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(54) **ORGANIC LIGHT EMITTING DIODE DISPLAY DEVICE**

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(57) **ABSTRACT**

An organic light emitting diode (OLED) display device including a first substrate, OLEDs disposed on the first substrate, a second substrate facing the first substrate, and reflective layers disposed on the encapsulation substrate. The reflective layers are offset with respect to the OLEDs, so that the OLED display device can be used as a mirror when the display device does not display an image.

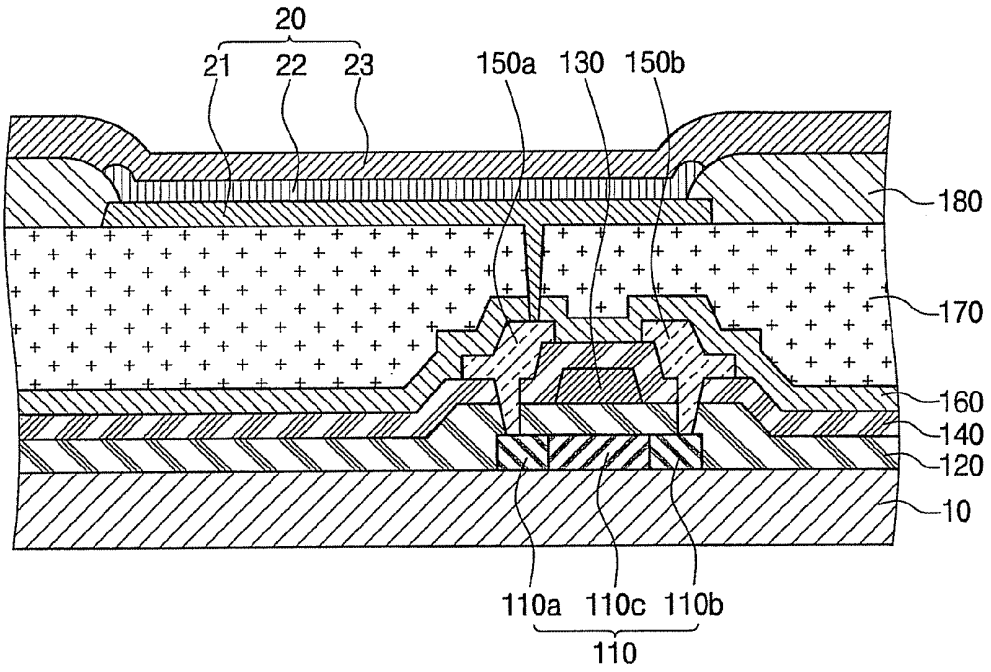


FIG.1

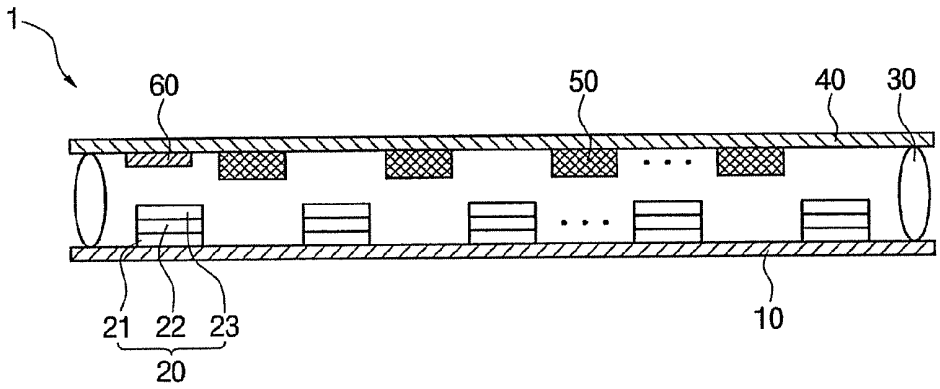
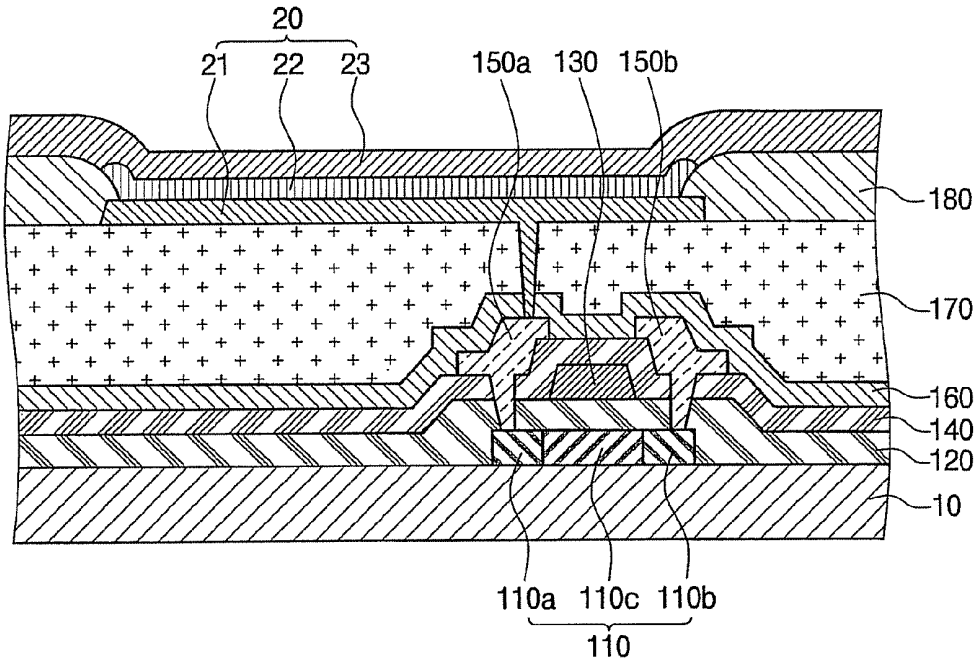

