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(54) **ORGANIC LIGHT-EMITTING DISPLAY APPARATUS AND METHOD OF MANUFACTURING THE SAME**

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(22) Filed: **Oct. 1, 2019**

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(63) Continuation of application No. 15/871,837, filed on Jan. 15, 2018, now Pat. No. 10,476,025.

(30) **Foreign Application Priority Data**

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H01L 27/32	(2006.01)
H01L 51/00	(2006.01)
H01L 51/56	(2006.01)

(52) **U.S. Cl.**

CPC ***H01L 51/5228*** (2013.01); ***H01L 51/5225*** (2013.01); ***H01L 51/56*** (2013.01); ***H01L 51/0023*** (2013.01); ***H01L 27/3211*** (2013.01)

(57) **ABSTRACT**

An organic light-emitting display (OLED) apparatus includes: a first electrode; a second electrode disposed separate from the first electrode; a pixel-defining layer covering an edge of the first electrode and an edge of the second electrode; a first organic functional layer disposed on the first electrode and the pixel-defining layer including a first emission layer; a first opposing electrode covering a top surface and enclosing an outer circumference of side surfaces of the first organic functional layer; a second organic functional layer disposed on the second electrode and the pixel-defining layer including a second emission layer; and a second opposing electrode covering a top surface and enclosing an outer circumference of side surfaces of the second organic functional layer. An area of the first opposing electrode in contact with the pixel-defining layer is greater than an area of the second opposing electrode in contact with the pixel-defining layer.

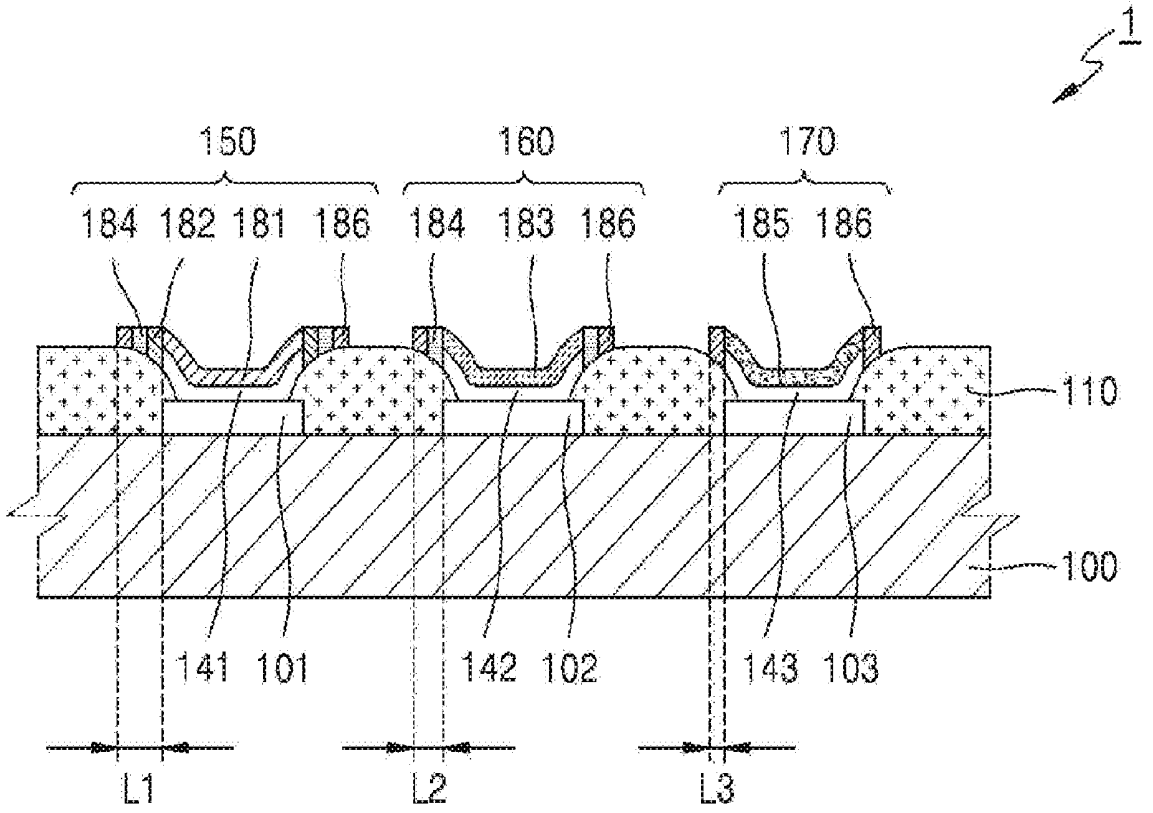


FIG. 1

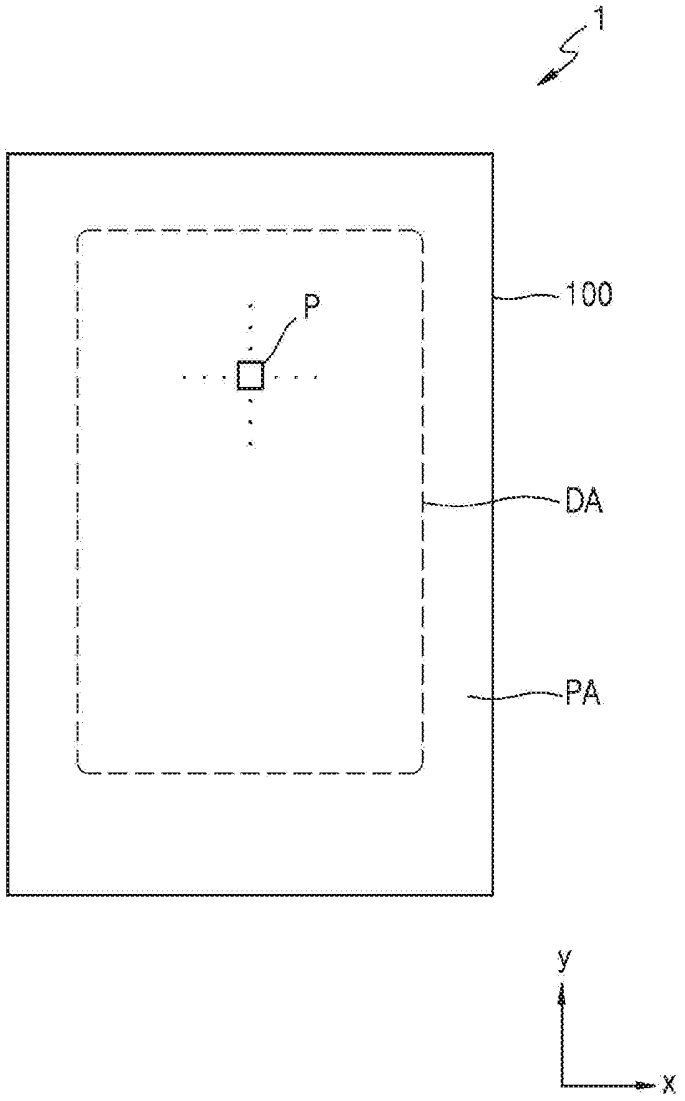
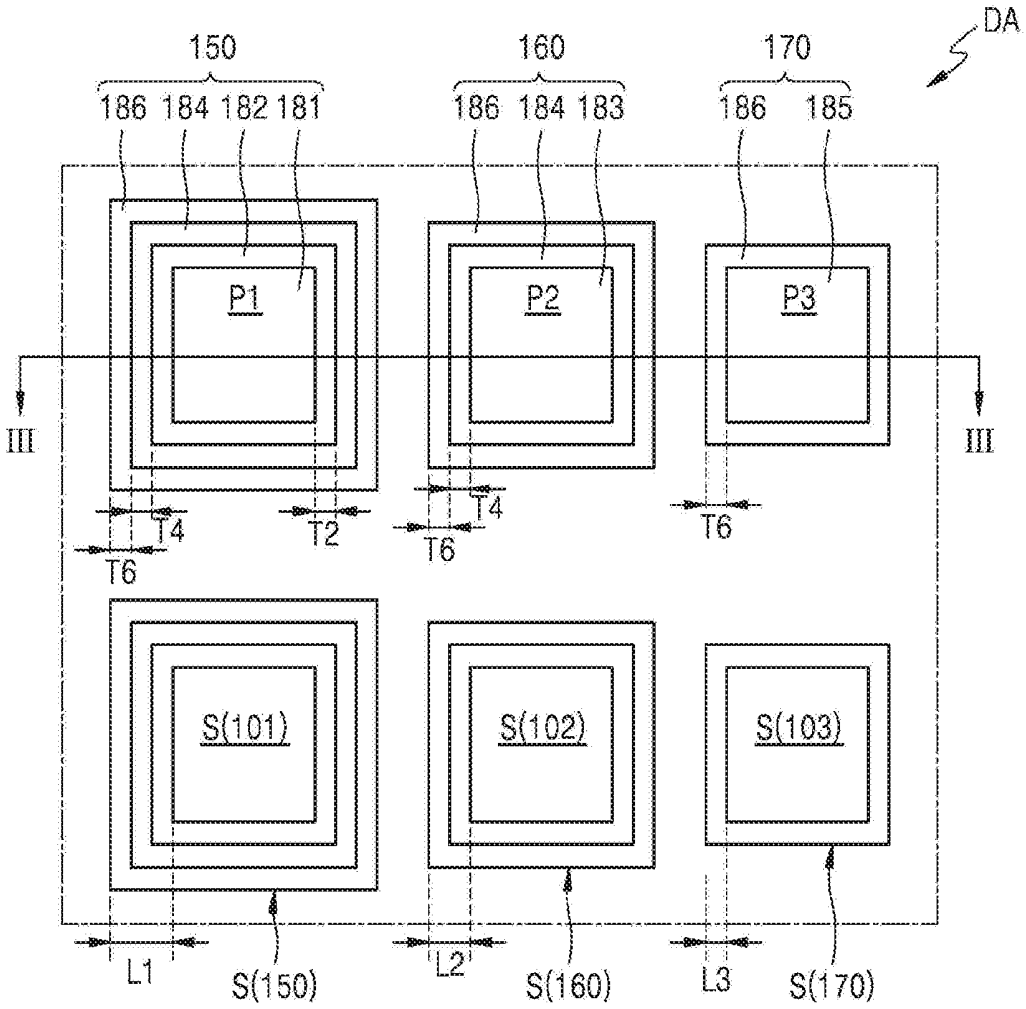


FIG. 2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186 184 182 181
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P2
P3
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III
T4
T2
T6
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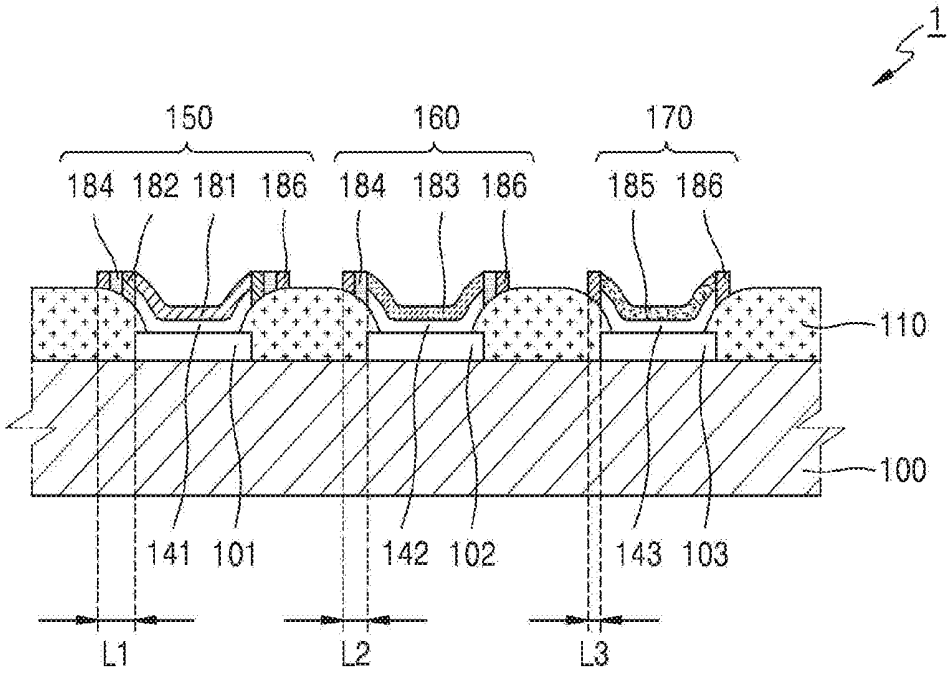
T6
T6
S(101)
S(102)
S(103)
L1
S(150)
L2
S(160)
L3
S(170)

FIG. 3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L1
L2
L3

FIG. 4

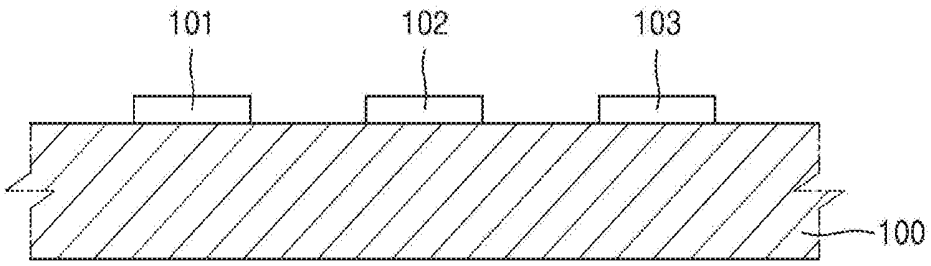

FIG. 5

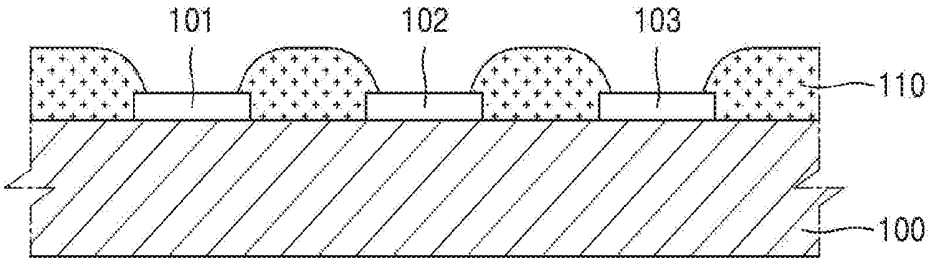

FIG. 6A

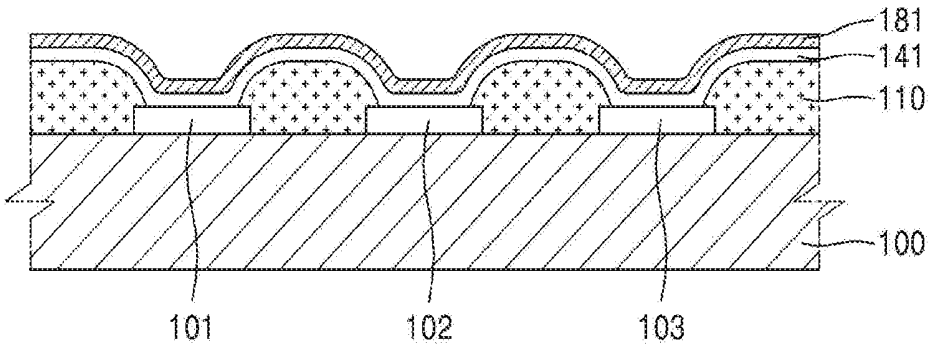
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FIG. 6B

