1, dans lequel au moins :

le bloc (173, 273, 373) entoure la couche émettrice organique (175, 275, 375) de manière à définir la région de pixels (P) ; ou
le bloc (173, 273, 373) comprend un matériau hydrophobe.

3. Dispositif d'affichage électroluminescent organique selon n'importe quelle revendication précédente, dans lequel le bloc (173, 273) comprend un trou de contact (177, 277), la seconde électrode (180, 280) étant connectée électriquement à la ligne conductrice auxiliaire (150, 250) par le biais du trou de contact de manière à réduire une résistance de la seconde électrode (180, 280).

4. Dispositif d'affichage électroluminescent organique selon n'importe quelle revendication précédente, dans lequel au moins :

le dispositif d'affichage électroluminescent organique comprend en outre une électrode auxiliaire (271, 371) dans la région non de pixels (NP), l'électrode auxiliaire se trouvant dans une même couche que la première électrode (270, 370) mais séparée de la première électrode (270, 370) par le bloc (273, 373), l'électrode auxiliaire étant couplée électriquement à la ligne

conductrice auxiliaire (250, 350) ;
le dispositif d'affichage électroluminescent organique comprend en outre un transistor à couches minces (DTr) par-dessus le substrat (101, 201, 301) et une couche de passivation (119, 219, 319) par-dessus le transistor à couches minces, dans lequel la ligne conductrice auxiliaire (150, 250, 350) et la première électrode (170, 270, 370) sont toutes les deux formées par-dessus la couche de passivation ; ou
une surface latérale du bloc (273, 373) a une forme en gradins (295, 395), la surface latérale du bloc (273, 373) se joignant à la première électrode (270, 370) entre la région de pixels (P) et la région non de pixels (NP).

5. Dispositif d'affichage électroluminescent organique selon n'importe quelle revendication précédente, dans lequel au moins :

l'épaisseur (t1) de la ligne conductrice auxiliaire (150, 250, 350) est supérieure à une somme d'épaisseurs de la première électrode (170, 270, 370), de la couche émettrice organique (175, 275, 375) et de la seconde électrode (180, 280, 380) ; ou
une épaisseur (t2) d'une partie du bloc (173, 273, 373) mesurée entre une surface supérieure de la partie du bloc (173, 273, 373) et une surface supérieure de la ligne conductrice auxiliaire (150, 250, 350) est inférieure à une épaisseur (t1) de la ligne conductrice auxiliaire (150, 250, 350) mesurée entre une surface supérieure du substrat (101, 201, 301) et la surface supérieure de la ligne conductrice auxiliaire (150, 250, 350) .

6. Dispositif d'affichage électroluminescent organique selon n'importe quelle revendication précédente, dans lequel au moins :

la ligne conductrice auxiliaire (150, 250, 350) a une résistance de couche inférieure à une résistance de couche de la seconde électrode (180, 280, 380) ; ou
la seconde électrode (180, 280, 380) a une épaisseur (t3) telle qu'une transmittance de lumière de la seconde électrode (180, 280, 380) est 10 % ou plus ou une résistance de couche de la seconde électrode (180, 280, 380) est 100 Ω/carré ou moins.

7. Procédé de fabrication d'un dispositif d'affichage électroluminescent organique (100, 200, 300), le dispositif comprenant :

la formation d'un substrat (101, 201, 301) définissant une région de pixels (P) et une région non de pixels (NP) ;
la formation d'une première électrode (170, 270, 370) par-dessus le substrat (101, 201, 301) dans la région de pixels (P);
la formation d'une ligne conductrice auxiliaire (150, 250, 350) par-dessus le substrat (101, 201, 301) dans la région non de pixels (NP), une épaisseur (t1) de la ligne conductrice auxiliaire (150, 250, 350) étant supérieure à une épaisseur de la première électrode (170, 270, 370) ;
la formation d'un bloc (173, 273, 373) pour couvrir la ligne conductrice auxiliaire (150, 250, 350) ;
la formation d'une couche émettrice organique (175, 275, 375) par-dessus la première électrode (170, 270, 370) dans la région de pixels (P) à travers une ouverture du bloc (173, 273, 373) dans la région de pixels (P) ; et
la formation d'une seconde électrode (180, 280, 380) par-dessus la couche émettrice organique (175, 275, 375) dans la région de pixels (P) et par-dessus le bloc (173, 273, 373) dans la région non de pixels (NP), la seconde électrode (180, 280, 380) étant connectée à la ligne conductrice auxiliaire (150, 250, 350),
dans lequel le bloc (173, 273) couvre des surfaces latérales et une partie de la surface supérieure de la ligne conductrice auxiliaire (150, 250).

8. Procédé selon la revendication 7, dans lequel la couche émettrice organique (175, 275, 375) est formée par un processus soluble.

9. Procédé selon l'une quelconque des revendications 7 à 8, comprenant en outre :
la formation d'un trou de contact (177, 277) dans le bloc (173, 273) avant la formation de la seconde électrode (180, 280), dans lequel la seconde électrode (180, 280) est connectée électriquement à la ligne conductrice auxiliaire (150, 250) à travers le trou de contact de manière à réduire une résistance de la seconde électrode (180, 280).

10. Procédé selon l'une quelconque des revendications 7 à 9, comprenant en outre :
la formation d'une électrode auxiliaire (271, 371) dans la région non de pixels (NP), l'électrode auxiliaire se trouvant dans une même couche que la première électrode (270, 370), l'électrode auxiliaire dans la région non de pixels (NP) et la première électrode (270, 370) étant formées simultanément, dans lequel la ligne conductrice auxiliaire (250, 350) est couplée électriquement à l'électrode auxiliaire.

11. Procédé selon la revendication 10, dans lequel le bloc (173, 273, 373) comprend un matériau hydrophobe et est formé par un processus soluble pour

remplir un espace entre l'électrode auxiliaire et la première électrode (170, 270, 370) pour séparer l'électrode auxiliaire et la première électrode (170, 270, 370),
facultativement dans lequel une surface latérale du bloc (273, 373) a une forme en gradins (295, 395), la surface latérale du bloc (273, 373) joignant la première électrode (270, 370) entre la région de pixels (P) et la région non de pixels (NP).

12. Procédé selon l'une quelconque des revendications 7 à 11, comprenant en outre :

la formation d'un transistor à couches minces (DTr) par-dessus le substrat (101, 201, 301) avant la formation de la première électrode (170, 270, 370) et de la ligne conductrice auxiliaire (150, 250, 350) ; et
la formation d'une couche de passivation (119, 219, 319) par-dessus le transistor à couches minces avant la formation de la première électrode (170, 270, 370) et de la ligne conductrice auxiliaire (150, 250, 350),
dans lequel la ligne conductrice auxiliaire (150, 250, 350) et la première électrode (170, 270, 370) sont toutes les deux formées par-dessus la couche de passivation.

