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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, including a substrate; a first reflective layer, a second reflective layer, and a third reflective layer that are separately disposed on the substrate; a first insulating layer on the first reflective layer, but not on the second reflective layer and the third reflective layer; a second insulating layer on the first insulating layer and the second reflective layer, but not on the third reflective layer; and a first pixel electrode for red emission on the second insulating layer and corresponding to the first reflective layer, a second pixel electrode for green emission on the second insulating layer and corresponding to the second reflective layer, and a third pixel electrode for blue emission on the third reflective layer.

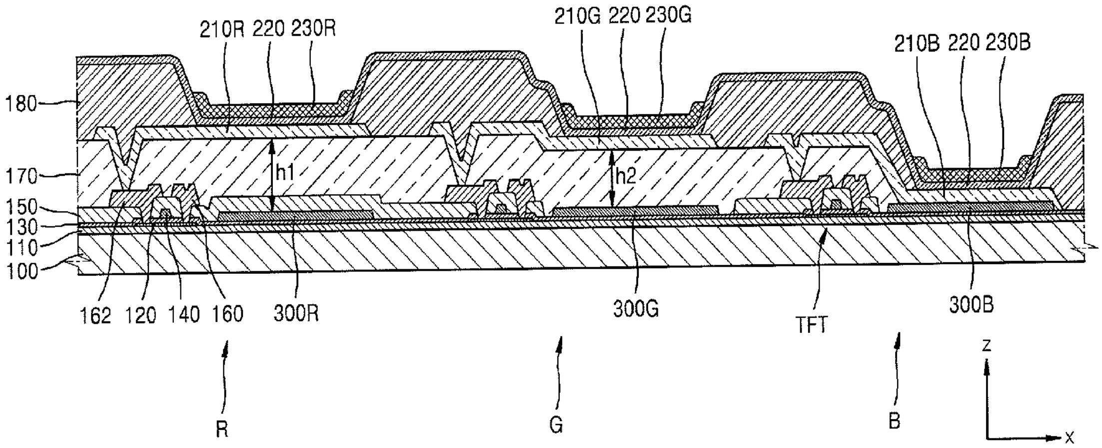
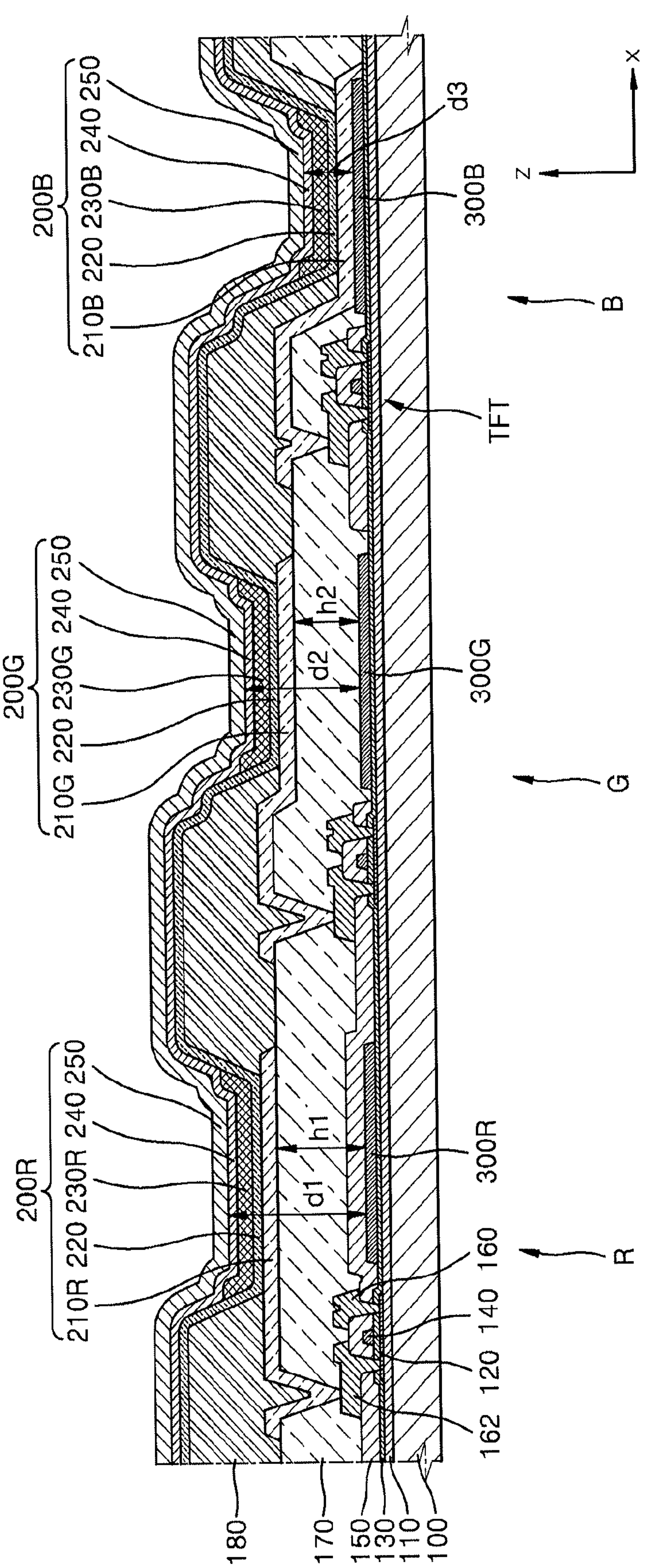


FIG. 1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200G
210G 220 230G 240 250
200B
210B 220 230B 240 250
d1
h1
d2
h2
d3
300R
300G
300B
160
140
120
162
TFT
R
G
B
x
z
180
170
150
130
110
100

FIG. 2

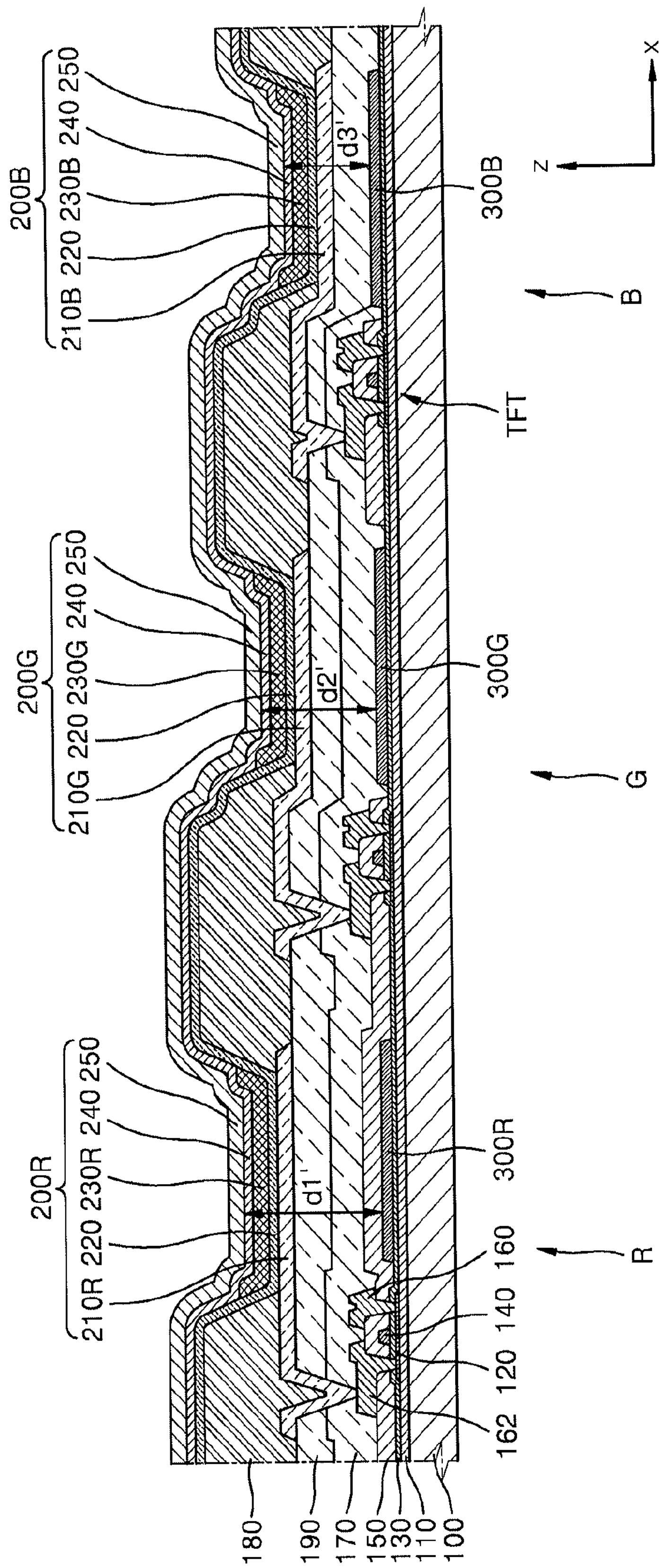

200B
210B 220 230B 240 250
d3'
300B
B
TFT
200G
210G 220 230G 240 250
d2'
300G
G
200R
210R 220 230R 240 250
d1'
300R
R
160
140
120
162
180
190
170
150
130
110
100
Z
X