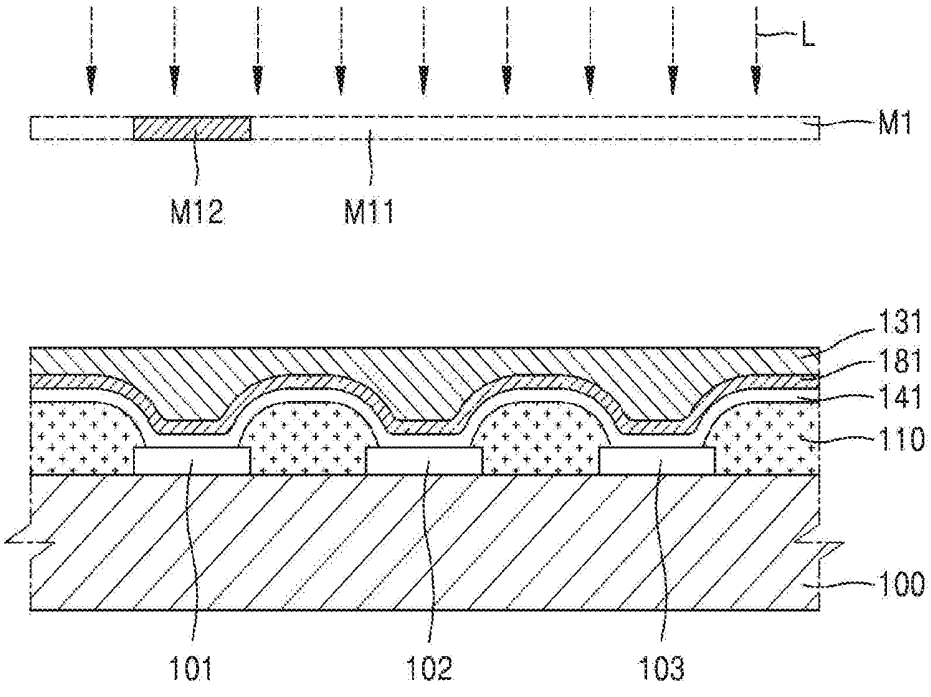
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FIG. 6C

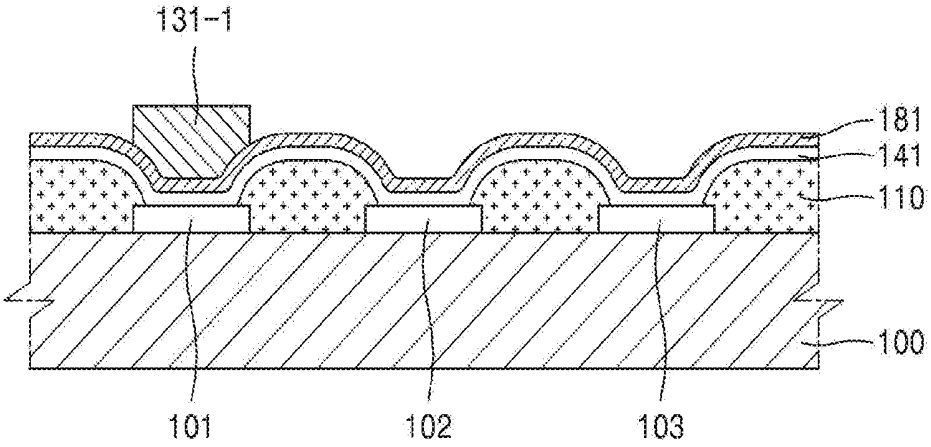
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FIG. 6D

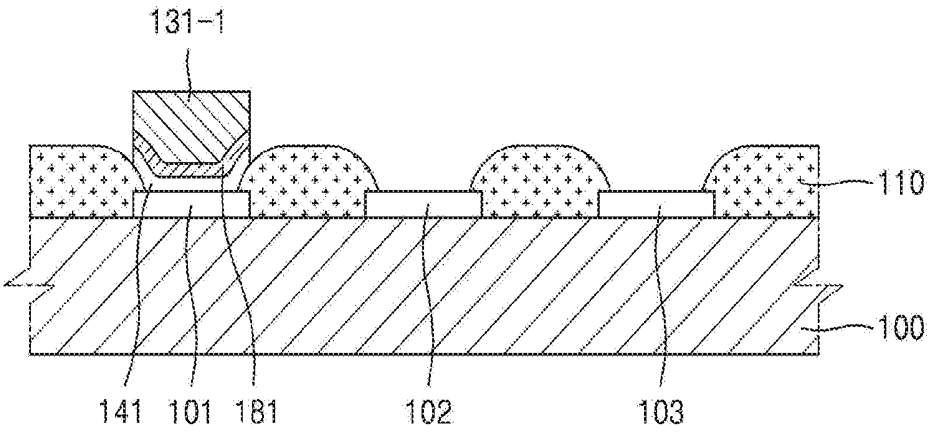
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FIG. 6E

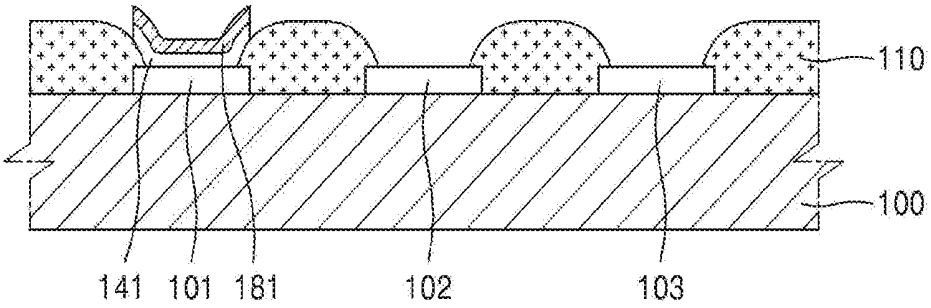
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FIG. 6F

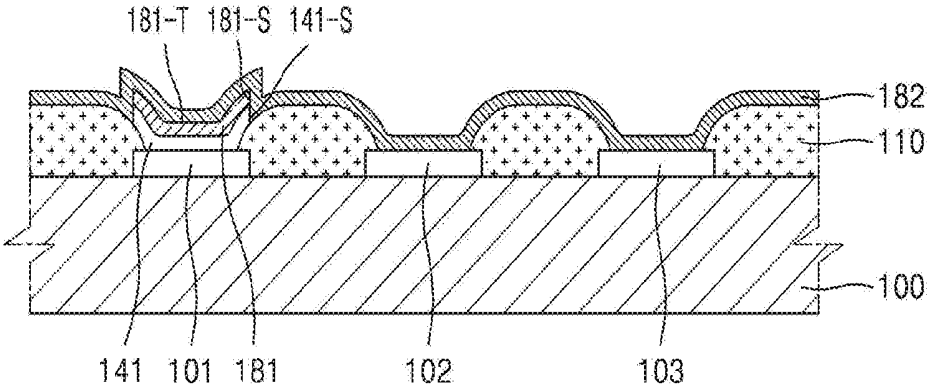
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FIG. 6G

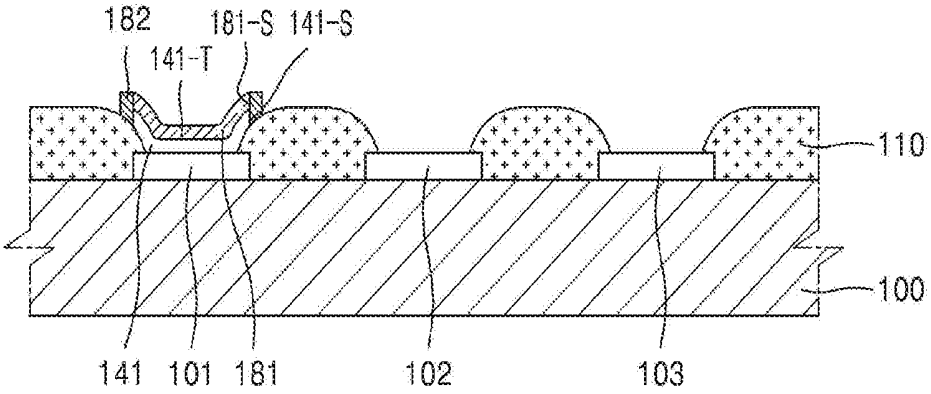

FIG. 7A

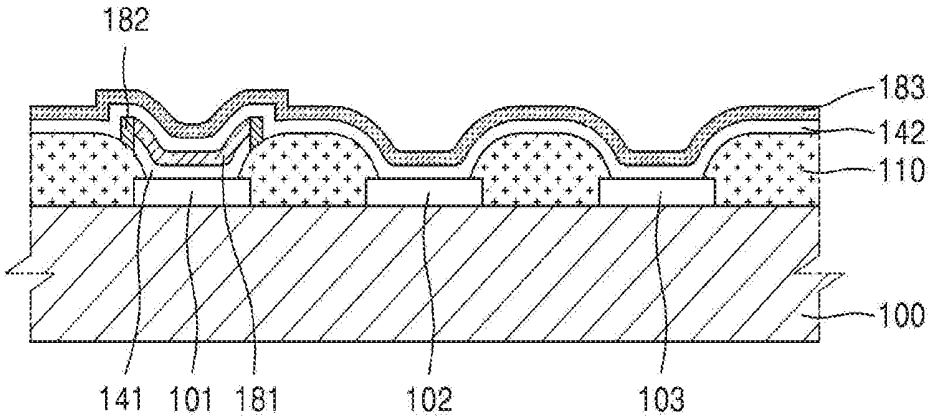
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FIG. 7B

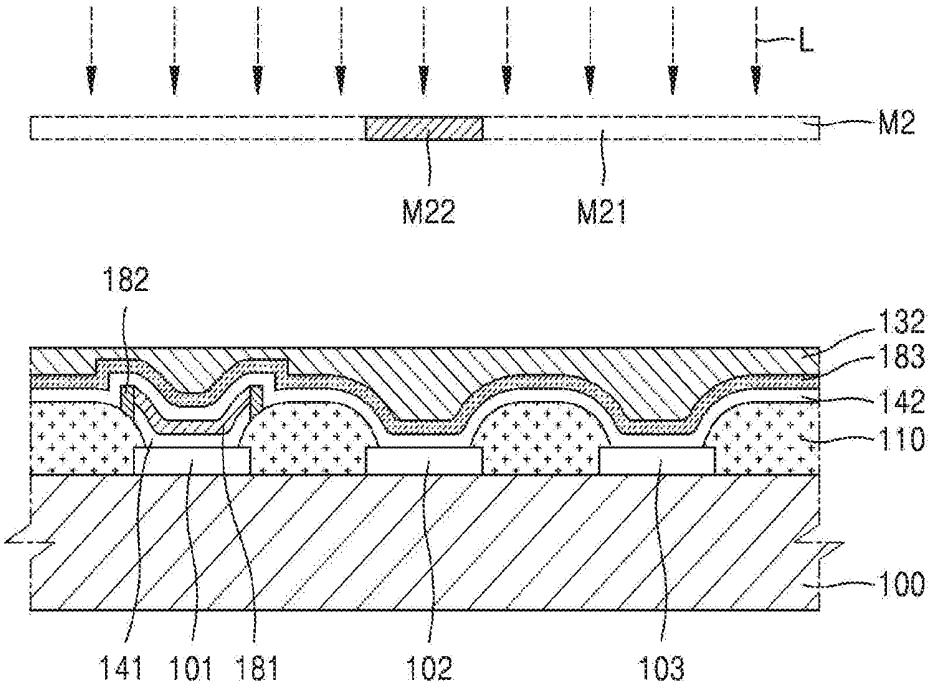
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FIG. 7C

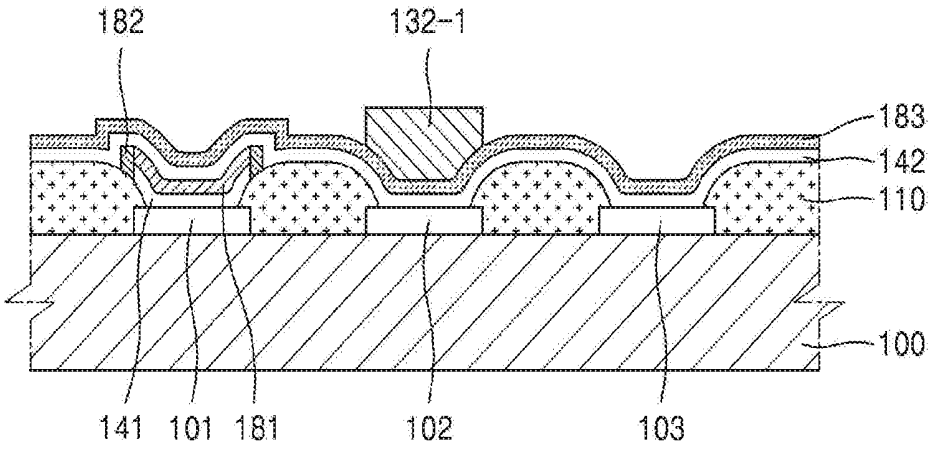
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FIG. 7D

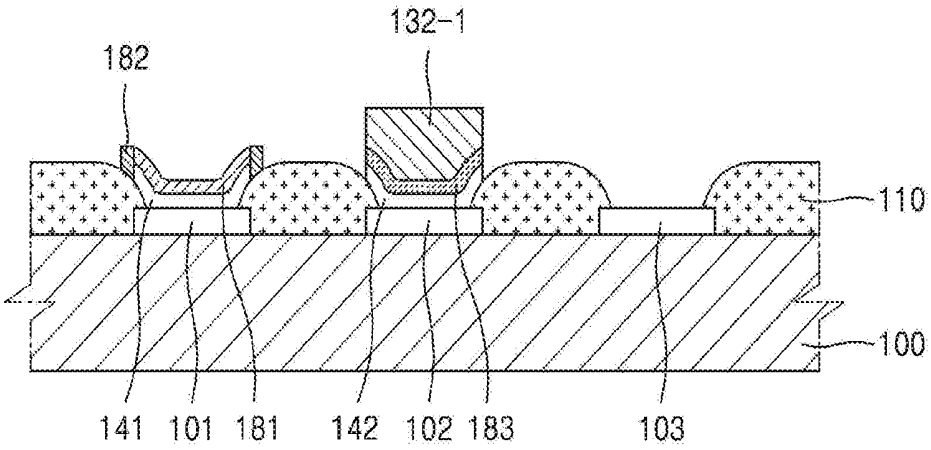
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FIG. 7E

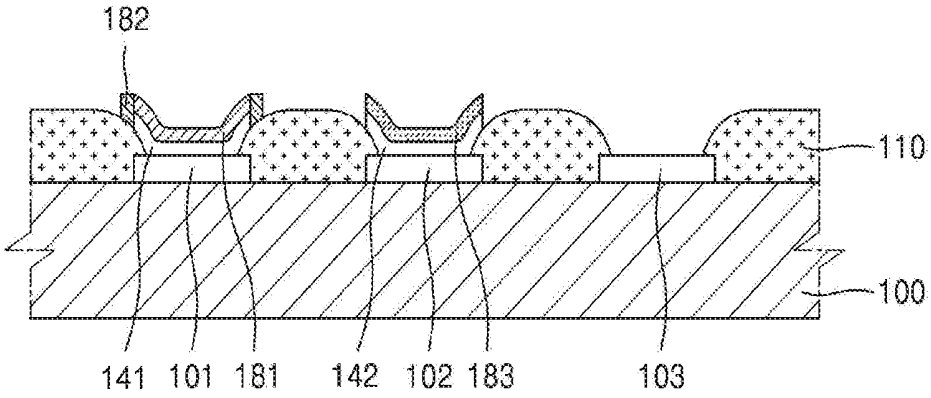
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FIG. 7F