FIG. 1
Related Art

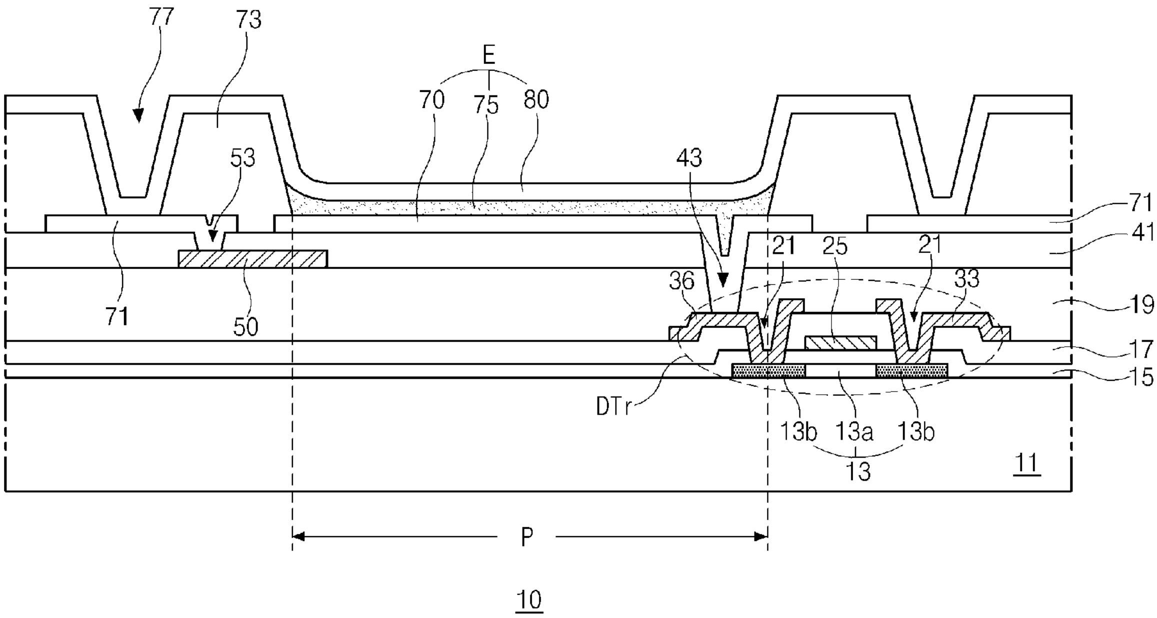


FIG. 2

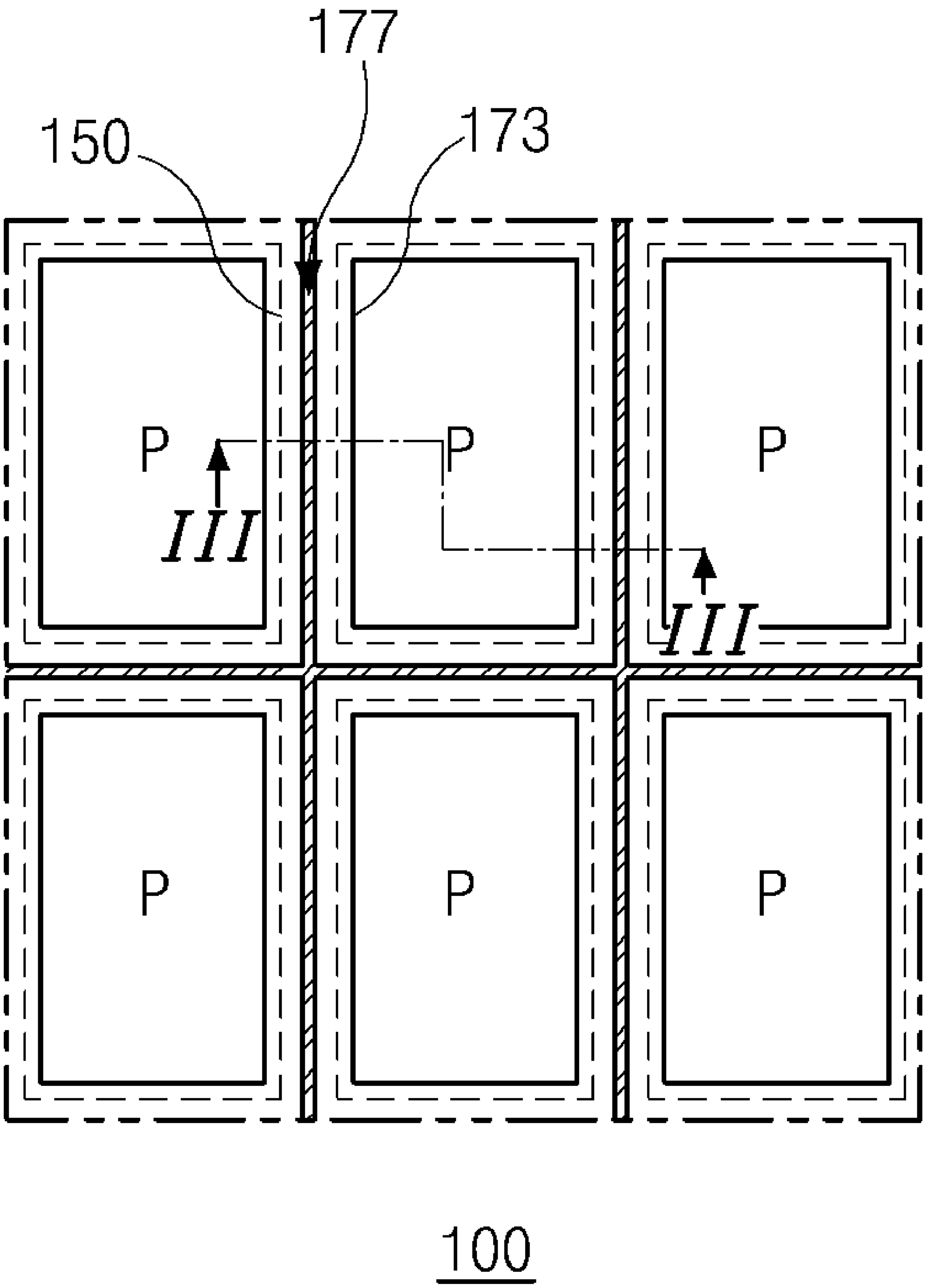
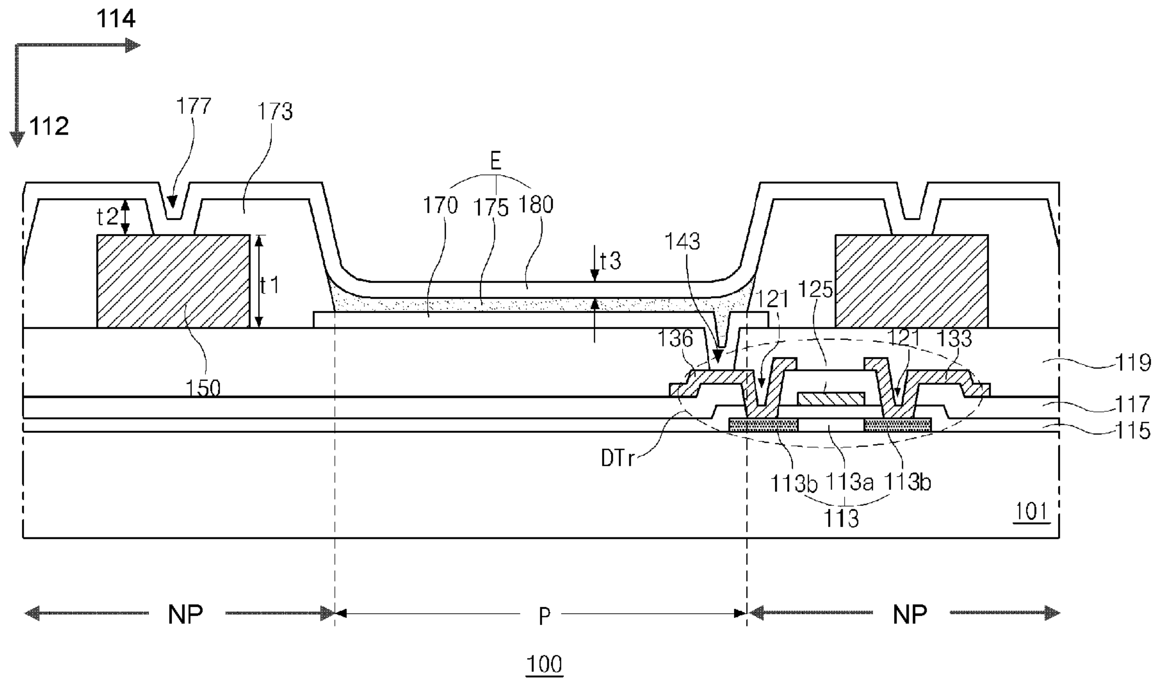