FIG. 3

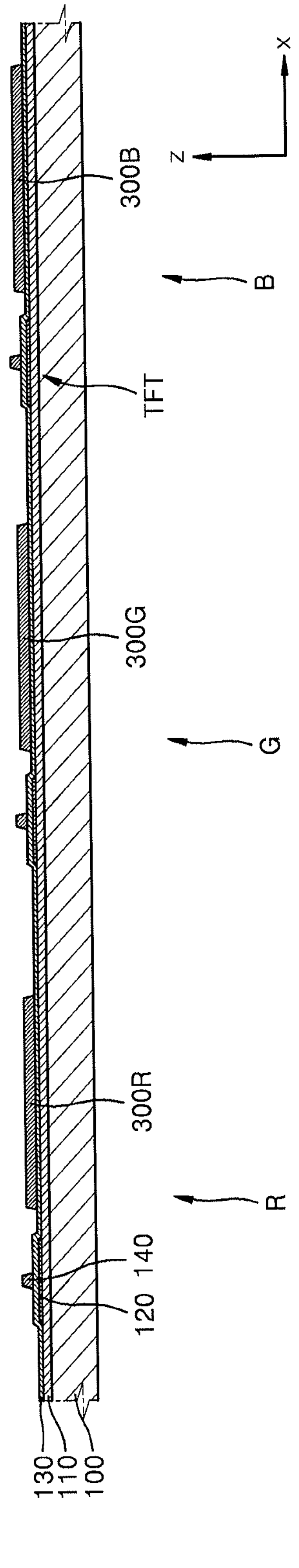


FIG. 4

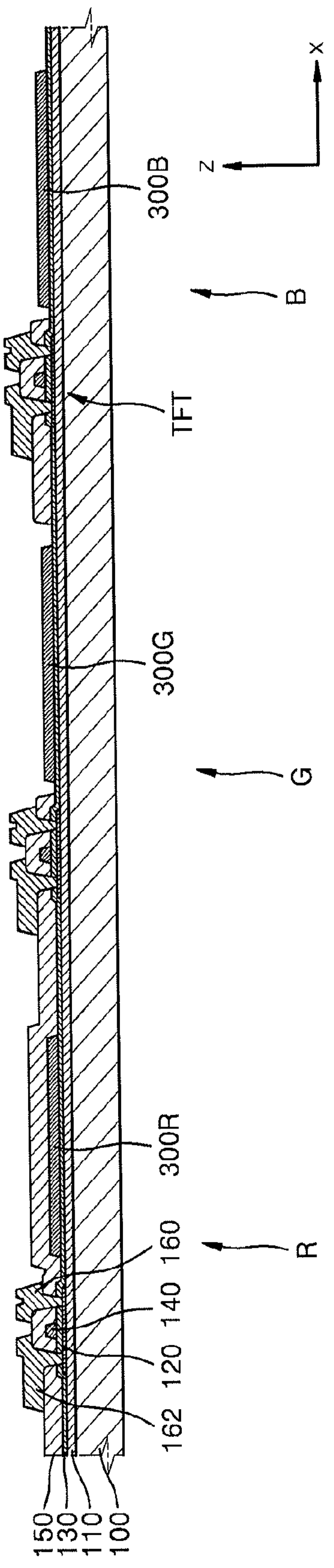


FIG. 5

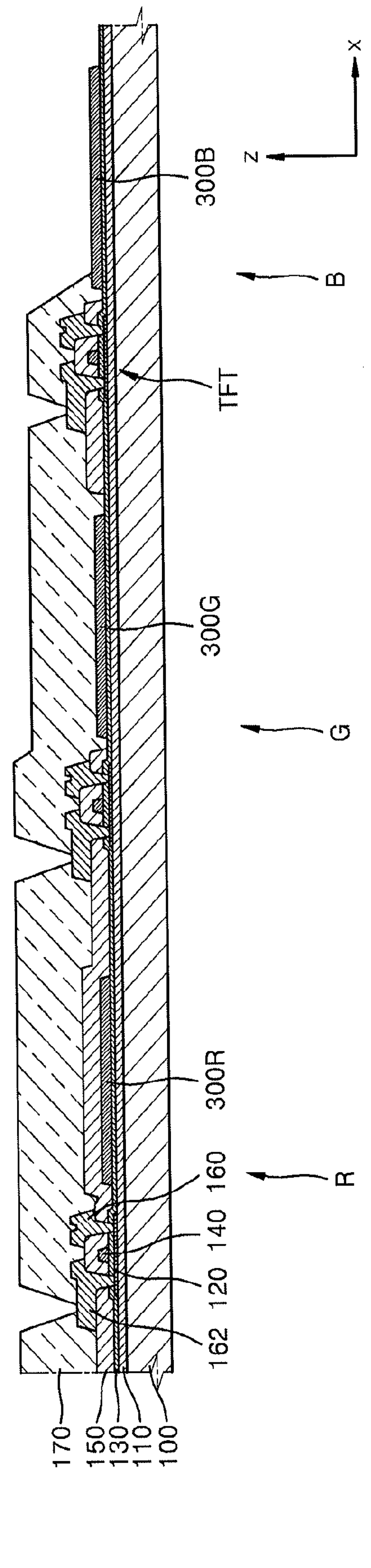
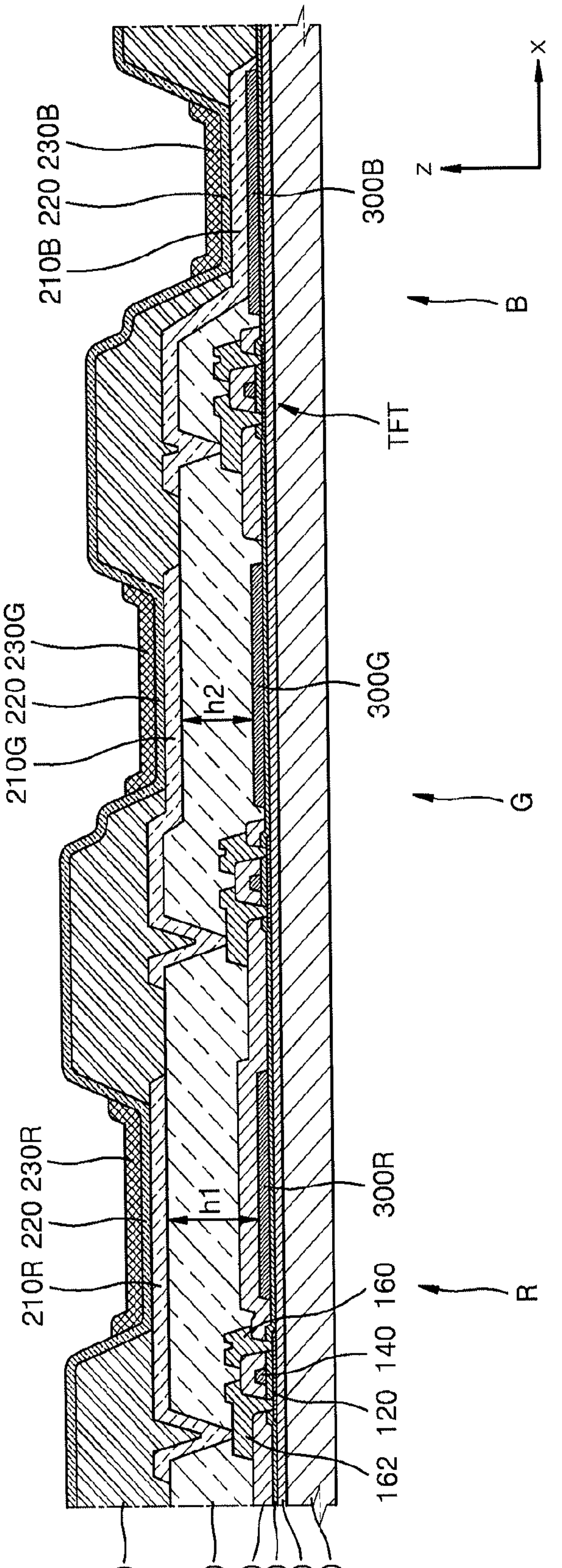


FIG. 6


210B 220 230B
300B
B
TFT
210G 220 230G
h2
300G
G
210R 220 230R
h1
300R
R
160
140
120
162
180
170
150
130
110
100
X
Z

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

CROSS-REFERENCE TO RELATED APPLICATION

[0001] Korean Patent Application No. 10-2014-0122042, filed on Sep. 15, 2014, in the Korean Intellectual Property Office, and entitled: "Organic Light-Emitting Display Apparatus and Method of Manufacturing the Same," is incorporated by reference herein in its entirety.