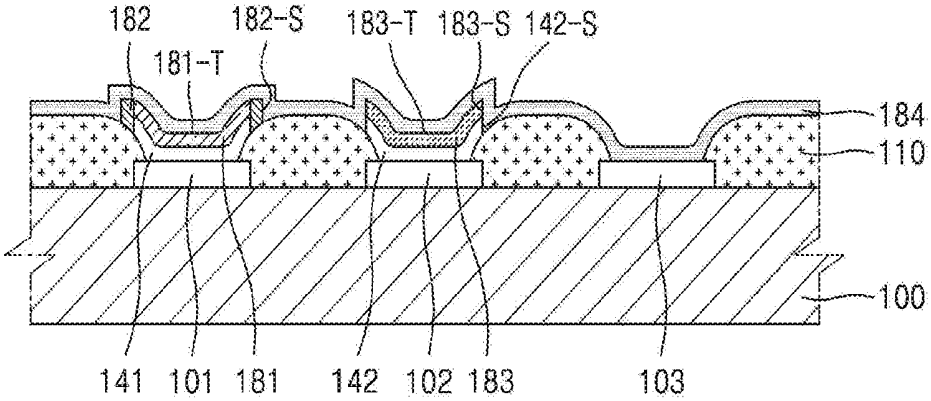
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FIG. 7G

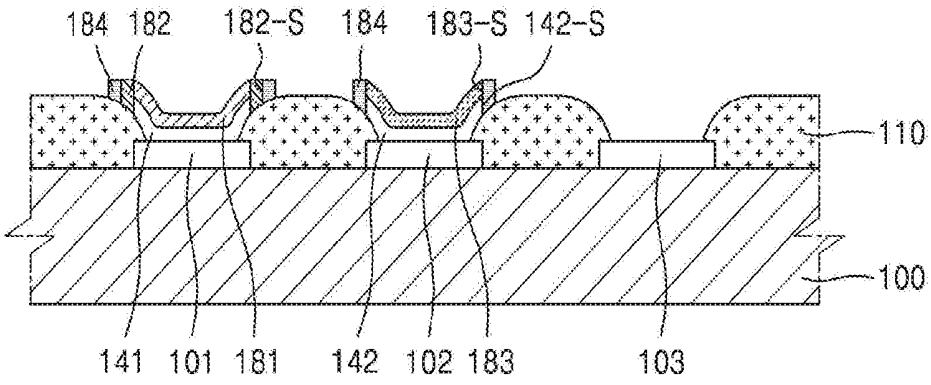

FIG. 8A

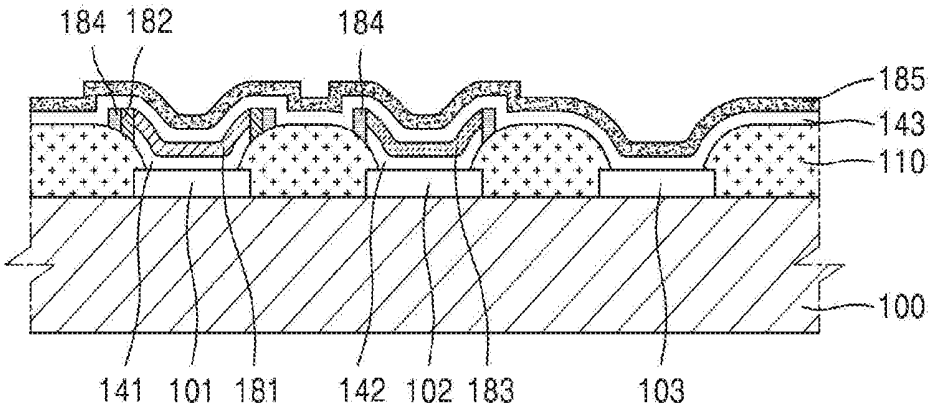
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FIG. 8B

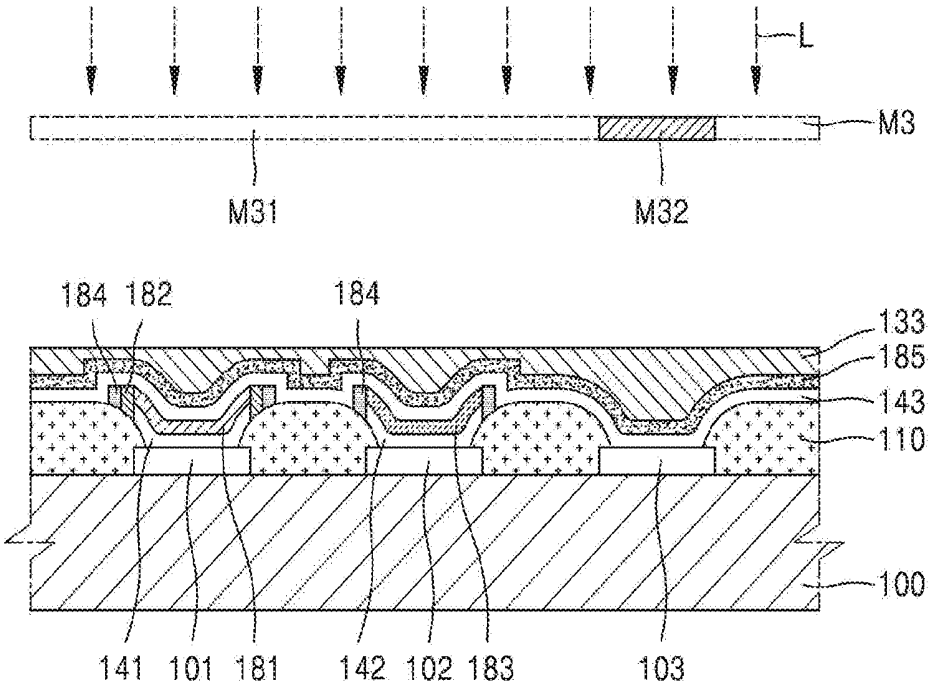
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FIG. 8C

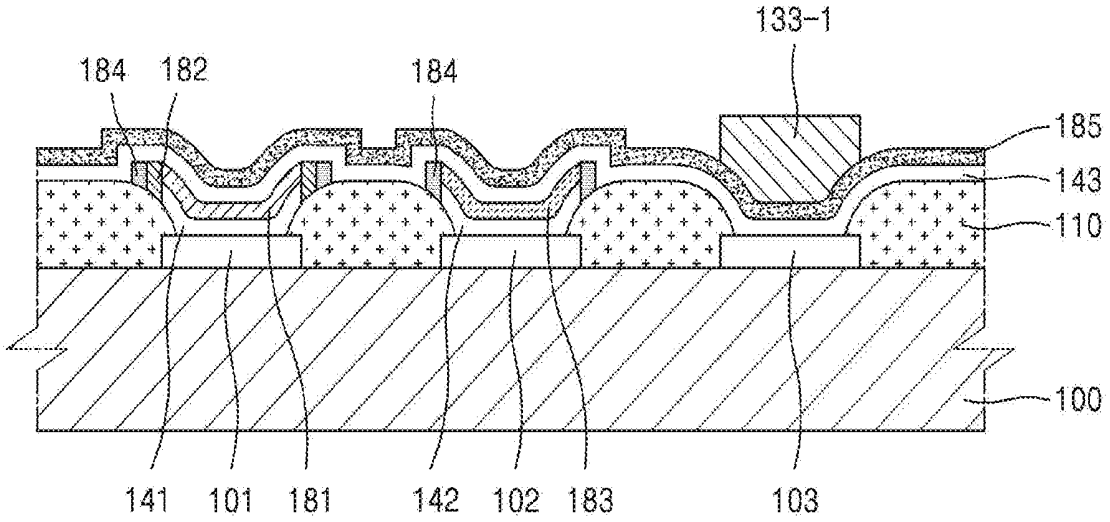
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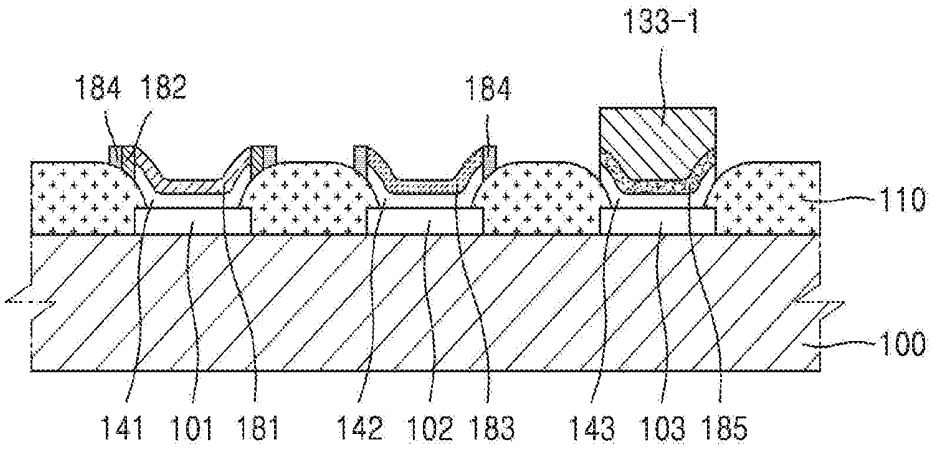
FIG. 8D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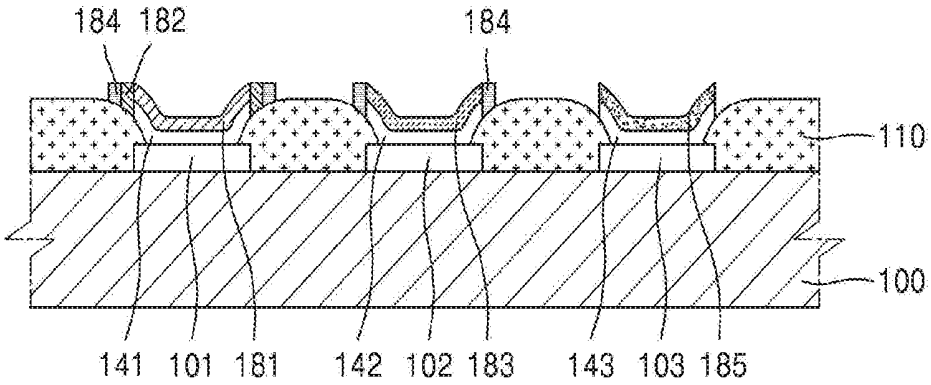
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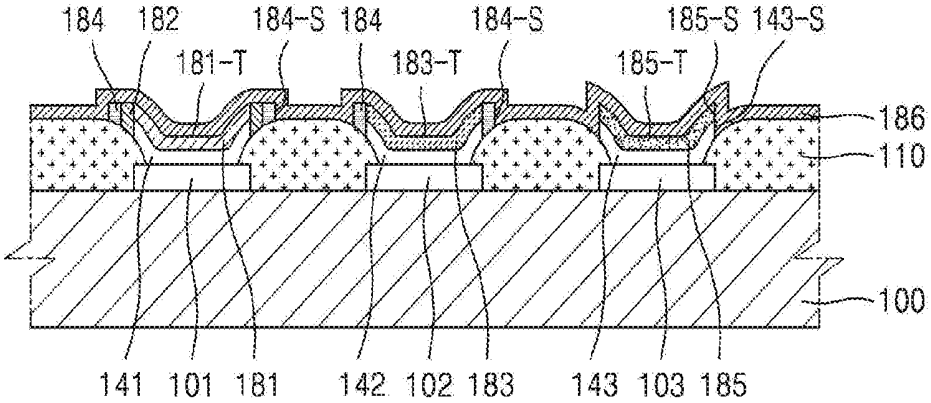
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FIG. 8G

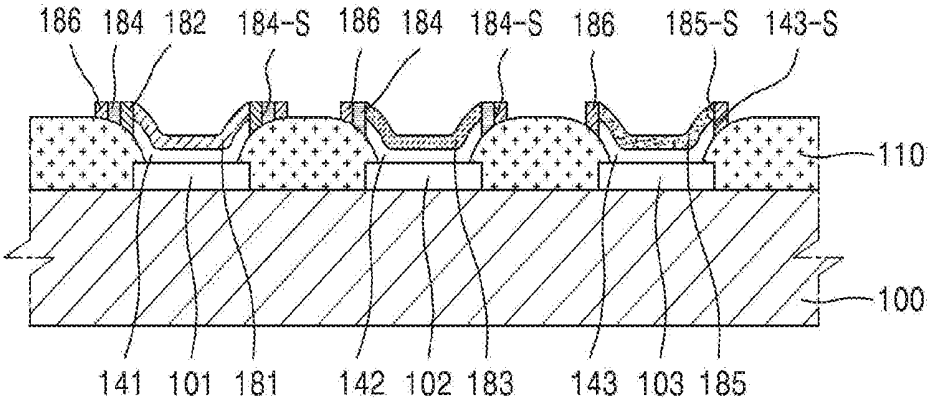
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FIG. 9A

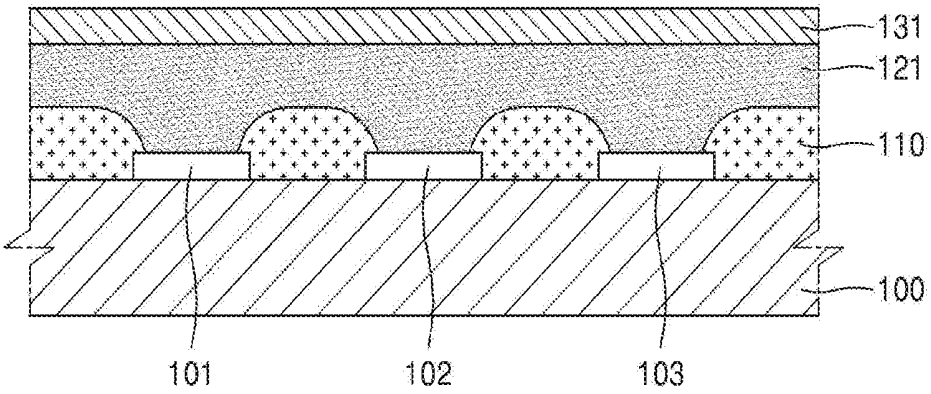
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FIG. 9B