FIG. 3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E
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NP
P
NP
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FIG. 4A

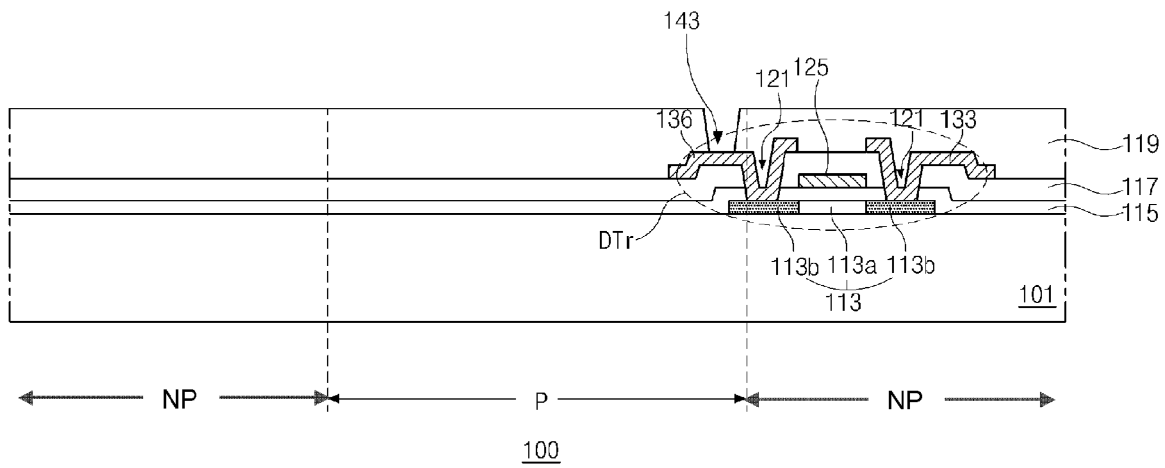
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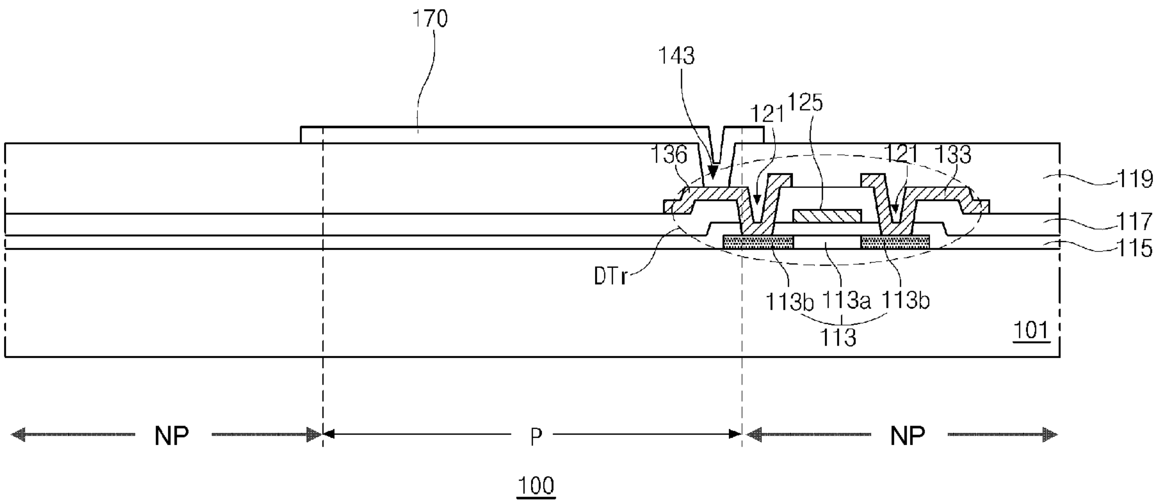
FIG. 4B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P
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100

