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

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(57) **ABSTRACT**

An organic light-emitting display apparatus includes a substrate; an active layer disposed on the substrate; a gate electrode disposed so as to be insulated from the active layer and to correspond to a part of the active layer; a source electrode including a first source electrode layer connected to the active layer, and a second source electrode layer connected to the first source electrode layer and is larger than the first source electrode layer; a drain electrode including a first drain electrode layer connected to the active layer, and a second drain electrode layer connected to the first drain electrode layer and is larger than the first drain electrode layer; a pixel electrode electrically connected to at least one of the source electrode or the drain electrode; and a color filter disposed between the substrate and the pixel electrode.

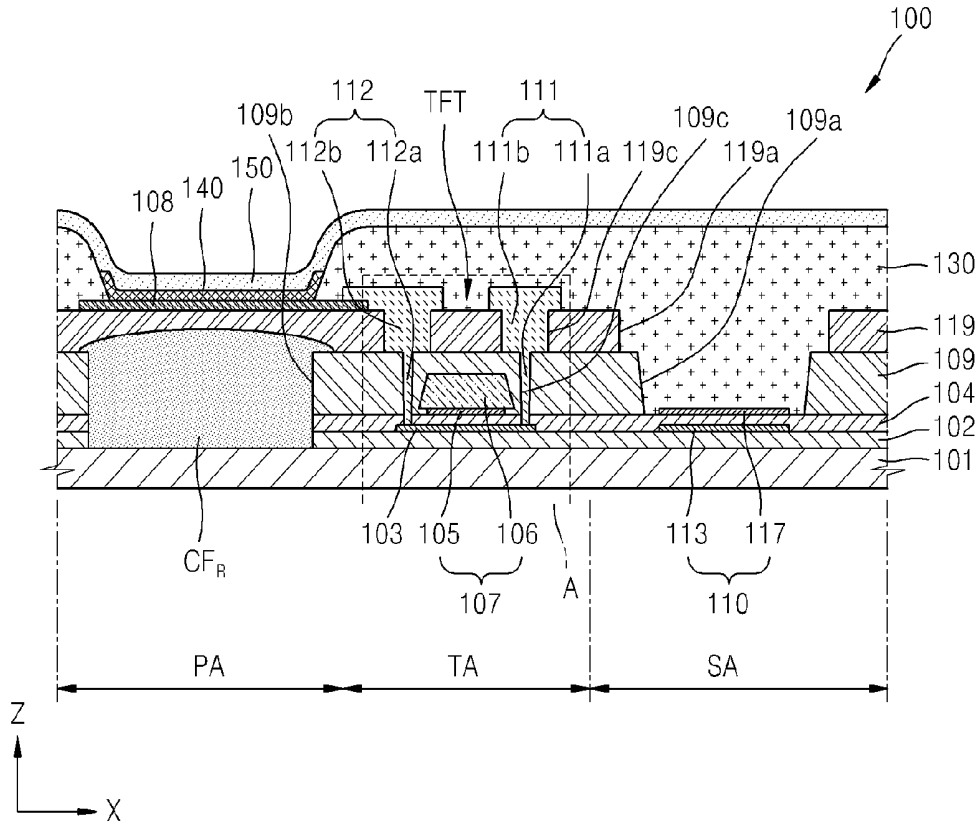

FIG. 1

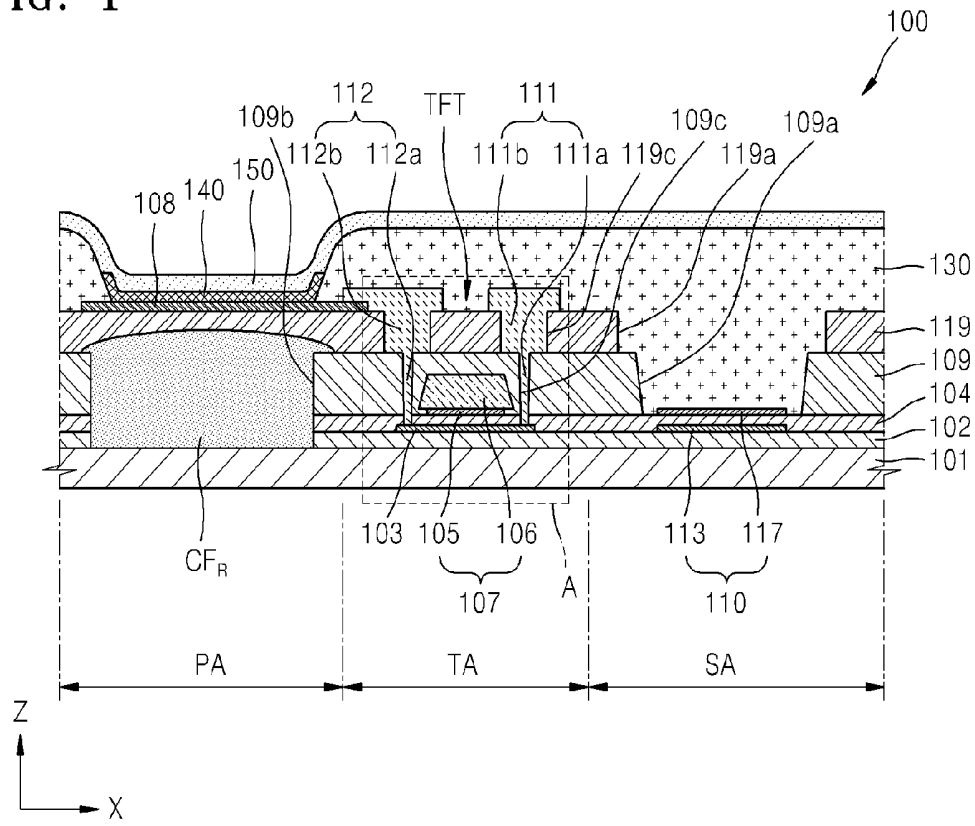
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FIG. 2

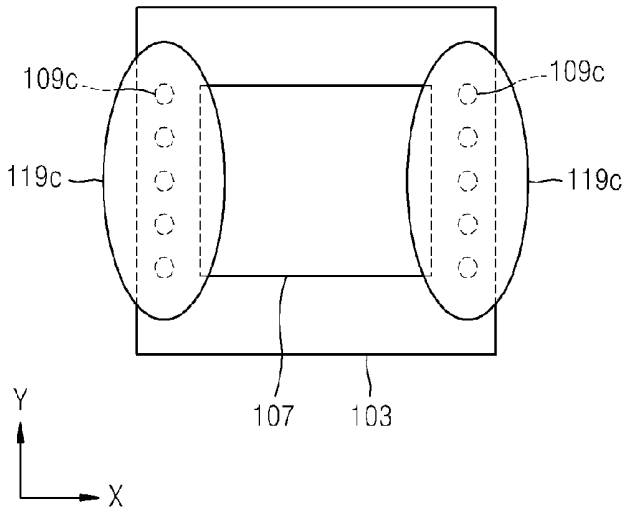
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FIG. 3

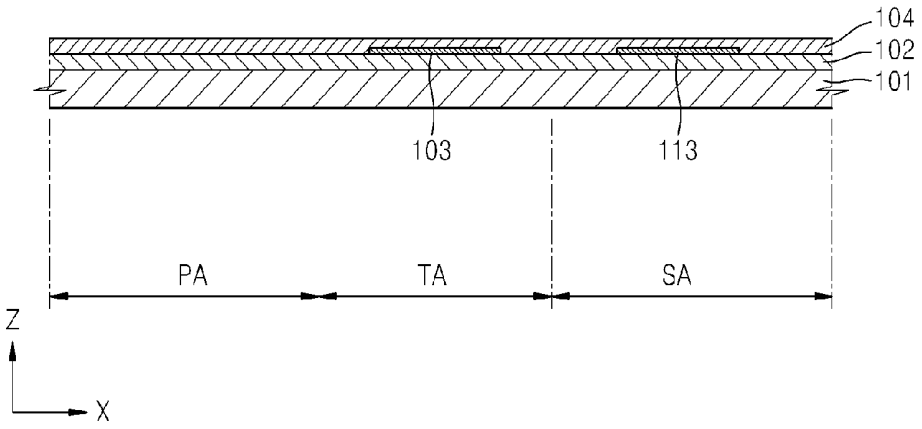
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FIG. 4

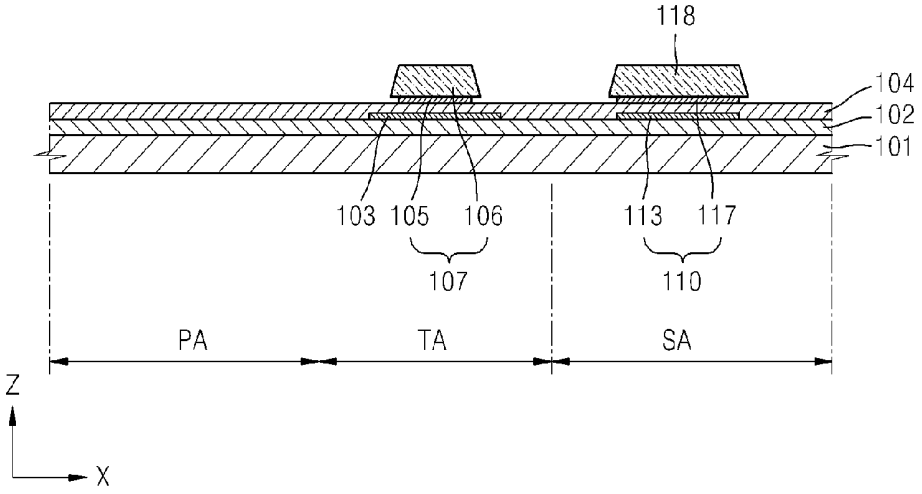
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FIG. 5