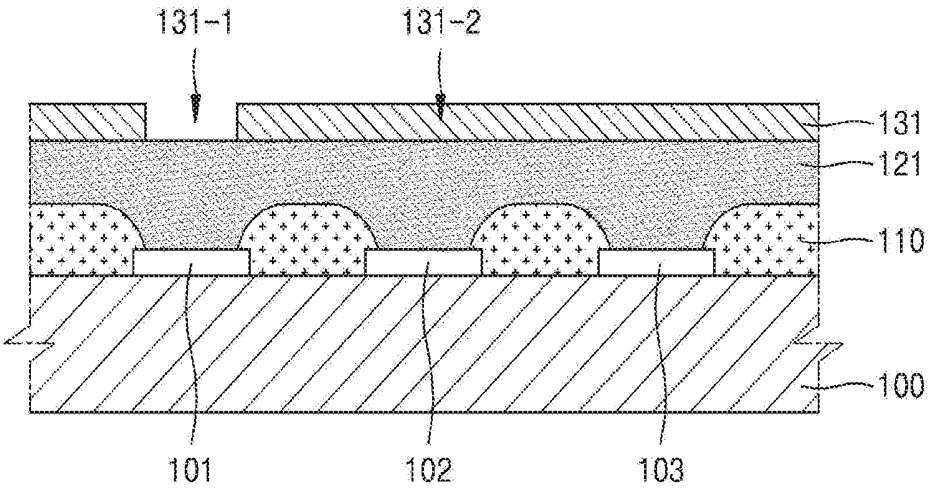
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FIG. 9C

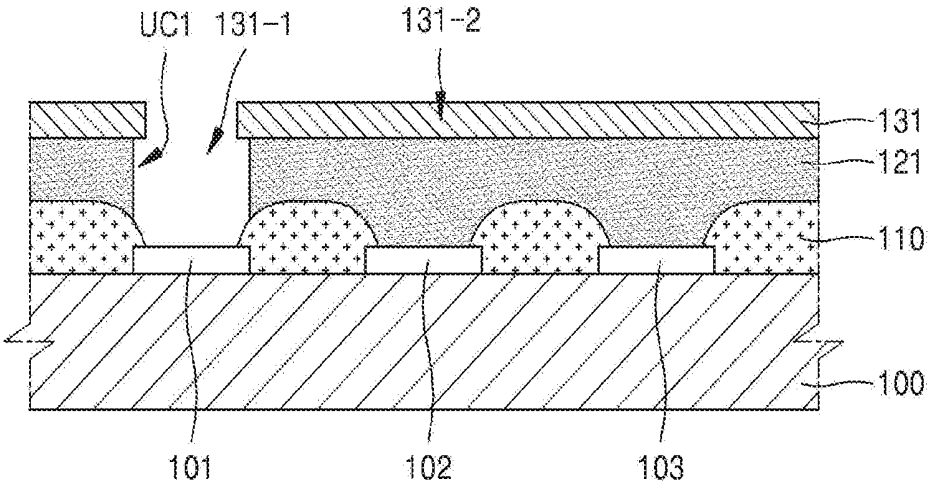
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FIG. 9D

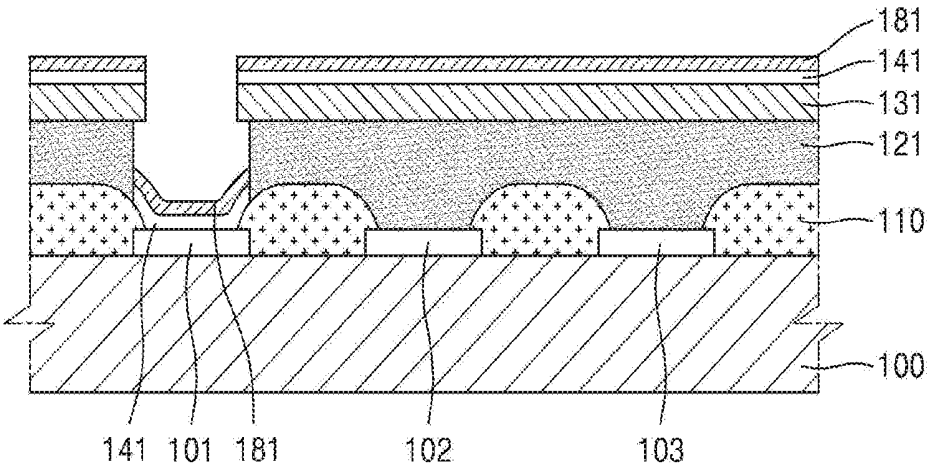
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FIG. 9E

