US 20050264184A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2005/0264184 A1**

Park et al. (43) **Pub. Date: Dec. 1, 2005**

(54) **METHOD OF FABRICATING ORGANIC LIGHT EMITTING DISPLAY**

(76) Inventors: **Joon-Young Park**, Seoul (KR); **Jang-Hyuk Kwon**, Suwon-si (KR)

Correspondence Address:
MCGUIREWOODS, LLP
1750 TYSONS BLVD
SUITE 1800
MCLEAN, VA 22102 (US)

(21) Appl. No.: **11/128,178**

(22) Filed: **May 13, 2005**

(30) **Foreign Application Priority Data**

May 28, 2004 (KR) 2004-38047

Publication Classification

(51) **Int. Cl.**[7] **H01J 1/62**; H01J 63/04

(52) **U.S. Cl.** **313/504**

(57) **ABSTRACT**

A method of fabricating an organic light emitting display is provided, in which, a first electrode is formed above a substrate having first and second regions, respectively, an emission layer is formed in the first and second regions, a second electrode is formed on the emission layer in the first and second regions, and a reflecting layer pattern is selectively formed on the second electrode in the second region.

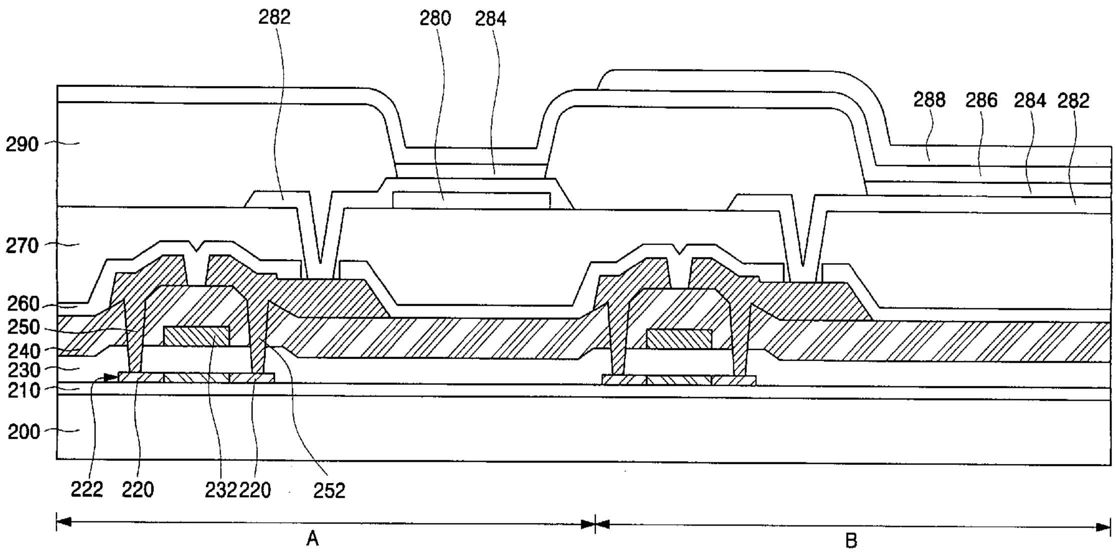


FIG.1A
(PRIOR ART)

