US 20130126872A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2013/0126872 A1**

(43) **Pub. Date: May 23, 2013**

Cho

(54) **ORGANIC LIGHT-EMITTING DISPLAY APPARATUS**

(76) Inventor: **Kyu-Sik Cho**, Yongin-city (KR)

(21) Appl. No.: **13/528,959**

(22) Filed: **Jun. 21, 2012**

(30) **Foreign Application Priority Data**

Nov. 21, 2011 (KR) 10-2011-0121735

Publication Classification

(51) **Int. Cl.**
H01L 27/32 (2006.01)

(52) **U.S. Cl.**
USPC **257/59**; 257/72; 257/E27.119; 257/40

(57) **ABSTRACT**

An organic light-emitting display includes a substrate, a first electrode on the substrate, an intermediate layer on the first electrode, and including an organic light-emitting layer, a second electrode on the intermediate layer, and a reflective member on sides of the intermediate layer to reflect visible light generated by the intermediate layer, the reflective member contacting the second electrode.

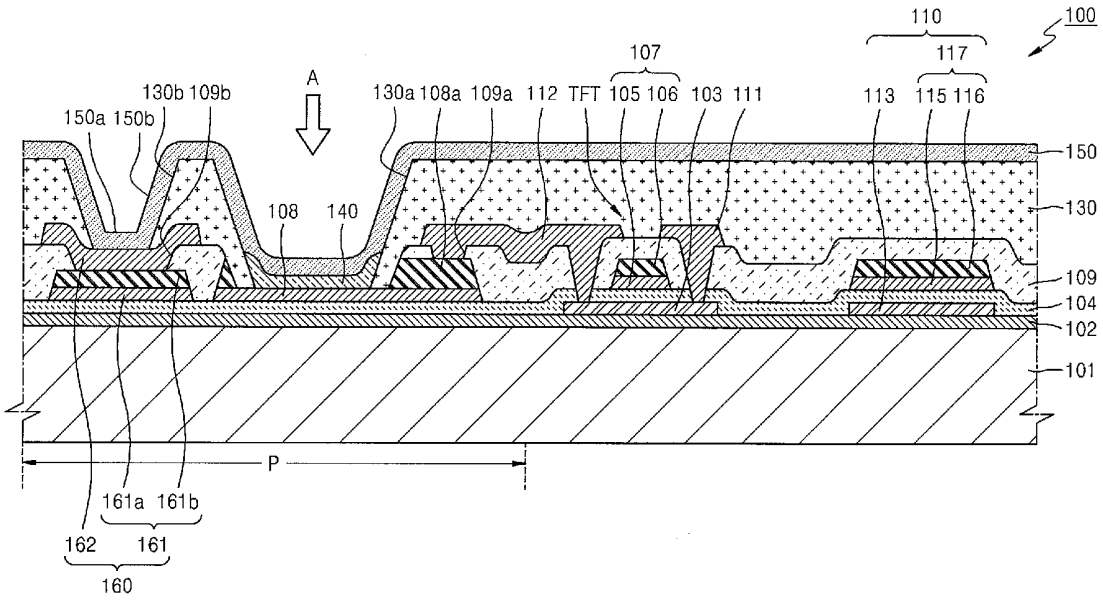


FIG. 1

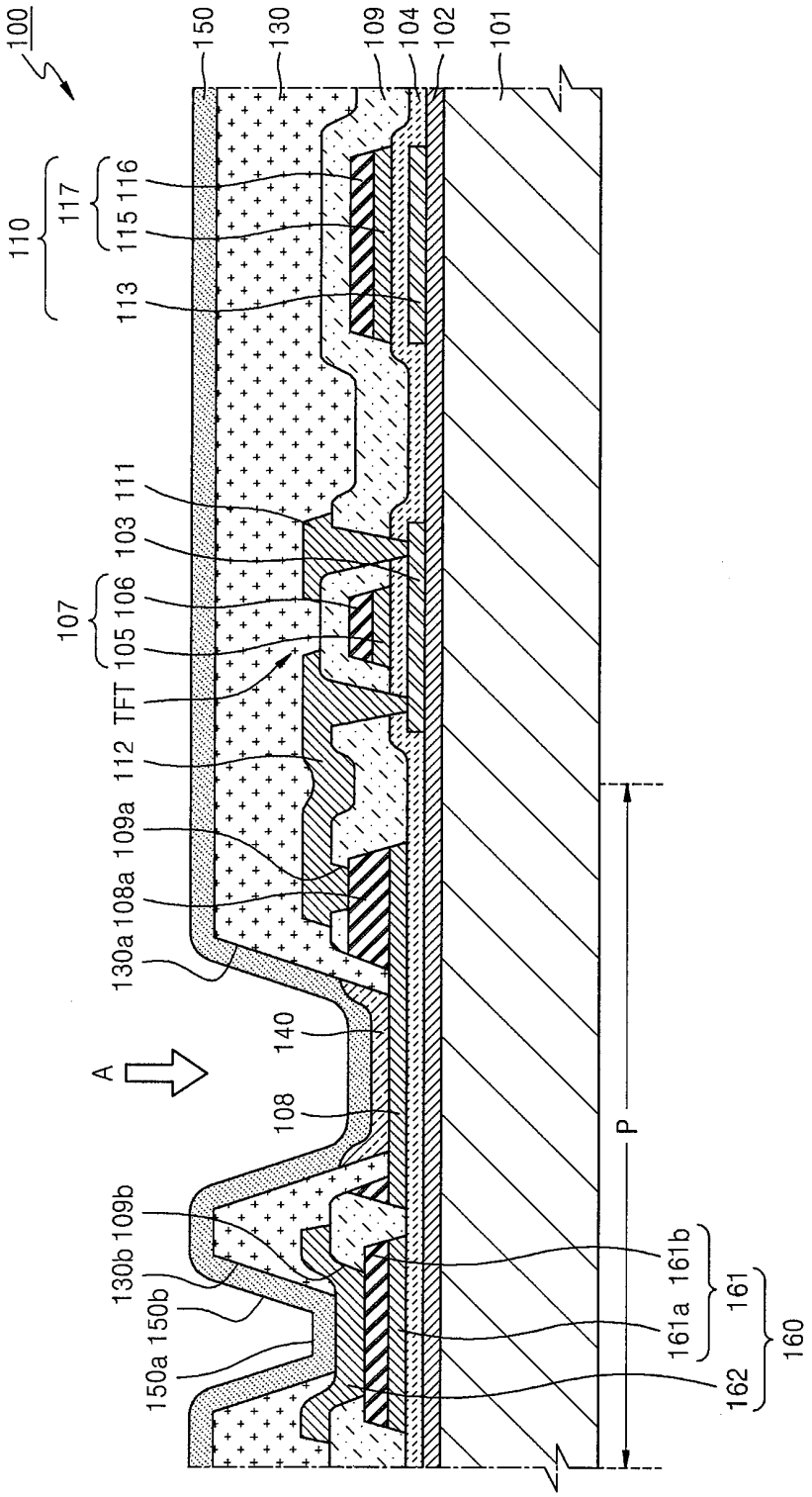

100
150
130
109
104
102
101
110
117
116
115
113
111
103
107
106
105
TFT
112
109a
108a
130a
140
A
108
P
109b
130b
150b
150a
161b
161a
161
160
162

