



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
10.05.2017 Bulletin 2017/19

(51) Int Cl.:
H01L 51/00^(2006.01) H01L 27/32^(2006.01)

(21) Application number: **16184355.2**

(22) Date of filing: **16.08.2016**

(84) Designated Contracting States:
AL 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 RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

- **BAE, Hyo-Dae**
41420 Daegu (KR)
- **OH, Young-Mu**
04917 Seoul (KR)
- **LEE, Jeong-Won**
10382 Gyeonggi-do (KR)
- **SONG, Heon-Il**
10907 Gyeonggi-do (KR)
- **YEO, Jong-Hoon**
405-231 Incheon (KR)

(30) Priority: **03.11.2015 KR 20150154133**

(71) Applicant: **LG Display Co., Ltd.**
Yeongdeungpo-gu
Seoul
150-721 (KR)

(74) Representative: **Morrall, Jonathan Ian McLachlan et al**
Kilburn & Strode LLP
20 Red Lion Street
London WC1R 4PJ (GB)

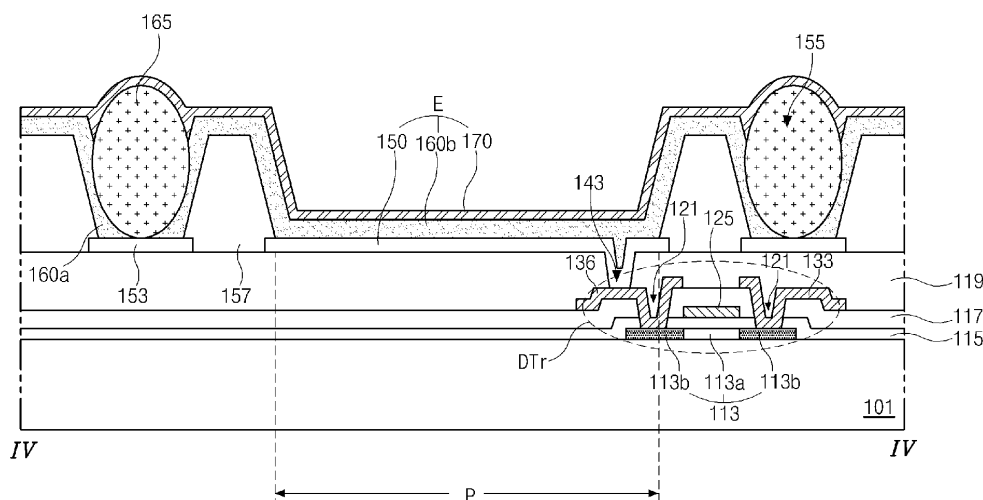
(72) Inventors:
• **PAEK, Seung-Han**
14541 Gyeonggi-do (KR)

(54) **ORGANIC LIGHT EMITTING DISPLAY DEVICE AND METHOD OF FABRICATING THE SAME**

(57) An organic light emitting display device includes a substrate including a pixel region; a first electrode over the substrate and in the pixel region; an auxiliary electrode over the substrate, the auxiliary electrode spaced apart from the first electrode and at a boundary of the pixel region; a second electrode over the first electrode and the auxiliary electrode; an organic layer disposed

between each of the first electrode and the auxiliary electrode, and the second electrode and the auxiliary electrode; and a conductive member comprising a conductive droplet between the auxiliary electrode and the second electrode and electrically connecting the second electrode to the auxiliary electrode.

FIG. 4



Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority from Korean Patent Application No. 10-2015-0154133, filed in Korea on November 3, 2015.

BACKGROUND

1. FIELD

[0002] The present disclosure relates to an organic light emitting display (OLED) device, and more particularly, to an OLED being capable of preventing a brightness un-uniformity problem.

2. DISCUSSION OF RELATED ART

[0003] 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.

[0004] Among these flat panel display devices, since the OLED device as a self-emission type display device does not require a backlight unit, the OLED device may have advantages of light weight and thin profile.

[0005] 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.

[0006] 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.

[0007] 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.

[0008] 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.

[0009] However, when the thickness of the second electrode is lowered, the resistance of the second electrode is increased such that a voltage drop problem in the second electrode is generated. Namely, a brightness un-uniformity problem in the OLED device is generated.

[0010] Particularly, the above brightness un-uniformity problem is serious in a large-size OLED device.

[0011] To prevent the above brightness un-uniformity problem, an auxiliary line, which is connected to the sec-

ond electrode, may be formed to reduce the resistance of the second electrode.

[0012] FIG. 1 is a schematic plane view of the related art OLED device, and FIG. 2 is a schematic cross-sectional view taken along the line II-II in FIG. 1.

[0013] Referring to FIG. 1, the related art OLED device includes a substrate 11, which includes a plurality of pixel regions P, a first electrode 50 disposed on or over the substrate 11 and in each pixel region P, an auxiliary electrode 53 disposed at a boundary of the pixel region P and a bank 57 disposed at the boundary of the pixel region P. The auxiliary electrode 53 is spaced apart from the first electrode 50. The bank 57 covers the auxiliary electrode 53 and edges of the first electrode 50 and includes an auxiliary contact hole 55 exposing a portion of the auxiliary electrode 53.

[0014] The auxiliary electrode 53 and the auxiliary contact hole 55 have substantially the same width as the first electrode 50 and are separately arranged at each pixel region P.

[0015] Referring to FIG. 2, a semiconductor layer 13 including a first region 13a and second regions 13b at both sides of the first region 13a is formed on the substrate 11. The first region 13a is formed of intrinsic polysilicon, and the second region 13b is formed of impurity-doped poly-silicon.

[0016] 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.

[0017] 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.

[0018] 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.

[0019] The semiconductor layer 13, the gate electrode 25, the source electrode 33 and the drain electrode 36 constitute a driving TFT DTr.

[0020] A passivation layer 19, which may provide a flat top surface, is formed on or over the driving TFT DTr and over an entire surface of the substrate 11. A drain contact hole 43 exposing the drain electrode 36 of the driving TFT DTr is formed through the passivation layer 19.

[0021] The first electrode 50, which is connected to the drain electrode 36 through the drain contact hole 43, is formed on the passivation layer 19 and in the pixel region P, and the auxiliary electrode 53, which is spaced apart from the first electrode 50, is formed on the passivation layer 19 and at the boundary of the pixel region P.

[0022] The bank 57, which includes the auxiliary contact hole 55 exposing the auxiliary electrode 53 and cov-

ers edges of the first electrode 50 and the auxiliary electrode 53, is formed a the boundary of the pixel region P.

[0023] The bank 57 has a lattice shape to surround the pixel region P, and an organic emitting layer 60 is formed on the first electrode 50 in the pixel region P. In addition, a second electrode 70 is formed over an entire surface of the substrate 11 including the bank 57 and the organic emitting layer 60. As a result, the second electrode 70 is electrically connected to auxiliary electrode 53 through the auxiliary contact hole 55.

[0024] The first and second electrodes 50 and 70 and the organic emitting layer 60 therebetween constitute an organic emitting diode E.

[0025] Since the auxiliary electrode 53 is electrically connected to the second electrode 70, the sheet resistance of the second electrode 70 is lowered. As a result, the brightness un-uniformity problem can be prevented or minimized.

[0026] On the other hand, the organic emitting layer 60 may include a hole injection layer (HIL), a hole transport layer (HTL), an emitting material layer (EML), an electron transport layer (ETL) and an electron injection layer (EIL) sequentially stacked on the first electrode 50.

[0027] Each of the layers of the organic emitting layer 60 may be formed by a solution process or a deposition process. For example, since some materials for each layer of the organic emitting layer 60 has bad stability for the soluble process, the HIL, the HTL and the EML are formed by the soluble process and the ETL and the EIL are formed by the deposition process.