1
60
50
40
30
21
22
23
20
10

FIG.2


20
21
22
23
150a
130
150b
180
170
160
140
120
10
110a
110c
110b
110

ORGANIC LIGHT EMITTING DIODE DISPLAY DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of Korean Patent Application No. 2009-9730, filed Feb. 6, 2009, in the Korean Intellectual Property Office, the disclosure of which is hereby incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] Aspects of the present invention relate to an organic light emitting diode (OLED) display device.

[0004] 2. Description of the Related Art

[0005] In recent years, the developments of semiconductor fabrication technology and image processing technology have led to the rapid commercialization and increased usage of flat panel display devices (FPDs), which are lightweight and provide high-resolution images. The FPDs may include liquid crystal display devices (LCDs), plasma display panels (PDPs), vacuum fluorescent display devices (VFDs), and organic light emitting diode (OLED) display devices.

[0006] Among the above-described FPDs, the LCDs and OLED display devices are being broadly adopted for personal portable devices, such as portable phones, personal digital assistant (PDA), and portable computers, because they can be made thin and lightweight, and can produce high-resolution images. In particular, the LCDs and OLED display devices are widely used as outer and inner windows of dual-window portable phones.

[0007] An OLED display device is a self-emissive display device that electrically excites a fluorescent organic compound to emit light. In the OLED display device, an organic compound layer may be formed between a positive electrode (anode) and a negative electrode (cathode), and holes and electrons may be injected into the organic compound layer. The holes and electrons may recombine in the organic compound layer and generate light to display an image.

[0008] In order to meet various users' demands, electronic appliances are becoming increasingly multifunctional. As a result, research is being conducted toward developing multifunctional OLED display devices having not only a display function, but also other functions.

SUMMARY OF THE INVENTION

[0009] Aspects of the present invention provide an organic light emitting diode (OLED) display device including a first substrate, OLEDs disposed on the first substrate, an encapsulation substrate that faces the first substrate, and reflective layers formed on the encapsulation substrate. The reflective layers are staggered with respect to the OLEDs, so that the display device can be used as a mirror when the display device does not display an image.

[0010] According to aspects of the present invention, the reflective layers may be disposed on a top surface or a bottom surface of the second substrate.

[0011] According to aspects of the present invention, the OLED display device may further include a thin film transistor (TFT) having a semiconductor layer. The TFT may be disposed between the first substrate and the OLEDs.

[0012] According to aspects of the present invention, the reflective layers may have a reflection rate of 90%, or higher.

[0013] According to aspects of the present invention, the reflective layers may each include at least one thin layer selected from the group consisting of a chrome (Cr)-based metal layer, an aluminum (Al)-based metal layer, a silver (Ag)-based metal layer, a tin (Sn)-based metal layer, a molybdenum (Mo)-based metal layer, an iron (Fe)-based metal layer, a platinum (Pt)-based metal layer, and a mercury (Hg)-based metal layer.

[0014] According to aspects of the present invention, the OLED display device may further include at least one moisture absorbent material.