FIG. 2

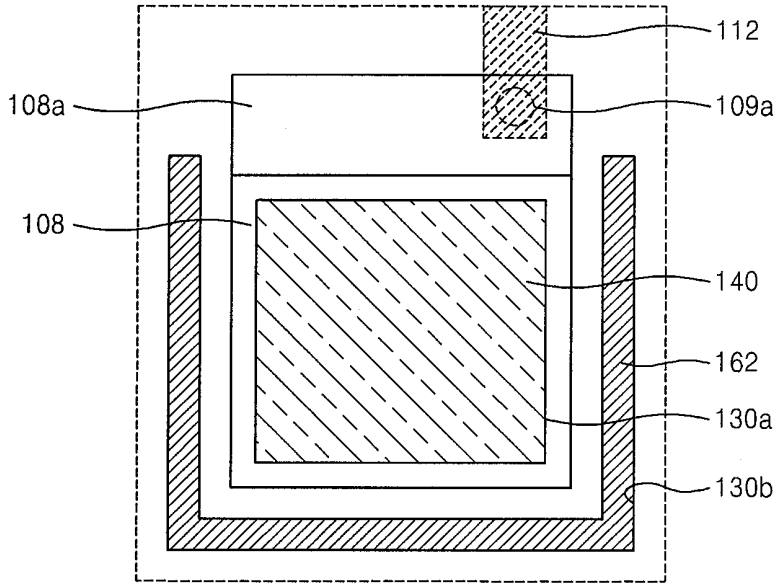


FIG. 3

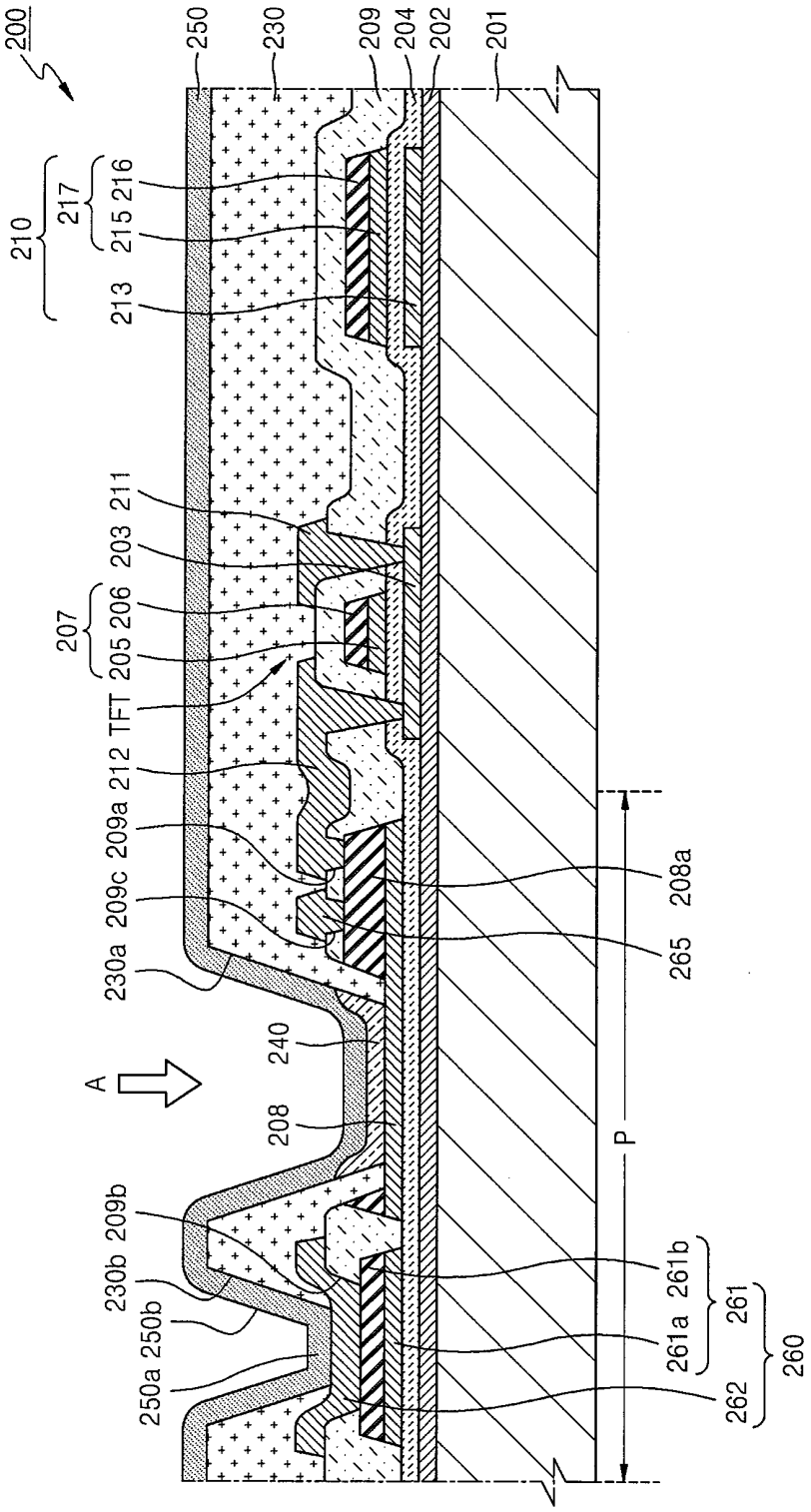

200
250
230
209
204
202
201
210
217
216
215
213
211
203
207
206
205
TFT
212
209a
209c
230a
240
208
A
208a
265
P
209b
230b
250b
250a
261b
261a
261
262
260