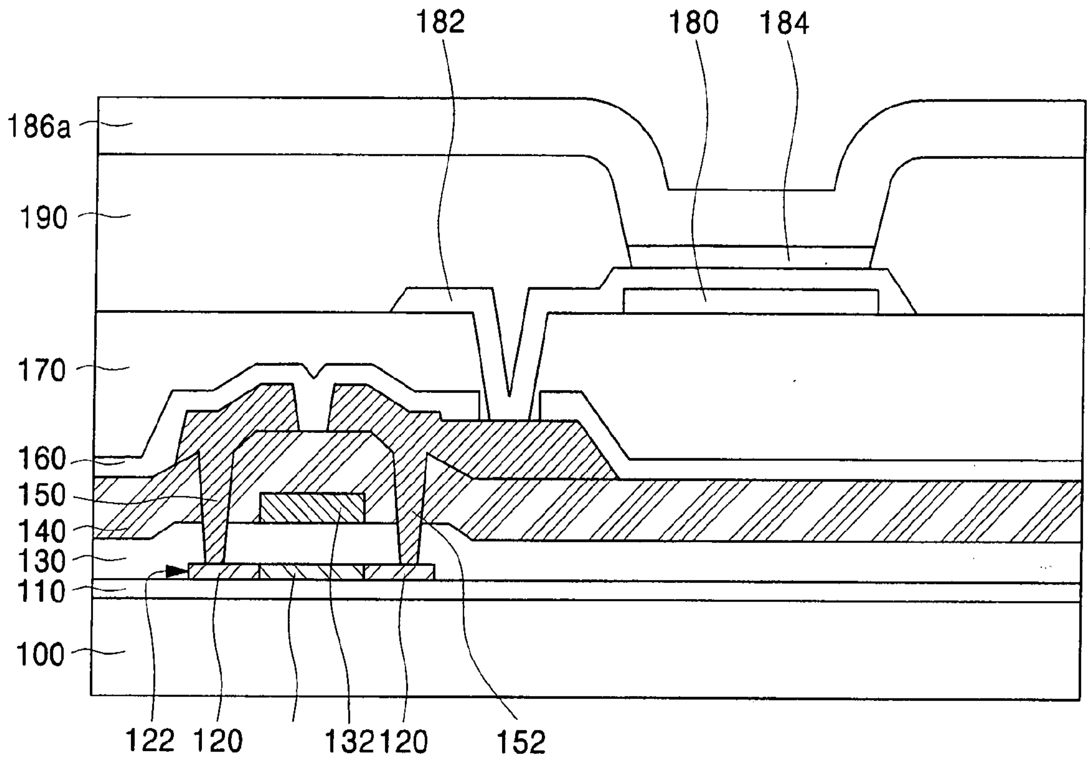


FIG.1B
(PRIOR ART)