FIG. 4C

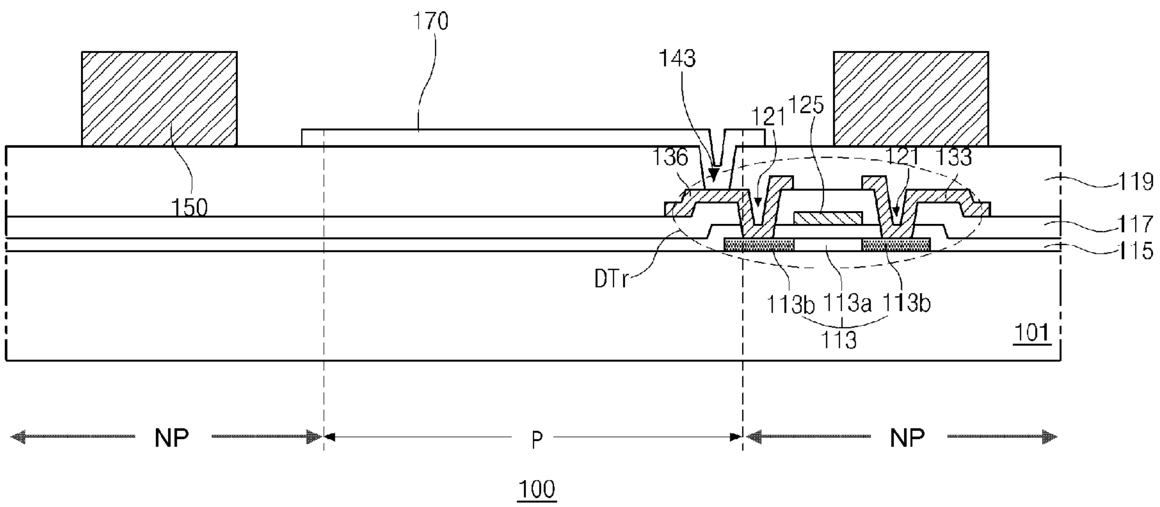
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FIG. 4D

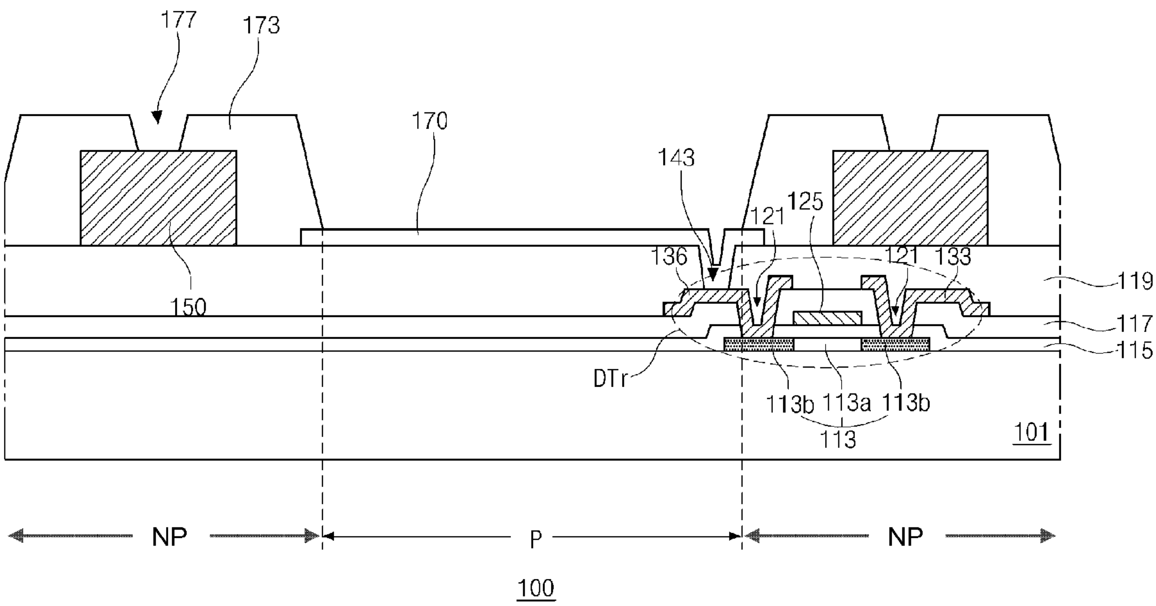
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FIG. 4E