FIG. 4

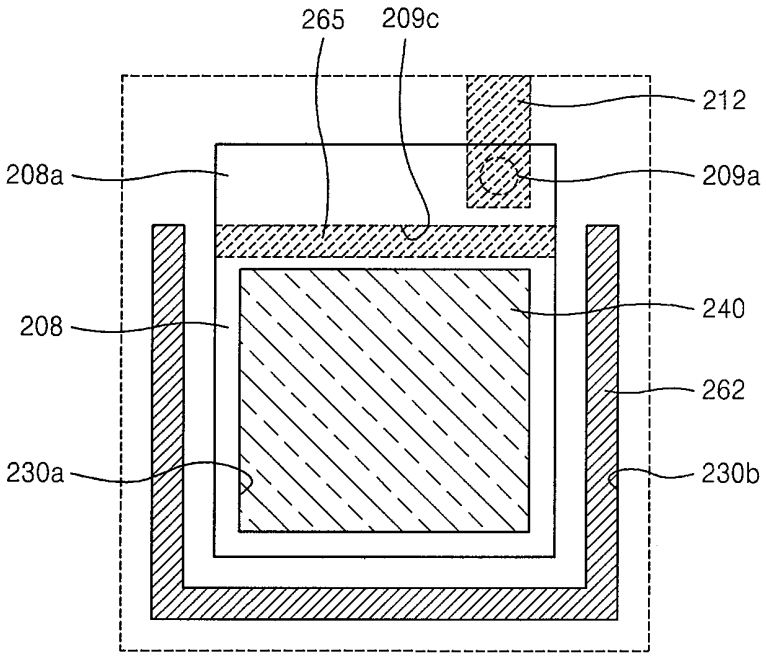


FIG. 5

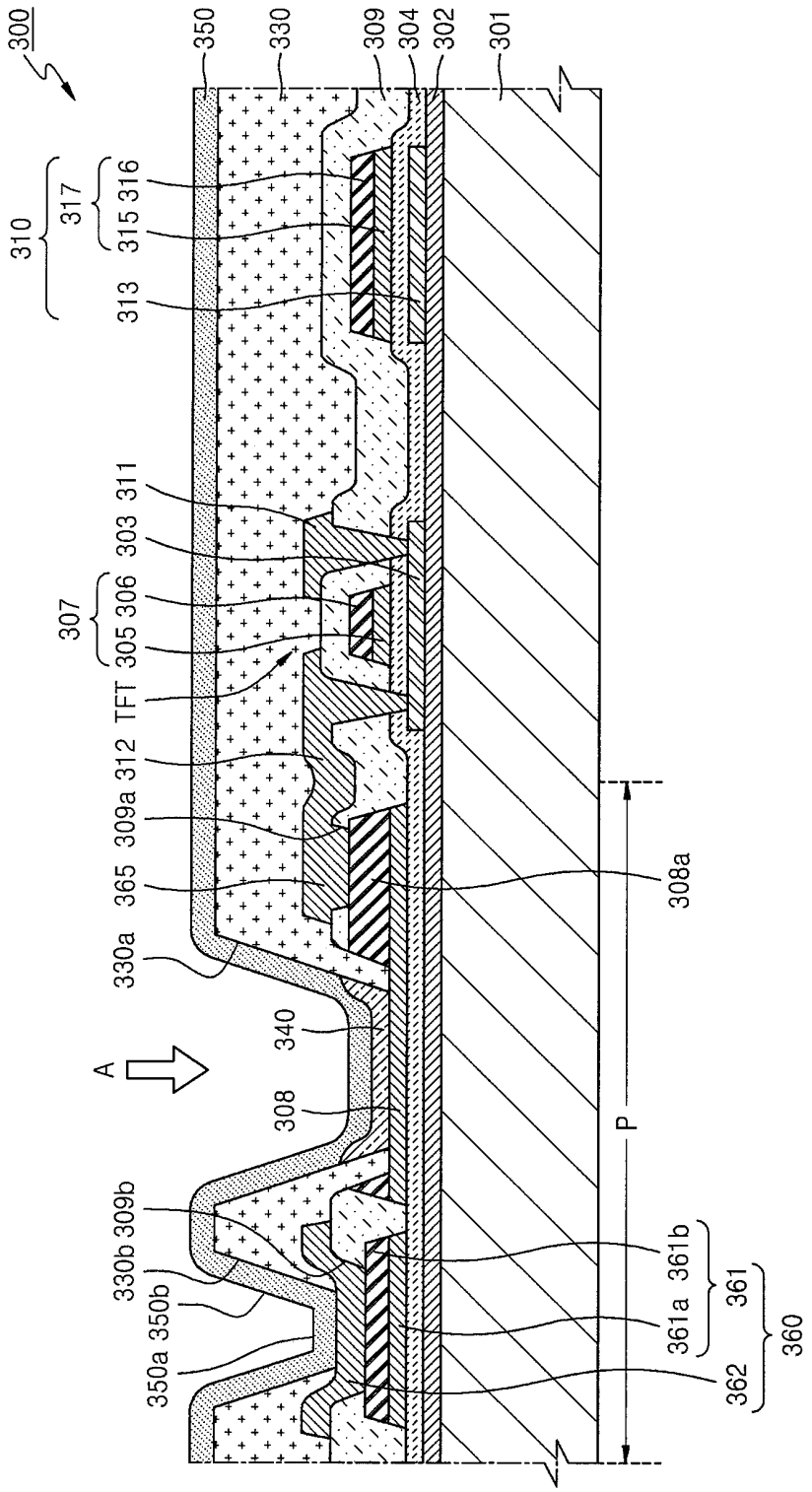
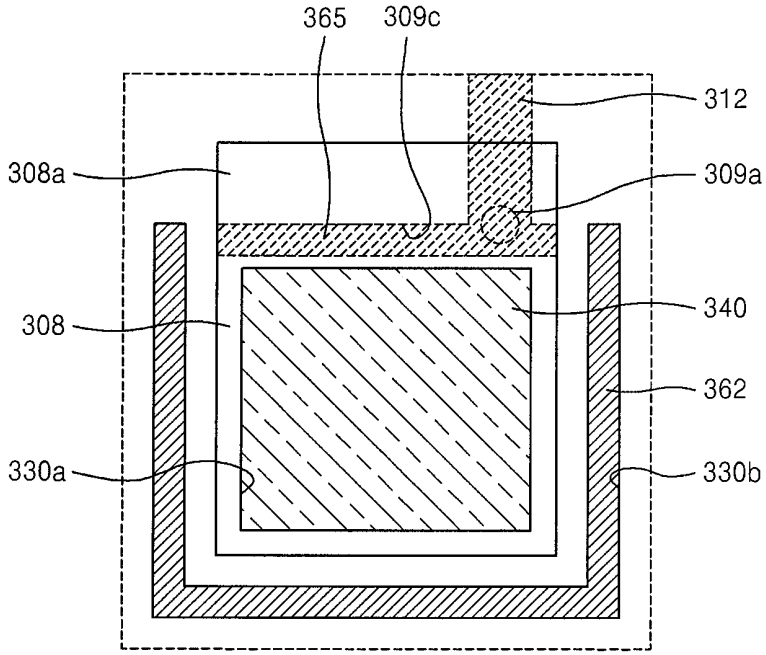

300
350
330
309
304
302
301
310
317
316
315
313
311
303
307
306
305
TFT
312
309a
365
330a
340
A
308
308a
P
330b
309b
350b
350a
361b
361a
361
362
360

FIG. 6



ORGANIC LIGHT-EMITTING DISPLAY APPARATUS

CROSS-REFERENCE TO RELATED PATENT APPLICATION

[0001] This application claims priority to and the benefit of Korean Patent Application No. 10-2011-0121735, filed on Nov. 21, 2011, 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 invention relates to an organic light-emitting display apparatus.

[0004] 2. Description of Related Art

[0005] Portable flat panel display devices have recently become popular. Organic light-emitting display apparatuses, which are self-emissive display devices from among flat panel display devices, are given attention as next-generation display devices because the organic light-emitting display apparatuses have a wide viewing angle, high contrast, and fast response time.

[0006] An organic light-emitting display apparatus includes an intermediate layer, a first electrode, and a second electrode. The intermediate layer includes an organic light-emitting layer that generates visible light when a voltage is applied across the first electrode and the second electrode.

[0007] The visible light generated by the organic light-emitting layer travels toward a user/viewer of the organic light-emitting display apparatus, and the user recognizes an image. However, part of the visible light generated by the organic light-emitting layer does not travel toward the user.

[0008] Accordingly, the light efficiency of the organic light-emitting display apparatus is reduced and there is a limitation in improving image quality.

SUMMARY

[0009] Embodiments of the present invention provide an organic light-emitting display apparatus that improves image quality.

[0010] According to an embodiment of the present invention, there is provided an organic light-emitting display apparatus including a substrate, a first electrode on the substrate, an intermediate layer on the first electrode, and including an organic light-emitting layer, a second electrode on the intermediate layer, and a reflective member on sides of the intermediate layer to reflect visible light generated by the intermediate layer, the reflective member contacting the second electrode.