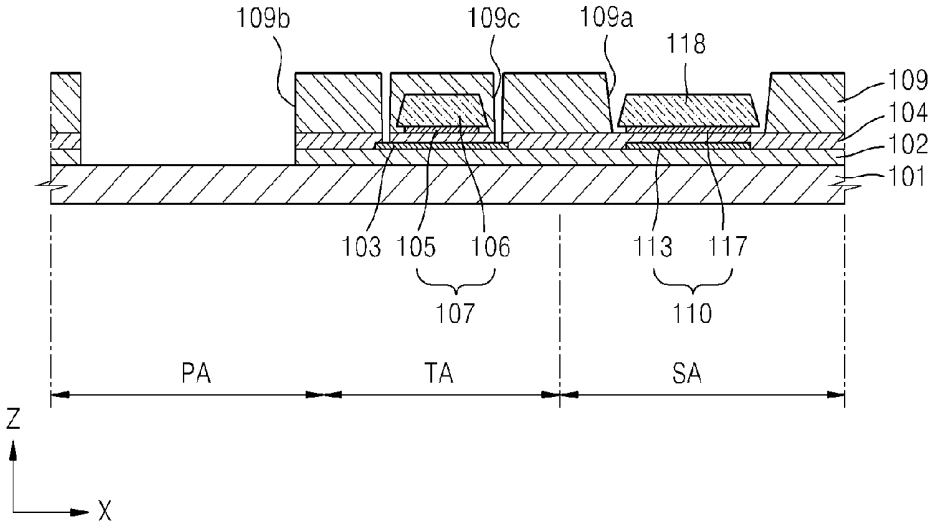
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FIG. 6

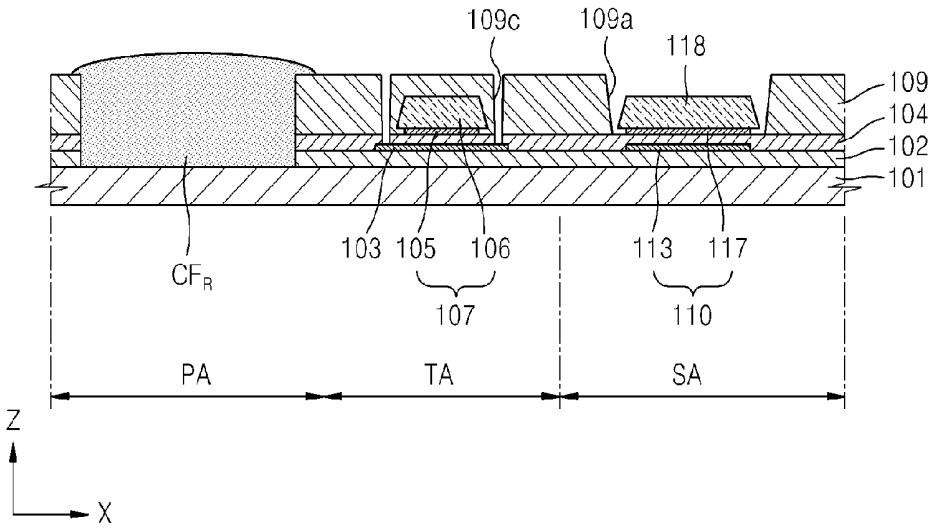
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FIG. 7

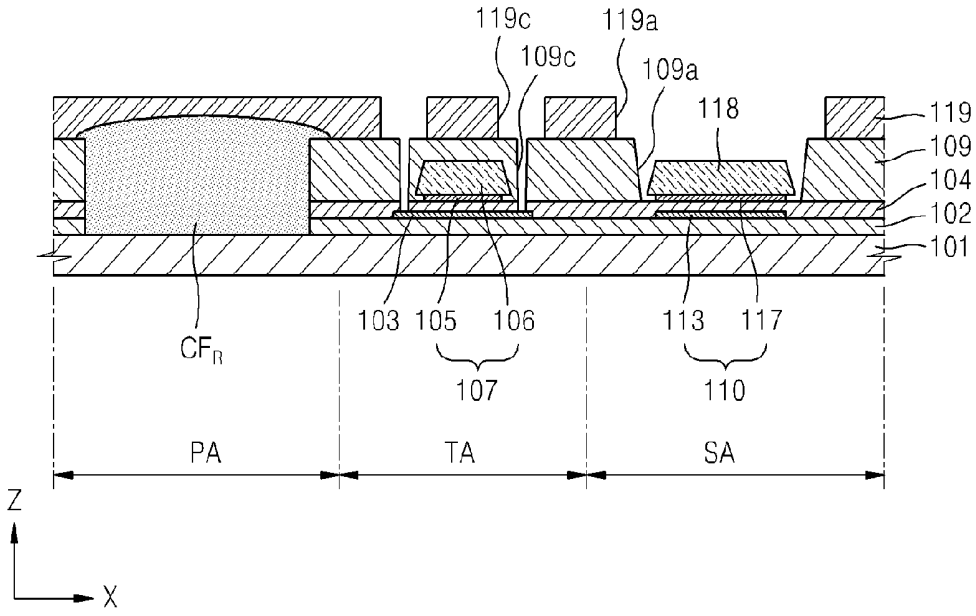
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FIG. 8

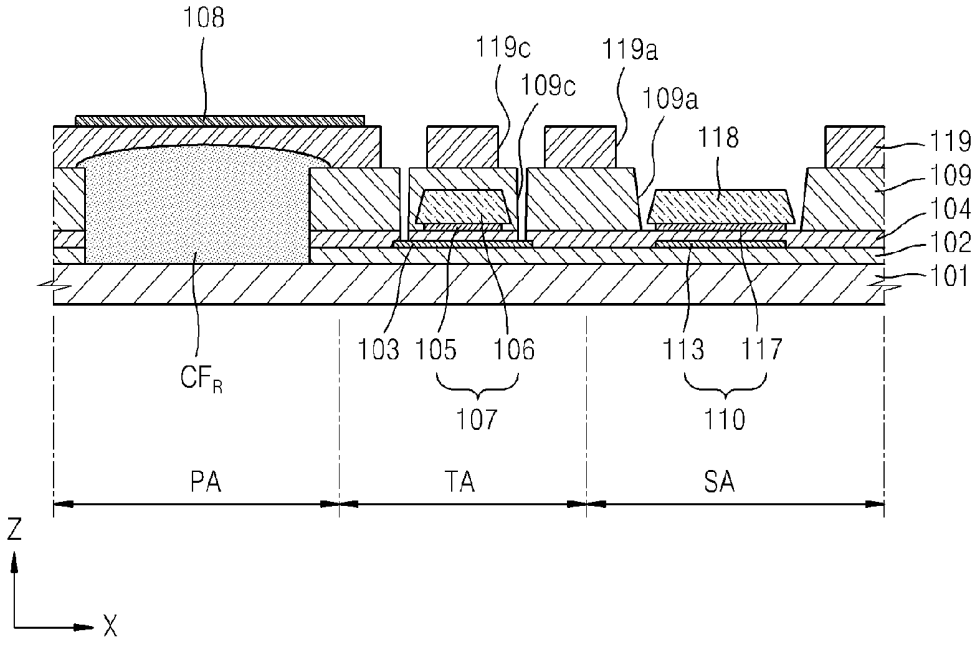
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FIG. 9

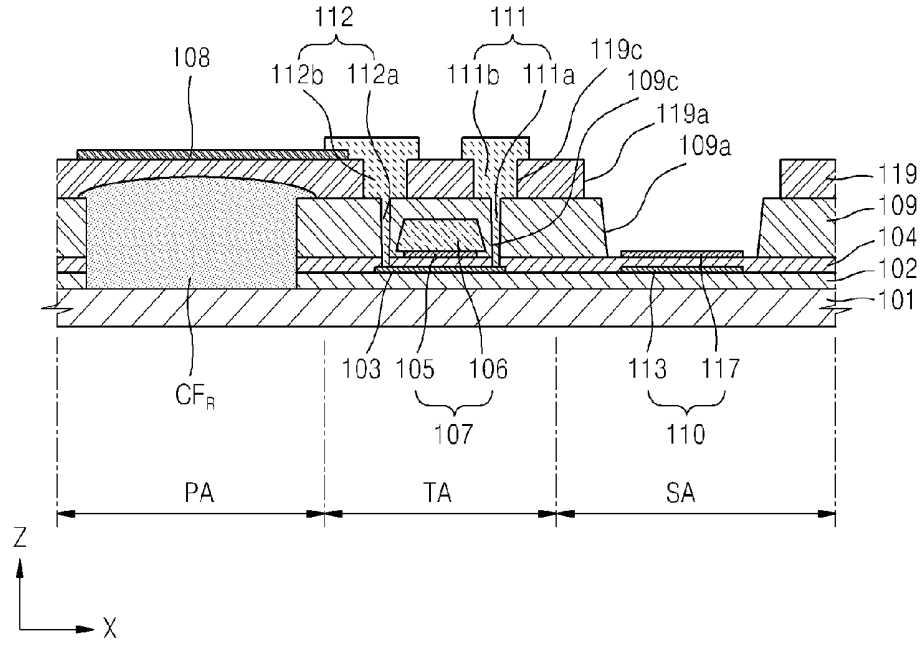
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FIG. 10