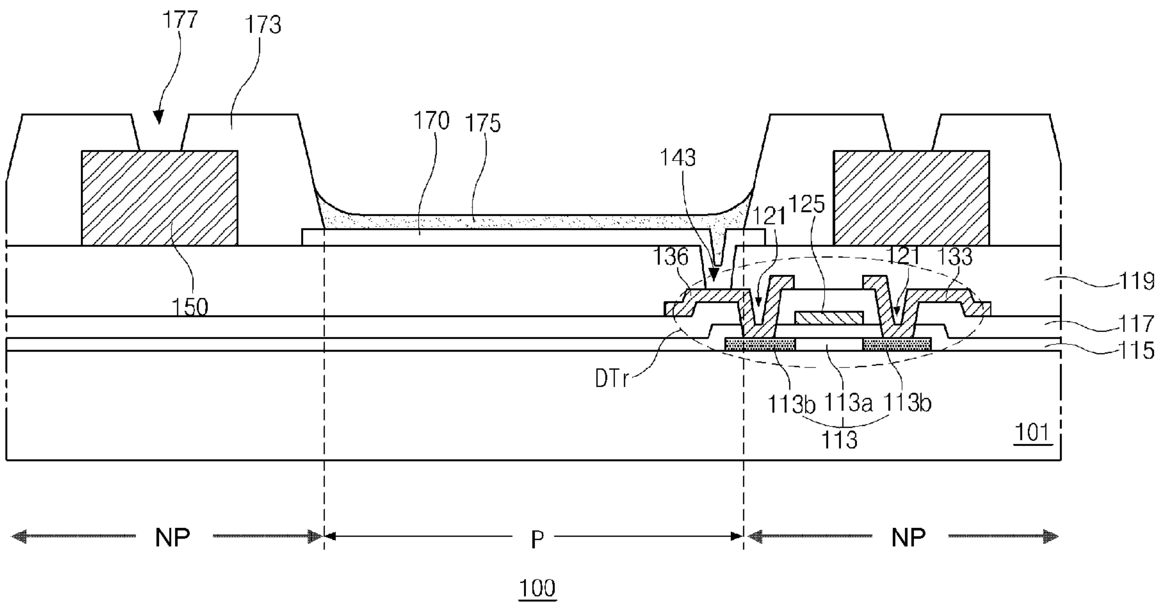
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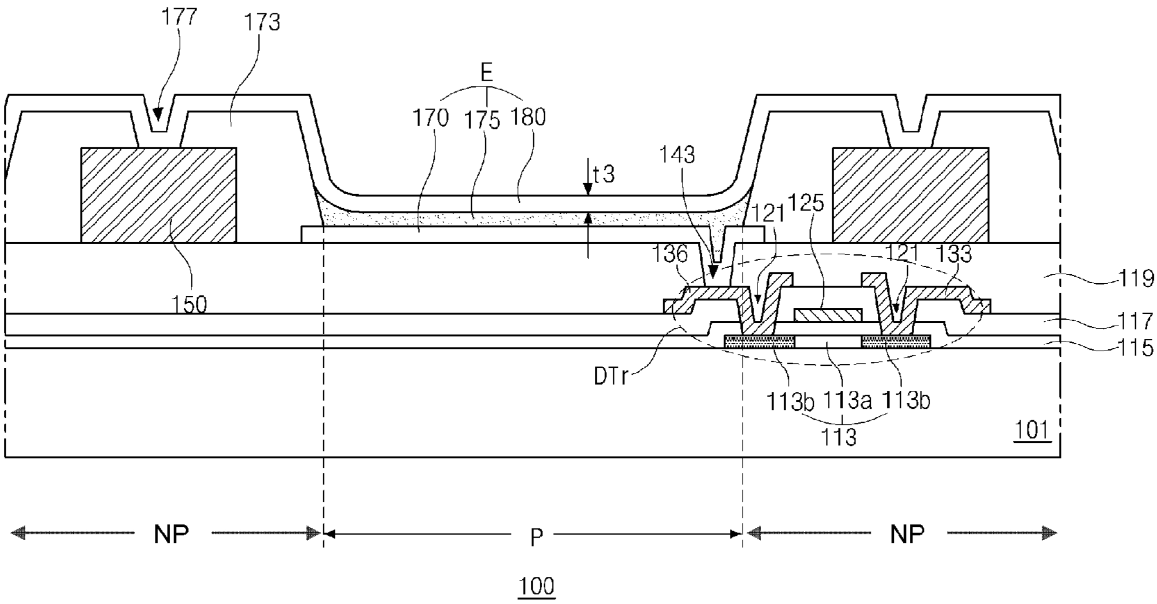
FIG. 4F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101
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100

FIG. 5

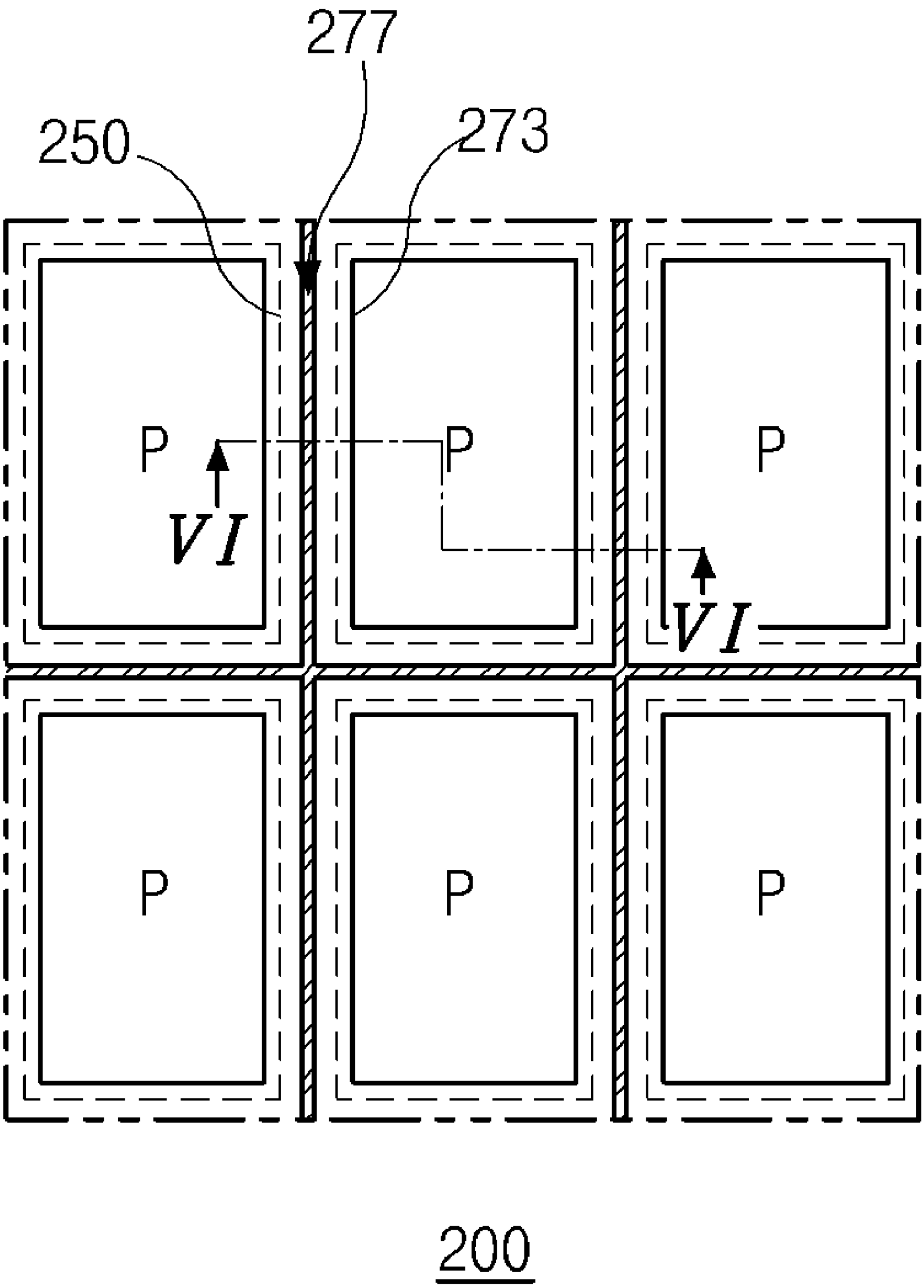
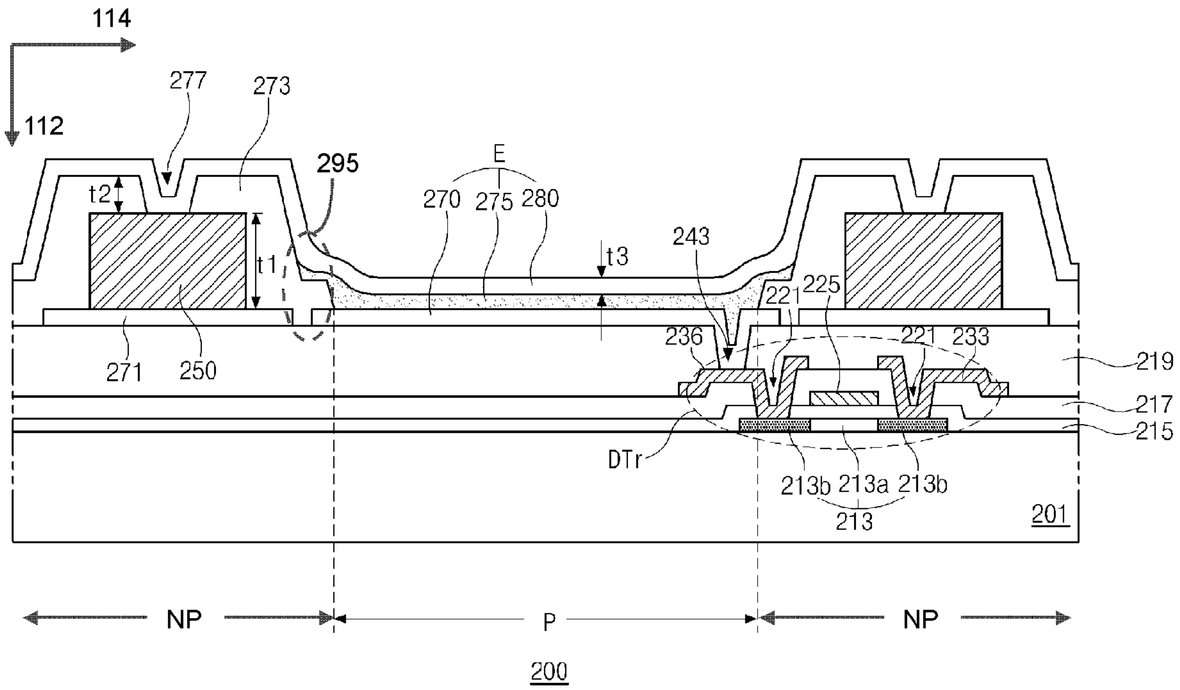