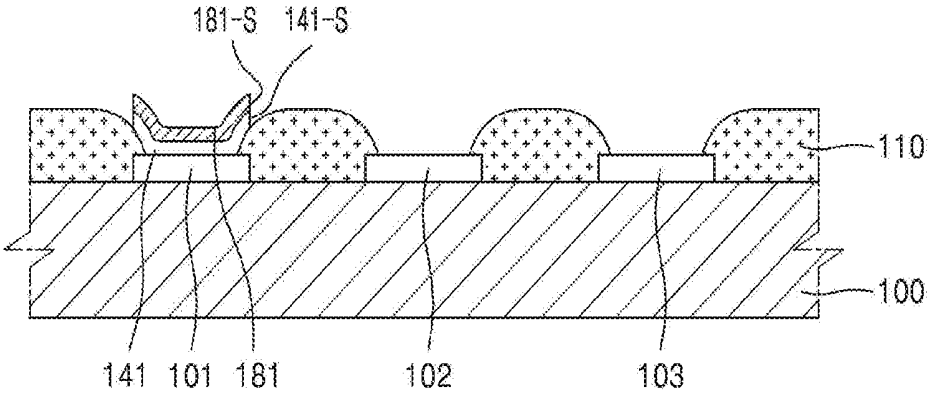

FIG. 10A

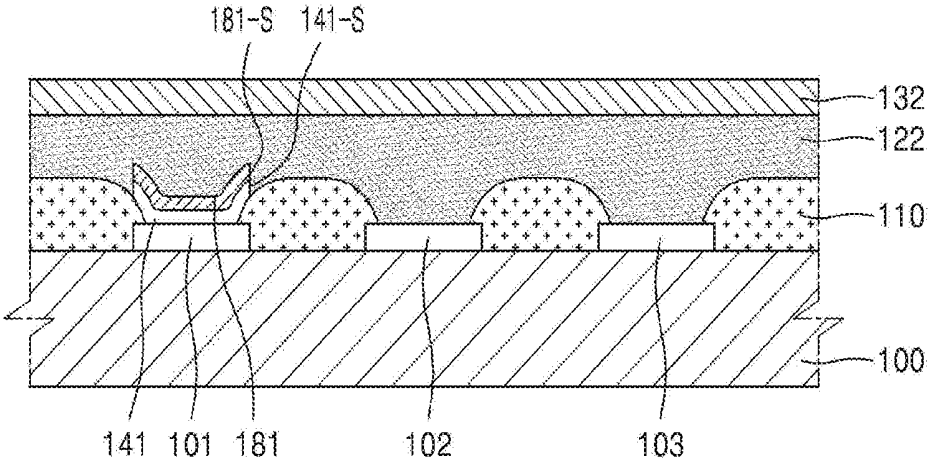

FIG. 10B

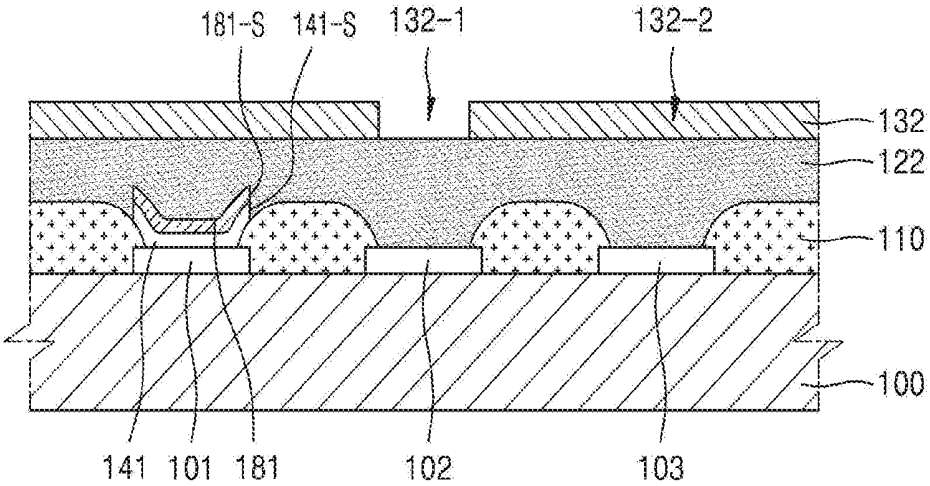

FIG. 10C

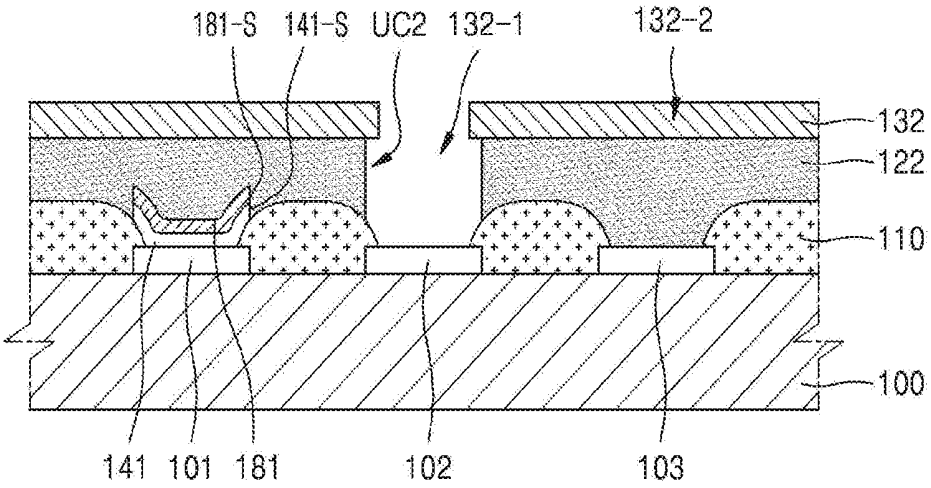

FIG. 10D

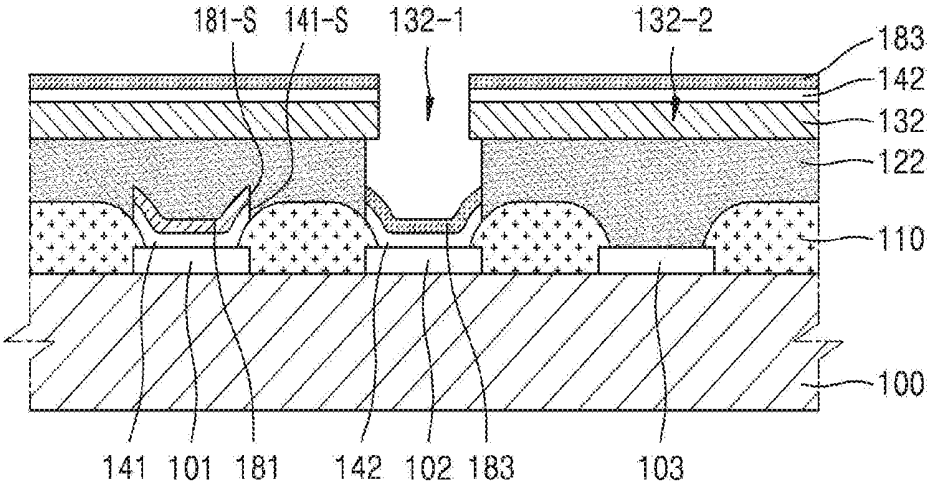

FIG. 10E

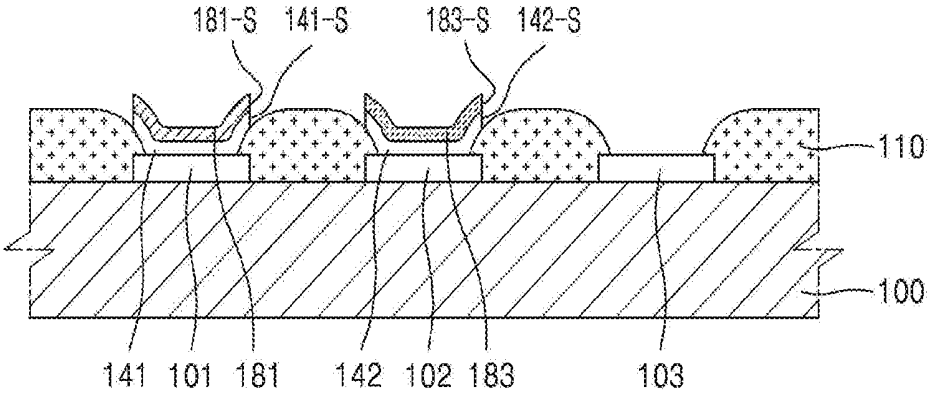

FIG. 11A

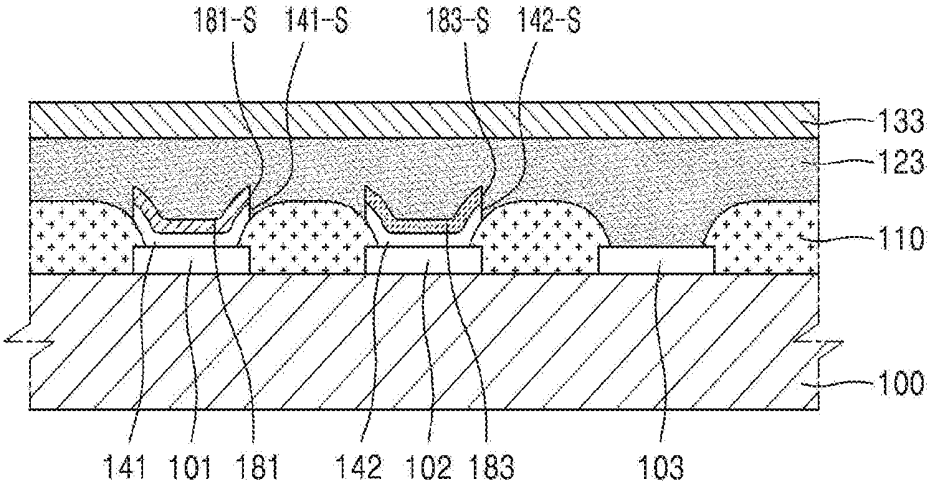

FIG. 11B

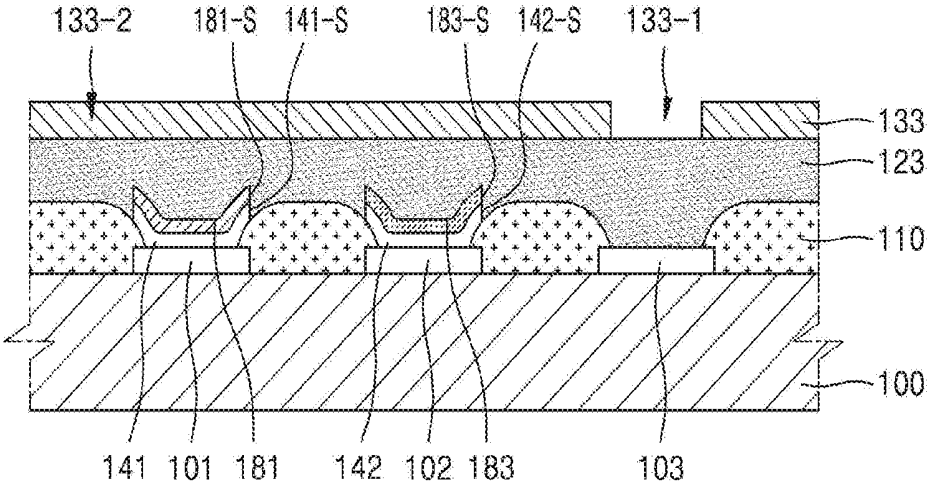

FIG. 11C

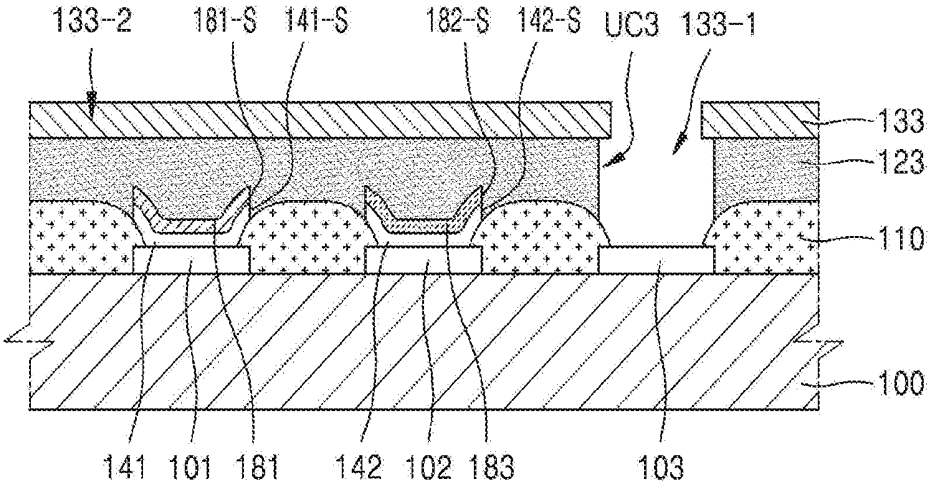

FIG. 11D

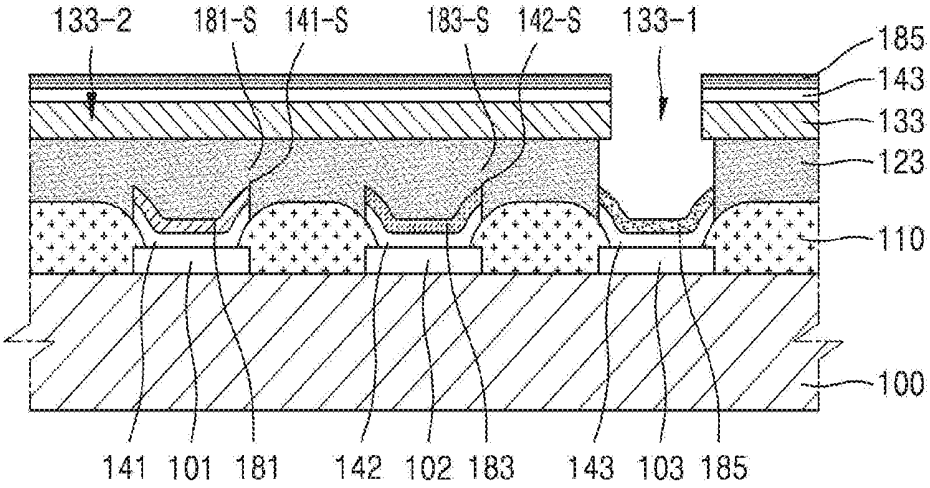

FIG. 11E

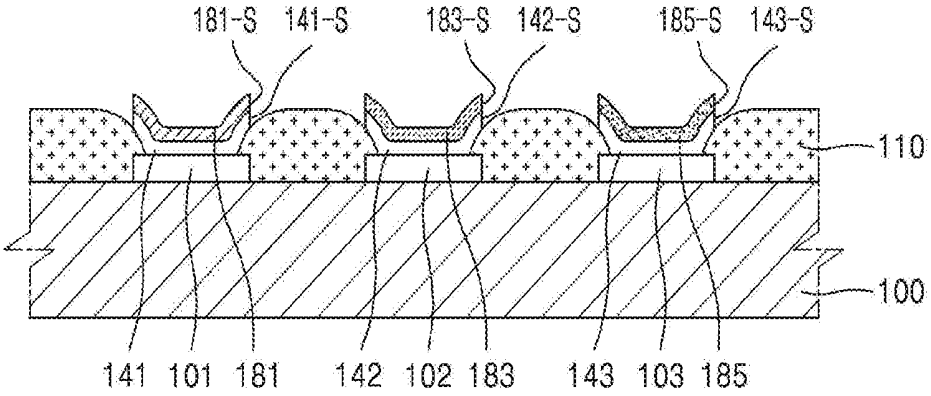
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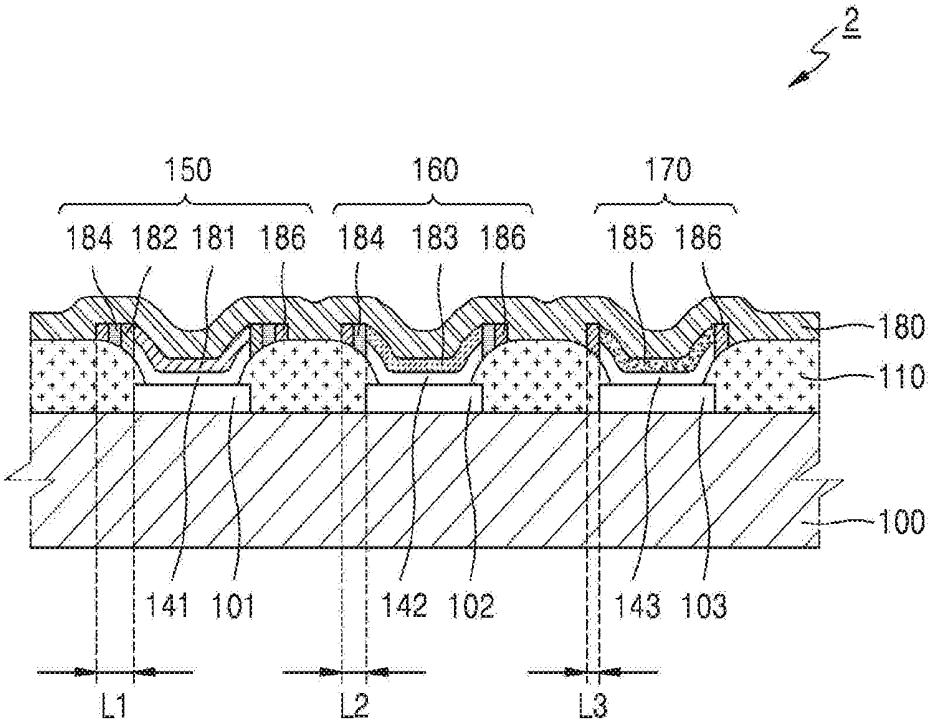
FIG. 12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184 182 181 186 184 183 186 185 186
180
110
100
141 101 142 102 143 103
L1
L2
L3

ORGANIC LIGHT-EMITTING DISPLAY APPARATUS AND METHOD OF MANUFACTURING THE SAME

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application is a continuation of U.S. patent application Ser. No. 15/871,837, filed on Jan. 15, 2018, and claims priority from and the benefit of Korean Patent Application No. 10-2017-0030811, filed on Mar. 10, 2017, each of which is hereby incorporated by reference for all purposes as if fully set forth herein.

ACKGROUND

Field

[0002] Exemplary embodiments of the present invention relate to an organic light-emitting display (OLED) apparatus and a method of manufacturing the same.

Discussion of the Background

[0003] An organic light-emitting display (OLED) apparatus is a self-emitting display apparatus that includes a hole injection electrode, an electron injection electrode, and an organic emission layer between the hole injection electrode and the electron injection electrode, and emits light when holes injected from the hole injection electrode and electrons injected from the electron injection electrode recombine in the organic emission layer. The OLED apparatus has advantages such as low power consumption, high luminance, and fast response rates, and thus has received attention as a next-generation display apparatus.

[0004] The above information disclosed in this Background section is only for enhancement of understanding of the background of the inventive concepts. Therefore, it may contain information that does not form the prior art that was already known to a person of ordinary skill in the art or was publically available prior to an effective filing date of subject matter disclosed herein.

SUMMARY

[0005] Exemplary embodiments of the present invention provide an organic light-emitting display (OLED) apparatus that may increase a resolution and reduce defects and manufacturing costs, and a method of manufacturing the OLED apparatus.

[0006] Additional features of the invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the invention.

[0007] An exemplary embodiment of the present invention discloses an organic light-emitting display (OLED) apparatus including: a first electrode; a first organic functional layer disposed on the first electrode, the first organic functional layer including a first emission layer; a first opposing electrode covering a top surface and side surfaces of the first organic functional layer; a second electrode disposed separate from the first electrode; a second organic functional layer disposed on the second electrode, the second organic functional layer including a second emission layer; and a second opposing electrode covering a top surface and side surfaces of the second organic functional layer, wherein a lateral thickness of the first opposing electrode covering the side surfaces of the first organic functional layer may be greater than a lateral thickness of the second opposing electrode covering the side surfaces of the second organic functional layer.

[0008] A first color of light emitted from the first emission layer may be different from a second color of light emitted from the second emission layer.

[0009] Each of the first organic functional layer and the second organic functional layer may include at least one layer selected from the group consisting of a hole injection layer, a hole transport layer, an electron injection layer, and an electron transport layer.

[0010] A thickness of a portion of the first opposing electrode covering the top surface of the first organic functional layer may be as same as a thickness of a portion of the second opposing electrode covering the top surface of the second organic functional layer.

[0011] The OLED apparatus may further include a pixel-defining layer including an insulating layer, the pixel-defining layer covering an edge of the first electrode and an edge of the second electrode.

[0012] An edge of the first organic functional layer and an edge of the second organic functional layer may be disposed on an inclined surface of the pixel-defining layer.

[0013] The OLED apparatus may further include a common electrode that is commonly and integrally disposed on the first opposing electrode and the second opposing electrode.

[0014] The common electrode may cover side surfaces of the first opposing electrode and side surfaces of the second opposing electrode.

[0015] The OLED apparatus may further include: a third electrode disposed separate from the first electrode and the second electrode; a third organic functional layer disposed on the third electrode, the third organic functional layer including a third emission layer; and a third opposing electrode covering a top surface and side surfaces of the third organic functional layer, wherein the lateral thickness of the second opposing electrode covering the side surfaces of the second organic functional layer is greater than a lateral thickness of the third opposing electrode covering the side surfaces of the third organic functional layer.

[0016] A first color of light emitted from the first emission layer, a second color of light emitted from the second emission layer, and a third color of light emitted from the third emission layer may be different from one another.

[0017] An exemplary embodiment of the present invention also discloses an organic light-emitting display (OLED) apparatus including: a first electrode; a first organic functional layer disposed on the first electrode, the first organic functional layer including a first emission layer; a first opposing electrode covering a top surface and side surfaces of the first organic functional layer; a second electrode disposed separate from the first electrode; a second organic functional layer disposed on the second electrode, the second organic functional layer including a second emission layer; and a second opposing electrode covering a top surface and side surfaces of the second organic functional layer, wherein an area of the first opposing electrode in plan view may be greater than an area of the second opposing electrode in plan view.

[0018] The first opposing electrode may include a first conductive layer covering the top surface of the first organic functional layer, a second conductive layer surrounding the

side surfaces of the first organic functional layer, a fourth conductive layer surrounding side surfaces of the second conductive layer, and a sixth conductive layer surrounding side surfaces of the fourth conductive layer, and wherein the second opposing electrode may include a third conductive layer covering the top surface of the second organic functional layer, the fourth conductive layer surrounding the side surfaces of the second organic functional layer, and the sixth conductive layer surrounding the side surfaces of the fourth conductive layer.

[0019] An exemplary embodiment of the present invention also discloses a method of manufacturing an organic light-emitting display (OLED) apparatus, including: disposing a first electrode and a second electrode separate from each other on a substrate; sequentially disposing a first organic functional layer and a first conductive layer over the first electrode; patterning the first organic functional layer and the first conductive layer such that side surfaces of the first organic functional layer and side surfaces of the first conductive layer are exposed; disposing a second conductive layer; patterning the second conductive layer such that the second conductive layer covers the side surfaces of the first organic functional layer and the side surfaces of the first conductive layer; sequentially disposing a second organic functional layer and a third conductive layer over the first conductive layer, the second conductive layer, and the second electrode; patterning the second organic functional layer and the third conductive layer such that side surfaces of the second organic functional layer and side surfaces of the third conductive layer are exposed; disposing a fourth conductive layer; and patterning the fourth conductive layer such that the fourth conductive layer covers the side surfaces of the second organic functional layer, side surfaces of the second conductive layer, and the side surfaces of the third conductive layer.

[0020] The patterning the second conductive layer and the patterning the fourth conductive layer may include a dry etching method.

[0021] The patterning of the first organic functional layer and the first conductive layer may include: disposing a first photoresist on the first conductive layer; removing a second portion of the first photoresist such that a first portion of the first photoresist is formed at a location corresponding to the first electrode; removing the first organic functional layer and the first conductive layer at a location corresponding to the second portion; and removing the first portion of the first photoresist.

[0022] Removing the first organic functional layer and the first conductive layer may include a dry etching method.

[0023] The dry etching method may include: a first process of dry-etching the first conductive layer; and a second process of dry-etching the second organic functional layer.

[0024] The sequentially disposing the first organic functional layer and the first conductive layer, the disposing the second conductive layer, the sequentially disposing the second organic functional layer and the third conductive layer, and the disposing the fourth conductive layer may include a deposition process.

[0025] The disposing the first electrode and the second electrode may include: disposing an insulating layer to cover an edge of the first electrode and an edge of the second electrode.

[0026] The method of manufacturing the OLED apparatus may further include: disposing a common electrode on the first conductive layer, the second conductive layer, the third conductive layer, and the fourth conductive layer, wherein the common electrode may be commonly and integrally formed.

[0027] The first organic functional layer and the second organic functional layer respectively may include a first emission layer and a second emission layer which emit light of different colors.

[0028] The disposing the first electrode and the second electrode may include: disposing, on the substrate, a third electrode separate from the first electrode and the second electrode; and the method further including: sequentially disposing a third organic functional layer and a fifth conductive layer on the first conductive layer, the second conductive layer, the third conductive layer, the fourth conductive layer, and the third electrode; patterning the third organic functional layer and a fifth conductive layer such that side surfaces of the third organic functional layer and side surfaces of the fifth conductive layer are exposed; disposing a sixth conductive layer; and patterning the sixth conductive layer covering the side surfaces of the third organic functional layer, the side surfaces of the second conductive layer, side surfaces of the fourth conductive layer, and the side surfaces of the fifth conductive layer.

[0029] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention, and together with the description serve to explain the principles of the invention.

[0031] FIG. **1** is a schematic plan view of an organic light-emitting display (OLED) apparatus according to a first embodiment.

[0032] FIG. **2** is a plan view illustrating a portion of a display area of the OLED apparatus as illustrated in FIG. **1**.

[0033] FIG. **3** is a cross-sectional view of the OLED apparatus according to the first embodiment, taken along a line of FIG. **2**.

[0034] FIG. **4** is a schematic cross-sectional view for explaining an exemplary operation of forming a plurality of anodes on a substrate of the OLED apparatus according to the first embodiment.

[0035] FIG. **5** is a schematic cross-sectional view for explaining an exemplary operation of forming a pixel-defining layer in the OLED apparatus according to the first embodiment.

[0036] FIGS. **6**A, **6**B, **6**C, **6**D, **6**E, **6**F, and **6**G are schematic cross-sectional views for explaining a first unit process of forming the OLED apparatus according to the first embodiment.