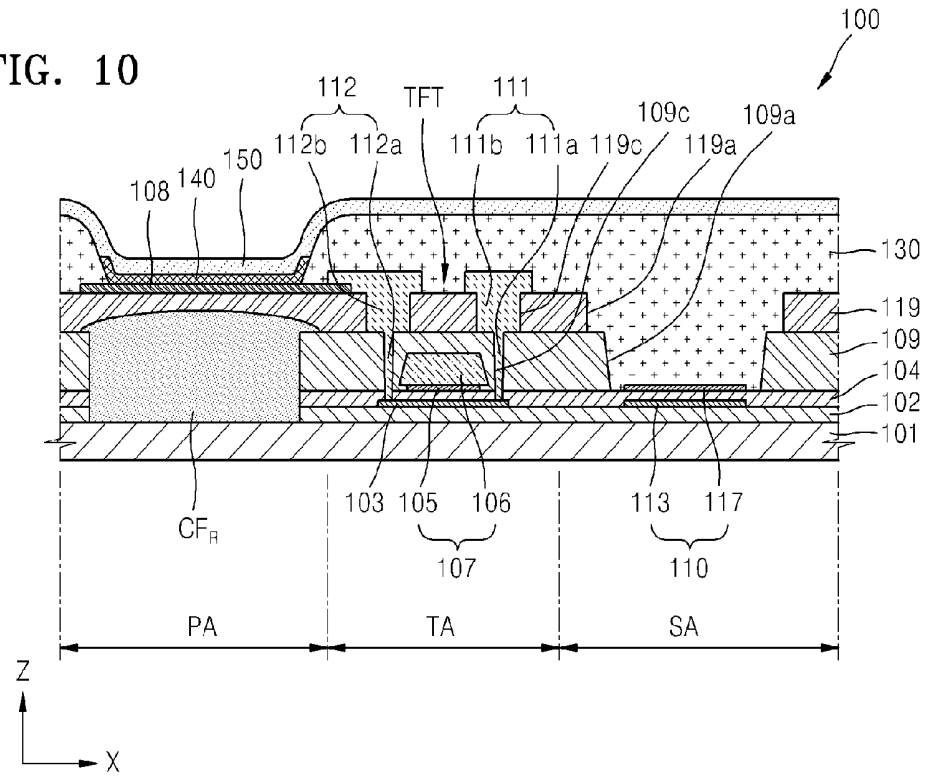
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FIG. 11

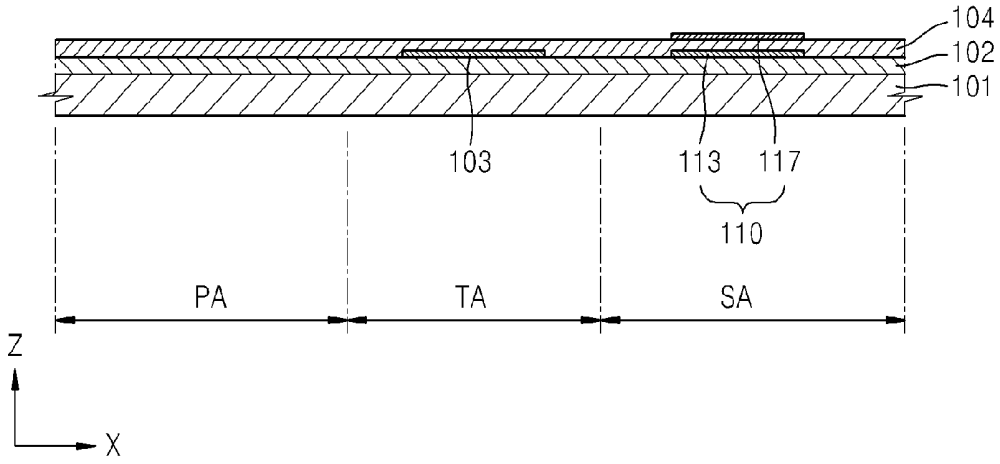
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FIG. 12

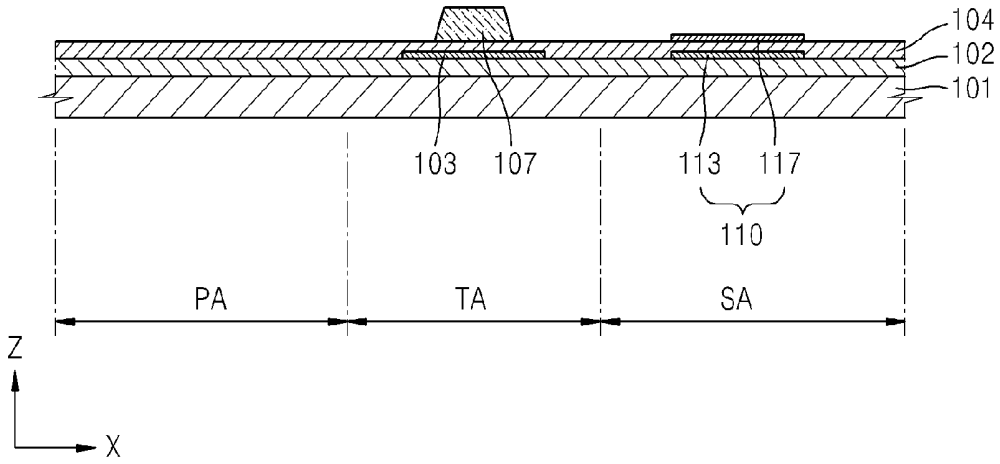
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FIG. 13

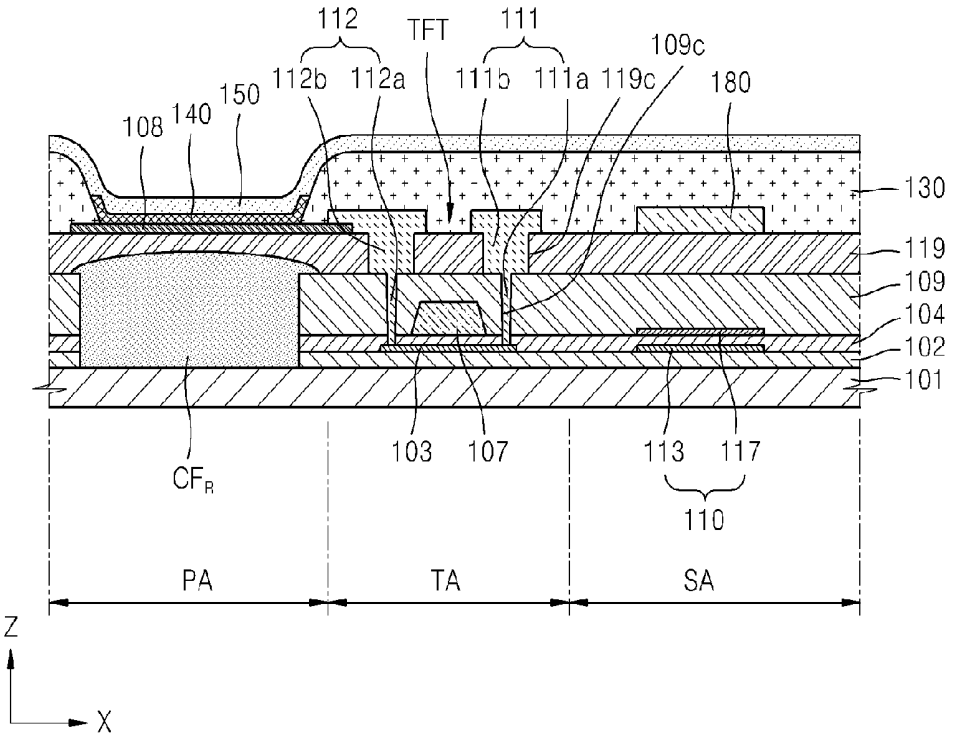
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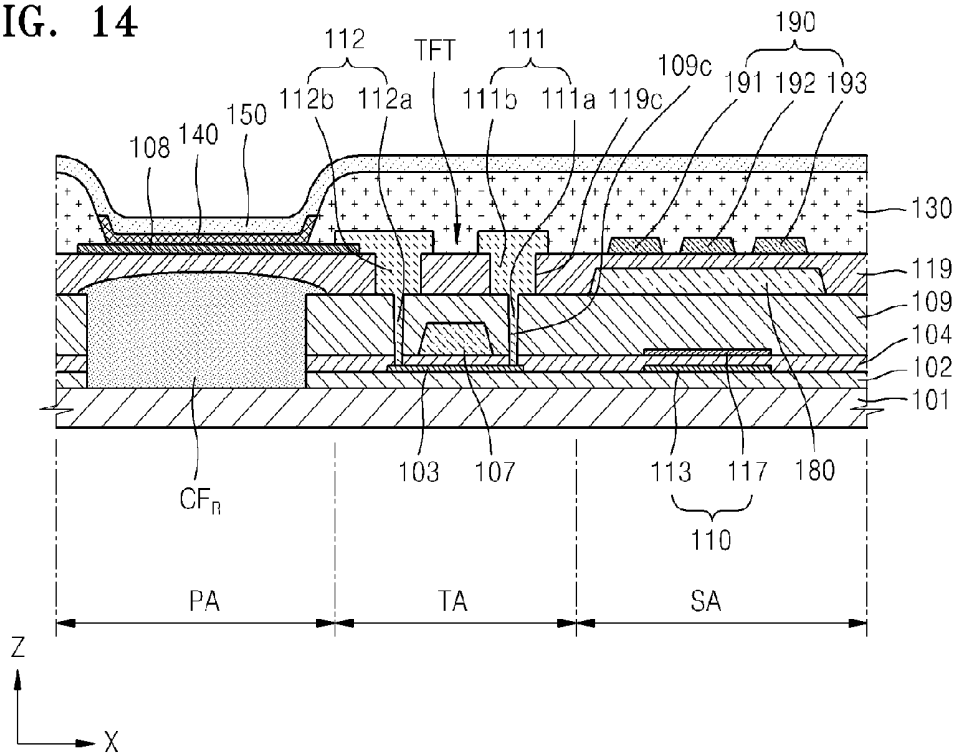
FIG. 14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ORGANIC LIGHT-EMITTING DISPLAY APPARATUS AND METHOD OF MANUFACTURING THE SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of Korean Patent Application No. 10-2013-0057295, filed on May 21, 2013 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein in its entirety by reference.