[0028] In addition, the blue emitting material does not provide the desired property by the soluble process. Accordingly, the blue emitting material pattern may be formed by the deposition process over an entire surface of the substrate 11. Namely, each of the HIL, the HTL, the red emitting material pattern and the green emitting material pattern is formed in each pixel region P by the solution process, while each of the blue emitting material pattern, the ETL and the EIL is formed over an entire surface of the substrate 11.

SUMMARY

[0029] Accordingly, embodiments are directed to an OLED device and a method of fabricating the same that substantially obviate one or more of the above problems due to limitations and disadvantages of the related art.

[0030] There is provided an OLED device including a second electrode having reduced sheet resistance.

[0031] An objective of the claimed subject-matter is to simplify a fabricating process and reduce production cost of an OLED device.

[0032] Additional features and advantages will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice. The objectives and other advantages will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the

appended drawings. Aspects of an invention are defined in the appended independent claims.

[0033] There is provided an organic light emitting display device including a substrate including a pixel region; a first electrode over the substrate and in the pixel region; an auxiliary electrode over the substrate and at a boundary of the pixel region; a second electrode over the first electrode and the auxiliary electrode; a conductive member between the auxiliary electrode and the second electrode and electrically connecting the second electrode to the auxiliary electrode; and an organic layer between each of the first electrode and the auxiliary electrode and the second electrode, wherein the organic layer is opened by the conductive member.

[0034] The organic layer may include a blue emitting layer.

[0035] The organic layer may further include at least one of the red emitting layer and a green emitting layer between the first and second electrodes.

[0036] The auxiliary electrode may extend along a boundary portion of the pixel region.

[0037] The organic light emitting display device may further include a bank disposed on edges of the first electrode and include an auxiliary contact hole exposing the auxiliary electrode.

[0038] The conductive member may be disposed in the auxiliary contact hole and may contact the auxiliary electrode in a portion where the organic layer is opened.

[0039] The conductive member may contact the auxiliary electrode and a side surface of the bank in the auxiliary contact hole.

[0040] There is further provided an organic light emitting display device including a substrate including a pixel region; a first electrode over the substrate and in the pixel region; an auxiliary electrode over the substrate and at a boundary of the pixel region; a bank on edges of the first electrode and including an auxiliary contact hole exposing the auxiliary electrode; an organic material pattern on the bank; an organic emitting layer on the first electrode; a conductive member in the auxiliary contact hole; and a second electrode on the conductive member and the organic layer, wherein the second electrode is electrically connected to the auxiliary electrode via the conductive member.

[0041] The organic material pattern may contact edges of the auxiliary electrode, and the conductive member may contact the center of the auxiliary electrode.

[0042] The conductive member may contact a side surface of the bank in the auxiliary contact hole and an upper surface of the auxiliary electrode.

[0043] The organic material pattern may have a thinner part on the auxiliary electrode, and the conductive member may be disposed on the thinner part of the organic material pattern.

[0044] There is also provided a method of fabricating an organic emitting display device including forming a first electrode and an auxiliary electrode over a substrate including a pixel region, wherein the first electrode is dis-

posed in the pixel region, and the auxiliary electrode is disposed at a boundary of the pixel region; forming a bank on edges of the first electrode and including an auxiliary contact hole exposing the auxiliary electrode; forming an organic material pattern on the bank and an organic emitting layer on the first electrode; forming a conductive member in the auxiliary contact hole and being electrically connected to the auxiliary electrode; and forming a second electrode on the conductive member and the organic layer.

[0045] The step of forming the conductive member may include dropping a metal paste into the auxiliary contact hole such that the organic material pattern in the auxiliary contact hole is dissolved; and drying the metal paste and the dissolved organic material pattern such that the conductive member directly or indirectly contacting the auxiliary electrode is formed.

[0046] The metal paste may include a conductive particle and a binder including a resin, a solvent and additives.

[0047] The step of forming the organic material pattern and the organic emitting layer may include forming a lower layer of the organic emitting layer by a solution process; and forming the organic material pattern and an upper layer of the organic emitting layer by a deposition process.

[0048] 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 claimed subject-matter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0049] The accompanying drawings, which are included to provide a further understanding of the 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 disclosure.

FIG. 1 is a schematic plane view of the related art OLED device.

FIG. 2 is a schematic cross-sectional view taken along the line II-II in FIG. 1.

FIG. 3 is a schematic plane view of an OLED device according to an embodiment.

FIG. 4 is a schematic cross-sectional view taken along the line IV-IV in FIG. 3.

FIGs. 5A to 5F are schematic cross-sectional views illustrating a fabricating process of an OLED device according to an embodiment.

DETAILED DESCRIPTION OF EMBODIMENTS

[0050] Reference will now be made in detail to embodiments, examples of which are illustrated in the accompanying drawings.

[0051] In the related art OLED device, since the blue emitting material pattern, the ETL and the EIL, which are

formed by the deposition process, are formed on or over the auxiliary electrode 53 as well as the first electrode 50. Accordingly, to electrically connect the second electrode 70 to the auxiliary electrode 53 through the auxiliary contact hole 55, the above layers on or over the auxiliary electrode 53 in the auxiliary contact hole 55 should be removed.

[0052] The above layers are removed by irradiating a laser beam onto the layers in the auxiliary contact hole. However, since an expensive laser irradiating apparatus is required, the fabricating process is complicated and the production cost is increased.

[0053] FIG. 3 is a schematic plane view of an OLED device according to an embodiment, and FIG. 4 is a schematic cross-sectional view taken along the line IV-IV in FIG. 3.

[0054] Referring to FIG. 3, an OLED device according to an embodiment includes a substrate 101, which includes a plurality of pixel regions P, a first electrode 150 disposed on or over the substrate 101 and in each pixel region P, an auxiliary electrode 153 disposed at a boundary of the pixel region P and a bank 157 disposed at the boundary of the pixel region P. The auxiliary electrode 153 is spaced apart from the first electrode 150. The bank 157 covers the auxiliary electrode 153 and edges of the first electrode 150 and includes an auxiliary contact hole 55 exposing a portion of the auxiliary electrode 153.

[0055] The auxiliary electrode 153 and the auxiliary contact hole 155 extend along a direction between adjacent pixel regions P.

[0056] Referring to FIG. 4, a semiconductor layer 113 including a first region 113a and second regions 113b at both sides of the first region 113a is formed on the substrate 101. The first region 113a is formed of intrinsic poly-silicon, and the second region 113b is formed of impurity-doped poly-silicon.

[0057] 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.

[0058] 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.

[0059] 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.

[0060] The semiconductor layer 113, the gate electrode 125, the source electrode 133 and the drain electrode 136 constitute a driving TFT DTr.

[0061] A passivation layer 119, which may provide a flat top surface, is formed on or over the driving TFT DTr

and over an entire surface of the substrate 101. A drain contact hole 143 exposing the drain electrode 136 of the driving TFT DTr is formed through the passivation layer 119.

[0062] The first electrode 150, which is connected to the drain electrode 136 through the drain contact hole 143, is formed on the passivation layer 119 and in the pixel region P, and the auxiliary electrode 153, which is spaced apart from the first electrode 150, is formed on the passivation layer 119 and at the boundary of the pixel region P.

[0063] The bank 157, which includes the auxiliary contact hole 155 exposing the auxiliary electrode 153 and covers edges of the first electrode 150 and the auxiliary electrode 153, is formed at the boundary of the pixel region P. The bank 157 has a lattice shape to surround the pixel region P.