[0037] FIGS. **7**A, **7**B, **7**C, **7**D, **7**E, **7**F, and **7**G are schematic cross-sectional views for explaining a second unit process of forming the OLED apparatus according to the first embodiment.

[0038] FIGS. **8**A, **8**B, **8**C, **8**D, **8**E, **8**F, and **8**G are schematic cross-sectional views for explaining a third unit process of forming the OLED apparatus according to the first embodiment.

[0039] FIGS. **9**A, **9**B, **9**C, **9**D, and **9**E are schematic cross-sectional views for explaining a first unit process of forming an organic light-emitting display (OLED) apparatus according to a comparative example.

[0040] FIGS. **10**A, **10**B, **10**C, **10**D, and **10**E are schematic cross-sectional views for explaining a second unit process of forming the OLED apparatus according to the comparative example.

[0041] FIGS. **11**A, **11**B, **11**C, **11**D, and **11**E are schematic cross-sectional views for explaining a third unit process of forming the OLED apparatus according to the comparative example.

[0042] FIG. **12** is a schematic cross-sectional view of an organic light-emitting display (OLED) apparatus according to a second embodiment.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

[0043] In the following description, for the purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of various exemplary embodiments. It is apparent, however, that various exemplary embodiments may be practiced without these specific details or with one or more equivalent arrangements. In other instances, well-known structures and devices are shown in block diagram form in order to avoid unnecessarily obscuring various exemplary embodiments.

[0044] Unless otherwise specified, the illustrated exemplary embodiments are to be understood as providing exemplary features of varying detail of various exemplary embodiments. Therefore, unless otherwise specified, the features, components, modules, layers, films, panels, regions, and/or aspects of the various illustrations may be otherwise combined, separated, interchanged, and/or rearranged without departing from the disclosed exemplary embodiments. Further, in the accompanying figures, the size and relative sizes of layers, films, panels, regions, etc., may be exaggerated for clarity and descriptive purposes. When an exemplary embodiment may be implemented differently, a specific process order may be performed differently from the described order. For example, two consecutively described processes may be performed substantially at the same time or performed in an order opposite to the described order. Also, like reference numerals denote like elements.

[0045] When an element or layer is referred to as being "on," "connected to," or "coupled to" another element or layer, it may be directly on, connected to, or coupled to the other element or layer or intervening elements or layers may be present. When, however, an element or layer is referred to as being "directly on," "directly connected to," or "directly coupled to" another element or layer, there are no intervening elements or layers present. Further, the x-axis, the y-axis, and the z-axis are not limited to three axes of a rectangular coordinate system, and may be interpreted in a broader sense. For example, the x-axis, the y-axis, and the z-axis may be perpendicular to one another, or may represent different directions that are not perpendicular to one another. For the purposes of this disclosure, "at least one of X, Y, and Z" and "at least one selected from the group consisting of X, Y, and Z" may be construed as X only, Y only, Z only, or any combination of two or more of X, Y, and Z, such as, for instance, XYZ, XYY, YZ, and ZZ. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

[0046] Although the terms "first," "second," etc. may be used herein to describe various elements, components, regions, layers, and/or sections, these elements, components, regions, layers, and/or sections should not be limited by these terms. These terms are used to distinguish one element, component, region, layer, and/or section from another element, component, region, layer, and/or section. Thus, a first element, component, region, layer, and/or section discussed below could be termed a second element, component, region, layer, and/or section without departing from the teachings of the present disclosure.

[0047] Spatially relative terms, such as "beneath," "below," "lower," "above," "upper," and the like, may be used herein for descriptive purposes, and, thereby, to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the drawings. Spatially relative terms are intended to encompass different orientations of an apparatus in use, operation, and/or manufacture in addition to the orientation depicted in the drawings. For example, if the apparatus in the drawings is turned over, elements described as "below" or "beneath" other elements or features would then be oriented "above" the other elements or features. Thus, the exemplary term "below" can encompass both an orientation of above and below. Furthermore, the apparatus may be otherwise oriented (e.g., rotated 90 degrees or at other orientations), and, as such, the spatially relative descriptors used herein interpreted accordingly.

[0048] The terminology used herein is for the purpose of describing particular embodiments and is not intended to be limiting. As used herein, the singular forms, "a," "an," and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. Moreover, the terms "comprises," "comprising," "includes," and/or "including," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, components, and/or groups thereof, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0049] Various exemplary embodiments are described herein with reference to sectional illustrations that are schematic illustrations of idealized exemplary embodiments and/or intermediate structures. As such, variations from the shapes of the illustrations as a result, for example, of manufacturing techniques and/or tolerances, are to be expected. Thus, exemplary embodiments disclosed herein should not be construed as limited to the particular illustrated shapes of regions, but are to include deviations in shapes that result from, for instance, manufacturing. For example, an implanted region illustrated as a rectangle will, typically, have rounded or curved features and/or a gradient of implant concentration at its edges rather than a binary change from implanted to non-implanted region. Likewise, a buried region formed by implantation may result in some implantation in the region between the buried region and the surface through which the implantation takes place. Thus, the regions illustrated in the drawings are schematic in nature and their shapes are not intended to illustrate the actual shape of a region of a device and are not intended to be limiting.

[0050] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the

art to which this disclosure is a part. Terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense, unless expressly so defined herein

[0051] FIG. **1** is a schematic plan view of an organic light-emitting display (OLED) apparatus **1** according to a first embodiment. FIG. **2** is a plan view illustrating a portion of a display area DA of the OLED apparatus as illustrated in FIG. **1**. FIG. **3** is a cross-sectional view of the OLED apparatus **1** of FIG. **1**, taken along a line of FIG. **2**.

[0052] Referring to FIG. **1**, the OLED apparatus **1** includes a substrate **100**. The substrate **100** includes a display area DA and a peripheral area PA outside the display area DA.

[0053] In the display area DA of the substrate **100**, pixels P including organic light-emitting devices (OLED) may be arranged. The peripheral area PA of the substrate **100** is an area where an image is not implemented and various wires for transmitting electrical signals to the display area DA are located in the peripheral area PA.

[0054] Referring to FIGS. **2** and **3**, the display area DA includes pixels P**1**, P**2**, and P**3** emitting light of different colors. Hereinafter, for convenience, the pixels P**1**, P**2**, and P**3** emitting light of different colors are referred to as a first pixel P**1**, a second pixel P**2**, and a third pixel P**3**.

[0055] According to an exemplary embodiment, the first pixel P**1** emits red light, the second pixel P**2** emits green light, and the third pixel P**3** emits blue light. In the present exemplary embodiment, three pixels, that is, the first, second, and third pixels P**1**, P**2**, and P**3**, are arranged in the display area DA. However, the exemplary embodiments are not limited thereto. in an exemplary embodiment, the display area DA may further include a fourth pixel (not shown) emitting white light in addition to the first, second, and third pixels P**1**, P**2**, and P**3**.

[0056] A first anode (or a first electrode) **101**, a second anode (or a second electrode) **102**, and a third anode (or a third electrode) **103** are respectively disposed in the first, second, and third pixels P**1**, P**2**, and P**3** on the substrate **100** and are spaced apart from each other.

[0057] A pixel-defining layer **110** covers end portions of the first, second, and third anodes **101**, **102**, and **103**.

[0058] A first organic functional layer **141** including a first emission layer, a second organic functional layer **142** including a second emission layer, and a third organic functional layer **143** including a third emission layer are respectively disposed on the first, second, and third anodes **101**, **102**, and **103**. A first auxiliary cathode (or a first opposing electrode) **150**, a second auxiliary cathode **160** (or a second opposing electrode), and a third auxiliary cathode **170** (or a third opposing electrode) are respectively disposed on the first, second, and third organic functional layers **141**, **142**, and **143**.

[0059] The first auxiliary cathode **150** includes a first conductive layer **181** disposed on the first organic functional layer **141**, a second conductive layer **182** covering side surfaces of the first organic functional layer **141**, a fourth conductive layer **184** covering side surfaces of the second conductive layer **182**, and a sixth conductive layer **186** covering side surfaces of the fourth conductive layer **184**. Thus, an area S(**150**) of the first auxiliary cathode **150** is greater than an area S(**101**) of the first anode **101** in the plan view.

[0060] The second auxiliary cathode **160** includes a third conductive layer **183** disposed on the second organic functional layer **142**, the fourth conductive layer **184** covering side surfaces of the second organic functional layer **142**, and the sixth conductive layer **186** covering side surfaces of the fourth conductive layer **184**. Thus, an area S(**160**) of the second auxiliary cathode **160** is greater than an area S(**102**) of the second anode **102** in the plan view.

[0061] The third auxiliary cathode **170** includes a fifth conductive layer **185** disposed on the third organic functional layer **143**, and the sixth conductive layer **186** covering side surfaces of the third organic functional layer **143**. Thus, an area S(**170**) of the third auxiliary cathode **170** is greater than an area S(**103**) of the third anode **103** in the plan view.

[0062] First, second, third, fourth, fifth, and sixth conductive layers **181**, **182**, **183**, **184**, **815**, and **186** may include metallic materials.

[0063] A sum of a lateral thickness T**2** of the second conductive layer **182**, a lateral thickness T**4** of the fourth conductive layer **184**, and a lateral thickness T**6** of the sixth conductive layer **186** is a lateral thickness L**1** of the first auxiliary cathode **150**. A sum of the lateral thickness T**4** of the fourth conductive layer **184** and the lateral thickness T**6** of the sixth conductive layer **186** is a lateral thickness L**2** of the second auxiliary cathode **160**. The lateral thickness T**6** of the sixth conductive layer **186** is equal to a lateral thickness L**3** of the third auxiliary cathode **170**. That is, the lateral thickness L**1** of a portion of the first auxiliary cathode **150** disposed on a side surface of the first organic functional layer **141** is greater than the lateral thickness L**2** of a portion of the second auxiliary cathode **160** disposed on a side surface of the second organic functional layer **142**. The lateral thickness L**2** of a portion of the second auxiliary cathode **160** disposed on the side surface of the second organic functional layer **142** is greater than the lateral thickness L**3** of a portion of the third auxiliary cathode **170** disposed on a side surface of the third organic functional layer **143**.

[0064] With reference to FIGS. **4**, **5**, **6**A, **6**B, **6**C, **6**D, **6**E, **6**F, **6**G, **7**A, **7**B, **7**C, **7**D, **7**E, **7**F, **7**G, **8**A, **8**B, **8**C, **8**D, **8**E, **8**F, and **8**G, a method of manufacturing the OLED apparatus **1** according to the present exemplary embodiment and the OLED apparatus **1** manufactured by the above method are described in more detail.

[0065] FIG. **4** is a schematic cross-sectional view for explaining an operation of forming the first, second, and third anodes **101**, **102**, and **103** on the substrate **100** of the OLED apparatus **1** according to the first embodiment. FIG. **5** is a schematic cross-sectional view for explaining an operation of forming a pixel-defining layer in the OLED apparatus **1** according to the first embodiment. FIGS. **6**A to **6**G are schematic cross-sectional views for explaining a first unit process of the OLED apparatus **1** according to the first embodiment. FIGS. **7**A to **7**G are schematic cross-sectional views for explaining a second unit process of the OLED apparatus **1** according to the first embodiment. FIGS. **8**A to **8**G are schematic cross-sectional views for explaining a third unit process of the OLED apparatus **1** according to the first embodiment.

[0066] Referring to FIG. **4**, the first anode **101**, the second anode **102**, and the third anode **103** are formed on the substrate **100**.

[0067] The substrate **100** may include various materials. For example, the substrate **100** may include glass or plastic. Examples of the plastic may include materials having excellent heat resistance and excellent durability such as polyimide, polyethylene naphthalate, polyethylene terephthalate, polyarylate, polycarbonate, polyetherimide, and polyethersulfone.

[0068] Additionally, a buffer layer for planarizing a top surface of the substrate **100** and preventing or reducing penetration of impurities may be further formed over the substrate **100**. For example, the buffer layer may be a layer or layers including silicon nitride, silicon oxide, and/or the like.

[0069] The first, second, and third anodes **101**, **102**, and **103** may be hole injection electrodes and include materials having a high work function. The first, second, and third anodes **101**, **102**, and **103** may each include a transparent conductive oxide component. For example, the first, second, and third anodes **101**, **102**, and **103** may include at least one of indium tin oxide, indium zinc oxide, zinc oxide, indium oxide, indium gallium oxide, and aluminum zinc oxide. Also, the first, second, and third anodes **101**, **102**, and **103** may each be a layer or layers including a metal such as silver (Ag), aluminum (Al), magnesium (Mg), lithium (Li), or calcium (Ca) and/or an alloy.

[0070] The first, second, and third anodes **101**, **102**, and **103** electrically contact first, second, and third thin-film transistors, respectively, wherein the first, second, and third thin-film transistors are disposed between the substrate **100** and the first, second, and third anodes **101**, **102**, and **103**.

[0071] Referring to FIG. **5**, the pixel-defining layer **110** surrounding edges of the first anode **101**, the second anode **102**, and the third anode **103** is formed on the substrate **100**.

[0072] Since edges of the first, second, and third anodes **101**, **102**, and **103** are sharp, when a current is applied after the first, second, and third auxiliary cathodes **150**, **160**, and **170** are formed, an electric field may be concentrated in the edges of the first, second, and third anodes **101**, **102** and **103**, and thus an electrical short circuit may occur during operation. However, in the present exemplary embodiment, the end portions of the first, second, and third anodes **101**, **102**, and **103** are covered by the pixel-defining layer **110**, and thus an electric field may be prevented or reduced from concentrating in the end portions of the first, second, and third anodes **101**, **102**, and **103**.

[0073] The pixel-defining layer **110** may be an organic insulating layer including, for example, a general-purpose polymer such as poly(methyl methacrylate) (PMMA) or polystyrene (PS), a polymer derivative having a phenol group, an acryl-based polymer, an imide-based polymer, an aryl ether-based polymer, an amide-based polymer, a fluorine-based polymer, a p-xylene-based polymer, a vinyl alcohol-based polymer, or a combination thereof.

[0074] Referring to FIG. **6**A, the first organic functional layer **141** and the first conductive layer **181** are sequentially deposited on the substrate **100** on which the first, second, and third anodes **101**, **102**, and **103** are formed.

[0075] The first organic functional layer **141** includes a first organic emission layer. Also, the first organic functional layer **141** may further include at least one functional layer including a hole injection layer, a hole transport layer, an electron transport layer, and an electron injection layer.

[0076] The first organic functional layer **141** may be formed by a vacuum deposition method. During a deposition process, the first organic functional layer **141** is formed on top surfaces of the first, second, and third anodes **101**, **102**, and **103** and on the pixel-defining layer **110**.

[0077] The first conductive layer **181** may be formed on the first organic functional layer **141** by a vacuum deposition method. The first conductive layer **181** may include Ag, Mg, Al, platinum (Pt), palladium (Pd), gold (Au), nickel (Ni), neodymium (Nd), iridium (Ir), chromium (Cr), Li, Ca, or an alloy thereof. The first conductive layer **181** may also include a transparent conductive material.

[0078] Referring to FIG. **6**B, a first photoresist **131** is disposed on the first conductive layer **181**. The first photoresist **131** is exposed to light using a first photomask M1 including an area M11 through which light L passes and an area M12 where light L is blocked.