FIG. 6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225
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213b
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NP
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FIG. 7A

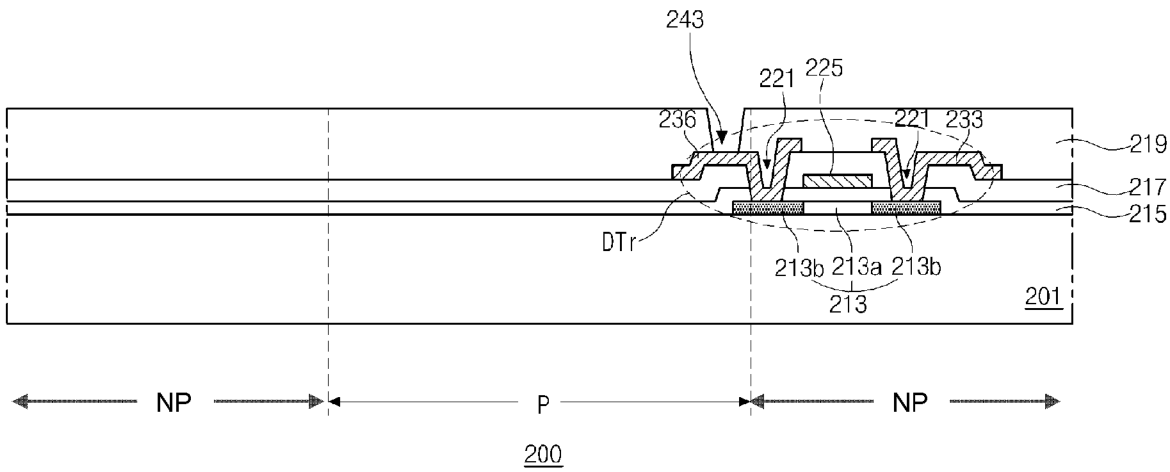
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FIG. 7B

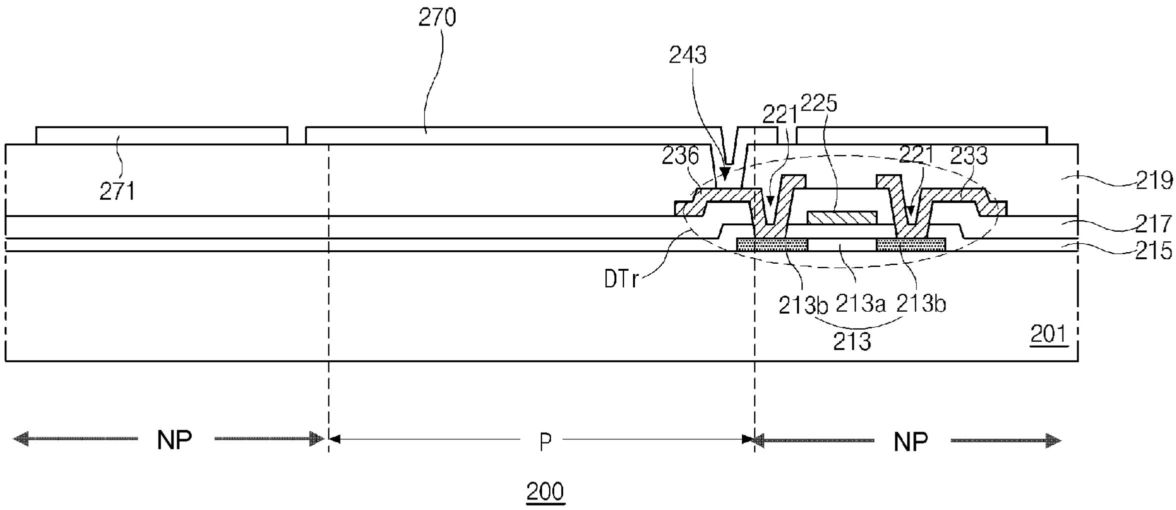
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FIG. 7C