BACKGROUND

[0002] 1. Field

[0003] One or more exemplary embodiments relate to a display apparatus, for example, to an organic light-emitting display apparatus and a method of manufacturing the same.

[0004] 2. Description of the Related Art

[0005] Among display apparatuses, an organic light-emitting display apparatus may have a wide viewing angle, an excellent contrast ratio, and a high response speed, and may be regarded as a next-generation display apparatus.

SUMMARY

[0006] Embodiments may be realized by providing an organic light-emitting display apparatus, including a substrate; a first reflective layer, a second reflective layer, and a third reflective layer that are separately disposed on the substrate; a first insulating layer on the first reflective layer, but not on the second reflective layer and the third reflective layer; a second insulating layer on the first insulating layer and the second reflective layer, but not on the third reflective layer; and a first pixel electrode for red emission on the second insulating layer and corresponding to the first reflective layer, a second pixel electrode for green emission on the second insulating layer and corresponding to the second reflective layer, and a third pixel electrode for blue emission on the third reflective layer.

[0007] The first pixel electrode, the second pixel electrode, and the third pixel electrode may be transparent electrodes.

[0008] The first insulating layer and the second insulating layer may be transparent insulating layers.

[0009] Each of the first reflective layer, the second reflective layer, and the third reflective layer may include a metal material.

[0010] The organic light-emitting display apparatus may further include a thin-film transistor electrically connected to each of the substrate, the first pixel electrode, the second pixel electrode, and the third pixel electrode. The thin-film transistor may include a semiconductor layer, a gate electrode, and source and drain electrodes, and each of the first reflective layer, the second reflective layer, and the third reflective layer may include a same material as one or more of the gate electrode or the source and drain electrodes of the thin-film transistor.

[0011] The first insulating layer may not be between the second pixel electrode and the second reflective layer and may not be between the third pixel electrode and the third reflective layer.

[0012] The second insulating layer may not be between the third pixel electrode and the third reflective layer.

[0013] The organic light-emitting display apparatus may further include a common layer on the first pixel electrode, the second pixel electrode, and the third pixel electrode, a red emission layer on the common layer and corresponding to the first pixel electrode, a green emission layer on the common layer and corresponding to the second pixel electrode, and a blue emission layer on the common layer and corresponding to the third pixel electrode.

[0014] The organic light-emitting display apparatus may further include an opposite electrode on the red emission layer, the green emission layer, and the blue emission layer and corresponding to the first pixel electrode, the second pixel electrode, and the third pixel electrode. A first distance between a surface of the first reflective layer facing the opposite electrode and a surface of the opposite electrode that corresponds to the first pixel electrode and faces the first pixel electrode may conform to an n^{th} resonance distance of light emitted from the red emission layer, a second distance between a surface of the second reflective layer facing the opposite electrode and a surface of the opposite electrode that corresponds to the second pixel electrode and faces the second pixel electrode may conform to an n^{th} resonance distance of light emitted from the green emission layer, and a third distance between a surface of the third reflective layer facing the opposite electrode and a surface of the opposite electrode that corresponds to the third pixel electrode and faces the third pixel electrode may conform to an n^{th} resonance distance of light emitted from the blue emission layer, where n is a natural number.

[0015] The organic light-emitting display apparatus may further include a third insulating layer on the second insulating layer and between the third pixel electrode and the third reflective layer.

[0016] Embodiments may be realized by providing a method of manufacturing an organic light-emitting display apparatus, the method including preparing a substrate, and forming a first reflective layer, a second reflective layer, and a third reflective layer on the substrate such that the first reflective layer, the second reflective layer, and the third reflective layer are separate from each other; forming a first insulating layer on the first reflective layer, but not on the second reflective layer and the third reflective layer; forming a second insulating layer on the first insulating layer and the second reflective layer, but not on the third reflective layer; and forming a first pixel electrode for red emission, a second pixel electrode for green emission, and a third pixel electrode for blue emission that correspond to the first reflective layer, the second reflective layer, and the third reflective layer, respectively, that are separately formed on the substrate.

[0017] The first pixel electrode, the second pixel electrode, and the third pixel electrode may be formed as transparent electrodes.

[0018] The method may further include forming a third insulating layer on the second insulating layer and between the third pixel electrode and the third reflective layer.

[0019] The first insulating layer, the second insulating layer, and the third insulating layer may be formed as transparent insulating layers.

[0020] Each of the first reflective layer, the second reflective layer, and the third reflective layer may be formed of a metal material.

[0021] The method may further include forming a thin-film transistor electrically connected to each of the first pixel electrode, the second pixel electrode, and the third pixel electrode. Forming the thin-film transistor may include forming a semiconductor layer, a gate electrode, and source and drain

electrodes, and forming the first reflective layer, the second reflective layer, and the third reflective layer may simultaneously be performed with one of forming the gate electrode or forming the source and drain electrodes.

[0022] The method may further include forming a common layer on the first pixel electrode, the second pixel electrode, and the third pixel electrode; and forming a red emission layer, a green emission layer, and a blue emission layer on the common layer. The red emission layer, the green emission layer, and the blue emission layer may correspond to the first pixel electrode, the second pixel electrode, and the third pixel electrode, respectively.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] Features will become apparent to those of skill in the art by describing in detail exemplary embodiments with reference to the attached drawings in which:

[0024] FIG. **1** illustrates a cross-sectional view of an organic light-emitting display apparatus according to an embodiment;

[0025] FIG. **2** illustrates a cross-sectional view of an organic light-emitting display apparatus according to an embodiment; and

[0026] FIGS. **3** through **6** illustrate cross-sectional views of a manufacturing procedure of the organic light-emitting display apparatus of FIG. **1**.

DETAILED DESCRIPTION

[0027] Example embodiments will now be described more fully hereinafter with reference to the accompanying drawings; however, they may be embodied in different forms and should not be construed as 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 exemplary implementations to those skilled in the art.

[0028] Those components that are the same or are in correspondence are rendered the same reference numeral regardless of the figure number, and redundant explanations are omitted.

[0029] Throughout the specification, while such terms as "first," "second," etc., may be used to describe various components, such components must not be limited to the above terms. The above terms are used only to distinguish one component from another. Also, a singular form may include plural forms, unless there is a particular description contrary thereto.

[0030] Throughout the specification, terms such as "comprise" or "comprising" are used to specify existence of features and/or components described in the specification, not excluding the existence of one or more other features and/or one or more other components. Also, it will be understood that when a layer, an area, a component, or the like is referred to as being "on" another layer, area, or component can be directly on another layer, area, or component or intervening layer, area, or component may also be present. Further, it will be understood that when a layer is referred to as being "under" another layer, it can be directly under, and one or more intervening layers may also be present. In addition, it will also be understood that when a layer is referred to as being "between" two layers, it can be the only layer between the two layers, or one or more intervening layers may also be present.

[0031] In the drawings, the dimensions or thicknesses of layers and regions may be exaggerated for clarity. For example, the thicknesses and sizes of elements in the drawings are arbitrarily shown for convenience of description.

[0032] Hereinafter, in one or more embodiments, X-axis, Y-axis, and Z-axis may not be limited to three axes on a rectangular coordinate system but may be interpreted as a broad meaning including the three axes. For example, the X-axis, Y-axis, and Z-axis may be perpendicular to each other or may indicate different directions that are not perpendicular to each other.