[0064] An organic material pattern 160a is disposed on an upper surface of the bank 153 and side surfaces of the bank 153 in the auxiliary contact hole 155 to expose the auxiliary electrode 153, and an organic emitting layer 160b is disposed on the first electrode 150. For example, the organic material pattern 160a may cover side surfaces of the bank 157 in the auxiliary contact hole 155 and may expose at least a portion of the auxiliary electrode 153 in the auxiliary contact hole 155. Alternatively, the organic material pattern 160a may expose an entire surface of the auxiliary electrode 153 in the auxiliary contact hole 155.

[0065] A conductive member 165 contacting the organic material pattern 160a and the exposed portion of the auxiliary electrode 153 is disposed in the auxiliary contact hole 155. For example, the conductive member 165 is a conductive droplet, a conductive ball, or a conductive elongated sphere.

[0066] In addition, a second electrode 170 is disposed over an entire surface of the substrate 101. Namely, the second electrode 170 contacts the organic emitting layer 160b on the first electrode 150 and the conductive member 165 in the auxiliary contact hole 155.

[0067] The first and second electrodes 150 and 170 and the organic emitting layer 160b therebetween constitute an organic emitting diode E.

[0068] The second electrode 170 is electrically connected to the auxiliary electrode 153 via the conductive member 165. As a result, the resistance or sheet resistance of the second electrode 170 is reduced due to the auxiliary electrode 153 such that the brightness non-uniformity problem can be prevented or minimized.

[0069] For example, the organic emitting layer 160b on the first electrode 150 may include an HIL, an HTL, an EML, an ETL and an EIL sequentially stacked on the first electrode 150. Some of the layers of the organic emitting layer 160b may be formed by a solution process, and the rest of the layers of the organic material layer 160b may be formed by a deposition process.

[0070] As mentioned above, because of the stability of the material and the emitting property in the layer formed

by the solution process, each of the HIL, the HTL, the red emitting material pattern and the green emitting material pattern may be formed in each pixel region P by the solution process, while each of the blue emitting material pattern, the ETL and the EIL may be formed over an entire surface of the substrate 101 by the deposition process.

[0071] In this instance, the organic material pattern 160a in the auxiliary contact hole 155 and on the auxiliary electrode 153 includes material patterns formed by the solution process. For example, the organic material pattern 160a may include an electron transport material pattern and an electron injection material pattern. Alternatively, the organic material pattern 160a may include a blue emitting material pattern, an electron transport material pattern and an electron injection material pattern.

[0072] On the other hand, when all layers of the organic emitting layer 160b are formed by the deposition process, the organic material pattern 160a may include similar structure as the organic emitting layer 160b, e.g., a hole injection material pattern, a hole transport material pattern, an electron transport material pattern and an electron injection material pattern.

[0073] Since the material layers, which are deposited, are formed on the auxiliary electrode 153 as well as the first electrode 150, the material layers on the auxiliary electrode 153 should be removed for an electric connection between the second electrode 170 and the auxiliary electrode 153.

[0074] In an embodiment, the organic material pattern 160a on the auxiliary electrode 153 is removed to expose the auxiliary electrode 153, and the conductive member 165 is formed on the exposed portion of the auxiliary electrode 153. In addition, the second electrode 170 is formed on the conductive member 165 such that the second electrode 170 and the auxiliary electrode 153 are electrically connected to each other via the conductive member 165.

[0075] The conductive member 165 may be a conductive droplet, a conductive ball, or a conductive elongated sphere. The conductive member 165 may be formed by dropping and drying a metal paste 163 (of FIG. 5D), which includes a conductive particle, e.g., silver (Ag), aluminum (Al), nickel (Ni) or gold (Au), and a binder, on the organic material pattern 160a in the auxiliary contact hole 155. The binder may include a resin, a solvent and additives.

[0076] In this instance, the materials on the auxiliary electrode 153 are dissolved into the solvent in the metal paste 163 (of FIG. 5D) such that the conductive member 165 contacts the auxiliary electrode 153 in the auxiliary contact hole 155 after the drying step. Accordingly, the organic material pattern 160a is formed on side surfaces of the bank 157 in the auxiliary contact hole 155 and exposes at least a portion of the auxiliary electrode 153 such that the conductive member 165 contacts the auxiliary electrode 153.

[0077] In other words, the organic layer including the organic material pattern 160a and the organic emitting

layer 160b covers an entire surface of the substrate 101 except a position of the conductive member 165. Namely, the organic layer is opened by the conductive member 165.

[0078] Alternatively, the organic material pattern 160a on the auxiliary electrode 153 and the side surface of the bank 157 in the auxiliary contact hole 155 may be completely removed such that the conductive member 165 may contact the side surface of the bank 157 as well as the auxiliary electrode 153.

[0079] On the other hand, the materials on the auxiliary electrode 153 may be partially dissolved by the solvent in the metal paste. In this instance, the organic material pattern 160a may cover edges portions of the auxiliary electrode 153 and only expose a center portion of the auxiliary electrode 153. Alternatively, the organic material pattern 160a may cover an entire surface of the auxiliary electrode 153 in the auxiliary contact hole with smaller thickness. Namely, a portion of the organic material pattern 160a on the auxiliary electrode 153 is thinner than a portion of the organic material pattern 160a on the side surface and/or the upper surface of the bank 153. In this instance, the organic material pattern 160a may have a "U" shape in a cross-sectional view at the auxiliary contact hole 155 having a thin thickness in a lower portion. Even when the auxiliary electrode 153 partially contacts the conductive member 165 or indirectly contacts the conductive member 165 with the thinner part of the organic material pattern 160a, the electrical connection between the second electrode 170 and the auxiliary electrode 153 via the conductive member 165 can be secured.

[0080] Namely, an end of the conductive member 165 is electrically connected to the auxiliary electrode 153 and the other end of the conductive member 165 is electrically connected to the second electrode 170 such that the second electrode 170 is electrically connected to the auxiliary electrode 153.

[0081] In the OLED device of the present disclosure, since the organic materials on the auxiliary electrode 153 in the auxiliary contact hole 155 are removed without the expensive laser irradiating apparatus, the fabricating process is simplified and the production cost is reduced. In addition, since the second electrode 170 is electrically connected to the auxiliary electrode 153 via the conductive member 165, the sheet resistance of the second electrode 170 is decreased. Moreover, since the step difference of the second electrode 170 in the auxiliary contact hole 155 is decreased due to the conductive member 165, the disconnection problem of the second electrode 170 in the step of the auxiliary contact hole is prevented. The conductive member 165 may fill the auxiliary contact hole 155 to provide a flat top surface with an upper surface of the organic material pattern 160a on the bank 157. In this instance, the second electrode 170 may have a flat top surface over the bank 157 and the auxiliary electrode 153.

[0082] The auxiliary electrode 153 and the auxiliary

contact hole 155 extend along a direction at the boundary of adjacent pixel regions P. As a result, the auxiliary contact hole 155 may be referred to as a groove.

[0083] In FIG. 3, the auxiliary electrode 153 and the auxiliary contact hole 155 horizontally extend. Alternatively, the auxiliary electrode 153 and the auxiliary contact hole 155 may extend in a vertical direction. Alternatively, the auxiliary electrode 153 and the auxiliary contact hole 155 may extend in a horizontal direction and a vertical direction such that the auxiliary electrode 153 and the auxiliary contact hole 155 may have a lattice shape.

[0084] Since the auxiliary electrode 153 and the auxiliary contact hole 155 extend along at least one of the horizontal and vertical directions, an area for dropping the metal paste is increased. Accordingly, a size margin of the conductive particle of the conductive member 165 and an aligning margin of the dropping process of the metal paste are increased such that the electrical connection between the second electrode 170 and the auxiliary electrode 153 is secured.

[0085] FIGs. 5A to 5F are schematic cross-sectional views illustrating a fabricating process of an OLED device according to an embodiment.