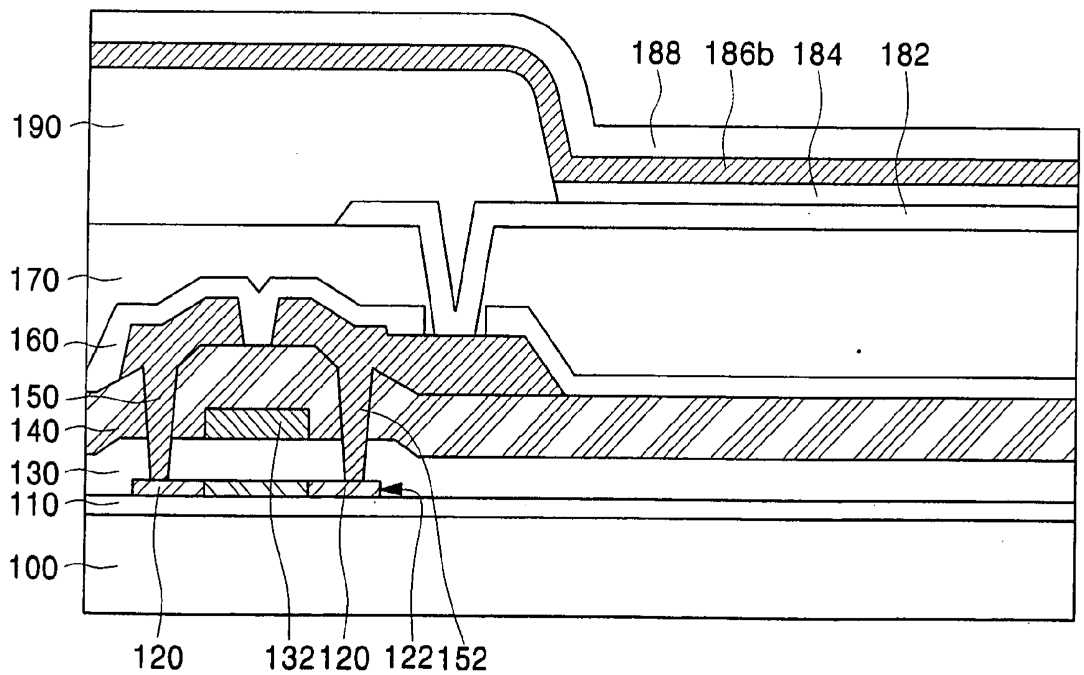
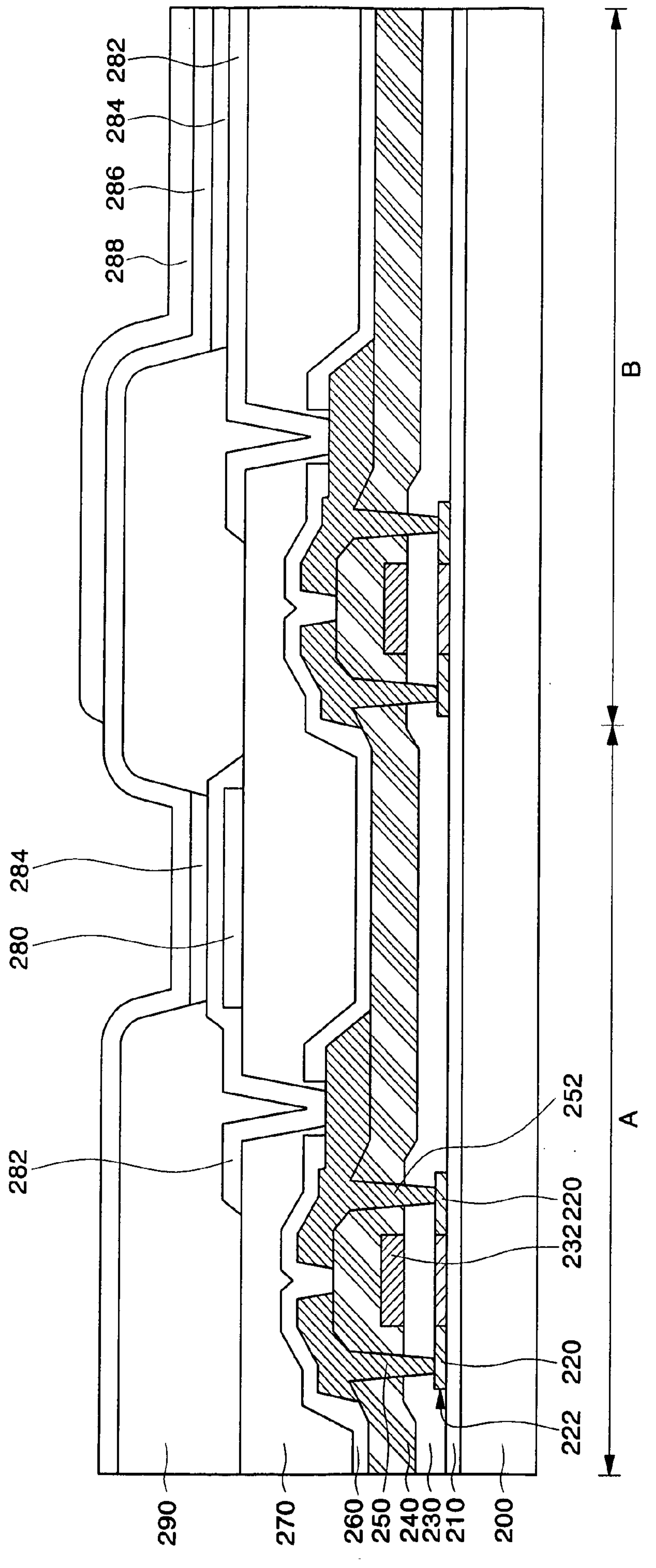


FIG.2


282
284
286
288
B
284
280
282
A
252
220
232
220
222
290
270
260
250
240
230
210
200

METHOD OF FABRICATING ORGANIC LIGHT EMITTING DISPLAY

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to and the benefit of Korean Patent Application No. 2004-38047, filed May 28, 2004, which is hereby incorporated by reference for all purposes as if fully set forth herein.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a method of fabricating an organic light emitting display (OLED) and, more particularly, to a method of forming an opposite electrode of an to OLED having a top emission region and a bottom emission region such that the opposite electrode is simultaneously formed on the top emission region and the bottom emission region.

[0004] 2. Description of the Related Art

[0005] An OLED is an emissive display that emits light by electrically exciting a fluorescent organic compound. The OLED is classified into a passive matrix type and an active matrix type depending on how driving pixels are arranged in a matrix or array form. The active matrix OLED consumes less power and has a higher resolution than the passive matrix OLED; therefore, the active matrix OLED is better suited for a large-sized display. The OLED is further classified into a top emission type, a bottom emission type, and a double-sided emission type based on a direction of light emitted from the organic compound. For example, the top emission OLED emits light in an opposite direction to a substrate having unit pixels and has a high aperture ratio.