[0033] In one or more embodiments, an order of processes may be different from that is described. For example, two processes that are sequentially described may be substantially simultaneously performed, or may be performed in an opposite order to the described order.

[0034] 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.

[0035] FIG. **1** illustrates a cross-sectional view of an organic light-emitting display apparatus according to an embodiment. Referring to FIG. **1**, the organic light-emitting display apparatus may include a substrate **100**, a first reflective layer **300**R, a second reflective layer **300**G, and a third reflective layer **300**B that are separately disposed on the substrate **100**, a first insulating layer **150** disposed on the first reflective layer **300**R, a second insulating layer **170** disposed on the first reflective layer **300**R and the second reflective layer **300**G, and a first pixel electrode **210**R, a second pixel electrode **210**G, and a third pixel electrode **210**B (also, referred to as 'pixel electrodes **210**R, **210**G, and **210**B') that correspond to the first reflective layer **300**R, the second reflective layer **300**G, and the third reflective layer **300**B, respectively.

[0036] The substrate **100** may be formed of various materials such as a glass material, a metal material, or a plastic material such as polyethylene terephthalate, polyethylene naphthalate, or polyimide. The first reflective layer **300**R, the second reflective layer **300**G, and the third reflective layer **300**B may be separately disposed on the substrate **100**, and an insulating layer such as a buffer layer **110** or a gate insulating layer **130** may be interposed between the substrate and the first reflective layer **300**R, the second reflective layer **300**G, and the third reflective layer **300**B. The first reflective layer **300**R, the second reflective layer **300**G, and the third reflective layer **300**B may be disposed below the first pixel electrode **210**R, the second pixel electrode **210**G, and the third pixel electrode **210**B, respectively, so as to correspond to the first pixel electrode **210**R, the second pixel electrode **210**G, and the third pixel electrode **210**B, respectively, and may reflect light in an opposite direction of the substrate **100**.

[0037] The first pixel electrode **210**R for red emission corresponding to the first reflective layer **300**R, the second pixel electrode **210**G for green emission corresponding to the second reflective layer **300**G, and the third pixel electrode **210**B for blue emission corresponding to the third reflective layer **300**B may be disposed on the first reflective layer **300**R, the second reflective layer **300**G, and the third reflective layer **300**B, respectively. Thin-film transistors TFT that may be electrically connected to the first pixel electrode **210**R, the second pixel electrode **210**G, and the third pixel electrode **210**B may be disposed respectively between the first reflective layer **300**R and the first pixel electrode **210**R, the second reflective layer **300**G and the second pixel electrode **210**G, and the third reflective layer **300**B and the third pixel electrode **210**B. Although not illustrated in FIG. **1**, a capacitor, for example, may be interposed therebetween.

[0038] Hereinafter, a general structure of the thin-film transistor TFT is described in detail. The thin-film transistor TFT may include a semiconductor layer **120**, a gate electrode **140**, a source electrode **160**, and a drain electrode **162** that may include amorphous silicon, polycrystalline silicon or an organic semiconductor material. The buffer layer **110** that may be formed of silicon oxide or silicon nitride may be disposed on the substrate **100**, the semiconductor layer **120** may be disposed on the buffer layer **110**, and a top surface of the substrate **100** may be planarized or penetration of foreign substances into the semiconductor layer **120** may be prevented.

[0039] The gate electrode **140** may be disposed on the semiconductor layer **120**, and, in response to a signal applied to the gate electrode **140**, the source electrode **160** and the drain electrode **162** may be electrically connected. In consideration of, for example, adhesion with an adjacent layer, surface planarization of a stacked layer, or formability, the gate electrode **140** may be formed as a single layer or a multistack layer including one or more of aluminum (Al), platinum (Pt), palladium (Pd), silver (Ag), magnesium (Mg), gold (Au), nickel (Ni), neodymium (Nd), iridium (Ir), chrome (Cr), lithium (Li), calcium (Ca), molybdenum (Mo), titanium (Ti), tungsten (W), or copper (Cu). The gate insulating layer **130** that may be formed of silicon oxide and/or silicon nitride may be interposed between the semiconductor layer **120** and the gate electrode **140**, and insulation between the semiconductor layer **120** and the gate electrode **140** may be assured.

[0040] The buffer layer **110** and the gate insulating layer **130** may be disposed on an overall surface of the substrate **100**.

[0041] The first insulating layer **150** may be disposed on the gate electrode **140** and may function as an interlayer insulating layer that may insulate the gate electrode **140** from the source electrode **160** and the drain electrode **162** to be described below. The first insulating layer **150** may be formed of a transparent or translucent material, e.g., a silicon oxide layer, a silicon nitride layer, or a silicon oxynitride layer.

[0042] The source electrode **160** and the drain electrode **162** may be formed on the first insulating layer **150**. The source electrode **160** and the drain electrode **162** may be electrically connected to the semiconductor layer **120** via contact holes that may be formed in the first insulating layer **150** and the gate insulating layer **130**. In consideration of conductivity, the source electrode **160** and the drain electrode **162** may be formed as a single layer or a multistack layer including one or more of aluminum (Al), platinum (Pt), palladium (Pd), silver (Ag), magnesium (Mg), gold (Au), nickel (Ni), neodymium (Nd), iridium (Ir), chrome (Cr), lithium (Li), calcium (Ca), molybdenum (Mo), titanium (Ti), tungsten (W), or copper (Cu).

[0043] A protective layer (not shown) may be disposed on the thin-film transistor TFT, and may cover the thin-film transistor TFT. The protective layer may be formed of an inorganic material such as silicon oxide, silicon nitride, or silicon oxynitride.

[0044] The second insulating layer **170** may be disposed on the protective layer. The second insulating layer **170** may function as a planarization layer or a protective layer. For example, as illustrated in FIG. **1**, a red sub-pixel **200**R, a green sub-pixel **200**G, and a blue sub-pixel **200**B (also, referred to as 'sub-pixels **200**R, **200**G, and **200**B') may be disposed on the thin-film transistor TFT, and the second insulating layer **170** may be disposed as the planarization layer for generally planarizing a surface of the thin-film transistor TFT. The second insulating layer **170** may be formed of an acryl-based organic material or benzocyclobutene (BCB). Referring to FIG. **1**, the second insulating layer **170** may be formed as a single layer. In an embodiment, the second insulating layer **170** may have various forms including a multistack layer. The second insulating layer **170** may be formed of a transparent or translucent material, e.g., a silicon oxide layer, a silicon nitride layer, or a silicon oxynitride layer.

[0045] Referring to FIG. **1**, as described above, the first reflective layer **300**R, the second reflective layer **300**G, and the third reflective layer **300**B may be separately disposed on the gate insulating layer **130**. In an embodiment, the first reflective layer **300**R, the second reflective layer **300**G, and the third reflective layer **300**B may be disposed on a same layer as the gate electrode **140** of the thin-film transistor TFT. The first reflective layer **300**R, the second reflective layer **300**G, and the third reflective layer **300**B may include a metal material, i.e., a same metal material as the gate electrode **140**, and each of the first reflective layer **300**R, the second reflective layer **300**G, and the third reflective layer **300**B may be formed as a single layer or a multistack layer including one or more of aluminum (Al), platinum (Pt), palladium (Pd), silver (Ag), magnesium (Mg), gold (Au), nickel (Ni), neodymium (Nd), iridium (Ir), chrome (Cr), lithium (Li), calcium (Ca), molybdenum (Mo), titanium (Ti), tungsten (W), or copper (Cu).

[0046] An opening for exposing at least one of the source electrode **160** and the drain electrode **162** of the thin-film transistor TFT may be formed on the second insulating layer **170**, and the first pixel electrode **210**R, the second pixel electrode **210**G, the third pixel electrode **210**B that may be electrically connected to the thin-film transistor TFT by contacting one of the source electrode **160** and the drain electrode **162** via the opening may be disposed on the second insulating layer **170** while the first pixel electrode **210**R, the second pixel electrode **210**G, and the third pixel electrode **210**B are separate from each other.