[0015] According to aspects of the present invention, each of the OLEDs may include a pixel electrode, an organic emission layer (EML), and an opposing electrode.

[0016] According to aspects of the present invention, the OLED display device may further include an emission protection layer covering the OLEDs.

[0017] 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

[0018] These and/or other aspects and advantages of the invention will become apparent and more readily appreciated from the following description of the exemplary embodiments, taken in conjunction with the accompanying drawings, of which:

[0019] FIG. **1** is a cross-sectional view of an organic light emitting diode (OLED) display device, according to an exemplary embodiment of the present invention; and

[0020] FIG. **2** is a cross-sectional view of a unit pixel of an active-matrix OLED.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

[0021] Reference will now be made in detail to the exemplary 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 exemplary embodiments are described below, in order to explain the aspects of the present invention, by referring to the figures.

[0022] Herein, when a first element is referred to as being formed or disposed "on" a second element, the first element can be disposed directly on the second element, or one or more other elements may be disposed therebetween. When a first element is referred to as being formed or disposed "directly on" a second element, no other elements are disposed therebetween.

[0023] FIG. **1** is a cross-sectional view of an organic light emitting diode (OLED) display device **1**, according to an exemplary embodiment of the present invention. Referring to FIG. **1**, the OLED display device **1** includes a plurality of OLEDs **20** formed on a surface of a first substrate **10**. Each of the OLEDs **20** includes a pixel electrode **21**, an organic emission layer (EML) **22**, and an opposing electrode **23**.

[0024] Although not shown, a hole injection layer (HIL) and a hole transport layer (HTL) may be formed between the pixel electrode **21** and the organic EML **22**, and an electron transport layer (ETL) and an electron injection layer (EIL) may be formed between the organic EML **22** and the oppos-

ing electrode **23**. The first substrate **10** may be selected from the group consisting of a glass substrate, a plastic substrate, and a metal substrate.

[0025] A buffer layer (not shown) may be formed on the first substrate **10**. The buffer layer may prevent the diffusion of moisture and/or impurities from the first substrate **10**. The buffer layer may be formed of silicon oxide (SiO_2), or silicon nitride (SiN_x), for example.

[0026] A sealant **30** may be coated between edges of the first substrate **10** and a second substrate **40**, so as to encapsulate the OLEDs **20** and bond to the first substrate **10** to the second substrate **40**. As a result, the first and second substrates **10** and **40** may be hermetically sealed by the sealant **30**, so that the OLEDs **20** can be protected from moisture.

[0027] The sealant **30** may be an ultraviolet (UV)-curable material, such as an epoxy, or a heat curable material. Alternatively, the sealant **30** may contain spacers, such as polymer beads or silica particles.

[0028] The second substrate **40** includes a bottom surface that faces the first substrate **10** and an opposing top surface. Reflective layers **50** are formed on the bottom surface of second substrate **40**. The reflective regions **50** are staggered with respect to the OLEDs **3**. In other words, the reflective layers **50** do not directly face the OLEDs **3**, and allow light from the OLEDs **3** to pass therebetween.

[0029] The reflective layers **50** may alternatively be formed on the top surface of the second substrate **40**. In this case, however, the reflective layers **50** may be susceptible to scratches or damage. Thus, the reflective layers **50** are generally formed on the bottom surface of the second substrate **40**.

[0030] The reflective layers **50** may be formed as a single reflective layer (not shown) that completely covers the bottom or top surface of the second substrate **40**. In this case, the single reflective layer should have a predetermined transmission rate and a predetermined reflection rate. In particular, the predetermined transmission rate should be set to allow the OLED display device **1** to properly display an image, and the predetermined reflection rate should be set such that the single reflection layer operates as a mirror, when the OLED display device **1** does not display an image.

[0031] However, because the reflective layers **50** are staggered with respect to the OLEDs **3**, the reflective layers **50** need not have the predetermined reflection and transmission rates, because the light from the OLEDs **20** can pass between the reflective layers and thereby display an image without passing through the reflective layers **50**. Therefore, a wider variety of materials can be used for the reflective layers **50**, without significantly degrading the luminous efficiency of the OLED display device **1**. In particular, the reflective layers **50** may be formed of a chrome (Cr)-based metal layer, an aluminum (Al)-based metal layer, a silver (Ag)-based metal layer, a tin (Sn)-based metal layer, a molybdenum (Mo)-based metal layer, an iron (Fe)-based metal layer, a platinum (Pt)-based metal layer, a mercury (Hg)-based metal layer, or a combination thereof. Also, the reflective layers **50** may have a reflection rate of at least about 90% and a transmission rate below 10%.