[0006] Demands for an OLED which incorporates both a main display, which is a top emission type, and an auxiliary display, which is a bottom emission type, is increasing for small-sized and low power consumption devices, such as cellular phones, handheld wireless devices, etc. Such type of the OLED is commonly used in cellular phones, which have a main display on one side and an auxiliary display on the other side. For example, when the cellular phone is in an idle mode, a user may observe such things as a call receiving state, battery information, time, etc., through the auxiliary display.

[0007] **FIG. 1***a* is a cross-sectional view of a conventional top emission OLED. Referring to **FIG. 1***a*, a buffer layer **110** having a predetermined thickness is formed on a substrate **100**, and then a thin film transistor (TFT) having a polysilicon pattern **122**, a gate electrode **132** and source and drain electrodes **150** and **152** is formed on the buffer layer **110**. Source and drain regions **120**, which are ion-implanted, are formed at opposite sides of the polysilicon pattern **122**, and a gate insulating layer **130** is formed on the entire surface of the structure including the polysilicon pattern **122**.

[0008] A passivation layer **160** having a predetermined thickness is subsequently formed on the entire surface of the structure and is etched by a photolithography process to form a first via contact hole (not shown) which exposes one, for example, the drain electrode **152**, of the source and drain electrodes **150** and **152**. The passivation layer **160** may be formed of a silicon nitride layer, a silicon oxide layer or a stacked layer of the silicon nitride layer and the silicon oxide layer.

[0009] A first insulating layer **170** is formed on the entire surface of the structure. The first insulating layer **170** may be made of polyimide, benzocyclobutene-series resin, spin on glass (SOG), or acrylate. The first insulating layer **170** is formed for planarization of an emission region.

[0010] Subsequently, the first insulating layer **170** is etched by a photolithography process to form a second via contact hole (not shown), which exposes the first via contact hole.

[0011] A reflecting layer (not shown) is subsequently formed on the entire surface of the structure. The reflecting layer is made of a material having a high reflectivity, such as aluminum, an aluminum alloy, molybdenum, titanium, gold, silver, and palladium.

[0012] The reflecting layer is subsequently etched by a photolithography process to form a reflecting layer pattern **180** in the emission region.

[0013] A thin layer for a pixel electrode (not shown) is subsequently formed on the entire surface of the structure. The pixel electrode thin layer is made of a transparent metal material, such as indium thin oxide (ITO).

[0014] The pixel electrode thin layer is subsequently etched by a photolithography process to form a pixel electrode **182**. The pixel electrode **182** contacts one of the source and drain electrodes **150** and **152**, e.g, the drain electrode **152** exposed by the second via contact hole. The pixel electrode **182** has a dual-layer structure including the reflecting layer pattern **180**.

[0015] A second insulating layer (not shown) is subsequently formed on the entire surface of the structure. The second insulating layer may be made of polyimide, benzocyclobutene, phenol-series resin, or acrylate. The second insulating layer is etched by a photolithography process to form a second insulating layer pattern **190** defining an emission region.

[0016] An emission layer **184** is formed in the emission region defined by the second insulating layer pattern **190** using a low molecular deposition technique or a laser induced thermal imaging technique. The emission layer **184** includes an organic emission layer (not shown) and at least one of an electron injection layer, an electron transport layer, a hole injection layer, a hole transport layer, and a hole blocking layer (not shown).

[0017] A magnesium-silver (Mg—Ag) layer is subsequently formed on the entire surface of the structure to form an opposite electrode **186***a*. The Mg—Ag layer is a transparent metal layer that transmits light emitted from the emission layer **184**.

[0018] **FIG. 1***b* is a cross-sectional view of a conventional bottom emission OLED. Referring to **FIG. 1***b*, when the second via hole of **FIG. 1***a* is formed, a pixel electrode **182** is formed that contacts the source and drain electrodes **150** and **152**. The pixel electrode **182** of **FIG. 1***b* may have a thickness different from a thickness of the pixel electrode **182** of **FIG. 1***a* due to emission characteristics of the OLED.