[0086] A method of fabricating the OLED device according to the present disclosure includes a step of forming a first electrode 150 and an auxiliary electrode 153, a step of forming a bank 153 including an auxiliary electrode 153, a step of forming an organic material pattern 160a and an organic emitting layer 160b, a step of removing a portion of the organic material pattern 160a and forming a conductive member 165 and a step of forming a second electrode 170.

[0087] As shown in FIG. 5A, the first electrode 150 and the auxiliary electrode 153 are formed over the substrate 101, where elements, e.g., the driving TFT DTr, the passivation layer 119, and so on are formed. The first electrode 150 is disposed in the pixel region P and is electrically connected to the drain electrode 136 of the driving TFT DTr through the drain contact hole 143. The auxiliary electrode 153 is disposed at the boundary of the pixel region P and is spaced apart from the first electrode 150. Each of the first electrode 150 and the auxiliary electrode 153 may be formed of the same material. For example, each of the first electrode 150 and the auxiliary electrode 153 may be formed of a transparent conductive material, e.g., indium-tin-oxide (ITO) and indium-zinc-oxide (IZO).

[0088] Next, as shown in FIG. 5B, an insulating material layer (not shown) is formed and patterned to form the bank 157. The bank 157 includes the auxiliary contact hole 155 and an opening. The auxiliary electrode 153 is exposed through the auxiliary contact hole 155, and the first electrode 150 is exposed through the opening. Namely, the bank 157 covers edges of the auxiliary electrode 153 and the first electrode 150.

[0089] Next, as shown in FIG. 5C, the organic material pattern 160a and the organic emitting layer 160b are formed over the substrate 101 including the bank 153.

The organic material pattern 160a is formed on the auxiliary electrode 153 in the auxiliary contact hole 155 and the upper and side surfaces of the bank 153. The organic emitting layer 160b is formed on the first electrode 150.

[0090] As mentioned above, the organic emitting layer 160b may include the HIL, the HTL, the EML, the ETL and the EIL sequentially stacked on the first electrode 150. Some of the layers of the organic emitting layer 160b may be formed of the deposition process, or all of the layers of the organic emitting layer 160a may be formed of the deposition process.

[0091] Because of the stability of the material and the emitting property in the layer formed by the solution process, each of the HIL, the HTL, the red emitting material pattern and the green emitting material pattern may be formed in each pixel region P by the solution process, while each of the blue emitting material pattern, the ETL and the EIL may be formed over an entire surface of the substrate 101 by the deposition process. This process may be referred to as a solution fabricating process.

[0092] In the solution fabricating process, the layers by the deposition process are formed in the boundary of the pixel region P as well as the center of the pixel region P. Namely, the organic material pattern 160a may have a double-layered structure of an electron transport material pattern and an electron injection material pattern or a triple-layered structure of a blue emitting material pattern, the electron transport material pattern and the electron injection material pattern. Alternatively, in the deposition fabricating process, the organic material pattern 160a may have a structure of a hole injection material pattern, a hole transport material pattern, the electron transport material pattern and the electron injection material pattern.

[0093] Next, as shown in FIG. 5D, a metal paste 163 is dropped into the auxiliary contact hole 155 using a dispenser 180 such that the organic material pattern 160a on the auxiliary electrode 153 is dissolved. In this instance, the organic material pattern 160a on the auxiliary electrode 153 may be completely or partially dissolved. In addition, the organic material pattern 160a on the side surface of the bank 157 in the auxiliary contact hole 155 may be dissolved.

[0094] The metal paste 163 and the dissolved organic material of the organic material pattern 160a are dried such that the conductive member 165 is formed in the auxiliary contact hole 155 as shown in FIG. 5E.

[0095] In FIG. 5E, an end of the conductive member 165 contacts a center of the auxiliary electrode 153. Alternatively, the conductive member 165 may contact an entire upper surface of the auxiliary electrode 153 in the auxiliary contact hole 155. In addition, the conductive member 165 may indirectly contact the auxiliary electrode 153 with a thin organic material pattern 160a therebetween. Moreover, the conductive member 165 may contact the side surface of the bank 157 in the auxiliary contact hole 155.

[0096] The conductive member 165 may be a conduc-

tive droplet, a conductive ball, or a conductive elongated sphere. The conductive member 165 may be formed by dropping and drying a metal paste 163, which includes a conductive particle, e.g., silver (Ag), aluminum (Al), nickel (Ni) or gold (Au), and a binder, on the organic material pattern 160a in the auxiliary contact hole 155. The binder may include a resin, a solvent and additives.

[0097] The materials on the auxiliary electrode 153 are dissolved into the solvent in the metal paste 163 and the materials and the solvent are removed by the drying step such that the conductive member 165 contacts the auxiliary electrode 153 in the auxiliary contact hole 155 after the drying step. Accordingly, the organic material pattern 160a is formed on side surfaces of the bank 157 in the auxiliary contact hole 155 and exposes at least a portion of the auxiliary electrode 153 such that the conductive member 165 contacts the auxiliary electrode 153.

[0098] Next, as shown in FIG. 5F, the second electrode 170 is formed on the organic emitting layer 160b, the conductive member 165 and the organic material pattern 160a on an upper surface of the bank 157. The second electrode 170 is formed over an entire surface of the substrate 101, and the first and second electrodes 150 and 170 and the organic emitting layer 160b constitute the organic emitting diode E.

[0099] The second electrode 170 contacts the conductive member 165 such that the second electrode 170 and the auxiliary electrode 153 are electrically connected to each other via the conductive member 165.

[0100] In the OLED device of the present disclosure, since the organic materials on the auxiliary electrode 153 in the auxiliary contact hole 155 are removed without the expensive laser irradiating apparatus, the fabricating process is simplified and the production cost is reduced. In addition, since the second electrode 170 is electrically connected to the auxiliary electrode 153 via the conductive member 165, the sheet resistance of the second electrode 170 is decreased. Moreover, since the step difference of the second electrode 170 in the auxiliary contact hole 155 is decreased due to the conductive member 165, the disconnection problem of the second electrode 170 in the step of the auxiliary contact hole is prevented.

[0101] It will be apparent to those skilled in the art that various modifications and variations can be made to the embodiments without departing from the scope of the appended claims. Thus, it is intended that the embodiments are not limiting and modifications and variations are covered provided they come within the scope of the appended claims and their equivalents.

Claims

1. An organic light emitting display device, comprising:
 - a substrate including a pixel region;
 - a first electrode over the substrate and in the pixel region;