[0011] The organic light-emitting display apparatus may further include a pixel defining layer between the reflective member and the second electrode, wherein the pixel defining layer includes a first opening corresponding to the intermediate layer, and a second opening corresponding to the reflective member, and wherein the reflective member and the second electrode contact each other in the second opening.

[0012] The second opening may extend corresponding to at least one side surface of the intermediate layer.

[0013] A width of the second opening may increase away from the substrate.

[0014] The second electrode may include a contact portion contacting a top surface of the reflective member in the second opening, and a side portion at a side of the second opening.

[0015] A surface of the side portion of the second electrode adjacent to the intermediate layer may be at an angle with the substrate.

[0016] The reflective member may extend corresponding to at least one side surface of the intermediate layer.

[0017] The reflective member may be spaced from the first electrode.

[0018] The organic light-emitting display apparatus may further include a thin film transistor (TFT) on the substrate, the TFT being electrically connected to the first electrode, and including an active layer, a gate electrode, a source electrode, and a drain electrode.

[0019] The reflective member may be spaced from the source electrode and the drain electrode.

[0020] The reflective member may include a same material as the gate electrode, the source electrode, or the drain electrode.

[0021] The reflective member may include a first member including a same material as the gate electrode, and a second member on the first member and including a same material as the source electrode and/or the drain electrode.

[0022] The organic light-emitting display apparatus may further include a conductive member on the first electrode and electrically connected to the source electrode or the drain electrode.

[0023] The organic light-emitting display apparatus may further include a reflective layer on the conductive member.

[0024] The reflective layer may extend corresponding to a side surface of the intermediate layer.

[0025] The reflective layer may be spaced from the reflective member.

[0026] The reflective layer may be spaced from the source electrode and the drain electrode.

[0027] The reflective layer may be electrically connected to any one of the source electrode and the drain electrode, and the source electrode or the drain electrode electrically connected to the reflective layer may be electrically connected to the first electrode.

[0028] The gate electrode and the first electrode may be at a same layer.

[0029] The gate electrode may include a first conductive layer, and a second conductive layer on the first conductive layer, wherein the first electrode includes a same material as the first conductive layer, and the reflective member may include a first member including a lower layer including a same material as the first conductive layer of the gate electrode, and an upper layer on the lower layer and including a same material as the second conductive layer of the gate electrode, and a second member on the first member and including a same material as the source electrode and/or the drain electrode.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] The above and other features and aspects of embodiments of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

[0031] FIG. **1** is a cross-sectional view illustrating an organic light-emitting display apparatus according to an embodiment of the present invention;

[0032] FIG. **2** is a partial plan view illustrating a portion P of the organic light-emitting display apparatus of the embodiment shown in FIG. **1**, the portion P being seen in an A direction, as indicated in FIG. **1**;

[0033] FIG. **3** is a cross-sectional view illustrating an organic light-emitting display apparatus according to another embodiment of the present invention;

[0034] FIG. **4** is a partial plan view illustrating a portion P of the organic light-emitting display apparatus of the embodiment shown in FIG. **3**, the portion P being seen in an A direction, as indicated in FIG. **3**;

[0035] FIG. **5** is a cross-sectional view illustrating an organic light-emitting display apparatus according to another embodiment of the present invention; and

[0036] FIG. **6** is a partial plan view illustrating a portion P of the organic light-emitting display apparatus of the embodiment shown in FIG. **5**, the portion P being seen in an A direction.

DETAILED DESCRIPTION

[0037] Embodiments of the present invention will now be described more fully with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown.

[0038] FIG. **1** is a cross-sectional view illustrating an organic light-emitting display apparatus **100** according to an embodiment of the present invention. FIG. **2** is a partial plan view illustrating a portion P of the organic light-emitting display apparatus **100** shown in FIG. **1** and seen in an A direction. For convenience of explanation, only an intermediate layer **140**, a first electrode **108**, a conductive portion **108***a*, a second member **162** of a reflective member **160**, a drain electrode **112**, a contact hole **109***a*, a first opening **130***a*, and a second opening **130***b* are illustrated in FIG. **2**.

[0039] In order to be easily distinguished from the second member **162** of the reflective member **160** in FIG. **2**, the drain electrode **112** and the contact hole **109***a* are indicated by dashed lines. Also, only a top surface of the second member **162** exposed through the second opening **130***b* from among surfaces of the second member **162** is illustrated in FIG. **2**.

[0040] Referring to FIGS. **1** and **2**, the organic light-emitting display apparatus **100** includes a substrate **101**, a thin film transistor (TFT), the first electrode **108**, the intermediate layer **140**, a second electrode **150**, the reflective member **160**, and a capacitor **110**.

[0041] The TFT includes an active layer **103**, a gate electrode **107**, a source electrode **111**, and a drain electrode **112**. The capacitor **110** includes a first capacitor electrode **113** and a second capacitor electrode **117**. The reflective member **160** includes a first member **161** and the second member **162**.

[0042] Each element will be explained in detail below.

[0043] The substrate **101** may be formed of, for example, a transparent glass material having SiO_2 as a main component, although the substrate **101** is not limited thereto, and may also be formed of a transparent plastic material. In the latter scenario, the plastic material for forming the substrate **101** may be at least one selected from various organic materials.

[0044] A buffer layer **102** is formed on the substrate **101**. The buffer layer **102** may include SiO_2 or SiN_x. The buffer layer **102** planarizes a top surface of the substrate **101** and reduces or prevents moisture and impurities from penetrating into the substrate **101**.

[0045] The active layer **103** and the first capacitor electrode **113** are formed on the buffer layer **102**. The active layer **103** and the first capacitor electrode **113** may be formed of the same material. Each of the active layer **103** and the first capacitor electrode **113** includes a semiconductor material. For example, the active layer **103** and the first capacitor electrode **113** include amorphous silicon or polycrystalline silicon.

[0046] A gate insulating film **104** is formed on the buffer layer **102** to cover the active layer **103** and the first capacitor electrode **113**.

[0047] The gate electrode **107**, the first electrode **108**, the first member **161** of the reflective member **160**, and the second capacitor electrode **117** are formed on the gate insulating film **104**.

[0048] The gate electrode **107** includes a first conductive layer **105** and a second conductive layer **106**. The first conductive layer **105** may include a transparent conductive material, for example, indium tin oxide (ITO).

[0049] The second conductive layer **106** may be formed on the first conductive layer **105** to include, for example, a metal or a metal alloy such as molybdenum (Mo), molybdenum-tungsten (MoW), or an aluminum (Al)-based alloy, but the present embodiment is not limited thereto.

[0050] The first electrode **108** may include a transparent conductive material and may be formed of the same material as that of the first conductive layer **105**.

[0051] The conductive portion **108***a* is located on a portion of a top surface of the first electrode **108**, and is formed of the same material as that of the second conductive layer **106**.

[0052] The first member **161** of the reflective member **160** is formed to be spaced apart from the first electrode **108**. The first member **161** includes a lower layer **161***a* and an upper layer **161***b*. The lower layer **161***a* is formed of the same material as that of the first conductive layer **105**, and the upper layer **161***b* is formed of the same material as that of the second conductive layer **106**.