[0019] A second insulating layer pattern **190** is subsequently formed over the structure to define an emission region of the pixel electrode **182**. An emission layer **184** is subsequently formed in the emission region of the pixel electrode **182**.

[0020] A LiF layer **186*b*** is subsequently formed on the entire surface of the structure. The LiF layer **186*b*** is an interface layer between an emission layer **184**, e.g., an organic layer of the emission layer **184**, and a reflecting electrode **188** and is approximately 10 Å thick to decrease a work function of the reflecting electrode **188**. For example, the reflecting electrode **188** may be made of aluminum.

[0021] The reflecting electrode **188** is formed on the LiF layer **186*b***. The reflecting electrode **188** is formed using a thermal deposition method or a sputtering method. A stacked structure or combination of the LiF layer **186*b*** and the reflecting electrode **188** is used as an opposite electrode.

[0022] Alternatively, an opposite electrode having a stacked or combined structure of an Mg—Ag layer and an aluminum layer may be formed after forming the emission layer.

[0023] In the OLED described above, the top emission OLED has a different structure than the bottom emission OLEDs relating to formation of the pixel electrode and the opposite electrode. Therefore, forming the top emission OLED and the bottom emission OLED on a single substrate complicates the fabrication process. Further, since the LiF layer of the bottom emission OLED is formed relatively thin, for example, the LiF layer is approximately 10 Å thick, when the reflecting electrode **188** is formed of aluminum using a sputtering method, the emission layer and the pixel electrode are adversely affected because the aluminum, or material used to form the reflecting electrode **188**, enters the emission layer **184** through pores in the LiF layer **186*b*** and degrades electrical and optical characteristics of the display. To solve at least the above-described problems, a thermal deposition method may be used to form the aluminum layer; however, this is a very unstable and time consuming process.

SUMMARY OF THE INVENTION

[0024] The present invention provides a method of fabricating an OLED that simplifies a fabrication process by simultaneously forming an opposite electrode using a same material in a top emission region and a bottom emission region, and may improve display reliability of the OLED by making it easy to form a reflecting layer which constitutes the opposite electrode in the bottom emission region.

[0025] According to an embodiment of the invention, there is provided a method of fabricating an organic light emitting display, including forming a first electrode above a substrate having first and second regions, respectively, forming an emission layer in the first and second regions, forming a second electrode on the emission layer in the first and second regions, and selectively forming a reflecting layer pattern on the second electrode in the second region.

[0026] Additional aspects and/or advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] The above and/or other features of the present invention will be described in reference to certain exemplary embodiments thereof with reference to the attached drawings:

[0028] **FIG. 1A** is a cross-sectional view of a conventional top emission OLED.

[0029] **FIG. 1B** is a cross-sectional view of a conventional bottom emission OLED.

[0030] **FIG. 2** is a cross-sectional view of an OLED according to an embodiment of invention.

DETAILED DESCRIPTION OF THE INVENTION

[0031] Reference will now be made in detail to the embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to the like elements throughout. The embodiments are described below in order to explain the present invention by referring to the figures.

[0032] **FIG. 2** is a cross-sectional view of an OLED according to an embodiment of the invention. It is understood that the invention is not limited to the embodiment shown in **FIG. 2**. Referring to **FIG. 2**, the OLED of **FIG. 2** includes a first region A and a second region B. The processes discussed below are simultaneously performed in the first and second regions A and B unless otherwise described. However, it is understood that the processes formed in the first and second regions A and B do not need to be performed simultaneously.

[0033] A buffer layer **210** having a predetermined thickness is provided or formed on a substrate **200** having a thin film transistor (TFT) formed thereon. The TFT includes a polysilicon pattern **222**, a gate electrode **232**, and source and drain electrodes **250** and **252** formed thereon. The source and drain regions **220** into which impurities are doped are provided at opposite sides of the polysilicon pattern **222**, and a gate insulating layer **230** is formed on the entire surface of the structure and covers the polysilicon pattern **222**.

[0034] A passivation layer **260** having a predetermined thickness is subsequently formed on the entire surface of the structure. The passivation layer **260** is etched by a photolithography process and forms a first via contact hole (not shown) thereon that exposes one of the source and drain electrodes **250** and **252**, for example, the drain electrode **252**. The passivation layer **260** may be formed of a silicon oxide layer, a silicon nitride layer, or a stacked layer thereof.