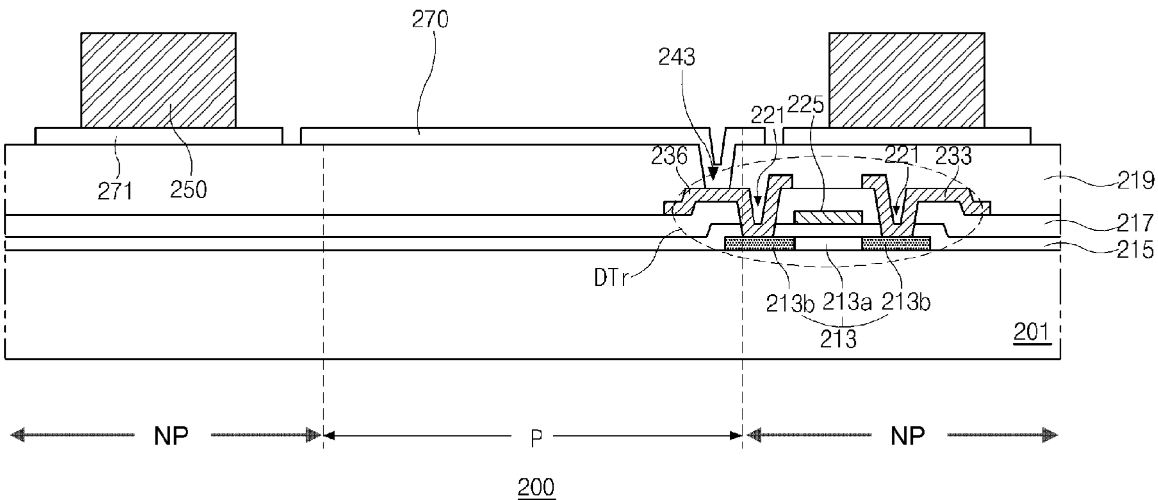
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FIG. 7D

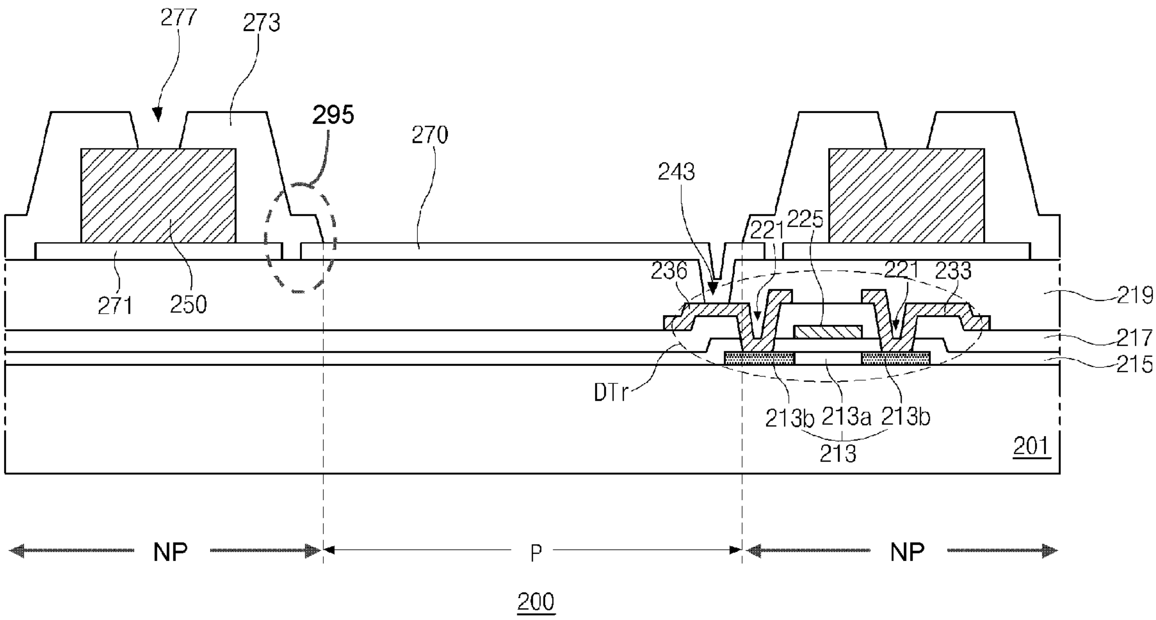
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FIG. 7E

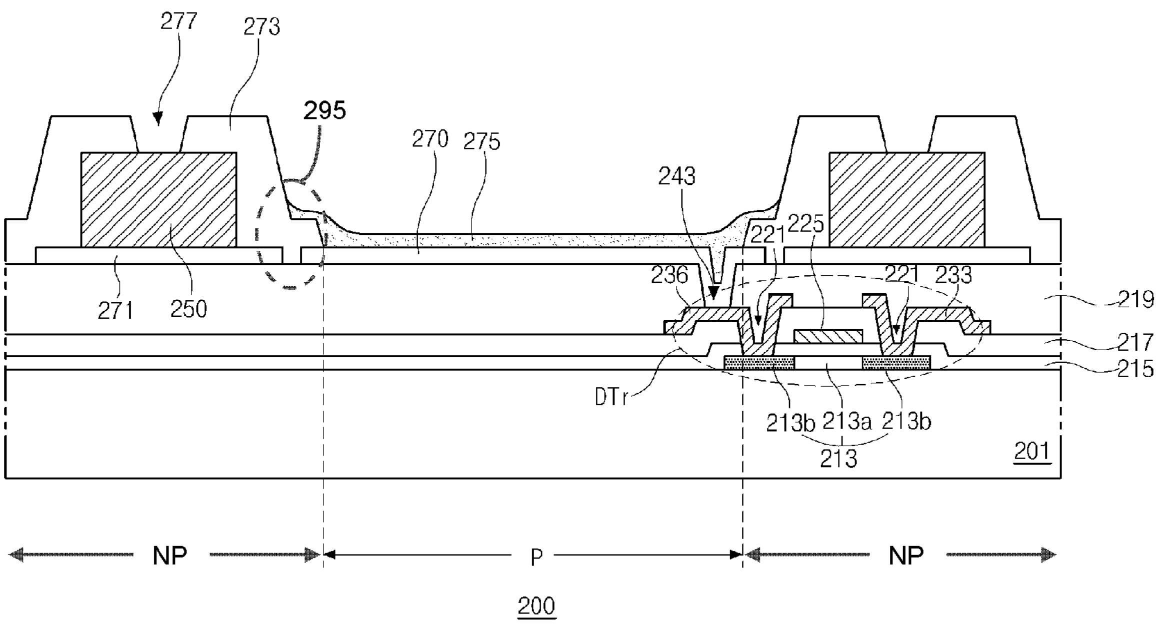
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FIG. 7F