[0053] The second capacitor electrode **117** includes a first layer **115** and a second layer **116**. The first layer **115** is formed of the same material as that of the first conductive layer **105**, and the second layer **116** is formed of the same material as that of the second conductive layer **106**.

[0054] An interlayer insulating film **109** is formed on the first electrode **108**, the gate electrode **107**, the first member **161**, and the second capacitor electrode **117**. The interlayer insulating film **109** may include any of various insulating materials such as an organic material or an inorganic material.

[0055] The source electrode **111**, the drain electrode **112**, and the second member **162** of the second reflective member **160** are formed on the interlayer insulating film **109**. The source electrode **111** and the drain electrode **112** are formed to be electrically connected to the active layer **103**. Each of the source electrode **111** and the drain electrode **112** may be formed of any of various materials, for example, a metal such as gold (Au), palladium (Pd), platinum (Pt), nickel (Ni), rhodium (Rh), ruthenium (Ru), iridium (Ir), osmium (Os), aluminum (Al), molybdenum (Mo), neodymium (Nd), tungsten (W), or an alloy of at least two of the metals, although the present embodiment is not limited thereto.

[0056] Any one of the source electrode **111** and the drain electrode **112** is electrically connected to the first electrode **108**. In the present embodiment, the drain electrode **112** is electrically connected to the first electrode **108** in FIGS. **1** and **2**. In detail, the interlayer insulating film **109** includes the contact hole **109***a*, and a first end of the drain electrode **112**

longitudinally extends (see FIG. **2**) to contact the conductive portion **108***a* via the contact hole **109***a*.

[0057] The second member **162** is formed on the first member **161**. In detail, the interlayer insulating film **109** includes a first via hole **109***b*, and the second member **162** is formed to correspond to the first via hole **109***b*. The second member **162** may be formed of the same material as that of the source electrode **111** or the drain electrode **112**.

[0058] A pixel defining layer **130** is formed on the TFT and the reflective member **160**. The pixel defining layer **130** is formed to expose a portion of the top surface of the first electrode **108** (e.g., through the first opening **130***a*), and the intermediate layer **140** is formed to contact the first electrode **108**. The intermediate layer **140** includes an organic light-emitting layer (not shown).

[0059] In detail, the pixel defining layer **130** includes the first opening **130***a* and the second opening **130***b*. The first opening **130***a* is formed to correspond to the portion of the top surface of the first electrode **108**, and the intermediate layer **140** is formed in the first opening **130***a* and is electrically connected to the first electrode **108**.

[0060] The second opening **130***b* of the pixel defining layer **130** is formed to correspond to a portion of a top surface of the second member **162** of the reflective member **160**. In the present embodiment, at least a surface of the second opening **130***b* (e.g., a surface of the pixel defining layer **130** in the second opening **130***b*) adjacent to the intermediate layer **140** may be inclined at an angle (e.g., an acute angle) with respect to the substrate **101**. For example, a width of the second opening **130***b* may increase upward from the substrate **101**, that is, farther away from the substrate **101**.

[0061] The second electrode **150** is formed on the intermediate layer **140**, and corresponds to the second opening **130***b*, and is electrically connected to the reflective member **160**. In detail, the second electrode **150** includes a contact portion **150***a* contacting the second member **162** in the second opening **130***b*, and a side portion **150***b* located at a side of the second opening **130***b* (e.g., a side of the pixel defining layer **130** in the second opening **130***b*).

[0062] When a voltage is applied through the first electrode **108** and the second electrode **150** (e.g., across the first electrode **108** and the second electrode **150**), the organic light-emitting layer of the intermediate layer **140** generates visible light.

[0063] The reflective member **160** is formed around the intermediate layer **140** (e.g., on three sides of the intermediate layer **140**, see FIG. **2**). In detail, the reflective member **160** may be formed to correspond to a side surface other than a side surface of the intermediate layer **140** adjacent to the conductive portion **108***a* from among side surfaces of the intermediate layer **140**.

[0064] The second opening **130***b* is formed around the intermediate layer **140** to correspond to the reflective member **160**, and the second electrode **150** is formed in the second opening **130***b*. Accordingly, the contact portion **150***a* and the side portion **150***b* of the second electrode **150** may be formed to correspond to the side surface of the intermediate layer **140**. In detail, the contact portion **150***a* and the side portion **150***b* of the second electrode **150** may be formed to correspond to a side surface other than a side surface of the intermediate layer **140** adjacent to the conductive portion **108***a* from among side surfaces of the intermediate layer **140**.

[0065] Accordingly, light traveling from the side surface of the intermediate layer **140** from among the visible light generated by the intermediate layer **140** is reflected by the reflective member **160** toward a user.

[0066] Also, due to the side portion **150***b* and the contact portion **150***a* of the second electrode **150** formed on the reflective member **160**, the light traveling toward the user is efficiently condensed. In particular, the side portion **150***b* of the second electrode **150** effectively reduces or prevents the light traveling from the side surface of the intermediate layer **140** from among the visible light generated by the intermediate layer **140** from being outwardly discharged away from the user, and effectively leads to light reflection in the organic light-emitting display apparatus **100**, thereby improving light efficiency through optical resonance.

[0067] In particular, since the second opening **130***b* is inclined at the acute angle with respect to the substrate **101**, most of the visible light generated by the intermediate layer **140** travels downward to the substrate **101**.

[0068] The reflective member **160** includes the first member **161** and the second member **162** in FIGS. **1** and **2**. However, the first member **161** and the second member **162** need not be separately formed, but may also be integrally formed with each other. That is, the reflective member **160** may be formed of the same material as that of the gate electrode **107**, and the reflective member **160** may also be formed of the same material as that of the source electrode **111** and/or the drain electrode **112**.

[0069] A sealing member (not shown) may be formed on the second electrode **150** to protect the intermediate layer **140** and other layers from external moisture or oxygen. To this end, the sealing member may be formed of any of various materials such as glass, plastic, an organic material, an inorganic material, or a combination of an organic material and an inorganic material.

[0070] In the organic light-emitting display apparatus **100** of the present embodiment, the reflective member **160** is formed to correspond to a side surface of the intermediate layer **140**. Light traveling from the side surface of the intermediate layer **140** from among visible light generated by the intermediate layer **140** is reflected by the reflective member **160** toward a user, thereby improving the light efficiency of the organic light-emitting display apparatus **100** and also improving image quality.

[0071] The side portion **150***b* and the contact portion **150***a* of the second electrode **150** formed on the reflective member **160** effectively reduce or prevent the light traveling from the side surface of the intermediate layer **140** from among the visible light generated by the intermediate layer **140** from being outwardly discharged away from the user, and effectively leads to light reflection in the organic light-emitting display apparatus **100**, thereby improving light efficiency through optical resonance.

[0072] The reflective member **160** may be formed of the same material as that of at least one of the gate electrode **107**, the source electrode **111**, or the drain electrode **112** to improve process convenience. The reflective member **160** may be formed at the same layer as that of the gate electrode **107**, the source electrode **111**, and/or the drain electrode **112** to improve image quality without increasing a thickness of the organic light-emitting display apparatus **100**.