- an auxiliary electrode over the substrate, the auxiliary electrode spaced apart from the first electrode and at a boundary of the pixel region; a second electrode over the first electrode and the auxiliary electrode;
- an organic layer disposed between each of the first electrode and the auxiliary electrode, and the second electrode and the auxiliary electrode; and
- a conductive member comprising a conductive droplet between the auxiliary electrode and the second electrode and electrically connecting the second electrode to the auxiliary electrode.
2. The organic light emitting display device according to claim 1, wherein the organic layer includes a blue light emitting layer.
 3. The organic light emitting display device according to claim 1 or 2, wherein the organic layer further includes at least one of a red light emitting layer and a green light emitting layer between the first and second electrodes.
 4. The organic light emitting display device according to any preceding claim, wherein the auxiliary electrode extends along a boundary portion of the pixel region.
 5. The organic light emitting display device according to any preceding claim, further comprising a bank over an edge of the first electrode, wherein the bank comprises an auxiliary contact hole exposing the auxiliary electrode.
 6. The organic light emitting display device according to claim 5, wherein the conductive member is disposed in the auxiliary contact hole and contacts the auxiliary electrode through an opening in the organic layer.
 7. The organic light emitting display device according to claim 5, wherein the conductive member contacts the auxiliary electrode and a side surface of the bank in the auxiliary contact hole.
 8. The organic light emitting display device according to any of claims 5-7, wherein the organic layer comprises:
 - an organic material pattern portion over the bank; and
 - an organic emitting layer portion over the first electrode.
 9. The organic light emitting display device according to claim 8, wherein the organic material pattern portion contacts edges of the auxiliary electrode, and the conductive member contacts a center of the auxiliary electrode.
 10. The organic light emitting display device according to claim 8, wherein the organic material pattern portion has a thinner portion over the auxiliary electrode, and the conductive member is over the thinner portion.
 11. A method of fabricating an organic emitting display device, comprising the steps of:
 - forming a first electrode and an auxiliary electrode over a substrate including a pixel region, wherein the first electrode is disposed in the pixel region, and the auxiliary electrode is spaced apart from the first electrode and disposed at a boundary of the pixel region;
 - forming an organic layer over the first electrode and auxiliary electrode;
 - forming a conductive member comprising a conductive droplet over the organic layer at a position of the auxiliary electrode; and
 - forming a second electrode over the organic layer and conductive member.
 12. The method of fabricating an organic emitting display device according to claim 11, further comprising the step of forming a bank over edges of the first electrode and including an auxiliary contact hole exposing the auxiliary electrode before the step of forming an organic layer over the first electrode and auxiliary electrode, wherein the step of forming an organic layer over the first electrode and auxiliary electrode comprises forming an organic material pattern portion over the bank and an organic emitting layer portion over the first electrode, and wherein the step of forming a conductive member over the organic layer at a position of the auxiliary electrode comprises forming a conductive member in the auxiliary contact hole such that it is electrically connected to the auxiliary electrode.
 13. The method according to claim 12, wherein the step of forming the conductive member comprises:
 - dropping a metal paste into the auxiliary contact hole such that the organic material pattern portion in the auxiliary contact hole is dissolved; and
 - drying the metal paste and the dissolved organic material pattern portion such that the conductive member directly or indirectly contacts the auxiliary electrode.
 14. The method according to claim 13, wherein the metal paste comprises a conductive particle and a binder comprising a resin, a solvent and an additive.

15. The method according to claim 13 or 14, wherein the step of forming the organic material pattern portion and the organic emitting layer portion comprises:

forming a lower layer of the organic emitting layer portion by a solution process; and
forming the organic material pattern portion and an upper layer of the organic emitting layer portion by a deposition process.