BACKGROUND

[0002] 1. Field

[0003] The present disclosure relates to an organic light-emitting display apparatus that is capable of simplifying and facilitating a manufacturing process and has an improved image quality, and a method of manufacturing the organic light-emitting display apparatus.

[0004] 2. Description of the Related Technology

[0005] Organic light-emitting display apparatuses are display apparatuses including an organic light-emitting device in a display area thereof. The organic light-emitting device includes a pixel electrode and a counter electrode that are opposite to each other, and an intermediate layer interposed between the pixel electrode and the counter electrode which includes an emission layer.

[0006] Such organic light-emitting display apparatuses are classified into active matrix type organic light-emitting display apparatuses and passive matrix type organic light-emitting display apparatuses, according to their respective driving method. In the active matrix type organic light-emitting display apparatus, controlling whether each sub-pixel emits light is performed through a thin film transistor (TFT) provided in each sub-pixel, while in the passive matrix type organic light-emitting display apparatus, controlling whether each sub-**0**pixel emits light is performed through electrodes that are arranged in a matrix. In the active matrix type organic light-emitting display apparatus, an organic light-emitting device is generally located on a TFT, and various films or layers such as a gate insulating layer or an insulating interlayer are used to form the TFT.

SUMMARY OF CERTAIN INVENTIVE ASPECTS

[0007] Embodiments of the present invention provide an organic light-emitting display apparatus that is capable of simplifying and facilitating a manufacturing process and has an improved image quality, and a method of manufacturing the organic light-emitting display apparatus.

[0008] According to an aspect of the present invention, there is provided an organic light-emitting display apparatus including: a substrate; an active layer disposed on the substrate; a gate electrode insulated from the active layer and configured to correspond to a part of the active layer; a source electrode including a first source electrode layer connected to the active layer and a second source electrode layer connected to the first source electrode layer, the second source electrode layer being larger than the first source electrode layer; a drain electrode including a first drain electrode layer connected to the active layer and a second drain electrode layer connected to the first drain electrode layer, the second drain electrode layer being larger than the first drain electrode layer; a pixel electrode electrically connected to any one of the source electrode and the drain electrode; and a color filter interposed between the substrate and the pixel electrode.

[0009] In addition, the organic light-emitting display apparatus may further include a first insulating interlayer covering the gate electrode and having a first contact hole; and a second insulating interlayer disposed on the first insulating interlayer and having a second contact hole.

[0010] In this case, the first source electrode layer and the first drain electrode layer correspond to the first contact hole, and the second source electrode layer and the second drain electrode layer correspond to the second contact hole.

[0011] A size of the first contact hole may be smaller than a size of the second contact hole.

[0012] The first insulating interlayer may include an inorganic material, and the second insulating interlayer may include an organic material.

[0013] The first insulating interlayer may have an opening corresponding to the pixel electrode, the color filter is located within the opening, and the pixel electrode may be disposed on the second insulating interlayer. In this case, a surface of the second insulating interlayer contacting the color filter may have a concave shape toward the inside of the second insulating interlayer.

[0014] A top surface of the second insulating interlayer may be planar.

[0015] Meanwhile, the organic light-emitting display apparatus may further include a first insulating interlayer covering the gate electrode and having a plurality of first contact holes; and a second insulating interlayer disposed on the first insulating interlayer and having a second contact hole connected to the plurality of first contact holes.

[0016] The organic light-emitting display apparatus may further include a capacitor including a first capacitor electrode and a second capacitor electrode that are both disposed on the substrate.

[0017] In this case, the organic light-emitting display apparatus may further include a first insulating interlayer covering the gate electrode; and a second insulating interlayer disposed on the first insulating interlayer, and the first insulating interlayer and the second insulating interlayer may each have an opening portion corresponding to the capacitor.

[0018] The organic light-emitting display apparatus may further include at least one of a data wiring or a power wiring disposed on the capacitor so as to correspond to the capacitor. One or more insulating layers may be interposed between at least one of the data wiring and the power wiring, and the capacitor. Alternatively, the organic light-emitting display apparatus may further include a first insulating interlayer covering the gate electrode; and a second insulating interlayer disposed on the first insulating interlayer, and the first insulating interlayer and the second insulating interlayer may both be interposed between the capacitor and the power wiring.

[0019] The organic light-emitting display apparatus may further include a data wiring disposed on the capacitor and corresponding to the capacitor. In this case, one or more insulating layers may be interposed between the capacitor and the data wiring.

[0020] Meanwhile, the organic light-emitting display apparatus may further include a first insulating interlayer covering the gate electrode; and a second insulating interlayer disposed on the first insulating interlayer, and the first insulating interlayer and the second insulating interlayer may both be interposed between the capacitor and the data wiring.

[0021] Alternatively, the organic light-emitting display apparatus may further include a power wiring and a data wiring both disposed on the capacitor and corresponding to the capacitor, wherein the power wiring and the data wiring may be disposed in different layers so as to overlap each other.

[0022] In this case, the organic light-emitting display apparatus may further include a first insulating interlayer covering the gate electrode; and a second insulating interlayer disposed on the first insulating interlayer, and the power wiring may be disposed on the first insulating interlayer, wherein the data wiring may be disposed on the second insulating interlayer. Alternatively, the organic light-emitting display apparatus may further include a first insulating interlayer covering the gate electrode; and a second insulating interlayer disposed on the first insulating interlayer, and the data wiring may be disposed on the first insulating interlayer, wherein the power wiring may be disposed on the second insulating interlayer.

[0023] The first capacitor electrode and the active layer may be disposed on the same layer, and the second capacitor electrode and the gate electrode may be disposed on the same layer.

[0024] The pixel electrode may be disposed on the same layer as at least a part of the second source electrode layer and at least a part of the second drain electrode layer.

[0025] The gate electrode may include a first conductive layer and a second conductive layer disposed on the first conductive layer, and the first capacitor electrode may include the same material as the first conductive layer and is disposed on the same layer as the first conductive layer.

[0026] According to another aspect of the present invention, there is provided a method of manufacturing an organic light-emitting display apparatus, the method including: forming an active layer on a substrate; forming a gate electrode configured to be insulated from the active layer and to overlap the active layer; forming a color filter on the substrate; forming a source electrode including a first source electrode layer connected to the active layer and a second source electrode layer connected to the first source electrode layer, the second source electrode layer being larger than the first source electrode layer; forming a drain electrode including a first drain electrode layer connected to the active layer and a second drain electrode layer connected to the first drain electrode layer, the second drain electrode layer being larger than the first drain electrode layer; and forming a pixel electrode electrically connected to any one of the source electrode and the drain electrode and corresponding to a color filter.

[0027] The method may further include forming a first insulating interlayer having a first contact hole configured to cover the gate electrode, and a second insulating interlayer disposed on the first insulating interlayer and having a second contact hole.

[0028] The forming of the source electrode and the forming of the drain electrode include forming the first source electrode layer and the first drain electrode layer so as to correspond to the first contact hole, and forming the second source electrode layer and the second drain electrode layer so as to correspond to the second contact hole.

[0029] In this case, the forming of the source electrode and the forming of the drain electrode may include simultaneously forming the first source electrode layer, the first drain electrode layer, the second source electrode layer, and the second drain electrode layer.