[0073] FIG. **3** is a cross-sectional view illustrating an organic light-emitting display apparatus **200** according to another embodiment of the present invention. FIG. **4** is a partial plan view illustrating a portion P of the organic light-emitting display apparatus **200** shown in FIG. **3** and seen in an

A direction. For convenience of explanation, only an intermediate layer **240**, a first electrode **208**, a conductive portion **208***a*, a second member **262** of a reflective member **260**, a drain electrode **212**, a reflective layer **265**, a contact hole **209***a*, a second via hole **209***c*, a first opening **230***a*, and a second opening **230***b* are illustrated in FIG. **4**.

[0074] In order to be easily distinguished from the second member **262** of the reflective member **260** in FIG. **4**, the drain electrode **212**, the reflective layer **265**, and the contact hole **209***a* are indicated by dashed lines. Also, only a top surface of the second member **262** exposed through the second opening **230***b* from among surfaces of the second member **262** is illustrated in FIG. **4**.

[0075] Referring to FIGS. **3** and **4**, the organic light-emitting display apparatus **200** includes a substrate **201**, a TFT, the first electrode **208**, the intermediate layer **240**, a second electrode **250**, the reflective member **260**, the reflective layer **265**, and a capacitor **210**.

[0076] The TFT includes an active layer **203**, a gate electrode **207**, a source electrode **211**, and the drain electrode **212**. The capacitor **210** includes a first capacitor electrode **213** and a second capacitor electrode **217**. The reflective member **260** includes a first member **261** and the second member **262**.

[0077] Each element will be explained in detail below.

[0078] A buffer layer **202** is formed on the substrate **201**, and the active layer **203** and the first capacitor electrode **213** are formed on the buffer layer **202**. A gate insulating film **204** is formed on the buffer layer **202** to cover the active layer **203** and the first capacitor electrode **213**.

[0079] The gate electrode **207**, the first electrode **208**, the first member **261** of the reflective member **260**, and the second capacitor electrode **217** are formed on the gate insulating film **204**.

[0080] The gate electrode **207** includes a first conductive layer **205** and a second conductive layer **206**. The first electrode **208** may include a transparent conductive material and may be formed of the same material as that of the first conductive layer **205**.

[0081] The conductive portion **208***a* is formed on a portion of a top surface of the first electrode **208** of the same material as that of the second conductive layer **206**.

[0082] The first member **261** of the reflective member **260** is formed to be spaced apart from the first electrode **208**. The first member **261** includes a lower layer **261***a* and an upper layer **261***b*. The lower layer **261***a* is formed of the same material as that of the first conductive layer **205** and the upper layer **261***b* is formed of the same material as that of the second conductive layer **206**.

[0083] The second capacitor electrode **217** includes a first layer **215** and a second layer **216**. The first layer **215** is formed of the same material as that of the first conductive layer **205** and the second layer **216** is formed of the same material as that of the second conductive layer **206**.

[0084] An interlayer insulating film **209** is formed on the first electrode **208**, the gate electrode **207**, the first member **261**, and the second capacitor electrode **217**. The source electrode **211**, the drain electrode **212**, and the second member **262** of the reflective member **260** are formed on the interlayer insulating film **209**. The source electrode **211** and the drain electrode **212** are formed to be electrically connected to the active layer **203**.

[0085] The source electrode **211** or the drain electrode **212** is electrically connected to the first electrode **208**. In the present embodiment, the drain electrode **212** is electrically connected to the first electrode **208**, as shown in FIGS. **3** and **4**. In detail, the interlayer insulating film **209** includes the contact hole **209***a*, and a first end of the drain electrode **212** longitudinally extends to contact the conductive portion **208***a* via the contact hole **209***a*.

[0086] The second member **262** is formed on the first member **261**. In detail, the interlayer insulating film **209** includes a first via hole **209***b*, and the second member **262** is formed to correspond to the first via hole **209***b*.

[0087] The reflective layer **265** is formed on the conductive portion **208***a*. In detail, the interlayer insulating film **209** includes the second via hole **209***c*, and the reflective layer **265** is formed to correspond to the second via hole **209***c*. The reflective layer **265** longitudinally extends to correspond to a side surface of the intermediate layer **240** and is spaced apart from the reflective member **260**. Also, the reflective layer **265** is formed to be spaced apart from the source electrode **211** and the drain electrode **212**.

[0088] A pixel defining layer **230** is formed on the TFT and the reflective member **260**. The pixel defining layer **230** is formed to expose a portion of the top surface of the first electrode **208**, and the intermediate layer **240** is formed to contact the first electrode **208**. The intermediate layer **240** includes an organic light-emitting layer (not shown).

[0089] In detail, the pixel defining layer **230** includes the first opening **230***a* and the second opening **230***b*. The first opening **230***a* is formed to correspond to the portion of the top surface of the first electrode **208**, and the intermediate layer **240** is formed in the first opening **230***a* and is electrically connected to the first electrode **208**.

[0090] The second opening **230***b* of the pixel defining layer **230** is formed to correspond to a portion of a top surface of the second member **262** of the reflective member **260**. In this case, at least a surface of the second opening **230***b* (e.g., a surface of the pixel defining layer **230** in the second opening **230***b*) adjacent to the intermediate layer **240** from among surfaces of the second opening **230***b* may be inclined at an angle (e.g., an acute angle) with respect to the substrate **201**. For example, a width of the second opening **230***b* may increase upward from the substrate **201**, that is, away from the substrate **201**.

[0091] The second electrode **250** is formed on the intermediate layer **240**. The second electrode **250** is located in the second opening **230***b* to be electrically connected to the reflective member **260**. In detail, the second electrode **250** includes a contact portion **250***a* contacting the second member **262** in the second opening **230***b*, and also includes a side portion **250***b* at a side of the second opening **230***b*.

[0092] The reflective member **260** is formed around the intermediate layer **240** (e.g., on three sides of the intermediate layer **240**, see FIG. **4**). In detail, the reflective member **260** may be formed to correspond to a side surface other than a side surface of the intermediate layer **240** adjacent to the conductive portion **208***a* from among side surfaces of the intermediate layer **240**.

[0093] The second opening **230***b* is formed around the intermediate layer **240** to correspond to the reflective member **260**, and the second electrode **250** is formed in the second opening **230***b*. Accordingly, the contact portion **250***a* and the side portion **250***b* of the second electrode **250** may be formed to correspond to the side surface of the intermediate layer **240**. In detail, the contact portion **250***a* and the side portion **250***b* of the second electrode **250** may be formed to correspond to a side surface other than a side surface of the inter-

mediate layer **240** adjacent to the conductive portion **208***a* from among side surfaces of the intermediate layer **240**.

[0094] Accordingly, light traveling from the side portion of the intermediate layer **240** from among visible light generated by the intermediate layer is reflected by the reflective member **260** toward a user.

[0095] Also, due to the side portion **250***b* and the contact portion **250***a* of the second electrode **250** formed on the reflective member **260**, the light traveling toward the user is effectively condensed. In particular, the side portion **250***b* of the second electrode **250** effectively reduces or prevents the light traveling from the side surface of the intermediate layer **240** from among the visible light generated by the intermediate layer **240** from being outwardly discharged away from the user, and effectively leads to light reflection in the organic light-emitting display apparatus **200**, thereby improving light efficiency through optical resonance.

[0096] In particular, since the second opening **230***b* is inclined at the acute angle with respect to the substrate **201**, most of the visible light generated by the intermediate layer **240** travels downward to the substrate **201** without being lost.