10

15

20

25

30

35

40

45

50

55

FIG. 1
Related Art

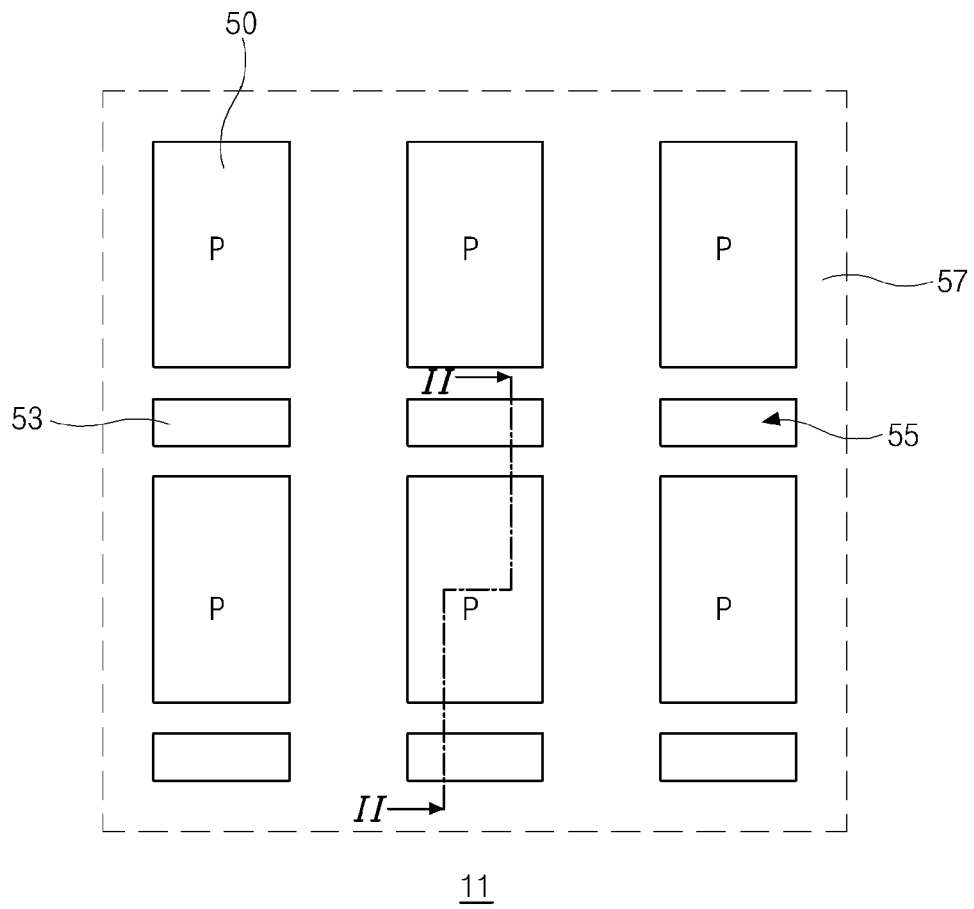


FIG. 2
Related Art

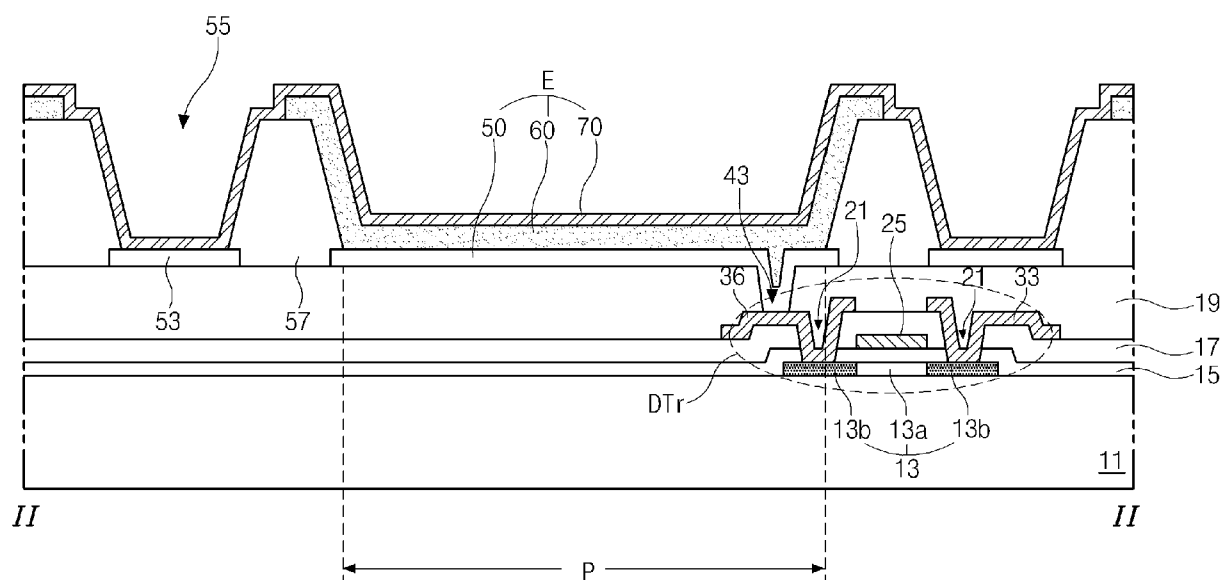


FIG. 3

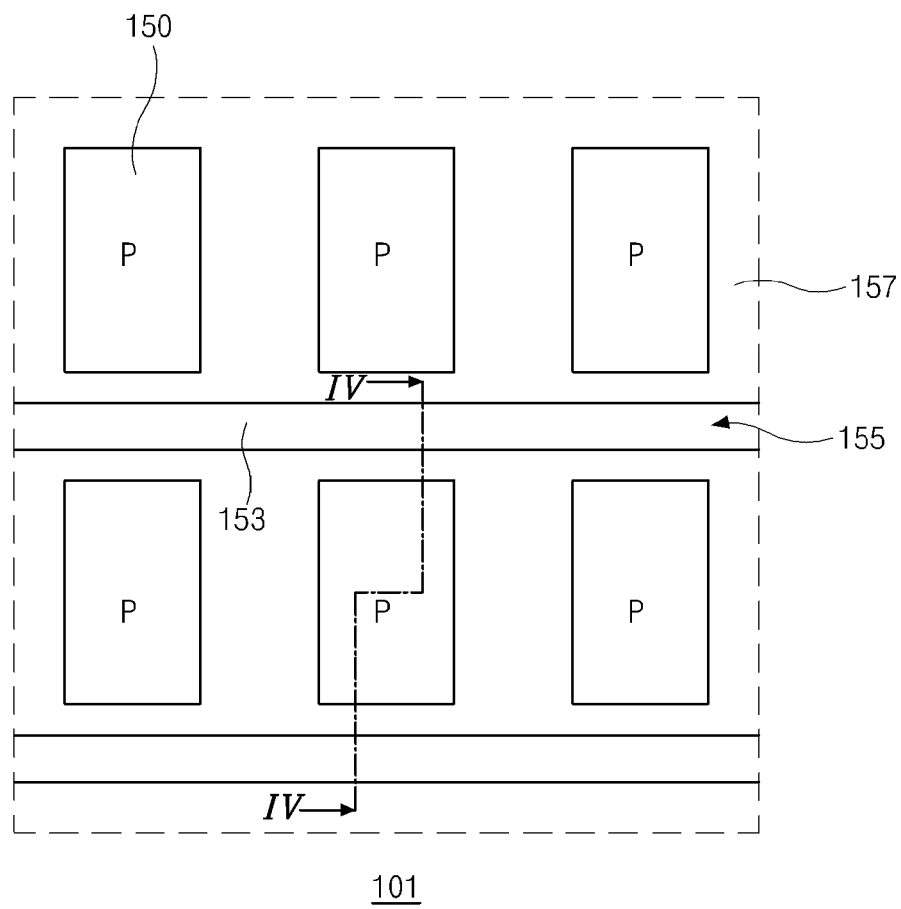


FIG. 4

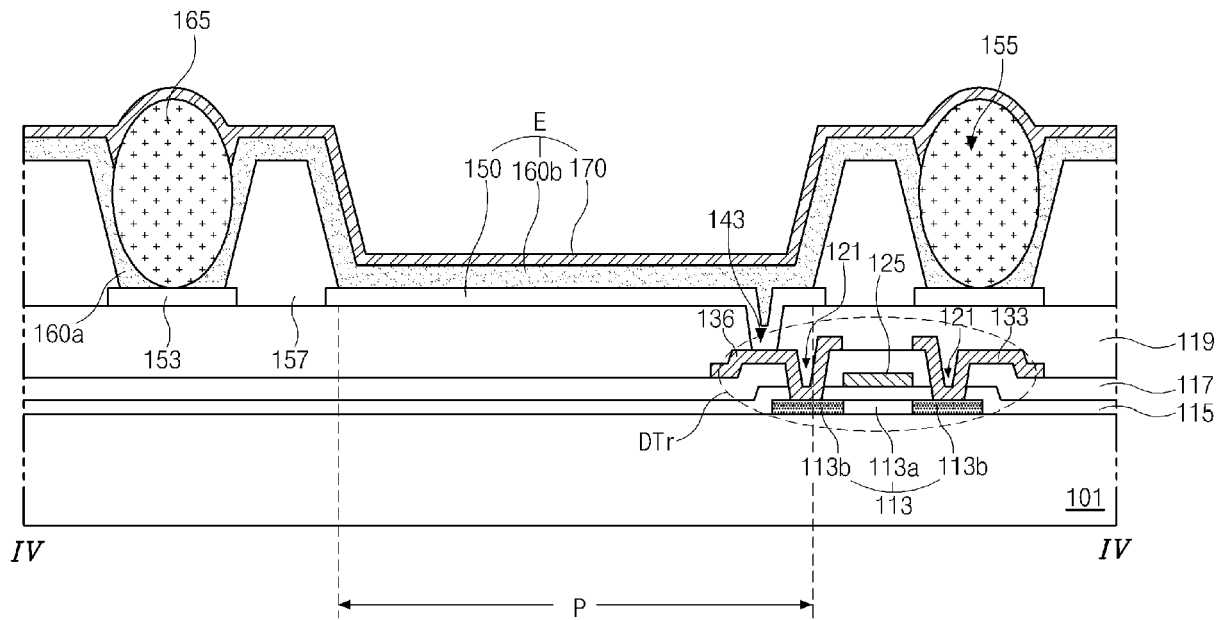


FIG. 5A

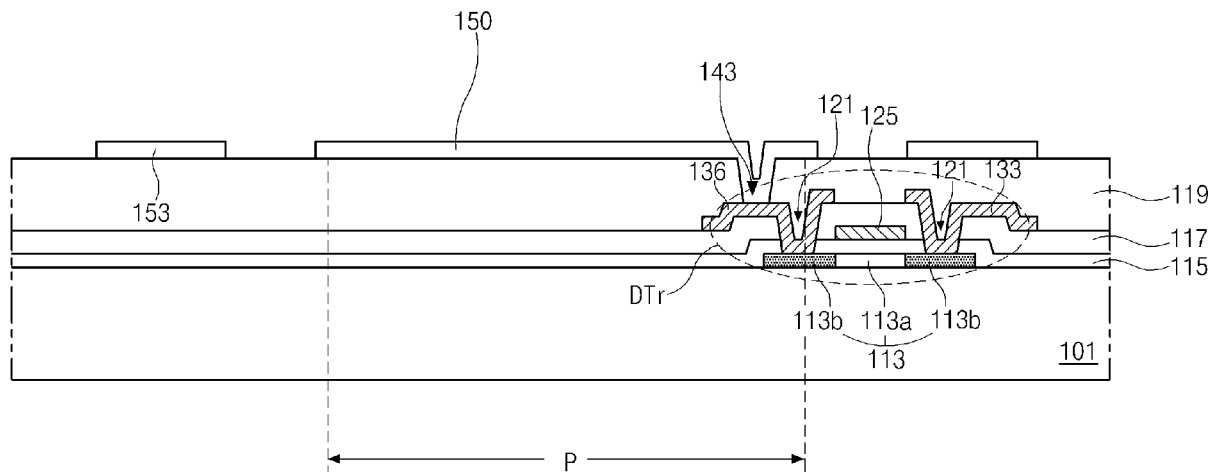


FIG. 5B

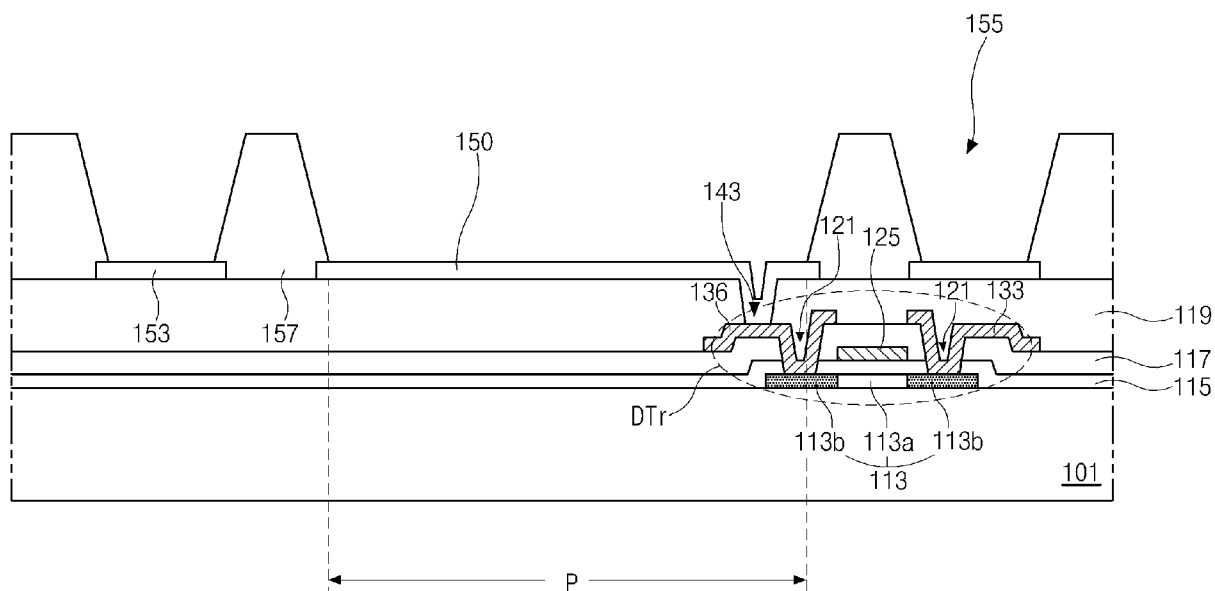


FIG. 5C

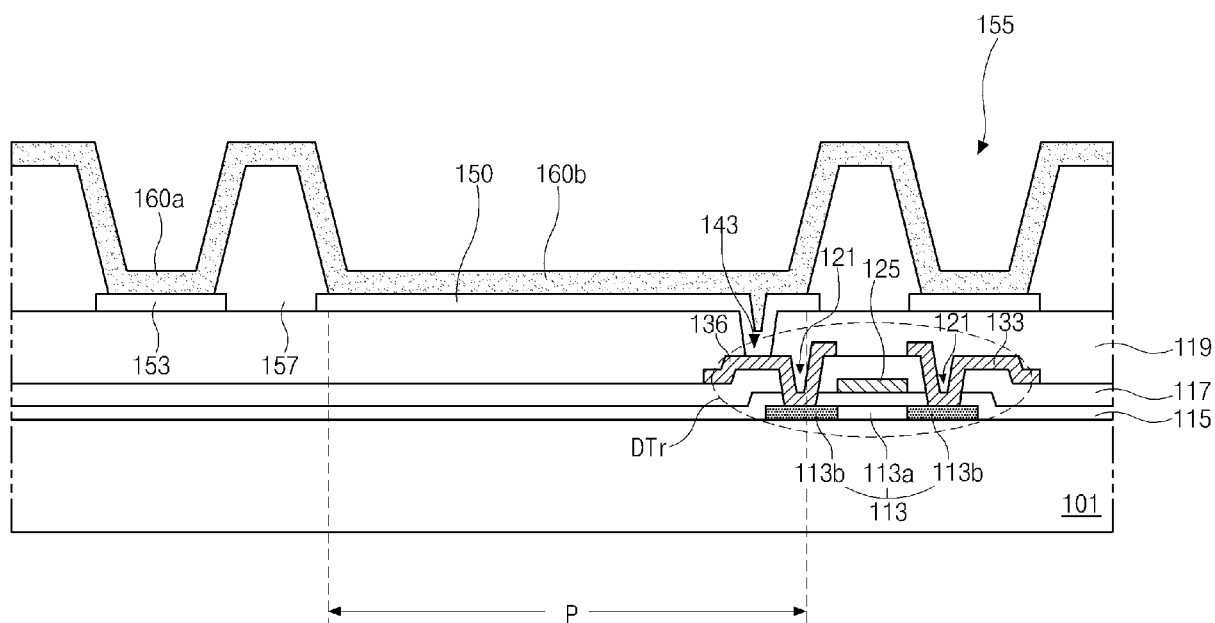


FIG. 5D

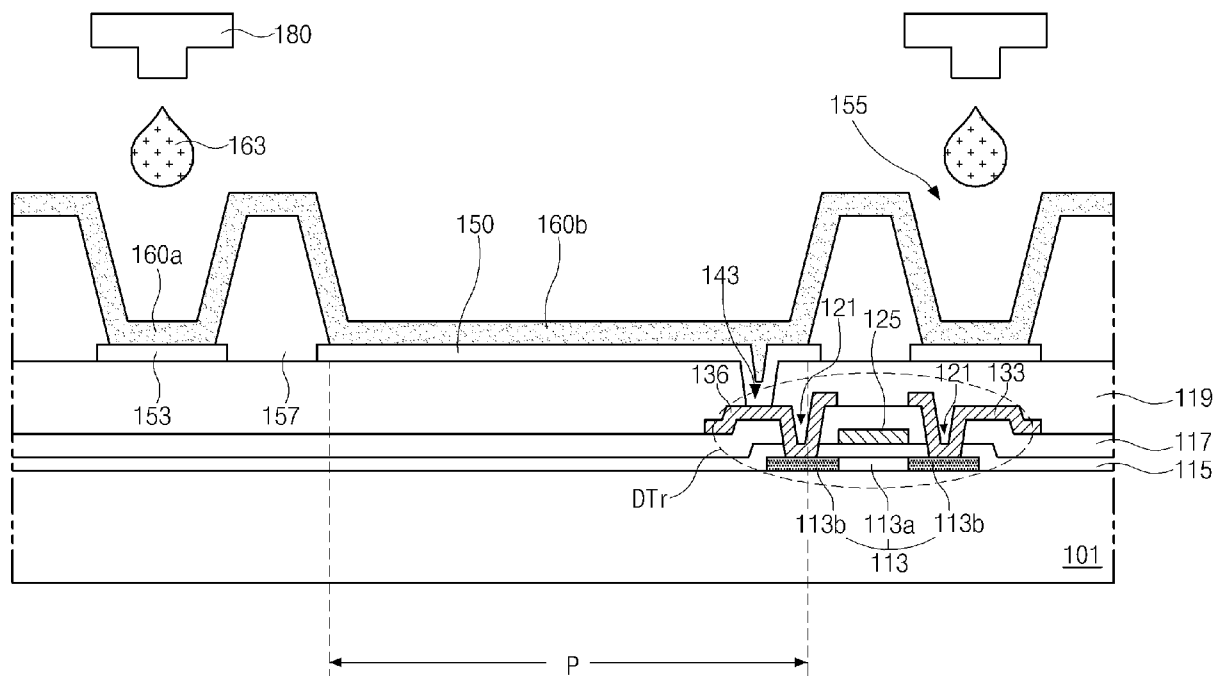


FIG. 5E

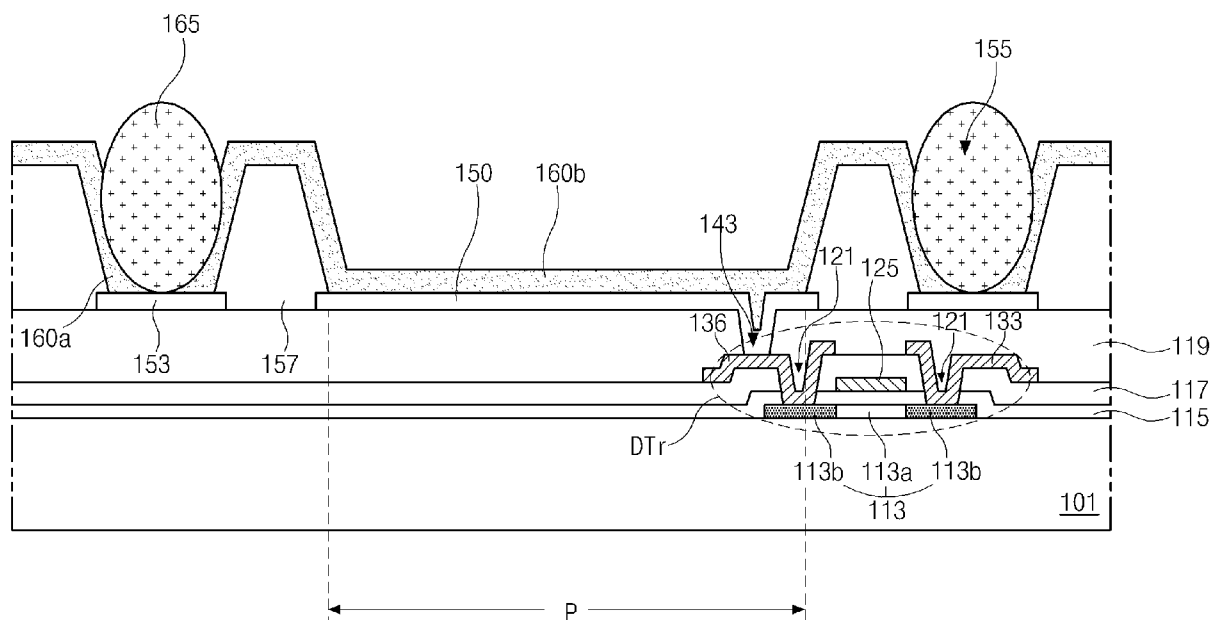
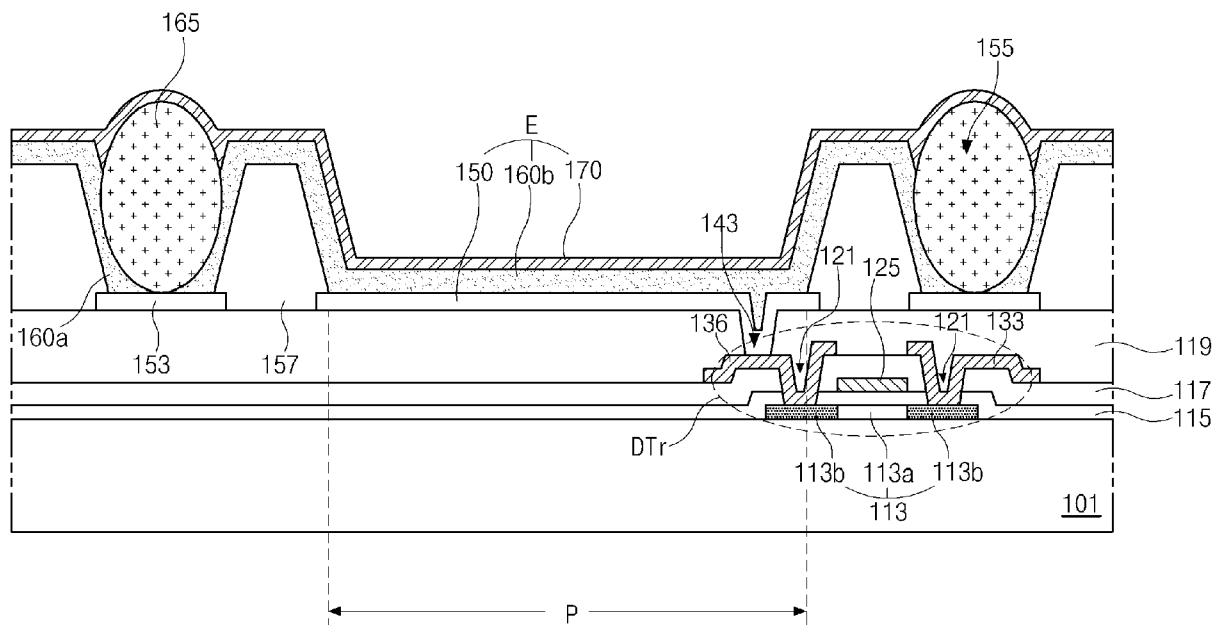


FIG. 5F





EUROPEAN SEARCH REPORT

Application Number
EP 16 18 4355

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2014/183479 A1 (PARK SUNGHEE [KR] ET AL) 3 July 2014 (2014-07-03) * figure 3 *	1,11	INV. H01L51/00 H01L27/32
X	US 2015/090989 A1 (MATSUMOTO YUKO [JP] ET AL) 2 April 2015 (2015-04-02) * figure 4 *	1,11	
X	US 2014/346459 A1 (SONG JUNG-BAE [KR] ET AL) 27 November 2014 (2014-11-27) * paragraph [0042] - paragraph [0072]; figure 10 *	1-10	