[0030] The forming of the second insulating interlayer may include: forming a first insulating interlayer configured to cover the gate electrode; forming a first contact hole configured to expose a part of the active layer and an opening corresponding to an area where the pixel electrode is to be formed, in the first insulating interlayer; forming a second insulating interlayer configured to cover the first insulating interlayer; and forming a second contact hole configured to expose a part of the active layer in the second insulating interlayer. The forming of the color filter may include forming the color filter within the opening of the first insulating interlayer, and the forming of the second insulating interlayer may include forming the second insulating interlayer so as to cover the color filter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031] The above and other features and advantages of the present invention will become more apparent by describing in detail certain embodiments thereof with reference to the attached drawings in which:

[0032] FIG. **1** is a schematic cross-sectional view illustrating an organic light-emitting display apparatus according to an embodiment of the present invention;

[0033] FIG. **2** is a detailed plan view illustrating a portion "A" of FIG. **1**;

[0034] FIGS. **3** through **10** are schematic cross-sectional views illustrating processes of a method of manufacturing an organic light-emitting display apparatus according to another embodiment of the present invention;

[0035] FIGS. **11** through **13** are schematic cross-sectional views illustrating processes of a method of manufacturing an organic light-emitting display apparatus according to another embodiment of the present invention; and

[0036] FIG. **14** is a schematic cross-sectional view illustrating an organic light-emitting display apparatus according to another embodiment of the present invention.

DETAILED DESCRIPTION OF CERTAIN INVENTIVE EMBODIMENTS

[0037] The present invention will now be described more fully with reference to the accompanying drawings, in which certain embodiments of the invention are shown. The invention may, however, be embodied in many different forms, and should not be construed as being limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the concept of the invention to one of ordinary skill in the art. In the drawings, the thicknesses of layers and regions may be exaggerated for clarity. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items. Expressions such as "at least one of," when preceding a list of elements, modify the entire list of elements and do not modify the individual elements of the list.

[0038] In the following embodiments, an x-axis, a y-axis, and a z-axis are not limited to three axes on an orthogonal coordinates system, and may be construed as a broad sense including this. For example, the x-axis, the y-axis, and the z-axis may be perpendicular to each other, or may refer to different directions that are not perpendicular to each other.

[0039] It will also be understood that when an element such as a layer, region, or substrate is referred to as being "on" another element, it may be directly on the other element, or intervening elements may also be present.

[0040] A conventional organic light-emitting display apparatus has a problem in that a short defect may occur between a gate electrode and a source electrode or between the gate electrode and a drain electrode, due to the inflow of particles when forming various films or layers during a manufacturing process, morphology of a member that is formed under the various films or layers, for example, morphology of the gate electrode or the like, or due to other factors. In particular, when a high-resolution organic light-emitting display apparatus is manufactured, line widths of wirings and intervals between the wirings are narrowed, and thus the above-mentioned problem frequently occurs, which results in a limitation in terms of improving the image quality of the organic light-emitting display apparatus.

[0041] FIG. **1** is a schematic cross-sectional view illustrating an organic light-emitting display apparatus **100** according to an embodiment of the present invention.

[0042] Referring to FIG. **1**, the organic light-emitting display apparatus **100** may include a substrate **101**, a buffer layer **102**, a gate insulating layer **104**, a pixel electrode **108**, a thin film transistor TFT, an intermediate layer **140**, a counter electrode **150**, a first insulating interlayer **109**, a second insulating interlayer **119**, a pixel definition layer **130**, and a capacitor **110**.

[0043] The substrate **101** may have a plurality of areas, for example, an emission area PA, a transistor area TA, and a storage area SA.

[0044] The emission area PA of the substrate **101** is an area where at least the intermediate layer **140** is disposed and visible light emitted from the intermediate layer **140** may reach or pass therethrough. The transistor area TA is an area where various electrical signals for controlling whether emission occurs in the emission area PA and for controlling the degree of the emission in the emission area PA are generated and/or transmitted. The thin film transistor TFT may be disposed in the transistor area TA.

[0045] The thin film transistor TFT includes an active layer **103**, a gate electrode **107**, a source electrode **111**, and a drain electrode **112**. In addition, the source electrode **111** includes a first source electrode layer **111***a* and a second source electrode layer **111***b*, and the drain electrode **112** includes a first drain electrode layer **112***a* and a second drain electrode layer **112***b*.

[0046] The capacitor **110** is disposed in the storage area SA. The capacitor **110** includes a first capacitor electrode **113** and a second capacitor electrode **117**.

[0047] The substrate **101** including the emission area PA, the transistor area TA, and the storage area SA may be a SiO_2-based translucent glass material, but the present invention is not limited thereto. That is, the substrate **101** may be formed of any material as long as the material has a translucent property, for example, a translucent plastic material.

[0048] The buffer layer **102** is formed on the substrate **101**. The buffer layer **102** may prevent impurities from penetrating the active layer **103** or the like. The buffer layer **102** may include an inorganic material such as silicon oxide, silicon nitride, silicon oxynitride, aluminum oxide, aluminum nitride, titanium oxide, or titanium nitride, or an organic material such as polyimide, polyester, or acryl. In addition, the buffer layer **102** may be a single layer or may be a stack of a plurality of layers.

[0049] The active layer **103** and the first capacitor electrode **113** may be disposed on the buffer layer **102**, and specifically, the active layer **103** may be disposed in the transistor area TA and the first capacitor electrode **113** may be disposed in the storage area SA. The active layer **103** and the first capacitor electrode **113** may include the same material. For example, the active layer **103** and the first capacitor electrode **113** may include a material such as semiconductor silicon.

[0050] The gate insulating layer **104** is disposed on the buffer layer **102** so as to cover the active layer **103** and the first capacitor electrode **113**. The gate electrode **107** and the second capacitor electrode **117** are disposed on the gate insulating layer **104**.

[0051] The gate electrode **107** may include a first conductive layer **105** and a second conductive layer **106**. The first conductive layer **105** may be formed so as to be thinner than the second conductive layer **106**. The first conductive layer **105** may include, for example, ITO, IZO, ZnO, In_2O_3, IGO, or AZO, but the present invention is not limited thereto. As long as the first conductive layer **105** is formed to have such a thickness that a dopant may pass during a doping process, the first conductive layer **105** may include Mo, MoW, an Al-based alloy, or the like. The second conductive layer **106** may be disposed on the first conductive layer **105**, may include a metal or a metal alloy such as Mo, MoW, or an Al-based alloy, and may have a single-layered structure or a multi-layered structure. The second conductive layer **106** may have, for example, a stacked structure of Mo/Al/Mo.

[0052] The second capacitor electrode **117** and the first conductive layer **105** may be disposed on the same layer and may include the same material. That is, the second capacitor electrode **117** and the first conductive layer **105** of the gate electrode **107** may be simultaneously formed.

[0053] The first insulating interlayer **109** is formed on the gate insulating layer **104** so as to cover the gate electrode **107** and the second capacitor electrode **117**. The first insulating interlayer **109** may be formed so as to include various insulating materials, and may preferably include an inorganic material. The first insulating interlayer **109** includes a first contact hole **109***c*, an opening portion **109***a*, and an opening **109***b*.

[0054] The first contact hole **109***c* of the first insulating interlayer **109** exposes a part of the active layer **103** in the transistor area TA. The opening portion **109***a* of the first insulating interlayer **109** exposes at least one area of a top surface of the second capacitor electrode **117** in the storage area SA. The opening **109***b* of the first insulating interlayer **109** is located in the emission area PA so that a color filter CF_R is located within the opening **109***b*. The first source electrode layer **111***a* of the source electrode **111** and the first drain electrode layer **112***a* of the drain electrode **112** are disposed so as to correspond to the first contact hole **109***c* of the first insulating interlayer **109**. Specifically, the first source electrode layer **111***a* and the first drain electrode layer **112***a* are formed so as to be connected to the active layer **103** through the first contact hole **109***c*. The first source electrode layer **111***a* and the first drain electrode layer **112***a* may include various materials, for example, a metal such as Au, Pd, Pt, Ni, Rh, Ru, Ir, Os, Al, Mo, Nd, Mo, W, or an alloy containing at least two of these materials.

[0055] The color filter CF_R is located within the opening **109***b* of the first insulating interlayer **109**. The color filter CF_R is located on an optical path in which light emitted from the intermediate layer **140** passes to the outside through the substrate **101**, so that light having a predetermined wavelength passes to the outside of the substrate **101**. The color filter CF_R is located within the opening **109***b* of the first insulating

interlayer **109**, but the present invention is not limited thereto. As shown in FIG. **1**, openings are formed in the buffer layer **102** or the gate insulating layer **104** below the first insulating interlayer **109**, and thus the color filter CF_R may also be located within the openings. That is, the color filter CF_R may be disposed between the substrate **101** and the pixel electrode **108**.

[0056] The second insulating interlayer **119** is disposed on the insulating interlayer **109** so as to cover the color filter CF_R. The second insulating interlayer **119** may include various insulating materials, and may preferably include an organic material. As shown in FIG. **1**, the color filter CF_R may be formed in such a way that the top surface thereof is formed convex during the formation process thereof. Thus, a surface of the second insulating interlayer **119** which comes into contact with the color filter CF_R may be formed concave toward the inside of the second insulating interlayer **119**.

[0057] The second insulating interlayer **119** includes a second contact hole **119***c*. In addition, the second insulating interlayer **119** is disposed so as not to cover at least one area of the top surface of the second capacitor electrode **117**. Specifically, the second insulating interlayer **119** may include an opening portion **119***a* that overlaps the top surface of the second capacitor electrode **117**.

[0058] The second source electrode layer **111***b* of the source electrode **111** and the second drain electrode layer **112***b* of the drain electrode **112** are disposed so as to correspond to the second contact hole **119***c* of the second insulating interlayer **119**. That is, the second source electrode layer **111***b* may be connected to the first source electrode layer **111***a*, and the second drain electrode layer **112***b* may be connected to the first drain electrode layer **112***a*. The second source electrode layer **111***b* and the second drain electrode layer **112***b* may include various materials, for example, a metal such as Au, Pd, Pt, Ni, Rh, Ru, Ir, Os, Al, Mo, Nd, Mo, W, or an alloy containing at least two of these materials.