[0047] The first pixel electrode **210**R, the second pixel electrode **210**G, and the third pixel electrode **210**B may be formed as transparent or translucent electrodes. When the first pixel electrode **210**R, the second pixel electrode **210**G, and the third pixel electrode **210**B are formed as transparent or translucent electrodes, the first pixel electrode **210**R, the second pixel electrode **210**G, and the third pixel electrode **210**B may be formed of ITO, IZO, ZnO, In_2O_3, IGO or AZO. In an embodiment, the first pixel electrode **210**R, the second pixel electrode **210**G, and the third pixel electrode **210**B may be formed of various materials and may have one of various structures including, for example, a single-layer structure or a multilayer structure.

[0048] A pixel-defining layer **180** may be disposed on the second insulating layer **170**. The pixel-defining layer **180** may define pixels by having openings that respectively correspond to sub-pixels, i.e., the pixel-defining layer **180** has openings that cover sides of the pixel electrodes **210**R, **210**G, and **210**B and expose center portions of the pixel electrodes **210**R, **210**G, and **210**B, respectively. As illustrated in FIG. **1**, the pixel-defining layer **180** may increase a distance between ends of the pixel electrodes **210**R, **210**G, and **210**B and an opposite electrode **250** that may be disposed above each of the pixel electrodes **210**R, **210**G, and **210**B, and may prevent an arc occurring at the ends of the pixel electrodes **210**R, **210**G, and **210**B. The pixel-defining layer **180** may be formed of an organic material such as polyimide.

[0049] As illustrated in FIG. **1**, the red sub-pixel **200**R, the green sub-pixel **200**G, and the blue sub-pixel **200**B that may include the first pixel electrode **210**R, the second pixel electrode **210**G, and the third pixel electrode **210**B, respectively, may be disposed on the second insulating layer **170**. Each of the sub-pixels **200**R, **200**G, and **200**B may include an emission layer (EML). For example, the red sub-pixel **200**R may include the first pixel electrode **210**R and a red emission layer **230**R that may be disposed on the first pixel electrode **210**R so as to correspond to the first pixel electrode **210**R, the green sub-pixel **200**G may include the second pixel electrode **210**G and a green emission layer **230**G that may be disposed on the second pixel electrode **210**G so as to correspond to the second pixel electrode **210**G, and the blue sub-pixel **200**B may include the third pixel electrode **210**B and a blue emission layer **230**B that may be disposed on the third pixel electrode **210**B so as to correspond to the third pixel electrode **210**B. The red emission layer **230**R, the green emission layer **230**G, and the blue emission layer **230**B (also referred to as 'emission layers **230**R, **230**G, and **230**B') may have wavelength ranges that are different from each other, and in a case of front emission by which light may be reflected from the first reflective layer **300**R through the third reflective layer **300**B and may travel in the opposite direction of the substrate **100**, different resonance distances may be applied thereto.

[0050] A first common layer **220** may be interposed between the pixel electrodes **210**R, **210**G, and **210**B and the red emission layer **230**R, the green emission layer **230**G, and the blue emission layer **230**B. The first common layer **220** may not be partitioned according to the pixel electrodes **210**R, **210**G, and **210**B, and may be disposed on an overall surface of the substrate **100**. The first common layer **220** may have a structure in which, for example, a hole injection layer (HIL) or a hole transport layer (HTL), are singularly or multiply stacked. A second common layer **240** may be interposed between the opposite electrode **250** and each of the red emission layer **230**R, the green emission layer **230**G, and the blue emission layer **230**B. The second common layer **240** may not be partitioned according to the sub-pixels **200**R, **200**G, and **200**B, and may be disposed on an overall surface of the substrate **100**. The second common layer **240** may have a structure in which, for example, an electron transport layer (ETL) or an electron injection layer (EIL), are singularly or multiply stacked. Referring to FIG. **1**, for example, the first common layer **220** may be disposed below the emission layers **230**R, **230**G, and **230**B, and the second common layer **240** may be disposed on the emission layers **230**R, **230**G, and **230**B. In an embodiment, only the first common layer **220** or the second common layer **240** may be disposed.

[0051] The red emission layer **230**R through the blue emission layer **230**B, the first common layer **220**, and the second common layer **240** may include a small molecule material or a polymer material. The small molecule material may include various organic materials including, for example, copper phthalocyanine (CuPc), N,N'-Di(naphthalene-1-yl)-N,N-diphenyl-benzidine (NPB), or tris-8-hydroxyquinoline aluminum)(Alq3). The layers may be formed using, for example, a vapor deposition method.

[0052] The red emission layer **230**R through the blue emission layer **230**B, the first common layer **220**, and the second common layer **240** may include the polymer material, and they may include a HTL as the first common layer **220**. For example, the polymer HTL may be formed of poly(3,4-ethylenedioxythiophene) (PEDOT), and the red emission layer **230**R through the blue emission layer **230**B may be formed of, for example, a poly-phenylenevinylene (PPV)-based polymer material or a polyfluorene-based polymer material, using a screen printing method, an inkjet printing method, or a laser induced thermal imaging (LITI) method.

[0053] The opposite electrode **250** may be disposed on the red emission layer **230**R through the blue emission layer **230**B and may be disposed on an overall surface of the substrate **100**. In an embodiment, the opposite electrode **250** may be integrally formed with the sub-pixels **200**R, **200**G, and **200**B.

[0054] The opposite electrode **250** may be formed as a transparent or translucent electrode. For example, when the opposite electrode **250** is formed as transparent or translucent electrode, the opposite electrode **250** may have a layer formed of Li, Ca, LiF/Ca, LiF/Al, Al, Ag, Mg, or a compound thereof having a small work function and a transparent or translucent conductive layer including ITO, IZO, ZnO or In_2O_3.

[0055] Referring to FIG. **1**, as described above, the first reflective layer **300**R, the second reflective layer **300**G, and the third reflective layer **300**B may be separately disposed on the gate insulating layer **130**. In an embodiment, the first reflective layer **300**R, the second reflective layer **300**G, and the third reflective layer **300**B may be disposed on a same layer as the gate electrode **140** and may include a same material as the gate electrode **140**. In an embodiment, the first reflective layer **300**R, the second reflective layer **300**G, and the third reflective layer **300**B may include a same material as the source electrode **160** and the drain electrode **162**.

[0056] The first insulating layer **150** may be disposed on the first reflective layer **300**R, and the second insulating layer **170** may be further disposed on the first insulating layer **150** that may be disposed on the first reflective layer **300**R. The first pixel electrode **210**R for red emission may be disposed on the second insulating layer **170** so as to correspond to the first reflective layer **300**R.

[0057] The second insulating layer **170** may be disposed on the second reflective layer **300**G. Unlike the first reflective layer **300**R, the first insulating layer **150** may not be on the second reflective layer **300**G, and compared to a distance h**1** between a top surface of the first reflective layer **300**R and a top surface of the insulating layer **170** that may be disposed on the first reflective layer **300**R, a distance h**2** between a top surface of the second reflective layer **300**G and a top surface of the second insulating layer **170** that may be disposed on the second reflective layer **300**G may be decreased by an amount equal to a thickness of the first insulating layer **150**. The first insulating layer **150** and the second insulating layer **170** may not be disposed on the third reflective layer **300**B. Thus, the third pixel electrode **210**B for blue emission may be directly disposed on the third reflective layer **300**B so as to correspond to the third reflective layer **300**B.

[0058] As described above, the first insulating layer **150** may be interposed between the first pixel electrode **210**R and the first reflective layer **300**R, may not be interposed between the second pixel electrode **210**G and the second reflective layer **300**G, and may not be interposed between the third pixel electrode **210**B and the third reflective layer **300**B. The second insulating layer **170** may be interposed between the first pixel electrode **210**R and the first reflective layer **300**R and between the second pixel electrode **210**G and the second reflective layer **300**G, and may not be interposed between the third pixel electrode **210**B and the third reflective layer **300**B.

[0059] As described above, the red emission layer **230**R, the green emission layer **230**G, and the blue emission layer **230**B may have different wavelength ranges, and the red sub-pixel **200**R, the green sub-pixel **200**G, and the blue sub-pixel **200**B may have different resonance distances.

[0060] A distance d**1** between a surface of the first reflective layer **300**R that faces the opposite electrode **250** and a surface of the opposite electrode **250** that corresponds to the first pixel electrode **21** OR and faces the first pixel electrode **21** OR may conform to an n^{th} resonance distance of light that is emitted from the red emission layer **230**R (where n may be a natural number). The resonance distance d**1** of the red sub-pixel **200**R may be between about 1000 Å and about 9000 Å.