[0032] The OLED display device **1** may further include a moisture absorbent material **60**. The moisture absorbent material **60** may be selected from the group consisting of BaO, GaO, zeolite, CaO, or a metal oxide. Alternatively, the moisture absorbent material **60** may be a transparent moisture absorbent material, such as Polymer Nano Porous Layer (PNPL).

[0033] The moisture absorbent material **60** may be disposed between the first and second substrates **10** and **40**. For example, the moisture absorbent material **60** may be formed on a top surface of the first substrate **1**, or the bottom surface of the second substrate **40**. The moisture absorbent material should be positioned so as not to degrade the luminous efficiency of the OLED display device **1**.

[0034] The OLED display device **1** may further include an emission protection layer (not shown) covering the OLEDs **20**, in order to protect the OLEDs **20** from air. The emission protection layer may be formed of one selected from the group consisting of SiN_x, SiO_2, and Al_2O_3, to a thickness of from about 10 to 5000 Å. When the emission protection layer is formed to a thickness of less than about 10 Å, the protection effect of the emission protection layer may not be sufficient. When the emission protection layer is formed to a thickness of more than about 5000 Å, the luminous efficiency may be lowered, and processing time may be unnecessarily increased.

[0035] The present invention may be applied to an OLED display device including passive-matrix OLEDs (passive-matrix OLED display device) and to an OLED display device including active-matrix OLEDs (active-matrix OLED display device). An active-matrix OLED display device will be described with reference to FIG. **2**, which is a cross-sectional view of a unit pixel of an active-matrix OLED. Referring to FIG. **2**, the active-matrix OLED display device includes a TFT interposed between a first substrate **10** and an OLED **20**.

[0036] A buffer layer (not shown) may be formed on the first substrate **10**. The buffer layer may prevent diffusion of moisture and/or impurities from the first substrate **10**. Thereafter, an amorphous silicon (a-Si) layer may be formed on the buffer layer and crystallized into a polycrystalline silicon (poly-Si) layer. The poly-Si layer may be patterned to form a semiconductor layer **110** having a predetermined pattern. During or after the formation of the a-Si layer, a dehydrogenation process may be performed to lower the hydrogen concentration thereof.

[0037] Thereafter, a gate insulating layer **120** may be formed on the first substrate **10** and the semiconductor layer **110**, to protect underlying elements and electrically insulate the underlying elements from other elements that will be formed on the gate insulating layer **120**. Afterwards, a metal layer, formed of aluminum (Al), an aluminum (Al) alloy, molybdenum (Mo), or a molybdenum (Mo) alloy, may be deposited on the gate insulating layer **120**. The metal layer is patterned to form a gate electrode **130** corresponding to a region of the semiconductor layer **110**.

[0038] Subsequently, N-type or P-type impurities may be implanted in the semiconductor layer **110**, using the gate electrode **130** as a mask, thereby forming source and drain regions **110***a* and **110***b* in the semiconductor layer **110**. In this case, the source and drain regions **110***a* and **110***b* flank a channel region **110***c* that is not doped with the impurities.

[0039] Thereafter, an interlayer insulating layer **140** is formed on the gate insulating layer **120** and the gate electrode **130**. The interlayer insulating layer **140** protects and insulates the underlying elements from elements that will be formed on the interlayer insulating layer **140**. The buffer layer, the gate

insulating layer **120**, and the interlayer insulating layer **140** may be formed of silicon oxide (SiO_2), silicon nitride (SiN_x), or multiple layers thereof.

[0040] Contact holes are formed in the interlayer insulating layer **140** and the gate insulating layer **120**, to expose the source and drain regions **110***a* and **110***b*. Source and drain electrodes **150***a* and **150***b* are formed on the interlayer insulating layer **140** and connected to the source and drain regions **110***a* and **110***b*, respectively, through the contact holes, thereby completing the TFT. The source and drain electrodes **150***a* and **150***b* may be formed of one selected from the group consisting of Al, an Al alloy, Mo, and an Mo alloy.

[0041] A TFT protection layer **160** is formed on the first substrate **10** and the TFT. The TFT protection layer **160** may be formed of SiO_2, SiN_x, or multiple layers thereof.

[0042] A planarization layer **170** is then formed on the TFT protection layer **160**. The planarization layer **170** may be an organic layer. The planarization layer **170** may be formed of one selected from the group consisting of acryl, benzocyclobutene (BCB), and polyimide.