[0059] The first source electrode layer **111***a* of the source electrode **111** may be smaller than the second source electrode layer **111***b*. Specifically, the first contact hole **109***c* of the first insulating interlayer **109** may be smaller than the second contact hole **119***c* of the second insulating interlayer **119**, the first source electrode layer **111***a* may correspond to the first contact hole **109***c*, and the second source electrode layer **111***b* may correspond to the second contact hole **119***c*. In addition, as shown in FIG. **2**, a plurality of the first contact holes **109***c* may be located to be connected to one second contact hole **119***c* when needed, so that a plurality of the first source electrode layers **111***a* may be disposed to be connected to the second source electrode layer **111***b*.

[0060] The first drain electrode layer **112***a* of the drain electrode **112** may be smaller than the second drain electrode layer **112***b*. Specifically, the first contact hole **109***c* of the first insulating interlayer **109** may be smaller than the second contact hole **119***c* of the second insulating interlayer **119**, the first drain electrode layer **112***a* may correspond to the first contact hole **109***c*, and the second drain electrode layer **112***b* may correspond to the second contact hole **119***c*. In addition, as shown in FIG. **2**, a plurality of the first contact holes **109***c* may be located to be connected to one second contact hole **119***c*, so that a plurality of the first drain electrode layers **112***a* may be disposed to be connected to the second drain electrode layer **112***b*.

[0061] As a result, in the organic light-emitting display apparatus, two insulating interlayers **109** and **119** may be interposed between the gate electrode **107**, and the second source electrode layer **111***b* and second drain electrode layer **112***b* so as to effectively prevent a short defect from occurring between the gate electrode **107** and the second source electrode layer **111***b* and/or between the gate electrode **107** and the second drain electrode layer **112***b* due to foreign substances generated between the gate electrode **107** and the second source electrode layer **111***b* and/or between the gate electrode **107** and the second drain electrode layer **112***b*, or metal materials remaining when forming the gate electrode **107** and the second source electrode layer **111***b* and/or the gate electrode **107** and the second drain electrode layer **112***b*.

[0062] In particular, the first insulating interlayer **109** containing an inorganic material having excellent water resistance and excellent step coverage may be disposed on the gate electrode **107** so as to effectively insulate the gate electrode **107** from the source electrode **111** and/or the drain electrode **112**. In addition, the second insulating interlayer **119** containing an organic material is disposed on the first insulating interlayer **109**, and thus the second insulating interlayer **119** may be easily formed to have a desired thickness. In addition, the top surface of the second insulating interlayer **119** may be formed flat, so that the second insulating interlayer **119** may also serve as a planarization layer.

[0063] Since the first contact hole **109***c* of the first insulating interlayer **109** is smaller than the second contact hole **119***c*, an interval between the source electrode **111** and the drain electrode **112** and intervals between other wirings are minimized, thereby allowing the high-resolution organic light-emitting display apparatus **100** to be realized. In addition, since the second contact hole **119***c* of the second insulating interlayer **119** is larger than the first contact hole **109***c*, an electrical property of the thin film transistor TFT may be improved. In particular, when a plurality of the first contact holes **109***c* are connected to one second contact hole **119***c*, an electrical contact property between the first source electrode layer **111***a* and the active layer **103** and an electrical contact property between the first drain electrode layer **112***a* and the active layer **103** may be preferably improved.

[0064] The pixel electrode **108** is located on the second insulating interlayer **119** so that at least a part of the pixel electrode **108** is located in the emission area PA. Thus, the color filter CF_R may be located between the pixel electrode **108** and the substrate **101**. The pixel electrode **108** includes a transmissive conductive material, for example, ITO, IZO, ZnO, In_2O_3, IGO, or AZO. An end of the pixel electrode **108** is electrically connected to the second drain electrode layer **112***b* so as to be covered by the second drain electrode layer **112***b* or to come into contact with the second drain electrode layer **112***b*, thereby allowing the pixel electrode **108** to receive an electrical signal from the second drain electrode layer **112***b*.

[0065] The pixel definition layer **130** may cover the second source electrode layer **111***b* of the source electrode **111**, the second drain electrode layer **112***b* of the drain electrode **112**, and the second capacitor electrode **117**. The pixel definition layer **130** may not cover at least a central portion of the top surface of the pixel electrode **108**.

[0066] The intermediate layer **140** has a multi-layered structure including an emission layer, and may be disposed on the pixel electrode **108**. Specifically, the intermediate layer **140** may be disposed on a portion that is not covered by the pixel definition layer **130** of the pixel electrode **108**. Although the intermediate layer **140** is located only on the pixel elec-

trode **108** in FIG. **1**, the present invention is not limited thereto. For example, a part of the intermediate layer **140** may be disposed as a common layer across a display area of the organic light-emitting display apparatus, or another part thereof may be disposed so as to correspond to the pixel electrode **108**.

[0067] The intermediate layer **140** may include a low or high molecular material. When the intermediate layer **140** is formed of a low molecular material, a hole injection layer (HIL), a hole transport layer (HTL), an emission layer (EML), an electron transport layer (ETL), and an electron injection layer (EIL), and the like may be formed to have a single-layered structure or a multi-layered structure. Examples of available organic materials may include copper phthalocyanine (CuPc), N,N'-di(naphthalene-1-yl)-N,N'-diphenyl-benzidine (NPB), tris-**8**-hydroxyquinoline aluminum (Alq3), and the like. These layers may be formed by vacuum deposition, laser induced thermal imaging (LITI), or the like.

[0068] When the intermediate layer **140** is formed of a high molecular material, the intermediate layer **140** may have a structure including an HTL and an EML. Poly-(3,4-ethylene-dihydroxy thiophene (PEDOT) or polyaniline (PANT) may be used as the HTL, and a poly-phenylenevinylene (PPV)-based high molecular material or a polyfluorene-based high molecular material may be used as the EML. These layers may be formed by screen printing, ink jet printing, LITI, or the like.

[0069] The intermediate layer **140** is not limited thereto, and may have any of various structures.

[0070] The counter electrode **150** may be disposed on the intermediate layer **140**. The counter electrode **150** may include a metal such as Ag, Mg, Al, Pt, Pd, Au, Ni, Nd, Ir, Cr, Li, or Ca. In addition, the counter electrode **150** may include ITO, IZO, ZnO, or In_2O_3 so as to be capable of light transmission when necessary.

[0071] In the organic light-emitting display apparatus **100**, two insulating interlayers **109** and **119** are interposed between the gate electrode **107**, and the second source electrode layer **111***b* and second drain electrode layer **112***b* so as to effectively prevent a short defect from occurring between the gate electrode **107** and the second source electrode layer **111***b* and/or between the gate electrode **107** and the second drain electrode layer **112***b*. Thus, the image quality of the organic light-emitting display apparatus **100** is improved.

[0072] In particular, the first contact hole **109***c* of the first insulating interlayer **109** is formed to be smaller than the second contact hole **119***c* so as to minimize an interval between the source electrode **111** and the drain electrode **112** and intervals between other wirings, thereby realizing the high-resolution organic light-emitting display apparatus **100**. In addition, the second contact hole **119***c* of the second insulating interlayer **119** is formed to be larger than the first contact hole **109***c*, thereby improving an electrical property of the thin film transistor TFT.

[0073] FIGS. **3** through **10** are schematic cross-sectional views illustrating processes of a method of manufacturing an organic light-emitting display apparatus according to another embodiment of the present invention.

[0074] First, as shown in FIG. **3**, the substrate **101** is prepared. Then, the buffer layer **102** is formed on the substrate **101**, and the active layer **103** and the first capacitor electrode **113** are formed on the buffer layer **102**. The first capacitor electrode **113** and the active layer **103** may be formed of the same material. In addition, the first capacitor electrode **113** and the active layer **103** may be simultaneously formed through a patterning processing using one mask. Then, the gate insulating layer **104** is formed on the buffer layer **102** so as to cover the active layer **103** and the first capacitor electrode **113**.

[0075] Subsequently, as shown in FIG. **4**, the gate electrode **107** and the second capacitor electrode **117** are formed on the gate insulating layer **104**. Specifically, a first conductive layer is formed on the gate insulating layer **104**, and a second conductive layer is formed on the first conductive layer, and then the gate electrode **107** is formed by simultaneously patterning the first and second conductive layers. In this process, the second capacitor electrode **117** and the cover layer **118** provided thereon may be simultaneously formed. That is, the first conductive layer **105** of the gate electrode **107** and the second capacitor electrode **117** may be formed of the same material, and the second conductive layer **106** of the gate electrode **107** and the cover layer **118** may be formed of the same material. A process of doping a portion that is not blocked by the gate electrode **107** of the active layer **103** with impurities may be performed using the gate electrode **107** as a mask.

[0076] The first conductive layer may be formed to have a thickness that is smaller than that of the second conductive layer in order to dope the first capacitor electrode **113** later through the second capacitor electrode **117**.