[0097] The reflective member **260** of the organic light-emitting display apparatus **200** of the present embodiment includes the first member **261** and the second member **262**, as shown in FIGS. **3** and **4**. However, the first member **261** and the second member **262** need not be separately formed, but may be integrally formed with each other. That is, the reflective member **260** may be formed of the same material as that of the gate electrode **207**, and the reflective member **260** may be formed of the same material as that of the source electrode **211** and/or the drain electrode **212**.

[0098] A sealing member (not shown) may be formed on the second electrode **250** to protect the intermediate layer **240** and other layers from external moisture or oxygen. To this end, the sealing member may be formed of any of various materials such as glass, plastic, an organic material, an inorganic material, or a combination of an organic material and an inorganic material.

[0099] In the organic light-emitting display apparatus **200**, the reflective member **260** is formed to correspond to the side surface of the intermediate layer **240**. Accordingly, the light efficiency of the organic light-emitting display apparatus **200** is improved, thereby improving image quality.

[0100] The side portion **250***b* and the contact portion **250***a* of the second electrode **250** formed on the reflective member **260** effectively reduce or prevent light traveling from the side surface of the intermediate layer **240** from among visible light generated by the intermediate layer **240** from being outwardly discharged away from the user, and effectively leads to light reflection in the organic light-emitting display apparatus **200**, thereby improving light efficiency through optical resonance.

[0101] Also, since the conductive portion **208***a* and the reflective layer **265** electrically connected to the conductive portion **208***a* reflect light traveling from the side surface of the intermediate layer **240** to the user (particularly, light traveling toward the drain electrode **212**, from among visible light generated by the intermediate layer **240**), light efficiency may be further improved.

[0102] FIG. **5** is a cross-sectional view illustrating an organic light-emitting display apparatus **300** according to another embodiment of the present invention. FIG. **6** is a partial plan view illustrating a portion P of the organic light-emitting display shown in FIG. **5** and seen in an "A" direction (i.e., the direction of the arrow indicated by reference character "A" in FIG. **5**). For convenience of explanation, an intermediate layer **340**, a first electrode **308**, a conductive portion **308***a*, a second member **362** of a reflective member **360**, a drain electrode **312**, a reflective layer **365**, a contact hole **309***a*, a second via hole **309***c*, a first opening **330***a*, and a second opening **330***b* are illustrated in FIG. **6**.

[0103] In order to be easily distinguished from the second member **362** of the reflective member **360** in FIG. **6**, the drain electrode **312**, the reflective layer **365**, and the contact hole **309***a* are indicated by dashed lines. Also, only a top surface of the second member **362** exposed through the second opening **330***b* from among surfaces of the second member **362** is illustrated in FIG. **6**.

[0104] Referring to FIGS. **5** and **6**, the organic light-emitting display apparatus **300** includes a substrate **301**, a TFT, the first electrode **308**, the intermediate layer **340**, a second electrode **350**, the reflective member **360**, the reflective layer **365**, and a capacitor **310**.

[0105] The TFT includes an active layer **303**, a gate electrode **307**, a source electrode **311**, and the drain electrode **312**. The capacitor **310** includes a first capacitor electrode **313** and a second capacitor electrode **317**. The reflective member **360** includes a first member **361** and the second member **362**.

[0106] Each element will be explained in detail below.

[0107] A buffer layer **302** is formed on the substrate **301**, and the active layer **303** and the first capacitor electrode **313** are formed on the buffer layer **302**. A gate insulating film **304** is formed on the buffer layer **302** to cover the active layer **303** and the first capacitor electrode **313**.

[0108] The gate electrode **307**, the first electrode **308**, the first member **361** of the reflective member **360**, and the second capacitor electrode **317** are formed on the gate insulating film **304**.

[0109] The gate electrode **307** includes a first conductive layer **305** and a second conductive layer **306**. The first electrode **308** may include a transparent conductive material and may be formed of the same material as that of the first conductive layer **305**.

[0110] The conductive portion **308***a* is formed on a portion of a top surface of the first electrode **308**, and is formed of the same material as that of the second conductive layer **306**.

[0111] The first member **361** of the reflective member **360** is formed to be spaced apart from the first electrode **308**. The first member **361** includes a lower layer **361***a* and an upper layer **361***b*. The lower layer **361***a* is formed of the same material as that of the first conductive layer **305** and the upper layer **361***b* is formed of the same material as that of the second conductive layer **306**.

[0112] The second capacitor electrode **317** includes a first layer **315** and a second layer **316**. The first layer **315** is formed of the same material as that of the first conductive layer **305** and the second layer **316** is formed of the same material as that of the second conductive layer **306**.

[0113] An interlayer insulating film **309** is formed on the first electrode **308**, the gate electrode **307**, the first member **361**, and the second capacitor electrode **317**. The source electrode **311**, the drain electrode **312**, and the second member **362** of the reflective member **360** are formed on the interlayer insulating film **309**. The source electrode **311** and the drain electrode **312** are electrically connected to the active layer **303**.

[0114] Any one of the source electrode **311** and the drain electrode **312** is electrically connected to the first electrode

308. In the present embodiment, the drain electrode 312 is electrically connected to the first electrode 308 in FIGS. 5 and 6. In detail, the interlayer insulating film 309 includes the contact hole 309*a*, and a first end of the drain electrode 312 longitudinally extends to contact the conductive portion 308*a* via the contact hole 309*a*.

[0115] The second member 362 is formed on the first member 361. In detail, the interlayer insulating film 309 includes a first via hole 309*b*. The second member 362 is formed to correspond to the first via hole 309*b*.

[0116] The reflective layer 365 is formed on the conductive portion 308*a*. In detail, the interlayer insulating film 309 includes the second via hole 309*c*, and the reflective layer 365 is formed to correspond to the second via hole 309*c*. The reflective layer 365 longitudinally extends to correspond to a side surface of the intermediate layer 340, and is spaced apart from the reflective member 360.

[0117] The reflective layer 365 is formed to be electrically connected to the drain electrode 312. In detail, the contact hole 309*a* is formed to communicate with (e.g., to be connected to) the second via hole 309*c*, and the reflective layer 365 is electrically connected to the drain electrode 312.

[0118] A pixel defining layer 330 is formed on the TFT and on the reflective member 360 to expose a portion of the top surface of the first electrode 308, and the intermediate layer 340 is formed to contact the first electrode 308. The intermediate layer 340 includes an organic light-emitting layer (not shown).

[0119] In detail, the pixel defining layer 330 includes the first opening 330*a* and the second opening 330*b*. The first opening 330*a* is formed to correspond to the portion of the top surface of the first electrode 308, and the intermediate layer 340 is formed in the first opening 330*a* and is electrically connected to the first electrode 308.

[0120] The second opening 330*b* of the pixel defining layer 330 is formed to correspond to a portion of a top surface of the second member 362 of the reflective member 360. In the present embodiment, at least a surface of the second opening 330*b* adjacent to the intermediate layer 340 from among surfaces of the second opening 330*b* (e.g., surfaces of the pixel defining layer 330 in the second opening 330*b*) may be inclined at an angle (e.g., an acute angle) with respect to the substrate 301. For example, a width of the second opening 330*b* may increase upward from the substrate 301, that is, away from the substrate 301.