[0061] A distance d**2** between a surface of the second reflective layer **300**G that faces the opposite electrode **250** and a surface of the opposite electrode **250** that corresponds to the second pixel electrode **210**G and faces the second pixel electrode **210**G may conform to an n^{th} resonance distance of light that is emitted from the green emission layer **230**G (where n may be a natural number). The resonance distance d**2** of the green sub-pixel **200**G may be between about 800 Å and about 8800 Å.

[0062] A distance d**3** between a surface of the third reflective layer **300**B that faces the opposite electrode **250** and a surface of the opposite electrode **250** that corresponds to the third pixel electrode **210**B and faces the third pixel electrode **210**B may correspond to an n^{th} resonance distance of light that is emitted from the blue emission layer **230**B (where n may be a natural number). The resonance distance d**3** of the blue sub-pixel **200**B may be between about 600 Å and about 8600 Å.

[0063] As described above, the red emission layer **230**R, the green emission layer **230**G, and the blue emission layer **230**B may have different wavelength ranges, and the red sub-pixel **200**R, the green sub-pixel **200**G, and the blue sub-pixel **200**B may be formed to have different resonance distances. For the red sub-pixel **200**R and the green sub-pixel **200**G that may have relatively long resonance distances, compared to that of the blue sub-pixel **200**B, a red auxiliary layer may be further disposed between the first pixel electrode **210**R and the red emission layer **230**R, and a resonance distance may be complemented, and a green auxiliary layer may be further disposed between the second pixel electrode **210**G and the green emission layer **230**G. In an embodiment, this further disposition may require at least two masks for forming the red auxiliary layer and the green auxiliary layer so as to provide different thicknesses for the red auxiliary layer and the green auxiliary layer for the red sub-pixel **200**R and the green sub-pixel **200**G, respectively.

[0064] As described above, the organic light-emitting display apparatus according to the present embodiment may have a structure in which the first pixel electrode **21** OR through the third pixel electrode **210**B are formed as transparent or translucent electrodes, and the first reflective layer **300**R through the third reflective layer **300**B that include a same metal material as the gate electrode **140** or the source and drain electrodes **160** and **162** of the thin-film transistor TFT are disposed to correspond to the first pixel electrode **210**R through the third pixel electrode **210**B, respectively. The first insulating layer **150** and the second insulating layer **170** may be interposed between the first pixel electrode **21** OR and the first reflective layer **300**R, the first insulating layer **150** may not be interposed between the second pixel electrode **210**G and the second reflective layer **300**G, and the first insulating layer **150** and the second insulating layer **170** may not be disposed between the third pixel electrode **210**B and the third reflective layer **300**B, and an appropriate resonance distance may be arranged for each of the sub-pixels without a separate auxiliary layer.

[0065] As described above, when a device unit such as the thin-film transistor TFT or the capacitor is formed, resonance distances may be matched with each other according to the sub-pixels using a structure of an insulating layer formed below the first pixel electrode **210**R through the third pixel electrode **210**B, and a process for the organic light-emitting display apparatus may be simplified without addition of a mask.

[0066] FIG. **2** illustrates a cross-sectional view of an organic light-emitting display apparatus according to an embodiment. Referring to FIG. **2**, the organic light-emitting display apparatus may include the substrate **100**, the first reflective layer **300**R, the second reflective layer **300**G, and the third reflective layer **300**B that are separately disposed on the substrate **100**, the first insulating layer **150** disposed on the first reflective layer **300**R, the second insulating layer **170** disposed on the first reflective layer **300**R and the second reflective layer **300**G, a third insulating layer **190** disposed on the second insulating layer **170** and the third reflective layer **300**B, and a first pixel electrode **210**R, a second pixel electrode **210**G, and a third pixel electrode **210**B that correspond to the first reflective layer **300**R, the second reflective layer **300**G, and the third reflective layer **300**B, respectively. In the embodiment of FIG. **2**, a structure of a thin-film transistor TFT or descriptions about sub-pixels **200**R, **200**G, and **200**B are the same as those of the embodiment of FIG. **1**, and detailed descriptions, which are the same as the aforementioned contents, will be omitted.

[0067] Referring to FIG. **2**, the third insulating layer **190** may be further disposed on the second insulating layer **170**. The third insulating layer **190** may be formed of a transparent organic material, e.g., a photoimide-based material, a photoacryl-based material, or a siloxane-based material.

[0068] The first insulating layer **150**, the second insulating layer **170**, and the third insulating layer **190** may be disposed on the first reflective layer **300**R, the second insulating layer **170** and the third insulating layer **190** may be disposed on the second reflective layer **300**G, and the third insulating layer **190** may be disposed on the third reflective layer **300**B. In the embodiment of FIG. **2**, the third insulating layer **190** may be further disposed on the second insulating layer **170**, and resonance distances d**1'**, d**2'**, and d**3'** may be further exactly adjusted according to the sub-pixels **200**R, **200**G, and **200**B.

[0069] Although the organic light-emitting display apparatus has been mainly described, also provided is a method of manufacturing the organic light-emitting display apparatus.

[0070] FIGS. **3** through **6** illustrate cross-sectional views of a manufacturing procedure of the organic light-emitting display apparatus of FIG. **1**. Referring to FIG. **3**, first, the substrate **100** that may be formed of various materials such as a glass material, a metal material, or a plastic material such as polyethylene terephthalate, polyethylene naphthalate, or polyimide is arranged. The buffer layer **110** that may be formed of silicon oxide or silicon nitride may be disposed on the substrate **100**, and a top surface of the substrate **100** may be planarized or penetration of foreign substances into the semiconductor layer **120** may be prevented. The semiconductor layer **120** may be patterned on the buffer layer **110**.

[0071] The gate insulating layer **130** that may be formed of silicon oxide and/or silicon nitride may be formed on the semiconductor layer **120**, the semiconductor layer **120** may be covered, and the gate insulating layer **130** may function to assure an insulation between the semiconductor layer **120** and the gate electrode **140**. The buffer layer **110** and the gate insulating layer **130** may be disposed on an overall surface of the substrate **100**.

[0072] The gate electrode **140** may be formed on the semiconductor layer **120**, and in response to a signal applied to the gate electrode **140**, the source electrode **160** and the drain electrode **162** may be electrically connected. In consideration of, for example, adhesion with an adjacent layer, surface planarization of a stacked layer, or formability, the gate electrode **140** may be formed as a single layer or a multistack layer including one or more of aluminum (Al), platinum (Pt), palladium (Pd), silver (Ag), magnesium (Mg), gold (Au), nickel (Ni), neodymium (Nd), iridium (Ir), chrome (Cr), lithium (Li), calcium (Ca), molybdenum (Mo), titanium (Ti), tungsten (W), or copper (Cu).

[0073] When the gate electrode **140** is formed, the first reflective layer **300**R, the second reflective layer **300**G, and the third reflective layer **300**B may also be formed to be separate from each other on the substrate **100**, and the first reflective layer **300**R, the second reflective layer **300**G, and the third reflective layer **300**B may be formed by including a same metal material as the gate electrode **140**. Referring to FIG. **1**, the first reflective layer **300**R, the second reflective layer **300**G, the third reflective layer **300**B, and the gate electrode **140** may be simultaneously formed. In an embodiment, the first reflective layer **300**R, the second reflective layer **300**G, and the third reflective layer **300**B may be formed by including a metal material, and the first reflective layer **300**R, the second reflective layer **300**G, and the third reflective layer **300**B may be simultaneously formed with the source electrode **160** and the drain electrode **162**. The first reflective layer **300**R, the second reflective layer **300**G, and the third reflective layer **300**B may be disposed below the first pixel electrode **210**R, the second pixel electrode **210**G, and the third pixel electrode **210**B, respectively, and may function to reflect light in an opposite direction of the substrate **100**.

[0074] Afterward, referring to FIG. **4**, the first insulating layer **150** may be formed on the gate electrode **140** and the first reflective layer **300**R. The first insulating layer **150** may not be formed on the second reflective layer **300**G and the third reflective layer **300**B. The first insulating layer **150** that may be formed on the gate electrode **140** may function as an interlayer insulating layer that may insulate the gate electrode **140** from the source electrode **160** and the drain electrode **162**. The first insulating layer **150** may be formed of a transparent or translucent material, e.g., a silicon oxide layer, a silicon nitride layer, or a silicon oxynitride layer.