[0079] Referring to FIG. **6**C, the first photoresist **131** is developed. The first photoresist **131** may be either a positive type or a negative type. In the present exemplary embodiment, the first photoresist **131** is a positive type. A first portion **131-1** of the developed first photoresist **131**, which corresponds to the first anode **101**, is formed as a pattern, and the rest of the first photoresist **131** is removed.

[0080] Referring to FIG. **6**D, the first portion **131-1** of the first photoresist **131** of FIG. **6**C is used as an etch mask, and the first organic functional layer **141** and the first conductive layer **181** are etched and patterned.

[0081] The first organic functional layer **141** and the first conductive layer **181** may be etched by a dry etching process. The dry etching process may be respectively performed on the first organic functional layer **141** and the first conductive layer **181**. For example, the first conductive layer **181** may be dry-etched by using a gas including fluorine F or chlorine Cl, and then the first organic functional layer **141** may be dry-etched by using oxygen gas.

[0082] Referring to FIG. **6**E, the first portion **131-1** (see FIG. **6**D) of the first photoresist **131** is removed. The first portion **131-1** of the first photoresist **131** may be removed by a dry process such as ashing or stripping.

[0083] As the first portion **131-1** of the first photoresist **131** is removed, the first organic functional layer **141** and the first conductive layer **181** are formed as patterns over the first anode **101**.

[0084] Referring to FIG. **6**F, the second conductive layer **182** is deposited on the structure illustrated in FIG. **6**E.

[0085] The second conductive layer **182** may include the same material as or a different material from the above-described first conductive layer **181**. The second conductive layer **182** covers a top surface **181**-T of the first conductive layer **181** as well as side surfaces **141**-S of the first organic functional layer **141** and side surfaces **181**-S of the first conductive layer **181**.

[0086] Referring to FIG. **6**G, the second conductive layer **182** is patterned such that portions of the second conductive layer **182**, which cover the side surfaces **141**-S of the first organic functional layer **141** and the side surfaces **181**-S of the first conductive layer **181**, is formed at a location corresponding to the first anode **101**, and the rest of the second conductive layer **182** is removed.

[0087] The second conductive layer **182** may be patterned by a dry etching method. The second conductive layer **182**

may be dry-etched by using a gas including F or Cl. By performing the dry etching method which does not use a solvent, damage to a solvent of the first organic functional layer **141** may be prevented or reduced, and by performing anisotropic etching, the second conductive layer **182** may only be disposed along the side surfaces **181**-S of the first conductive layer **181**, without increasing a thickness of the first conductive layer **181** from the top surface **181**-T thereof.

[0088] Also, the top surface **141**-T of the first organic functional layer **141** is covered by the first conductive layer **181**, and the side surfaces **141**-S thereof are surrounded by the second conductive layer **182**, thereby preventing or reducing deterioration of the first organic functional layer **141** which may be caused by a subsequent process.

[0089] After the first unit process is performed, the second unit process for forming the second organic functional layer **142** is performed at a location where the second anode **102** is disposed, the second organic functional layer **142** emitting light of a different color from the first organic functional layer **141**. Hereinafter, the second unit process is described with reference to FIGS. **7**A, **7**B, **7**C, **7**D, **7**E, **7**F, and **7**G.

[0090] Referring to FIG. **7**A, the second organic functional layer **142** and the third conductive layer **183** are sequentially deposited on the structure illustrated in FIG. **6**G.

[0091] The second organic functional layer **142** may include a second organic emission layer that emits light of a different color from the first organic emission layer. Also, the second organic functional layer **142** may further include at least one functional layer including a hole injection layer, a hole transport layer, an electron transport layer, and an electron injection layer. The second organic functional layer **142** may be formed by a vacuum deposition method.

[0092] The third conductive layer **183** may be formed on the second organic functional layer **142** by a vacuum deposition method. The third conductive layer **183** may include the same material as or a different material from the first conductive layer **181**. The third conductive layer **183** may also include the same material as or a different material from the second conductive layer **182**.

[0093] Referring to FIG. **7**B, a second photoresist **132** is disposed on the third conductive layer **183**. The second photoresist **132** is exposed to light using a second photomask M2 including an area M21 through which light L passes and an area M22 where light L is blocked.

[0094] Referring to FIG. **7**C, the second photoresist **132** is developed. The second photoresist **132** may be either a positive type or a negative type. In the present exemplary embodiment, the second photoresist **132** is a positive type. A first portion **132-1** of the developed second photoresist **132** is formed as a pattern and corresponds to the second anode **102**. The rest of the second photoresist **132** is removed.

[0095] Referring to FIG. **7**D, the second organic functional layer **142** and the third conductive layer **183** are etched and patterned by using the first portion **132-1** of the second photoresist **132** of FIG. **7**C as an etch mask.

[0096] The second organic functional layer **142** and the third conductive layer **183** may be etched by a dry etching process. The dry etching process may be respectively performed on the second organic functional layer **142** and the third conductive layer **183**. For example, the third conductive layer **183** may be dry-etched by using a gas including F or Cl, and then the second organic functional layer **142** may be dry-etched by using oxygen gas.

[0097] Referring to FIG. **7**E, the first portion **132-1** (see FIG. **7**D) of the second photoresist **132** is removed. The first portion **132-1** of the second photoresist **132** may be removed by a dry process such as ashing or stripping.

[0098] As the first portion **132-1** of the second photoresist **132** is removed, the second organic functional layer **142** and the third conductive layer **183** are formed as patterns over the second anode **102**.

[0099] Referring to FIG. **7**F, the fourth conductive layer **184** is deposited on the structure illustrated in FIG. **7**E.

[0100] The fourth conductive layer **184** may include the same material as or a different material from the above-described third conductive layer **183**. The fourth conductive layer **184** covers a top surface **183**-T of the third conductive layer **183** over the second anode **102** as well as side surfaces **142**-S of the second organic functional layer **142** and side surfaces **183**-S of the third conductive layer **183**.

[0101] The fourth conductive layer **184** covers the top surface **181**-T of the first conductive layer **181** over the first anode **101** as well as the side surfaces **182**-S of the second conductive layer **182**.

[0102] Referring to FIG. **7**G, the fourth conductive layer **184** is patterned such that portions of the fourth conductive layer **184**, which cover the side surfaces **182**-S of the second conductive layer **182**, are formed at a location corresponding to the first anode **101**, portions of the fourth conductive layer **184**, which cover the side surfaces **142**-S of the second organic functional layer **142** and the side surfaces **183**-S of the third conductive layer **183**, are formed at a location corresponding to the second anode **102**, and the rest of the fourth conductive layer **184** is removed.

[0103] The fourth conductive layer **184** is patterned by a dry etching method. The fourth conductive layer **184** may be dry-etched by using a gas including F or Cl. By performing the dry etching method which does not use a solvent, damage to a solvent of the second organic functional layer **142** may be prevented or reduced, and by performing anisotropic etching, the fourth conductive layer **184** may only be disposed along the side surfaces **182**-S of the second conductive layer **182** and the side surfaces **183**-S of the third conductive layer **183**, without increasing respective thicknesses of the first conductive layer **181** and the third conductive layer **183** from the top surfaces **181**-T and **183**-T thereof.

[0104] Also, a top surface of the second organic functional layer **142** is covered by the third conductive layer **183**, and the side surfaces **142**-S of the second organic functional layer **142** are surrounded by the fourth conductive layer **184**, thereby preventing or reducing deterioration of the second organic functional layer **142** which may be caused by a subsequent process.

[0105] After the above-described second unit process is performed, a third unit process of forming the third organic functional layer **143** is performed at a location where the third anode **103** is disposed, wherein the third organic functional layer **143** emits light of a different color from the first organic functional layer **141** and the second organic functional layer **142**. The third unit process is described with reference to FIGS. **8**A to **8**G.

[0106] Referring to FIG. **8**A, the third organic functional layer **143** and the fifth conductive layer **185** are sequentially deposited on the structure illustrated in FIG. **7**G.

[0107] The third organic functional layer **143** may include a third organic emission layer that emits light of a different color from the first emission layer (not shown) and the second emission layer. The third organic functional layer **143** may further include at least one functional layer including a hole injection layer, a hole transport layer, an electron transport layer, and an electron injection layer. The third organic functional layer **143** may be formed by a vacuum deposition method.

[0108] The fifth conductive layer **185** may be formed on the third organic functional layer **143** by a vacuum deposition method. The fifth conductive layer **185** may include the same material as or a different material from the third conductive layer **183**. Also, the fifth conductive layer **185** may include the same material as or a different material from the fourth conductive layer **184**.

[0109] Referring to FIG. **8**B, a third photoresist **133** is disposed on the fifth conductive layer **185**. The third photoresist **133** is exposed to light using a third photomask M**3** including an area M**31** through which light L passes and an area M**32** where light L is blocked.

[0110] Referring to FIG. **8**C, the third photoresist **133** is developed. The third photoresist **133** may be of either a positive type or a negative type. In the present embodiment, the third photoresist **133** is of a positive type. A first portion **133-1** of the developed third photoresist **133** is formed as a pattern at a location corresponding to the third anode **103**, and the rest thereof is removed.

[0111] Referring to FIG. **8**D, the third organic functional layer **143** and the fifth conductive layer **185** are etched and then patterned using the first portion **133-1** of the third photoresist **133** of FIG. **8**C as an etch mask.

[0112] The third organic functional layer **143** and the fifth conductive layer **185** may be etched by a dry etching process. The dry etching process may be respectively performed on the third organic functional layer **143** and the fifth conductive layer **185**. For example, after the fifth conductive layer **185** is dry-etched by using a gas including F or Cl, the third organic functional layer **143** may be dry-etched by using oxygen gas.

[0113] Referring to FIG. **8**E, the first portion **133-1** (see FIG. **8**D) of the third photoresist **133** is removed. The first portion **133-1** of the third photoresist **133** may be removed by dry process such as ashing or stripping.

[0114] As the first portion **133-1** of the third photoresist **133** is removed, the third organic functional layer **143** and the fifth conductive layer **185** are formed as patterns over the third anode **103**.

[0115] Referring to FIG. **8**F, the sixth conductive layer **186** is deposited on the structure illustrated in FIG. **8**E.

[0116] The sixth conductive layer **186** may include the same material as or a different material from the above-described fifth conductive layer **185**.

[0117] The sixth conductive layer **186** covers a top surface **185**-T of the fifth conductive layer **185** as well as side surfaces **143**-S of the third organic functional layer **143** and side surfaces **185**-S of the fifth conductive layer **185** over the third anode **103**. The sixth conductive layer **186** covers the top surface **181**-T of the first conductive layer **181** as well as the side surfaces **184**-S of the fourth conductive layer **184** over the first anode **101**. In addition, the sixth conductive layer **186** covers the top surface **183**-T of the third conductive layer **183** as well as the side surfaces **184**-S of the fourth conductive layer **184** over the second anode **102**.

[0118] Referring to FIG. **8**G, the sixth conductive layer **186** is patterned such that portions of the sixth conductive layer **186**, which cover the side surfaces **184**-S of the fourth conductive layer **184**, are formed at a location corresponding to the first anode **101**, portions of the sixth conductive layer **186**, which cover the side surfaces **184**-S of the fourth conductive layer **184**, are formed at a location corresponding to the second anode **102**, portions of the sixth conductive layer **186**, which cover the side surfaces **143**-S of the third organic functional layer **143** and the side surfaces **185**-S of the fifth conductive layer **185**, are formed at a location corresponding to the third anode **103**, and the rest of the sixth conductive layer **186** is removed.

[0119] The sixth conductive layer **186** is patterned by a dry etching method. The sixth conductive layer **186** may be dry-etched by using a gas including F or Cl. By performing the dry etching method which does not use a solvent is not used, damage to a solvent of the third organic functional layer **143** may be prevented or reduced, and by performing anisotropic etching, the sixth conductive layer **186** may only disposed along the side surfaces **184**-S of the fourth conductive layer **184** and the side surfaces **185**-S of the fifth conductive layer **185**, without increasing respective thicknesses of the first, third, and fifth conductive layers **181**, **183**, and **185** from the top surfaces **181**-T, **183**-T, and **185**-T thereof.

[0120] According to the first, second, and third unit processes, in the first auxiliary cathode **150** (see FIG. **3**), the second conductive layer **182**, the fourth conductive layer **184**, and the sixth conductive layer **186** are formed adjacent to outer portions or edges of the first conductive layer **181**. In the second auxiliary cathode **160** (see FIG. **3**), the fourth conductive layer **184** and the sixth conductive layer **186** are formed adjacent to outer portions or edges of the third conductive layer **183**, and in the third auxiliary cathode **170** (see FIG. **3**), the sixth conductive layer **186** is formed on outer portions or edges of the fifth conductive layer **185**. Thus, an area of the first auxiliary cathode **150** in plan view is greater than an area of the second auxiliary cathode **160** in plan view, and the area of the second auxiliary cathode **160** in plan view is greater than an area of the third auxiliary cathode **170** in plan view.

[0121] The top surface of the third organic functional layer **143** is covered by the fifth conductive layer **185**, and the side surfaces **143**-S of the third organic functional layer **143** are surrounded by the sixth conductive layer **186**, thereby preventing or reducing deterioration of the third organic functional layer **143** that may be caused by a subsequent process.

[0122] FIG. **12** is a schematic cross-sectional view of an organic light-emitting display (OLED) apparatus **2** according to a second embodiment.

[0123] Referring to FIG. **12**, unlike the OLED apparatus **1** of FIG. **1**, the OLED apparatus **2** further includes a cathode **180**. The cathode **180** is integrally formed as a common electrode on the top surfaces and the side surfaces of the first, second, and third auxiliary cathodes **150**, **160**, and **170**.

[0124] The cathode **180** may include the same material as or a different material from the first, second, and third auxiliary cathodes **150**, **160**, and **170**. As described above, the first, second, and third auxiliary cathodes **150**, **160**, and **170** surround the side surfaces of the first, second, and third organic functional layers **141**, **142**, and **143** and function as barriers preventing or reducing penetration of external oxygen and moisture into the first, second, and third organic

functional layers **141**, **142**, and **143**, during the first, second, and third unit processes. The cathode **180**, which is a common electrode, is deposited again on the first, second, and third organic functional layers **141**, **142**, and **143** so as to protect the first, second, and third organic functional layers **141**, **142**, and **143** and decrease a voltage drop resulting from cathode resistance.

[0125] In the present embodiment, the first, second, and third anodes **101**, **102**, and **103** are described as hole injection electrodes, and the first, second, and third auxiliary cathodes **150**, **160**, and **170** are described as electron injection electrodes. However, these descriptions are merely examples, and the exemplary embodiments are not limited thereto. Electron injection electrodes may be formed respectively at locations where the first, second, and third anodes **101**, **102**, and **103** are disposed, and hole injection electrodes may be formed respectively at locations where the first, second, and third auxiliary cathodes **150**, **160**, and **170** and the cathode **180** are disposed.

[0126] During a process of depositing an organic functional layer using a metal mask in which an opening is formed, it is difficult to apply the metal mask to an ultra-high-definition display panel because it is difficult to precisely process the metal mask due to a thickness and alignment tolerance thereof, and also it is difficult to increase the size of the metal mask due to deflection caused by a weight of the metal mask. However, according to the present embodiment, patterns of the first, second, and third organic functional layers **141**, **142**, and **143** are formed by a dry process and a photolithography process, not by a deposition process using a metal mask, and thus problems that may be caused by using a metal mask may be solved.