[0121] The second electrode 350 is formed on the intermediate layer 340 to correspond to the second opening 330*b* and is electrically connected to the reflective member 360. In detail, the second electrode 350 includes a contact portion 350*a* contacting the second member 362 in the second opening 330*b* and a side portion 350*b* located at a side of the second opening 330*b*.

[0122] The reflective member 360 is formed around the intermediate layer 340 (e.g., on three sides of the intermediate layer 340, see FIG. 6). In detail, the reflective member 360 may be formed to correspond to a side surface other than a side surface of the intermediate layer 340 adjacent to the conductive portion 308*a* from among side surfaces of the intermediate layer 340.

[0123] The second opening 330*b* is formed around the intermediate layer 340 to correspond to the reflective member 360, and the second electrode 350 is formed in the second opening. Accordingly, the contact portion 350*a* and the side portion 350*b* of the second electrode 350 may be formed to correspond to the side surface of the intermediate layer 340. In detail, the contact portion 350*a* and the side portion 350*b* of the second electrode 350 may be formed to correspond to a side surface other than a side surface of the intermediate layer 340 adjacent to the conductive portion 308*a* from among side surfaces of the intermediate layer 340.

[0124] The reflective member 360 includes the first member 361 and the second member 362 in FIGS. 5 and 6. However, the first member 361 and the second member 362 might not be separately formed, but may instead be integrally formed with each other. That is, the reflective member 360 may be formed of the same material as that of the gate electrode 307, and the reflective member 360 may be formed of the same material as that of the source electrode 311 or the drain electrode 312.

[0125] A sealing member (not shown) may be formed on the second electrode 350 to protect the intermediate layer 340 and other layers from external moisture or oxygen. To this end, the sealing member may be formed of any of various materials such as glass, plastic, an organic material, an inorganic material, or a combination of an organic material and an inorganic material.

[0126] In the organic light-emitting display apparatus 300 of the present embodiment, the reflective member 360 is formed to correspond to the side surface of the intermediate layer 340. Accordingly, the light efficiency of the organic light-emitting display apparatus 300 is improved, thereby improving image quality.

[0127] The side portion 350*b* and the contact portion 350*a* of the second electrode 350 formed on the reflective member 360 effectively reduces or prevents light traveling from the side surface of the intermediate layer 340 from among visible light generated by the intermediate layer 340 from being outwardly discharged away from the user, and effectively leads to light reflection in the organic light-emitting display apparatus 300, thereby improving light efficiency through optical resonance.

[0128] Also, since the conductive portion 308*a* and the reflective layer 365 electrically connected to the conductive portion 308*a* reflect light traveling from the side surface of the intermediate layer 340 from among visible light generated by the intermediate layer 340 to the user, light efficiency may be further improved.

[0129] According to the present invention, an organic light-emitting display apparatus may improve image quality.

[0130] While the present invention has been particularly shown and described with reference to exemplary 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 and their equivalents.

What is claimed is:

1. An organic light-emitting display apparatus comprising:

a substrate;

a first electrode on the substrate;

an intermediate layer on the first electrode, and comprising an organic light-emitting layer;

a second electrode on the intermediate layer; and

a reflective member on sides of the intermediate layer to reflect visible light generated by the intermediate layer, the reflective member contacting the second electrode.

2. The organic light-emitting display apparatus of claim 1, further comprising a pixel defining layer between the reflective member and the second electrode,

wherein the pixel defining layer comprises:

a first opening corresponding to the intermediate layer; and

a second opening corresponding to the reflective member, and

wherein the reflective member and the second electrode contact each other in the second opening.

3. The organic light-emitting display apparatus of claim 2, wherein the second opening extends corresponding to at least one side surface of the intermediate layer.

4. The organic light-emitting display apparatus of claim 2, wherein a width of the second opening increases away from the substrate.

5. The organic light-emitting display apparatus of claim 2, wherein the second electrode comprises:

a contact portion contacting a top surface of the reflective member in the second opening; and

a side portion at a side of the second opening.

6. The organic light-emitting display apparatus of claim 5, wherein a surface of the side portion of the second electrode adjacent to the intermediate layer is at an angle with the substrate.

7. The organic light-emitting display apparatus of claim 1, wherein the reflective member extends corresponding to at least one side surface of the intermediate layer.

8. The organic light-emitting display apparatus of claim 1, wherein the reflective member is spaced from the first electrode.

9. The organic light-emitting display apparatus of claim 1, further comprising a thin film transistor (TFT) on the substrate, the TFT being electrically connected to the first electrode, and comprising an active layer, a gate electrode, a source electrode, and a drain electrode.

10. The organic light-emitting display apparatus of claim 9, wherein the reflective member is spaced from the source electrode and the drain electrode.

11. The organic light-emitting display apparatus of claim 9, wherein the reflective member comprises a same material as the gate electrode, the source electrode, or the drain electrode.

12. The organic light-emitting display apparatus of claim 9, wherein the reflective member comprises:

a first member comprising a same material as the gate electrode; and

a second member on the first member and comprising a same material as the source electrode and/or the drain electrode.

13. The organic light-emitting display apparatus of claim 9, further comprising a conductive member on the first electrode and electrically connected to the source electrode or the drain electrode.

14. The organic light-emitting display apparatus of claim 13, further comprising a reflective layer on the conductive member.

15. The organic light-emitting display apparatus of claim 14, wherein the reflective layer extends corresponding to a side surface of the intermediate layer.

16. The organic light-emitting display apparatus of claim 14, wherein the reflective layer is spaced from the reflective member.

17. The organic light-emitting display apparatus of claim 14, wherein the reflective layer is spaced from the source electrode and the drain electrode.

18. The organic light-emitting display apparatus of claim 14, wherein the reflective layer is electrically connected to any one of the source electrode and the drain electrode,

wherein the source electrode or the drain electrode electrically connected to the reflective layer is electrically connected to the first electrode.

19. The organic light-emitting display apparatus of claim 9, wherein the gate electrode and the first electrode are at a same layer.

20. The organic light-emitting display apparatus of claim 9, wherein

the gate electrode comprises:

a first conductive layer; and

a second conductive layer on the first conductive layer,

wherein the first electrode comprises a same material as the first conductive layer, and

wherein the reflective member comprises:

a first member comprising:

a lower layer comprising a same material as the first conductive layer of the gate electrode; and

an upper layer on the lower layer and comprising a same material as the second conductive layer of the gate electrode; and

a second member on the first member and comprising a same material as the source electrode and/or the drain electrode.

* * * * *

专利名称(译)	有机发光显示装置		
公开(公告)号	US20130126872A1	公开(公告)日	2013-05-23
申请号	US13/528959	申请日	2012-06-21
[标]申请(专利权)人(译)	曹圭SIK		
申请(专利权)人(译)	CHO，KYU-SIK		
当前申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
[标]发明人	CHO KYU SIK		
发明人	CHO, KYU-SIK		
IPC分类号	H01L27/32		
CPC分类号	H01L51/5212 H01L51/5271 H01L27/326 H01L27/3248 H01L27/3246		
优先权	1020110121735 2011-11-21 KR		
外部链接	Espacenet USPTO		

摘要(译)

有机发光显示器包括基板，基板上的第一电极，第一电极上的中间层，并包括有机发光层，中间层上的第二电极，以及位于中间层上的反射构件。中间层反射由中间层产生的可见光，反射构件接触第二电极。