[0077] Thereafter, as shown in FIG. **5**, the first insulating interlayer **109** is formed so as to cover the gate electrode **107**. The first insulating interlayer **109** may include the first contact hole **109***c* for exposing a part of the active layer **103**. Although not shown in FIG. **5**, a plurality of the first contact holes **109***c* may be formed so as to correspond to a part of the active layer **103** about the gate electrode **107** as shown in FIG. **2**. In addition, the first insulating interlayer **109** includes the opening portion **109***a* corresponding to the cover layer **118**, and includes the opening **109***b* in the emission area PA.

[0078] The first insulating interlayer **109** may be formed on the majority of the entire surface of the substrate **101**, and may be then patterned so as to form the first contact hole **109***c*, the opening portion **109***a*, and the opening **109***b*. That is, the first contact hole **109***c*, the opening portion **109***a*, and the opening **109***b* may be simultaneously formed. An opening may be formed in the buffer layer **102**, the gate insulating layer **104**, or the like below the first insulating interlayer **109** at the same time as when the opening **109***b* is formed, without being formed only in the first insulating interlayer **109**.

[0079] Thereafter, as shown in FIG. **6**, the color filter CF_R is formed within the opening **109***b* of the first insulating interlayer **109**. A sub-pixel shown in FIG. **6** corresponds to a red sub-pixel, and thus the sub-pixel is shown to form the red color filter CF_R, a blue color filter, a green color filter, or the like may be formed in a blue sub-pixel, a green sub-pixel, or the like. The color filter CF_R may be formed using various methods, for example, an ink jet printing method.

[0080] Subsequently, as shown in FIG. **7**, the second insulating interlayer **119** is formed on the first insulating interlayer **109** so as to cover the color filter CF_R, and the second insulating interlayer **119** may include the second contact hole **119***c* connected to the first contact hole **109***c*. The second contact hole **119***c* may be formed to have a diameter or the like that is larger than that of the first contact hole **109***c*. In particular, when the first insulating interlayer **109** is formed of an inorganic material and the second insulating interlayer **119**

is formed of an organic material, the first contact hole **109***c* may be easily formed to have a size that is smaller and more uniform than that of the second contact hole **119***c*. The second insulating interlayer **119** may include not only the second contact hole **119***c* but also the opening portion **119***a* that overlaps the top surface of the second capacitor electrode **117**.

[0081] The second insulating interlayer **119** may be formed on the majority of the entire surface of the substrate **101**, and may be then patterned so as to form the second contact hole **119***c* and the opening portion **119***a*. That is, the second contact hole **119***c* and the opening portion **119***a* may be simultaneously formed.

[0082] Thereafter, as shown in FIG. **8**, the pixel electrode **108** is formed so that at least a part of the pixel electrode **108** is located in the emission area PA of the substrate **101**. The pixel electrode **108** may be formed using various methods such as deposition, sputtering, or the like.

[0083] Then, as shown in FIG. **9**, the source electrode **111** and the drain electrode **112** are formed. Specifically, the first source electrode layer **111***a* of the source electrode **111** and the first drain electrode layer **112***a* of the drain electrode **112** are formed so as to correspond to the first contact hole **109***c* of the first insulating interlayer **109**, and the second source electrode layer **111***b* of the source electrode **111** and the second drain electrode layer **112***b* of the drain electrode **112** are formed so as to correspond to the second contact hole **119***c* of the second insulating interlayer **119**. At least one of the source electrode **111** and the drain electrode **112** is formed so as to come into contact with the pixel electrode **108**.

[0084] At this time, the first source electrode layer **111***a*, the first drain electrode layer **112***a*, the second source electrode layer **111***b*, and the second drain electrode layer **112***b* may be simultaneously formed through a patterning process using one mask. In this process, the first source electrode layer **111***a* and the first drain electrode layer **112***a* are naturally formed to be smaller than the second source electrode layer **111***b* and the second drain electrode layer **112***b*. In addition, in a case where the first contact holes **109***c* are formed as shown in FIG. **2**, a plurality of the first source electrode layers **111***a* are connected to one second source electrode layer **111***b*, and a plurality of the first drain electrode layers **112***a* are connected to one second drain electrode layer **112***b*.

[0085] The first source electrode layer **111***a*, the first drain electrode layer **112***a*, the second source electrode layer **111***b*, and the second drain electrode layer **112***b* may be simultaneously formed by forming a conductive layer so as to correspond to the majority of the entire surface of the substrate **101** and by removing a part of the conductive layer through a photolithography method. In this process, the cover layer **118** on the second capacitor electrode **117** may also be removed. After the cover layer **118** is removed, a doping process of injecting impurities into the first capacitor electrode **113** via the second capacitor electrode **117** may be performed when necessary. In a state where the cover layer **118** is removed, the second capacitor electrode **117** is thin, and thus the first capacitor electrode **113** may be doped.

[0086] Alternatively, the pixel electrode **108** may be formed at the same time as when the source electrode **111** or the drain electrode **112** is formed when necessary, without having to be previously formed. For example, the pixel electrode **108** may be formed integrally with the drain electrode **112**.

[0087] Thereafter, as shown in FIG. **10**, the pixel definition layer **130** is formed on the second insulating interlayer **119** so as to cover the second source electrode layer **111***b* of the source electrode **111**, the second drain electrode layer **112***b* of the drain electrode **112**, and the second capacitor electrode **117**. The pixel definition layer **130** may be formed so as not to cover at least a central portion of the pixel electrode **108**.

[0088] Thereafter, the intermediate layer **140** including an emission layer, and the counter electrode **150** may be formed.

[0089] In the method of manufacturing the organic light-emitting display apparatus, the gate electrode **107** is formed, and then two insulating interlayers **109** and **119** are formed before forming the source electrode **111** and the drain electrode **112** so as to effectively prevent a short defect from occurring between the gate electrode **107** and the source electrode **111** and/or the gate electrode **107** and the drain electrode **112**. Thus, the image quality of the organic light-emitting display apparatus **100** is improved.

[0090] In particular, the first contact hole **109***c* of the first insulating interlayer **109** is formed to be smaller than the second contact hole **119***c* so as to minimize an interval between the source electrode **111** and the drain electrode **112** and intervals between other wirings, thereby realizing the high-resolution organic light-emitting display apparatus **100**. In addition, the second contact hole **119***c* of the second insulating interlayer **119** is formed to be larger than the first contact hole **109***c*, thereby improving an electrical property of the thin film transistor TFT. In addition, a plurality of the first contact holes **109***c* may be formed so as to be connected to one second contact hole **119***c* when necessary so as to improve an electrical property between the first source electrode layer **111***a* and the active layer **103** and an electrical property between the first drain electrode layer **112***a* and the active layer **103**.

[0091] FIGS. **11** through **13** are schematic cross-sectional views illustrating processes of a method of manufacturing an organic light-emitting display apparatus according to another embodiment of the present invention. According to the method of manufacturing an organic light-emitting display apparatus, the gate insulating layer **104** is formed, and then the second capacitor electrode **117** is formed in the storage area SA, as shown in FIG. **11**. In this process, a process of forming and patterning a conductive layer may be performed. Subsequently, as shown in FIG. **12**, the gate electrode **107** is formed in the transistor area TA. In this process, a process of forming and patterning a conductive layer may be performed. The gate electrode **107** is formed to be thicker than the second capacitor electrode **117** so that the active layer **103** and the first capacitor electrode **113** are simultaneously doped but a portion that is blocked by the gate electrode **107** of the active layer **103** is not doped.

[0092] According to the method of manufacturing an organic light-emitting display apparatus, the gate electrode **107** and the first capacitor electrode **113** are separately formed, but the active layer **103** and the first capacitor electrode **113** are simultaneously doped, and thus the whole process does not become complicated.

[0093] The subsequent process of forming the first insulating interlayer **109**, the second insulating interlayer **119**, the source electrode **111**, the drain electrode **112**, and the like as shown in FIG. **13** is similar to or the same as that in the method of manufacturing of an organic light-emitting display apparatus according to the above-described embodiment, and thus, a description thereof will not be repeated here.

[0094] A power wiring **180** located on the second insulating interlayer **119** may be formed in the storage area SA at the same time as when the source electrode **111** and the drain electrode **112** are formed in the transistor area TA. The power wiring **180** may be a wiring for supplying power necessary for emission in the emission area PA. The power wiring **180** may be formed so as to overlap the capacitor **110** of the storage area SA. Accordingly, an additional area for forming the power wiring **180** is not required, and thus the image quality may be improved by enlarging an aperture which is an area ratio of the emission area PA in the organic light-emitting display apparatus.

[0095] The organic light-emitting display apparatus shown in FIG. **13** which is manufactured in this manner may be construed as an organic light-emitting display apparatus according to another embodiment of the present invention.

[0096] FIG. **14** is a schematic cross-sectional view illustrating an organic light-emitting display apparatus according to another embodiment of the present invention. The organic light-emitting display apparatus is different from the organic light-emitting display apparatus according to the above-described embodiment in that the power wiring **180** is disposed on the first insulating interlayer **109**. The power wiring **180** may be a wiring for supplying power necessary for emission in the emission area PA. The power wiring **180** may be formed so as to overlap the capacitor **110** of the storage area SA. Accordingly, an additional area for forming the power wiring **180** is not required, and thus the image quality may be improved by enlarging an aperture which is an area ratio of the emission area PA in the organic light-emitting display apparatus.