[0075] The source electrode **160** and the drain electrode **162** may be formed on the first insulating layer **150**. The source electrode **160** and the drain electrode **162** may be electrically connected to the semiconductor layer **120** via contact holes that may be formed in the first insulating layer **150** and the gate insulating layer **130**. In consideration of conductivity, the source electrode **160** and the drain electrode **162** may be formed as a single layer or a multistack layer including one or more of aluminum (Al), platinum (Pt), palladium (Pd), silver (Ag), magnesium (Mg), gold (Au), nickel (Ni), neodymium (Nd), iridium (Ir), chrome (Cr), lithium (Li), calcium (Ca), molybdenum (Mo), titanium (Ti), tungsten (W), or copper (Cu).

[0076] In an embodiment, a protective layer (not shown) may be disposed on the thin-film transistor TFT, and may cover the thin-film transistor TFT. The protective layer may be formed of an inorganic material such as silicon oxide, silicon nitride, or silicon oxynitride.

[0077] Afterward, referring to FIG. **5**, the second insulating layer **170** may be disposed on the thin-film transistor TFT. As illustrated in FIG. **5**, the red sub-pixel **200**R, the green sub-pixel **200**G, and the blue sub-pixel **200**B may be disposed on the thin-film transistor TFT, and the second insulating layer **170** may be disposed as a planarization layer for generally planarizing a top surface of the thin-film transistor TFT. Referring to FIG. **5**, the second insulating layer **170** may formed as a single layer. In an embodiment the second insulating layer **170** may have various forms including a multistack layer. The second insulating layer **170** may be formed of a transparent or translucent material, e.g., a silicon oxide layer, a silicon nitride layer, or a silicon oxynitride layer.

[0078] An opening for exposing at least one of the source electrode **160** and the drain electrode **162** of the thin-film transistor TFT may be formed on the second insulating layer **170**, and the first pixel electrode **210**R, the second pixel electrode **210**G, the third pixel electrode **210**B may be electrically connected to the thin-film transistor TFT by contacting one of the source electrode **160** and the drain electrode **162** via the opening.

[0079] In an embodiment, the second insulating layer **170** may be formed on the first reflective layer **300**R and the second reflective layer **300**G and may not be formed on the third reflective layer **300**B. The first insulating layer **150** may not be formed below the second insulating layer **170** that may be disposed on the second reflective layer **300**G, and a step difference equal to a thickness of the first insulating layer **150** may occur on the second insulating layer **170**.

[0080] Afterward, referring to FIG. **6**, the first pixel electrode **210**R for red emission that corresponds to the first reflective layer **300**R, the second pixel electrode **210**G for green emission that corresponds to the second reflective layer **300**G, and the third pixel electrode **210**B for blue emission that corresponds to the third reflective layer **300**B may be disposed on the first reflective layer **300**R, the second reflective layer **300**G, and the third reflective layer **300**B, respectively. The first pixel electrode **210**R, the second pixel electrode **210**G, and the third pixel electrode **210**B may be formed as transparent or translucent electrodes.

[0081] The pixel-defining layer **180** may be disposed on the second insulating layer **170**. The pixel-defining layer **180** may define pixels by having openings that respectively correspond to sub-pixels, i.e., the pixel-defining layer **180** has openings that cover sides of the pixel electrodes **210**R, **210**G, and **210**B and expose center portions of the pixel electrodes **210**R, **210**G, and **210**B, respectively. The pixel-defining layer **180** may be formed of an organic material such as polyimide.

[0082] The first common layer **220** may be formed on the pixel electrodes **210**R, **210**G, and **210**B. The first common layer **220** may not be partitioned according to the pixel electrodes **210**R, **210**G, and **210**B, and may be disposed on an overall surface of the substrate **100**. The first common layer **220** may have a structure in which, for example, an HIL or an HTL, are singularly or multiply stacked.

[0083] The red sub-pixel **200**R, the green sub-pixel **200**G, and the blue sub-pixel **200**B that may include the first pixel electrode **210**R, the second pixel electrode **210**G, and the third pixel electrode **210**B, respectively, may be disposed on the second insulating layer **170**. Each of the sub-pixels **200**R, **200**G, and **200**B may include an EML. For example, the red sub-pixel **200**R may include the first pixel electrode **21** OR and a red emission layer **230**R that may be disposed on the first pixel electrode **210**R so as to correspond to the first pixel electrode **210**R, the green sub-pixel **200**G may include the second pixel electrode **210**G and a green emission layer **230**G that may be disposed on the second pixel electrode **210**G so as to correspond to the second pixel electrode **210**G, and the blue sub-pixel **200**B may include the third pixel electrode **210**B and a blue emission layer **230**B that may be disposed on the third pixel electrode **210**B so as to correspond to the third pixel electrode **210**B. The red emission layer **230**R, the green emission layer **230**G, and the blue emission layer **230**B may have wavelength ranges that are different from each other, and in a case of front emission by which light may be reflected from the first reflective layer **300**R through the third reflective layer **300**B and may travel in the opposite direction of the substrate **100**, different resonance distances may be applied thereto.

[0084] The second common layer **240** may be formed on the red emission layer **230**R, the green emission layer **230**G, and the blue emission layer **230**B. The second common layer **240** may not be partitioned according to the sub-pixels **200**R, **200**G, and **200**B, and may be disposed on an overall surface of the substrate **100**. The second common layer **240** may have a structure in which, for example, an ETL or an EIL, are singularly or multiply stacked.

[0085] The opposite electrode **250** may be disposed on the red emission layer **230**R through the blue emission layer **230**B and may be disposed on an overall surface of the substrate **100**. In an embodiment, the opposite electrode **250** may be integrally formed with the sub-pixels **200**R, **200**G, and **200**B and may be formed as a transparent or translucent electrode.

[0086] As described above, the first reflective layer **300**R, the second reflective layer **300**G, and the third reflective layer **300**B may be separately disposed on the gate insulating layer **130**. The first insulating layer **150** may be disposed on the first reflective layer **300**R, and the second insulating layer **170** may be further disposed on the first insulating layer **150** that may be disposed on the first reflective layer **300**R. The first pixel electrode **21** OR for red emission may be disposed on the second insulating layer **170** so as to correspond to the first reflective layer **300**R.

[0087] The second insulating layer **170** may be disposed on the second reflective layer **300**G. Unlike the first reflective layer **300**R, the first insulating layer **150** may not be disposed on the second reflective layer **300**G, and compared to a distance h**1** between a top surface of the first reflective layer **300**R and a top surface of the insulating layer **170** that may be disposed on the first reflective layer **300**R, a distance h**2** between a top surface of the second reflective layer **300**G and a top surface of the second insulating layer **170** that may be disposed on the second reflective layer **300**G may be decreased by an amount equal to a thickness of the first insulating layer **150**. The first insulating layer **150** and the second insulating layer **170** may not be disposed on the third reflective layer **300**B. The third pixel electrode **210**B for red emission may be directly disposed on the third pixel electrode **210**B so as to correspond to the third reflective layer **300**B.

[0088] As described above, the red emission layer **230**R, the green emission layer **230**G, and the blue emission layer **230**B may have different wavelength ranges, and the red sub-pixel **200**R, the green sub-pixel **200**G, and the blue sub-pixel **200**B may have different resonance distances.

[0089] As described above, the red emission layer **230**R, the green emission layer **230**G, and the blue emission layer **230**B may have different wavelength ranges, and the red sub-pixel **200**R, the green sub-pixel **200**G, and the blue sub-pixel **200**B may be formed to have different resonance distances. For the red sub-pixel **200**R and the green sub-pixel **200**G that may have relatively long resonance distances, compared to that of the blue sub-pixel **200**B, a red auxiliary layer may be further disposed between the first pixel electrode **210**R and the red emission layer **230**R, and a resonance distance may be complemented, and a green auxiliary layer may be further disposed between the second pixel electrode **210**G and the green emission layer **230**G. In an embodiment, this further disposition may require at least two masks for forming the red auxiliary layer and the green auxiliary layer so as to provide different thicknesses for the red auxiliary layer and the green auxiliary layer for the red sub-pixel **200**R and the green sub-pixel **200**G, respectively.