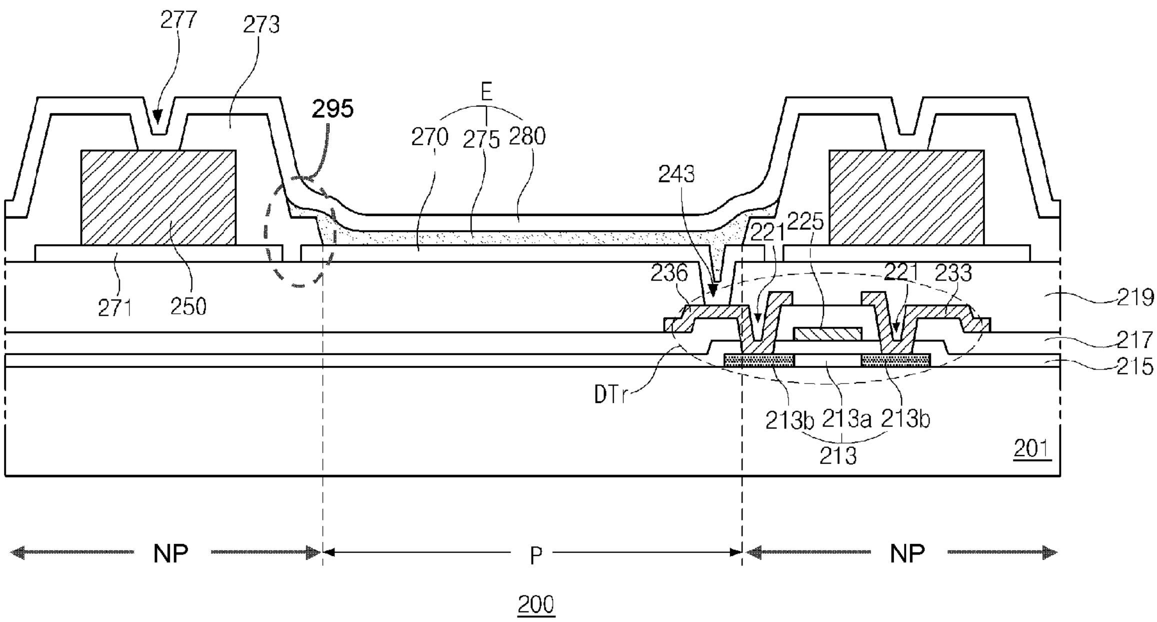
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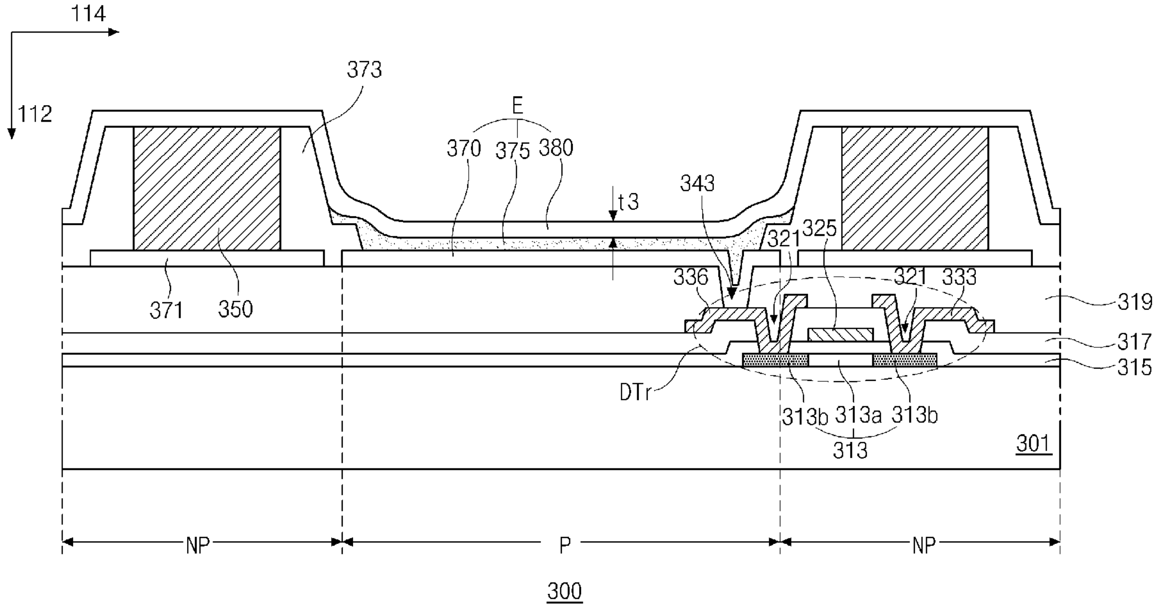
FIG. 8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DTr
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NP
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300

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- US 20100309101 A **[0030]**
- US 20050253508 A **[0031]**
- US 20090215350 A **[0032]**

专利名称(译)	有机发光显示装置		
公开(公告)号	[EP3113230B1](#)	公开(公告)日	2020-01-01
申请号	EP2016177110	申请日	2016-06-30
[标]申请(专利权)人(译)	乐金显示有限公司		
申请(专利权)人(译)	LG DISPLAY CO.，LTD.		
当前申请(专利权)人(译)	LG DISPLAY CO.，LTD.		
[标]发明人	YEO JONG HOON PAEK SEUNG HAN BAE HYO DAE OH YOUNG MU LEE JEONG WON SONG HEON IL		
发明人	YEO, JONG-HOON PAEK, SEUNG-HAN BAE, HYO-DAE OH, YOUNG-MU LEE, JEONG-WON SONG, HEON-IL		
IPC分类号	H01L27/32 H01L51/52		
CPC分类号	H01L27/3276 H01L2227/323 H01L27/3246 H01L27/3279 H01L51/5228 H01L2251/558 H01L27/124 H01L27/1259 H01L27/3262 H01L51/5237 H01L51/56		
优先权	1020150093272 2015-06-30 KR		
其他公开文献	EP3113230A1		
外部链接	[Espacenet](#)		

摘要(译)

一种有机发光显示装置，包括：基板，其包括像素区域和非像素区域；以及设置在基板上的像素。 在像素区域中的衬底上方的第一电极； 在像素区域中的第一电极上方的有机发光层； 在非像素区域中衬底上方的堤； 在非像素区域中被堤覆盖的辅助导线的厚度大于第一电极的厚度。第二电极在像素区域中的有机发射层上和非像素区域中的堤上，第二电极电连接到辅助导线。

FIG. 1
Related Art