[0043] The TFT protection layer **160** and the planarization layer **170** are etched, thereby forming a hole exposing one of the source and drain electrodes **150***a* and **150***b*. A pixel electrode **21** is formed on the planarization layer **170**. The pixel electrode **21** is connected to the exposed source or drain electrode **150***a* and **150***b*. The pixel electrode **21** may be a transparent electrode formed of indium tin oxide (ITO) or indium zinc oxide (IZO).

[0044] A reflective layer (not shown) may be formed under the pixel electrode **21**, to provide a top-emitting OLED. The reflective layer may be formed of one selected from the group consisting of platinum (Pt), gold (Au), iridium (Ir), chrome (Cr), magnesium (Mg), silver (Ag), aluminum (Al), and an alloy thereof. The reflective layer and the pixel electrode **21** may be stacked, in sequence.

[0045] A pixel defining layer **180**, having an opening to expose the pixel electrode **21**, is then formed. The pixel defining layer **180** may be formed of a material selected from the group consisting of benzocyclobutene (BCB), an acryl polymer, and a polyimide.

[0046] An organic EML **22** may be formed on the pixel electrode **21**, and an opposing electrode **23** may be formed on the organic EML **22**, thereby completing the formation of the OLED **20**. Although not shown, an HIL and an HTL may be formed between the pixel electrode **21** and the organic EML **22**, and an ETL and an EIL may be formed between the organic EML **22** and the opposing electrode **23**.

[0047] Although only a TFT having a top-gate electrode is described above, the present invention is not limited thereto, and may be also applied to a TFT having a bottom-gate electrode. According to aspects of the present invention, reflective layers are formed on an encapsulation substrate. The reflection layers are staggered with respect to a plurality of OLEDs, so that an OLED display device can display images and operate as a mirror.

[0048] Although a few exemplary 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 exemplary 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. An organic light emitting diode (OLED) display device comprising:

a first substrate;

OLEDs disposed on the first substrate;

a second substrate facing the first substrate, to encapsulate the OLEDs; and

reflective layers formed on the second substrate, which are separated so as not to directly face the OLEDs.

2. The OLED display device according to claim **1**, wherein the reflective layers are disposed on a top surface of the second substrate, which faces away from the first substrate, or are disposed on an opposing bottom surface of the second substrate.

3. The OLED display device according to claim **1**, further comprising thin film transistors (TFTs) disposed between the first substrate and the OLEDs.

4. The OLED display device according to claim **1**, wherein the reflective layers have a reflection rate of at least about 90%.

5. The OLED display device according to claim **1**, wherein the reflective layers each comprise one selected from the group consisting of a chrome (Cr)-based metal layer, an aluminum (Al)-based metal layer, a silver (Ag)-based metal layer, a tin (Sn)-based metal layer, a molybdenum (Mo)-based metal layer, an iron (Fe)-based metal layer, a platinum (Pt)-based metal layer, a mercury (Hg)-based metal layer, and a combination thereof.

6. The OLED display device according to claim **1**, further comprising at least one moisture absorbent material disposed between the first and second substrates.

7. The OLED display device according to claim **1**, wherein each of the OLEDs includes a pixel electrode, an organic emission layer, and an opposing electrode.

8. The OLED display device according to claim **1**, further comprising an emission protection layer disposed on the OLEDs.

9. The OLED display device according to claim **8**, wherein the thickness of the emission protection layer is from about 10 Å to 5000 Å.

10. The OLED display device according to claim **1**, wherein the reflective layers are disposed such that light generated by the OLEDs passes between the reflective layers, to form an image.

* * * * *

专利名称(译)	有机发光二极管显示装置		
公开(公告)号	US20100201609A1	公开(公告)日	2010-08-12
申请号	US12/697529	申请日	2010-02-01
[标]申请(专利权)人(译)	三星显示有限公司		
申请(专利权)人(译)	三星移动显示器有限公司.		
当前申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
[标]发明人	KIM EUN AH		
发明人	KIM, EUN-AH		
IPC分类号	G09G3/30 H01J1/62		
CPC分类号	H01L27/3244 H01L51/5271 H01L51/5237 H01L51/5259		
优先权	1020090009730 2009-02-06 KR		
外部链接	Espacenet USPTO		

摘要(译)

一种有机发光二极管（OLED）显示装置，包括第一基板，设置在第一基板上的OLED，面向第一基板的第二基板，以及设置在封装基板上的反射层。反射层相对于OLED偏移，使得OLED显示装置可以在显示装置不显示图像时用作镜子。