[0035] A first insulating layer **270** is formed on the entire surface of the structure. The first insulating layer **270** may be made from polyimide, benzocyclobutene-series resin, spin on glass (SOG), or acrylate. The first insulating layer **270** is subsequently formed over the emission region, e.g., planarizes the emission region.

[0036] The first insulating layer **270** is subsequently etched by a photolithography process and forms a second via contact hole (not shown) is formed thereon that exposes the first via contact hole.

[0037] A reflecting layer (not shown) is subsequently formed on an entire upper surface of the structure. The reflecting layer is made of a material having a high reflectivity, such as aluminum (Al), an aluminum alloy, molybdenum (Mo), titanium (Ti), gold (Au), silver (Ag), palladium (Pd), and the like.

[0038] The reflecting layer is etched by photolithography process and forms a first reflecting layer pattern **280** in an emission region of the first region A. The first reflecting layer pattern **280** reflects light in the first region A to increase luminance and light efficiency. The first reflecting layer **280** is not formed in the second region B.

[0039] A thin layer for a pixel electrode (not shown) is subsequently formed on an entire upper surface of the structure. The pixel electrode thin layer is made of a transparent metal material, such as indium thin oxide (ITO).

[0040] The pixel electrode thin layer is etched by photolithography process to form a pixel electrode **282** in each of the first and second regions A and B. The pixel electrode **282** contacts one of the source and drain electrodes **250** and **252** that is exposed by the second via contact hole, for example, the drain electrode **152**. As shown in **FIG. 2**, for example, the pixel electrode **282** in the first region A has a dual layer structure that includes the first reflecting layer pattern **280** and the pixel electrode **282**. It is understood that an additional process may be performed so that the pixel electrode **282** in the first region A has a different thicknesses than the pixel electrode **282** in the second region B.

[0041] A second insulating layer (not shown) is subsequently formed on an entire upper surface of the structure. The second insulating layer may be made of, for example, polyimide, benzocyclobutene-series resin, phenol-series resin, or acrylate. The second insulating layer is etched by photolithography process and forms a second insulating layer pattern **290**.

[0042] An emission layer **284** is subsequently formed in the emission region. The emission layer **284** may be formed using a low molecular deposition method, a laser induced thermal imaging method, or the like. The emission layer **284** includes an organic emission layer and at least one of an electron injection layer, an electron transport layer, a hole injection layer, a hole transport layer, and a hole blocking layer.

[0043] An opposite electrode **286** is subsequently formed on an entire upper surface of the structure. The opposite electrode **286** is formed having a thickness of approximately 10 to 100 Å in both of the first and second regions A and B. The opposite electrode **286** may be formed of a transparent metal layer, such as an Mg—Ag layer, a Ca—Ag layer, or a Ba—Ag layer.

[0044] A second reflecting layer pattern **288** is subsequently formed on or above the opposite electrode **286** in the second region B using a mask that exposes the second region B. The second reflecting layer pattern **288** may be formed of a metal layer having a high reflectivity, e.g., an aluminum (Al) layer, a silver (Ag) layer, a gold (Au) layer, a palladium (Pd) layer, and/or an alloy thereof.

[0045] The second reflecting layer pattern **288** is formed to approximately 100 to 3000 Å thick. The second reflecting layer pattern **288** is preferably formed to 500 to 2500 Å thick. The second reflecting layer pattern **288** may be formed by a thermal deposition method, a sputtering method, or the like. The second reflecting layer pattern **288** is preferably formed by a sputtering method to reduce a fabrication process time. The second reflecting layer pattern **288** may be formed using the sputtering method because the opposite electrode **286** is approximately 10 to 100 Å thick. Further, the opposite electrode in the second region B is a stacked structure of the opposite electrode **286** and the second reflecting layer pattern **288**.

[0046] A transparent sealing substrate is subsequently applied or provided on the opposite electrode, thereby completing the fabrication of the OLED.

[0047] As described above, according to the present invention, an opposite electrode is formed using the same material in the top emission region and the bottom emission region by a single process, thereby simplifying a fabrication process, reducing a fabrication time, and increasing fabrication output without adversely affecting the electrical and/or optical characteristics of the display.