[0090] As described above, the organic light-emitting display apparatus according to the present embodiment may have a structure in which the first pixel electrode **21** OR through the third pixel electrode **210**B are formed as transparent or translucent electrodes, and the first reflective layer **300**R through the third reflective layer **300**B that include a same metal material as the gate electrode **140** or the source and drain electrodes **160** and **162** of the thin-film transistor TFT are disposed to correspond to the first pixel electrode **210**R through the third pixel electrode **210**B, respectively. The first insulating layer **150** and the second insulating layer **170** may be interposed between the first pixel electrode **21** OR and the first reflective layer **300**R, the first insulating layer **150** may not be interposed between the second pixel electrode **210**G and the second reflective layer **300**G, and the first insulating layer **150** and the second insulating layer **170** may not be disposed between the third pixel electrode **210**B and the third reflective layer **300**B, and an appropriate resonance distance may be arranged for each of the sub-pixels without a separate auxiliary layer.

[0091] As described above, when a device unit such as the thin-film transistor TFT or the capacitor is formed, resonance distances may be matched with each other according to the sub-pixels using a structure of an insulating layer formed below the first pixel electrode **21** OR through the third pixel electrode **210**B, and a process for the organic light-emitting display apparatus may be simplified without addition of a mask.

[0092] By way of summation and review, in an organic light-emitting display apparatus, a thin-film transistor and organic light-emitting devices may be formed on a substrate, and the organic light-emitting devices may actively emit light. The organic light-emitting display apparatus may be used as a display unit of a small product such as a mobile phone or a display unit of a large product such as a television.

[0093] The organic light-emitting display apparatus may include organic light-emitting devices as sub-pixels that emit as red (R), green (G), and blue (B), respectively, and each of the organic light-emitting devices may include a pixel electrode and an opposite electrode that face each other, and an intermediate layer that may be disposed between the pixel electrode and the opposite electrode and may include an emission layer. Wavelength ranges of R, G, and B emissions that form an emission layer are different from each other, and an additional process may be required in forming the intermediate layer so as to adjust resonance distances of the sub-pixels.

[0094] As described above, according to the one or more of the above exemplary embodiments, an organic light-emitting display apparatus and method of manufacturing the same may improve emission efficiency via a mask-less structure.

[0095] Example embodiments have been disclosed herein, and although specific terms are employed, they are used and are to be interpreted in a generic and descriptive sense only and not for purpose of limitation. In some instances, as would be apparent to one of skill in the art as of the filing of the present application, features, characteristics, and/or elements described in connection with a particular embodiment may be used singly or in combination with features, characteristics, and/or elements described in connection with other embodiments unless otherwise specifically indicated. Accordingly, it will be understood by those of skill in the art that various changes in form and details may be made without departing from the spirit and scope of the present invention as set forth in the following claims.

What is claimed is:

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

a substrate;

a first reflective layer, a second reflective layer, and a third reflective layer that are separately disposed on the substrate;

a first insulating layer on the first reflective layer, but not on the second reflective layer and the third reflective layer;

a second insulating layer on the first insulating layer and the second reflective layer, but not on the third reflective layer; and

a first pixel electrode for red emission on the second insulating layer and corresponding to the first reflective layer, a second pixel electrode for green emission on the second insulating layer and corresponding to the second reflective layer, and a third pixel electrode for blue emission on the third reflective layer.

2. The organic light-emitting display apparatus as claimed in claim **1**, wherein the first pixel electrode, the second pixel electrode, and the third pixel electrode are transparent electrodes.

3. The organic light-emitting display apparatus as claimed in claim **2**, wherein the first insulating layer and the second insulating layer are transparent insulating layers.

4. The organic light-emitting display apparatus as claimed in claim **3**, wherein each of the first reflective layer, the second reflective layer, and the third reflective layer includes a metal material.

5. The organic light-emitting display apparatus as claimed in claim **4**, further comprising a thin-film transistor electrically connected to each of the substrate, the first pixel electrode, the second pixel electrode, and the third pixel electrode, wherein:

the thin-film transistor includes a semiconductor layer, a gate electrode, and source and drain electrodes, and

each of the first reflective layer, the second reflective layer, and the third reflective layer includes a same material as one or more of the gate electrode or the source and drain electrodes of the thin-film transistor.

6. The organic light-emitting display apparatus as claimed in claim **5**, wherein the first insulating layer is not between the second pixel electrode and the second reflective layer and is not between the third pixel electrode and the third reflective layer.

7. The organic light-emitting display apparatus as claimed in claim **5**, wherein the second insulating layer is not between the third pixel electrode and the third reflective layer.

8. The organic light-emitting display apparatus as claimed in claim **1**, further comprising a common layer on the first pixel electrode, the second pixel electrode, and the third pixel electrode, a red emission layer on the common layer and corresponding to the first pixel electrode, a green emission layer on the common layer and corresponding to the second pixel electrode, and a blue emission layer on the common layer and corresponding to the third pixel electrode.

9. The organic light-emitting display apparatus as claimed in claim **8**, further comprising an opposite electrode on the red emission layer, the green emission layer, and the blue emission layer and corresponding to the first pixel electrode, the second pixel electrode, and the third pixel electrode,

wherein a first distance between a surface of the first reflective layer facing the opposite electrode and a surface of the opposite electrode that corresponds to the first pixel electrode and faces the first pixel electrode conforms to an n^{th} resonance distance of light emitted from the red emission layer,

a second distance between a surface of the second reflective layer facing the opposite electrode and a surface of the opposite electrode that corresponds to the second pixel electrode and faces the second pixel electrode conforms to an n^{th} resonance distance of light emitted from the green emission layer, and

a third distance between a surface of the third reflective layer facing the opposite electrode and a surface of the opposite electrode that corresponds to the third pixel electrode and faces the third pixel electrode conform to an n^{th} resonance distance of light emitted from the blue emission layer,

where n is a natural number.

10. The organic light-emitting display apparatus as claimed in claim **1**, further comprising a third insulating layer on the second insulating layer and between the third pixel electrode and the third reflective layer.

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

preparing a substrate, and forming a first reflective layer, a second reflective layer, and a third reflective layer on the substrate such that the first reflective layer, the second reflective layer, and the third reflective layer are separate from each other;

forming a first insulating layer on the first reflective layer, but not on the second reflective layer and the third reflective layer;

forming a second insulating layer on the first insulating layer and the second reflective layer, but not on the third reflective layer; and

forming a first pixel electrode for red emission, a second pixel electrode for green emission, and a third pixel electrode for blue emission that correspond to the first reflective layer, the second reflective layer, and the third reflective layer, respectively, that are separately formed on the substrate.

12. The method as claimed in claim **11**, wherein the first pixel electrode, the second pixel electrode, and the third pixel electrode are formed as transparent electrodes.

13. The method as claimed in claim **11**, further comprising forming a third insulating layer on the second insulating layer and between the third pixel electrode and the third reflective layer.

14. The method as claimed in claim **13**, wherein the first insulating layer, the second insulating layer, and the third insulating layer are formed as transparent insulating layers.

15. The method as claimed in claim **14**, wherein each of the first reflective layer, the second reflective layer, and the third reflective layer is formed of a metal material.

16. The method as claimed in claim **15**, further comprising forming a thin-film transistor electrically connected to each of the first pixel electrode, the second pixel electrode, and the third pixel electrode, wherein:

forming the thin-film transistor includes forming a semiconductor layer, a gate electrode, and source and drain electrodes, and

forming the first reflective layer, the second reflective layer, and the third reflective layer is simultaneously performed with one of forming the gate electrode or forming the source and drain electrodes.

17. The method as claimed in claim **11**, further comprising:

forming a common layer on the first pixel electrode, the second pixel electrode, and the third pixel electrode; and

forming a red emission layer, a green emission layer, and a blue emission layer on the common layer,

wherein the red emission layer, the green emission layer, and the blue emission layer correspond to the first pixel electrode, the second pixel electrode, and the third pixel electrode, respectively.

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摘要(译)

一种有机发光显示装置，包括基板;第一反射层，第二反射层和第三反射层，分别设置在基板上;第一反射层上的第一绝缘层，但不在第二反射层和第三反射层上;第一绝缘层和第二反射层上的第二绝缘层，但不在第三反射层上;第二像素电极，用于第二绝缘层上的红色发射并对应于第一反射层，第二像素电极用于第二绝缘层上的绿色发射并且对应于第二反射层，第三像素电极用于蓝色发射第三反射层。

third reflective layer that are separately disposed on the sub-strate; a first insulating layer on the first reflective layer, but not on the second reflective layer and the third reflective layer; a second insulating layer on the first insulating layer and the