[0097] Meanwhile, a data wiring **190** may be disposed on the second insulating interlayer **119** when necessary, as shown in FIG. **14**. In this case, the data wiring **190** may be formed of the same material as the source electrode **111** or the drain electrode **112**, and may be formed at the same time as when forming the source electrode **111** or the drain electrode **112**. Alternatively, the data wiring **190** may be formed of the same material as the pixel electrode **108**, and may be formed at the same time as when forming the pixel electrode **108**.

[0098] The data wiring **190** may transmit a data signal from a data driving unit (not shown) to the emission area PA via the transistor area TA. The data wiring **190** may be disposed so as to overlap the capacitor **110** of the storage area SA. In addition, the data wiring **190** may be disposed so as to overlap the power wiring **180**.

[0099] FIG. **14** shows the data wiring **190** including a first data wiring **191**, a second data wiring **192**, and a third data wiring **193**. In this case, the data wiring **190** corresponds to one pixel, and the first data wiring **191**, the second data wiring **192**, and the third data wiring **193** may be construed as corresponding to a plurality of sub-pixels included in one pixel. However, embodiments of the present invention is not limited thereto, and the data wiring corresponding to each sub-pixel may be disposed so as to correspond to the capacitor **110** and the power wiring **180**. As another embodiment, the data wiring **190** may be formed on the first insulating interlayer **109**, and the power wiring **180** may be formed on the second insulating interlayer **119**.

[0100] According to embodiments of the present invention, it is possible to provide an organic light-emitting display apparatus that is capable of simplifying and facilitating a manufacturing process and has an improved image quality, and a method of manufacturing the organic light-emitting display apparatus. In addition, the scope of the present invention is not limited by these effects.

[0101] While the present invention has been particularly shown and described with reference to certain embodiments thereof, 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 of the present invention as defined by the following claims.

What is claimed is:

1. An organic light-emitting display apparatus comprising:
- a substrate;
- an active layer disposed on the substrate;
- a gate electrode insulated from the active layer and configured to correspond to a part of the active layer;
- a source electrode comprising a first source electrode layer connected to the active layer and a second source electrode layer connected to the first source electrode layer, the second source electrode layer being larger than the first source electrode layer;
- a drain electrode comprising a first drain electrode layer connected to the active layer and a second drain electrode layer connected to the first drain electrode layer, the second drain electrode layer being larger than the first drain electrode layer;
- a pixel electrode electrically connected to any one of the source electrode and the drain electrode; and
- a color filter interposed between the substrate and the pixel electrode.

2. The organic light-emitting display apparatus of claim **1**, further comprising:
- a first insulating interlayer covering the gate electrode and having a first contact hole; and
- a second insulating interlayer disposed on the first insulating interlayer and having a second contact hole.

3. The organic light-emitting display apparatus of claim **2**, wherein the first source electrode layer and the first drain electrode layer correspond to the first contact hole, and the second source electrode layer and the second drain electrode layer correspond to the second contact hole.

4. The organic light-emitting display apparatus of claim **2**, wherein a size of the first contact hole is smaller than a size of the second contact hole.

5. The organic light-emitting display apparatus of claim **2**, wherein the first insulating interlayer comprises an inorganic material, and the second insulating interlayer comprises an organic material.

6. The organic light-emitting display apparatus of claim **2**, wherein the first insulating interlayer has an opening corresponding to the pixel electrode, the color filter is located within the opening, and the pixel electrode is disposed on the second insulating interlayer.

7. The organic light-emitting display apparatus of claim **6**, wherein a surface of the second insulating interlayer contacting the color filter has a concave shape toward the inside of the second insulating interlayer.

8. The organic light-emitting display apparatus of claim **2**, wherein a top surface of the second insulating interlayer is planar.

9. The organic light-emitting display apparatus of claim **1**, further comprising:
- a first insulating interlayer covering the gate electrode and having a plurality of first contact holes; and

a second insulating interlayer disposed on the first insulating interlayer and having a second contact hole connected to the plurality of first contact holes.

10. The organic light-emitting display apparatus of claim **1**, further comprising a capacitor comprising a first capacitor electrode and a second capacitor electrode that are both disposed on the substrate.

11. The organic light-emitting display apparatus of claim **10**, further comprising:

a first insulating interlayer covering the gate electrode; and

a second insulating interlayer disposed on the first insulating interlayer,

wherein the first insulating interlayer and the second insulating interlayer each have an opening portion corresponding to the capacitor.

12. The organic light-emitting display apparatus of claim **10**, further comprising at least one of a data wiring and a power wiring disposed on the capacitor and corresponding to the capacitor.

13. The organic light-emitting display apparatus of claim **12**, wherein one or more insulating layers are interposed between at least one of the data wiring and the power wiring and the capacitor.

14. The organic light-emitting display apparatus of claim **12**, further comprising:

a first insulating interlayer covering the gate electrode; and

a second insulating interlayer disposed on the first insulating interlayer,

wherein the first insulating interlayer and the second insulating interlayer are both interposed between the capacitor and the power wiring.

15. The organic light-emitting display apparatus of claim **10**, further comprising a data wiring disposed on the capacitor and corresponding to the capacitor.

16. The organic light-emitting display apparatus of claim **15**, wherein one or more insulating layers are interposed between the capacitor and the data wiring.

17. The organic light-emitting display apparatus of claim **15**, further comprising:

a first insulating interlayer covering the gate electrode; and

a second insulating interlayer disposed on the first insulating interlayer,

wherein the first insulating interlayer and the second insulating interlayer are both interposed between the capacitor and the data wiring.

18. The organic light-emitting display apparatus of claim **10**, further comprising a power wiring and a data wiring both disposed on the capacitor and corresponding to the capacitor, wherein the power wiring and the data wiring are disposed in different layers so as to overlap each other.

19. The organic light-emitting display apparatus of claim **18**, further comprising:

a first insulating interlayer covering the gate electrode; and

a second insulating interlayer disposed on the first insulating interlayer,

wherein the power wiring is disposed on the first insulating interlayer, and the data wiring is disposed on the second insulating interlayer.

20. The organic light-emitting display apparatus of claim **18**, further comprising:

a first insulating interlayer covering the gate electrode; and

a second insulating interlayer disposed on the first insulating interlayer,

wherein the data wiring is disposed on the first insulating interlayer, and the power wiring is disposed on the second insulating interlayer.

21. The organic light-emitting display apparatus of claim **10**, wherein the first capacitor electrode and the active layer are disposed on the same layer, and the second capacitor electrode and the gate electrode are disposed on the same layer.

22. The organic light-emitting display apparatus of claim **1**, wherein the pixel electrode is disposed on the same layer as at least a part of the second source electrode layer and at least a part of the second drain electrode layer.

23. The organic light-emitting display apparatus of claim **1**, wherein the gate electrode comprises a first conductive layer and a second conductive layer disposed on the first conductive layer, and the first capacitor electrode comprises the same material as the first conductive layer and is disposed on the same layer as the first conductive layer.

24. A method of manufacturing an organic light-emitting display apparatus, the method comprising:

forming an active layer on a substrate;

forming a gate electrode configured to be insulated from the active layer and to overlap the active layer;

forming a color filter on the substrate;

forming a source electrode comprising a first source electrode layer connected to the active layer and a second source electrode layer connected to the first source electrode layer, the second source electrode layer being larger than the first source electrode layer;

forming a drain electrode comprising a first drain electrode layer connected to the active layer and a second drain electrode layer connected to the first drain electrode layer, the second drain electrode layer being larger than the first drain electrode layer; and

forming a pixel electrode electrically connected to any one of the source electrode and the drain electrode and corresponding to a color filter.

25. The method of claim **24**, further comprising forming a first insulating interlayer having a first contact hole configured to cover the gate electrode, and a second insulating interlayer disposed on the first insulating interlayer and having a second contact hole.

26. The method of claim **25**, wherein the forming of the source electrode and the forming of the drain electrode comprise forming the first source electrode layer and the first drain electrode layer so as to correspond to the first contact hole, and forming the second source electrode layer and the second drain electrode layer so as to correspond to the second contact hole.

27. The method of claim **25**, wherein the forming of the source electrode and the forming of the drain electrode comprises simultaneously forming the first source electrode layer, the first drain electrode layer, the second source electrode layer, and the second drain electrode layer.

28. The method of claim **25**, wherein the forming of the second insulating interlayer comprises:

forming a first insulating interlayer configured to cover the gate electrode;

forming a first contact hole configured to expose a part of the active layer and an opening corresponding to an area where the pixel electrode is to be formed, in the first insulating interlayer;

forming a second insulating interlayer configured to cover the first insulating interlayer; and

forming a second contact hole configured to expose a part of the active layer in the second insulating interlayer,

wherein the forming of the color filter comprises forming the color filter within the opening of the first insulating interlayer, and the forming of the second insulating interlayer comprises forming the second insulating interlayer so as to cover the color filter.

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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.		
当前申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
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摘要(译)

一种有机发光显示装置，包括基板;设置在基板上的有源层;栅电极设置成与有源层绝缘并对应于有源层的一部分;源电极，包括连接到有源层的第一源电极层，和连接到第一源电极层并且大于第一源电极层的第二源电极层;漏电极，包括连接到有源层的第一漏电极层，和连接到第一漏电极层并且大于第一漏电极层的第二漏电极层;像素电极，电连接到源电极或漏电极中的至少一个;滤色器，设置在基板和像素电极之间。