[0048] Although a few embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.

What is claimed is:

1. A method of fabricating an organic light emitting display, comprising:

forming a first electrode above a substrate having a first region and a second regions;

forming an emission layer in the first region and the second region;

forming a second electrode on the emission layer in the first and second regions; and

selectively forming a reflecting layer pattern on the second electrode in the second region.

2. The method of claim 1, further comprising:

forming at least one thin film transistor between the substrate and the first electrode.

3. The method of claim 1, wherein the first electrode is a pixel electrode.

4. The method of claim 3, further comprising:

forming a reflecting layer pattern below the pixel electrode in the first region.

5. The method of claim 1, wherein the second electrode is an opposite electrode.

6. The method of claim 1, wherein the second electrode comprises a transparent metal layer.

7. The method of claim 1, further comprising:

forming the second electrode from one of an Mg—Ag layer, a Ca—Ag layer, or a Ba—Ag layer.

8. The method of claim 6, further comprising:

forming the second electrode from one of an Mg—Ag layer, a Ca—Ag layer, or a Ba—Ag layer.

9. The method of claim 1, wherein the second electrode is approximately 10 to 100 Å thick.

10. The method of claim 1, wherein the reflecting layer pattern comprises an aluminum layer, a silver layer, a gold layer, a palladium layer, or an alloy thereof.

11. The method of claim 1, wherein the reflecting layer pattern is approximately 100 to 3000 Å thick.

12. The method of claim 1, wherein the reflecting layer pattern is approximately 500 to 2500 Å thick.

13. The method of claim 1, further comprising:

forming the reflecting layer pattern using a thermal deposition technique.

14. The method of claim 1, further comprising:

forming the reflecting layer pattern using a sputtering technique.

15. The method of claim 1, further comprising:

using a mask that exposes the second region to selectively form the reflecting layer pattern on the second electrode in the second region.

16. A method of forming an opposite electrode of an organic light emitting display substrate having a top emission region and a bottom emission region, comprising:

forming the opposite electrode on an entire surface of the substrate; and

selectively forming a reflecting layer on the opposite electrode formed in the bottom emission region;

wherein the reflecting layer is approximately 100 to 3000 Å thick.

17. The method of claim 16, wherein the reflecting layer is approximately 500 to 2500 Å thick.

18. The method of claim 17, wherein the opposite electrode of the organic light emitting display substrate is simultaneously formed on the top emission region and the bottom emission region.

19. An organic light emitting display substrate having a top emission region and a bottom emission region, comprising:

a first electrode provided in the top and bottom emission regions;

an emission layer provided on the first electrode;

a second electrode provided on the emission layer; and

a reflecting layer pattern provided on the second electrode in only the bottom emission region of the organic light emitting display substrate, wherein the reflecting layer is approximately 500 to 2500 Å thick.

20. The organic light emitting display substrate of claim 19, wherein the second electrode in the top emission region is a top emission opposite electrode,

wherein the second electrode in the bottom emission region and the corresponding reflecting layer pattern is a bottom emission opposite electrode, and

wherein the top emission opposite electrode and the bottom emission opposite electrode are simultaneously formed.

* * * * *

专利名称(译)	制造有机发光显示器的方法		
公开(公告)号	US20050264184A1	公开(公告)日	2005-12-01
申请号	US11/128178	申请日	2005-05-13
[标]申请(专利权)人(译)	PARK JOON YOUNG KWON张赫		
申请(专利权)人(译)	PARK俊YOUNG KWON JANG赫		
当前申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
[标]发明人	PARK JOON YOUNG KWON JANG HYUK		
发明人	PARK, JOON-YOUNG KWON, JANG-HYUK		
IPC分类号	H05B33/10 H01J1/62 H01J63/04 H01L27/32		
CPC分类号	H01L27/3267 H01L2251/558 H01L51/5271		
优先权	1020040038047 2004-05-28 KR		
其他公开文献	US7850500		
外部链接	Espacenet USPTO		

摘要(译)

提供一种制造有机发光显示器的方法，其中，第一电极分别形成在具有第一和第二区域的基板上方，在第一和第二区域中形成发光层，在第一和第二区域上形成第二电极。在第一和第二区域中的发光层，以及在第二区域中的第二电极上选择性地形成反射层图案。