A	US 2005/253508 A1 (OKANO KIYOSHI [JP]) 17 November 2005 (2005-11-17) * figure 5 *	1,11	
A	US 2013/134449 A1 (CHEN PENG-YU [TW] ET AL) 30 May 2013 (2013-05-30) * figure 5 *	1,11	
			TECHNICAL FIELDS SEARCHED (IPC)
			H01L
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 10 March 2017	Examiner Bernabé Prieto, A
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			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 16 18 4355

5

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.

10-03-2017

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2014183479 A1	03-07-2014	CN 104885251 A	02-09-2015
		EP 2939286 A1	04-11-2015
		KR 20140085979 A	08-07-2014
		US 2014183479 A1	03-07-2014
		WO 2014104703 A1	03-07-2014

US 2015090989 A1	02-04-2015	JP 2015069854 A	13-04-2015
		US 2015090989 A1	02-04-2015

US 2014346459 A1	27-11-2014	KR 20140136787 A	01-12-2014
		US 2014346459 A1	27-11-2014

US 2005253508 A1	17-11-2005	JP 2005327674 A	24-11-2005
		US 2005253508 A1	17-11-2005

US 2013134449 A1	30-05-2013	CN 102623644 A	01-08-2012
		TW 201321871 A	01-06-2013
		US 2013134449 A1	30-05-2013

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- KR 1020150154133 [0001]

专利名称(译)	有机发光显示装置及其制造方法		
公开(公告)号	EP3166155A1	公开(公告)日	2017-05-10
申请号	EP2016184355	申请日	2016-08-16
[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	PAEK SEUNG HAN BAE HYO DAE OH YOUNG MU LEE JEONG WON SONG HEON IL YEO JONG HOON		
发明人	PAEK, SEUNG-HAN BAE, HYO-DAE OH, YOUNG-MU LEE, JEONG-WON SONG, HEON-IL YEO, JONG-HOON		
IPC分类号	H01L51/00 H01L27/32		
CPC分类号	H01L27/3244 H01L51/5203 H01L51/56 H01L27/3246 H01L27/3279 H01L51/0022 H01L2227/323 H01L51/0003 H01L51/0021 H01L51/504 H01L51/5212 H01L51/5228		
优先权	1020150154133 2015-11-03 KR		
外部链接	Espacenet		

摘要(译)

一种有机发光显示装置，包括：包括像素区域的基板；基板上和像素区域中的第一电极；基板上方的辅助电极，辅助电极与第一电极间隔开并位于像素区域的边界处；第一电极和辅助电极上的第二电极；设置在第一电极和辅助电极中的每一个之间的有机层，以及第二电极和辅助电极；导电构件包括位于辅助电极和第二电极之间的导电液滴，并将第二电极电连接到辅助电极。

FIG. 4