[0127] In the present embodiment, an organic functional layer and an auxiliary cathode are formed by a photolithography process and a dry process instead of a process of using an expensive fluorine-based resin or solvent, and thus manufacturing costs may be reduced by reducing costs of an expensive fluorine-based resin coating.

[0128] Hereinafter, a method of manufacturing an organic light-emitting display (OLED) apparatus according to a comparative example is described with reference to FIGS. **9**A to **9**E.

[0129] FIGS. **9**A, **9**B, **9**C, **9**D, and **9**E are schematic cross-sectional views for explaining a first unit process of forming an OLED apparatus according to a comparative example. FIGS. **10**A, **10**B, **10**C, **10**D, and to **10**E are schematic cross-sectional views for explaining a second unit process of forming the OLED apparatus according to the comparative example. FIGS. **11**A, **11**B, **11**C, **11**D, and to **11**E are schematic cross-sectional views for explaining a third unit process of forming the OLED apparatus according to the comparative example.

[0130] Referring to FIG. **9**A, a first lift-off layer **121** including a fluoropolymer is formed over the substrate **100** on which the first, second, and third anodes **101**, **102**, and **103** and the pixel-defining layer **110** covering end portions or edges of the first, second, and third anodes **101**, **102**, and **103** are formed. Then, the first photoresist **131** is formed on the first lift-off layer **121**.

[0131] Referring to FIG. **9**B, the first photoresist **131** is patterned. The first photoresist **131** is exposed and developed and then the first portion **131-1** corresponding to the first anode **101** is removed therefrom, and a second portion **131-2** other than the first portion **131-1** is formed.

[0132] Referring to FIG. **9**C, the first lift-off layer **121** is etched by using a pattern of the first photoresist **131** of FIG. **9**B as an etch mask and using a first solvent including fluorine F. During the etching process, a portion of the first lift-off layer **121** disposed on the first anode **101** at a location corresponding to the first portion **131-1** is etched. The first lift-off layer **121** is etched to form a first undercut profile UC**1** under a surface of a boundary of the first portion **131-1** of the first photoresist **131**.

[0133] Referring to FIG. **9**D, the first organic functional layer **141** and the first conductive layer **181** are sequentially formed over the structure illustrated in FIG. **9**C.

[0134] Referring to FIG. **9**E, a first lift-off process is performed to entirely remove all remaining portions of the first lift-off layer **121**, and accordingly, the first organic functional layer **141** and the first conductive layer **181** are formed as patterns over the first anode **101**. In this case, the side surfaces **141**-S of the first organic functional layer **141** and the side surfaces **181**-S of the first conductive layer **181** are exposed.

[0135] After the first unit process is completed, the second unit process is performed.

[0136] Referring to FIG. **10**A, a second lift-off layer **122** and the second photoresist **132** are sequentially formed over the structure illustrated in FIG. **9**E.

[0137] The second lift-off layer **122** includes a fluoropolymer. The fluoropolymer is electrochemically stable due to its low interaction with other materials, but when the second lift-off layer **122** contacts the side surfaces **141**-S of the first organic functional layer **141**, the first organic functional layer **141** may be deteriorated.

[0138] Referring to FIG. **10**B, the second photoresist **132** is exposed and developed. The second photoresist **132** is patterned such that the first portion **132-1** corresponding to the second anode **102** is removed and a second portion **132-2** other than the first portion **132-1** is formed.

[0139] Referring to FIG. **10**C, the second lift-off layer **122** is etched by using a pattern of the second photoresist **132** of FIG. **10**B as an etch mask and using the first solvent including fluorine F. During the etching process, a portion of the second lift-off layer **122** disposed on the second anode **102** at a location corresponding to the first portion **132-2** is etched. The second lift-off layer **122** is etched to form a second undercut profile UC**2** under a surface of a boundary of the second portion **132-2** of the second photoresist **132**.

[0140] During a wet etching process using the first solvent, the first solvent is absorbed by the second lift-off layer **122**, and thus delivered to the first organic functional layer **141** through the side surfaces **141**-S of the first organic functional layer **141**.

[0141] Referring to FIG. **10**D, the second organic functional layer **142** and the third conductive layer **183** are sequentially formed over the structure illustrated in FIG. **10**C.

[0142] Referring to FIG. **10**E, the second lift-off process is performed to entirely remove all remaining portions of the second lift-off layer **122**, and accordingly the first organic functional layer **141** and the first conductive layer **181** are formed as patterns over the first anode **101**, and the second organic functional layer **142** and the third conductive layer **183** are formed as patterns over the second anode **102**.

[0143] In this case, the side surfaces **141**-S of the first organic functional layer **141** and the side surfaces **181**-S of the first conductive layer **181** are exposed. In addition, the

side surfaces **142**-S of the second organic functional layer **142** and the side surface **183**-S of the third conductive layer **183** are exposed.

[0144] After the second unit process is completed, the third unit process is performed.

[0145] Referring to FIG. **11**A, a third lift-off layer **123** and a third photoresist **133** are sequentially formed over the structure illustrated in FIG. **10**E.

[0146] The third lift-off layer **123** includes a fluoropolymer. The fluoropolymer is electrochemically stable due to its low interaction with other materials, but when the third lift-off layer **123** contacts the side surfaces **141**-S of the first organic functional layer **141** and the side surfaces **142**-S of the second organic functional layer **142**, the first organic functional layer **141** and the second organic functional layer **142** may be deteriorated.

[0147] Referring to FIG. **11**B, the third photoresist **133** is exposed and developed. The third photoresist **133** is patterned such that the first portion **133-1** corresponding to the third anode **103** is removed therefrom and a second portion **133-2** other than the first portion **133-1** is formed.

[0148] Referring to FIG. **11**C, the third lift-off layer **123** is etched by using a pattern of the third photoresist **133** of FIG. **11**B as an etch mask and using the first solvent including fluorine F. During the wet etching process using the first solvent, the first solvent may be absorbed by the third lift-off layer **123**, and thus may be delivered to the first organic functional layer **141** and the second organic functional layer **142** through the side surfaces **141**-S of the first organic functional layer **141** and the side surfaces **142**-S of the second organic functional layer **142**.

[0149] Referring to FIG. **11**D, the third organic functional layer **143** and the fifth conductive layer **185** are sequentially formed over the structure illustrated in FIG. **11**C.

[0150] Referring to FIG. **11**E, the third lift-off process is performed to entirely remove all remaining portions of the third lift-off layer **123**, and accordingly, the first organic functional layer **141** and the first conductive layer **181** over the first anode **101**, the second organic functional layer **142** and the third conductive layer **183** over the second anode **102**, and the third organic functional layer **143** and the fifth conductive layer **185** over the third anode **103** are formed as patterns.

[0151] In this case, the side surfaces **141**-S of the first organic functional layer **141** and the side surfaces **181**-S of the first conductive layer **181** are exposed. In addition, the side surfaces **142**-S of the second organic functional layer **142** and the side surfaces **183**-S of the third conductive layer **183** are exposed. Moreover, the side surfaces **143**-S of the third organic functional layer **143** and the side surfaces **185**-S of the fifth conductive layer **185** are exposed.

[0152] That is, according to the method of manufacturing the OLED apparatus according to the comparative example of FIGS. **9**A, **9**B, **9**C, **9**D, and **9**E, the side surfaces **141**-S, **142**-S, and **143**-S of the first, second, and third organic functional layers **141**, **142**, and **143** are exposed during the first, second, and third unit processes such that the first, second, and third organic functional layers **141**, **142**, and **143** may be damaged due to a lift-off layer and a solvent, and as the first, second, and third lift-off processes are repeated, manufacturing costs may increase due to an increase in the use of expensive fluorine-based resin.

[0153] Although not illustrated in the drawings, the above-described OLED apparatuses may further include an encapsulation member that encapsulates an organic emission layer. The encapsulation member may include a glass substrate, a metal foil, and a thin-film encapsulation layer in which an inorganic layer and an organic layer are combined.

[0154] According to the above embodiments, since an emission layer is formed without using a fine metal mask (FMM), a high-resolution display panel may be formed.

[0155] Also, according to an exemplary embodiment, dry etching is performed instead of lift-off processing in which fluorine-based resin and a fluorine-based solvent are used, and thus damage to an organic functional layer due to the fluorine-based resin and the fluorine-based solvent may decrease such that a yield may be improved.

[0156] In addition, according to an exemplary embodiment, manufacturing costs may be reduced without using expensive fluorine-based resin.

[0157] It should be understood that embodiments described herein should be considered in a descriptive sense only and not for purposes of limitation. Descriptions of features or aspects within each embodiment should typically be considered as available for other similar features or aspects in other embodiments.

[0158] While one or more embodiments have been described with reference to the figures, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope as defined by the following claims.

What is claimed is:

1. An organic light-emitting display (OLED) apparatus, comprising:

a first electrode;

a second electrode disposed separate from the first electrode;

a pixel-defining layer covering an edge of the first electrode and an edge of the second electrode;

a first organic functional layer disposed on the first electrode and the pixel-defining layer, the first organic functional layer comprising a first emission layer;

a first opposing electrode covering a top surface and enclosing an outer circumference of side surfaces of the first organic functional layer;

a second organic functional layer disposed on the second electrode and the pixel-defining layer, the second organic functional layer comprising a second emission layer; and

a second opposing electrode covering a top surface and enclosing an outer circumference of side surfaces of the second organic functional layer,

wherein an area of the first opposing electrode in contact with the pixel-defining layer is greater than an area of the second opposing electrode in contact with the pixel-defining layer.

2. The OLED apparatus of claim **1**, wherein a first color of light emitted from the first emission layer is different from a second color of light emitted from the second emission layer.

3. The OLED apparatus of claim **1**, wherein each of the first organic functional layer and the second organic functional layer comprises at least one layer selected from the group consisting of a hole injection layer, a hole transport layer, an electron injection layer, and an electron transport layer.

4. The OLED apparatus of claim **1**, wherein a thickness of a portion of the first opposing electrode covering the top

surface of the first organic functional layer is as same as a thickness of a portion of the second opposing electrode covering the top surface of the second organic functional layer.

5. The OLED apparatus of claim **1**, wherein the pixel-defining layer comprises an insulating layer.

6. The OLED apparatus of claim **5**, wherein an edge of the first organic functional layer and an edge of the second organic functional layer are disposed on an inclined surface of the pixel-defining layer.

7. The OLED apparatus of claim **1**, further comprising a common electrode that is commonly and integrally disposed on the first opposing electrode and the second opposing electrode.

8. The OLED apparatus of claim **7**, wherein the common electrode covers side surfaces of the first opposing electrode and side surfaces of the second opposing electrode.

9. The OLED apparatus of claim **1**, further comprising:

a third electrode disposed separate from the first electrode and the second electrode;

a third organic functional layer disposed on the third electrode, the third organic functional layer comprising a third emission layer; and

a third opposing electrode covering a top surface and enclosing an outer circumference of side surfaces of the third organic functional layer,

wherein the pixel-defining layer further covers an edge of the third electrode, and

wherein an area of the second opposing electrode in contact with the pixel-defining layer is greater than an area of the third opposing electrode in contact with the pixel-defining layer.

10. The OLED apparatus of claim **9**, wherein a first color of light emitted from the first emission layer, a second color of light emitted from the second emission layer, and a third color of light emitted from the third emission layer are different from one another.

11. An organic light-emitting display (OLED) apparatus, comprising:

a first electrode;

a first organic functional layer disposed on the first electrode, the first organic functional layer comprising a first emission layer;

a first opposing electrode comprising a first conductive layer covering a top surface of the first organic functional layer, a second conductive layer surrounding side surfaces of the first organic functional layer, a third conductive layer surrounding side surfaces of the second conductive layer, and a fourth conductive layer surrounding side surfaces of the third conductive layer;

a second electrode disposed separate from the first electrode;

a second organic functional layer disposed on the second electrode, the second organic functional layer comprising a second emission layer; and

a second opposing electrode comprising a fifth conductive layer covering a top surface of the second organic functional layer, a sixth conductive layer surrounding side surfaces of the second organic functional layer, and a seventh conductive layer surrounding side surfaces of the sixth conductive layer.

12. The OLED apparatus of claim **11**, wherein, in a plan view, an area of the first opposing electrode is greater than an area of the second opposing electrode.

13. The OLED apparatus of claim **11**, wherein the material of the third conductive layer is the same as that of the sixth conductive layer.

14. The OLED apparatus of claim **11**, further comprising a pixel-defining layer comprising an insulating layer, the pixel-defining layer covering an edge of the first electrode and an edge of the second electrode.

15. The OLED apparatus of claim **14**, wherein an edge of the first organic functional layer and an edge of the second organic functional layer are disposed on an inclined surface of the pixel-defining layer.

16. The OLED apparatus of claim **11**, further comprising a common electrode that is commonly and integrally disposed on the first opposing electrode and the second opposing electrode.

17. The OLED apparatus of claim **16**, wherein the common electrode covers side surfaces of the first opposing electrode and side surfaces of the second opposing electrode.

18. The OLED apparatus of claim **11**, further comprising:

a third electrode disposed separate from the first electrode and the second electrode;

a third organic functional layer disposed on the third electrode, the third organic functional layer comprising a third emission layer; and

a third opposing electrode comprising an eighth conductive layer covering a top surface of the third organic functional layer, and a ninth conductive layer surrounding side surfaces of the third organic functional layer.

19. The OLED apparatus of claim **18**, wherein the material of the ninth conductive layer is the same as those of the forth conductive layer and the seventh conductive layer.

* * * * *

专利名称(译)	有机发光显示装置及其制造方法		
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[标]申请(专利权)人(译)	三星显示有限公司		
申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
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发明人	CHOI, SHINIL YANG, SUNGHOON		
IPC分类号	H01L51/52 H01L27/32 H01L51/00 H01L51/56		
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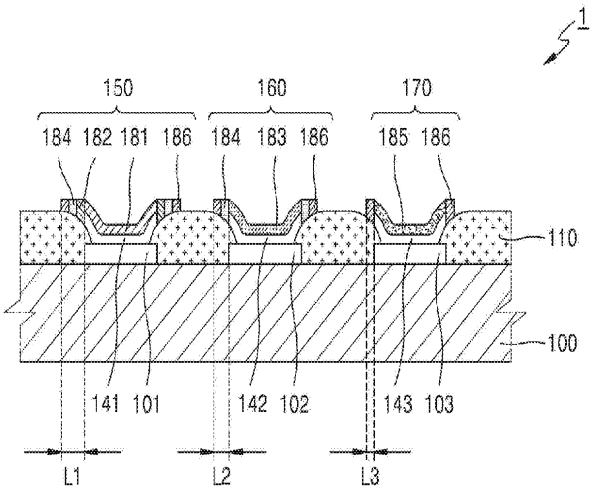
摘要(译)

有机发光显示（OLED）装置包括：第一电极；和第二电极。 与第一电极分开设置的第二电极； 像素限定层，其覆盖第一电极的边缘和第二电极的边缘； 设置在第一电极上的第一有机功能层和包括第一发射层的像素限定层； 第一相对电极，其覆盖顶表面并且包围第一有机功能层的侧表面的外圆周； 第二有机功能层设置在第二电极上，并且像素限定层包括第二发射层； 第二相对电极，其覆盖顶表面并包围第二有机功能层的侧表面的外周。 与像素限定层接触的第一相对电极的面积大于与像素限定层接触的第二相对电极的面积。