



US010636863B2

(12) **United States Patent**
Kim

(10) **Patent No.:** **US 10,636,863 B2**
(45) **Date of Patent:** **Apr. 28, 2020**

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

(71) Applicant: **LG Display Co., Ltd.**, Seoul (KR)

(72) Inventor: **Eunah Kim**, Osan-si (KR)

(73) Assignee: **LG Display Co., Ltd.**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **16/195,455**

(22) Filed: **Nov. 19, 2018**

(65) **Prior Publication Data**

US 2019/0165077 A1 May 30, 2019

(30) **Foreign Application Priority Data**

Nov. 30, 2017 (KR) 10-2017-0162454

(51) **Int. Cl.**
H01L 27/32 (2006.01)
H01L 51/00 (2006.01)
H01L 51/52 (2006.01)

(52) **U.S. Cl.**
CPC **H01L 27/3276** (2013.01); **H01L 27/3258** (2013.01); **H01L 51/0097** (2013.01); **H01L 51/5253** (2013.01)

(58) **Field of Classification Search**
CPC H01L 27/3276; H01L 51/0097
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

9,601,557 B2 3/2017 Yang et al.
9,608,215 B2 3/2017 Minami et al.

9,755,168 B2	9/2017	Minami et al.
9,818,974 B2	11/2017	Kwon et al.
10,069,092 B2	9/2018	Minami et al.
10,224,344 B2	3/2019	Lee et al.
10,276,814 B2	4/2019	Minami et al.
10,396,141 B2	8/2019	Kawata
2012/0146886 A1	6/2012	Minami et al.
2014/0138637 A1	5/2014	Yang et al.
2014/0217373 A1	8/2014	Youn et al.
2014/0232956 A1*	8/2014	Kwon G02F 1/133305 349/12
2016/0172427 A1	6/2016	Lee et al.
2016/0174304 A1	6/2016	Kim et al.
2016/0181346 A1*	6/2016	Kwon H01L 27/3276 257/40
2017/0155066 A1	6/2017	Minami et al.

(Continued)

FOREIGN PATENT DOCUMENTS

JP 2012-128006 A 7/2012
JP 2016-503515 A 2/2016

(Continued)

OTHER PUBLICATIONS

Japan Patent Office, Notice of Reasons for Refusal, JP Patent Application No. 2018-218089, dated Dec. 24, 2019, 12 pages.

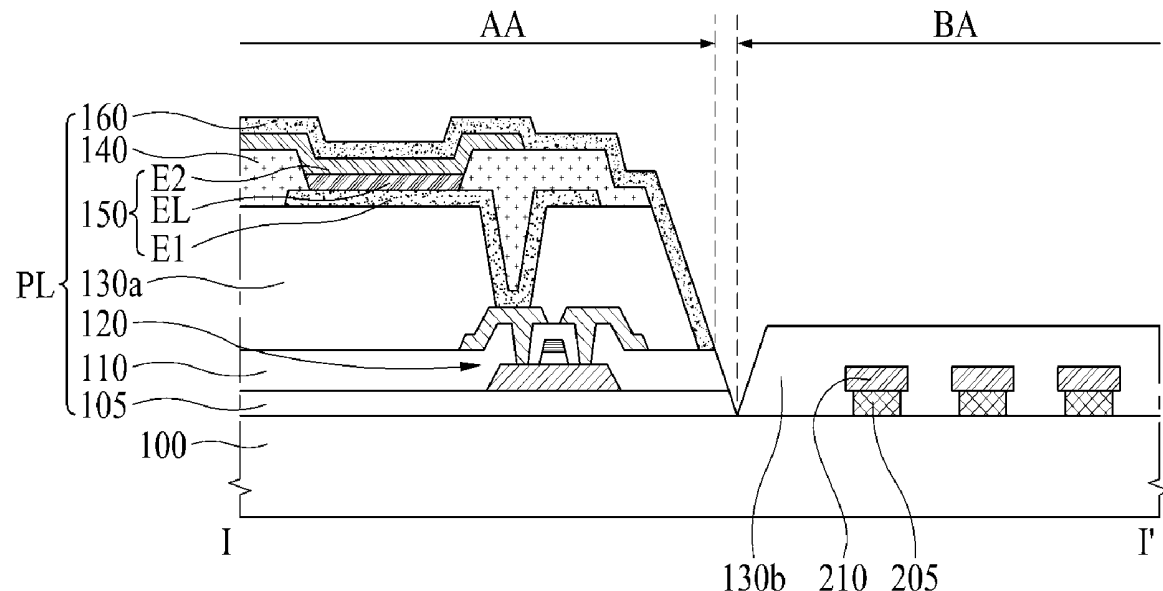
Primary Examiner — Jamie C Niesz

(74) Attorney, Agent, or Firm — Fenwick & West LLP

(57) **ABSTRACT**

An organic light emitting display device is disclosed, which enhances an adhesion between a substrate and a routing line and minimizes a crack of the routing line. The organic light emitting display device comprises a substrate having a display area and a bending area; a routing line arranged on the bending area of the substrate; and a lower layer formed between the substrate and the routing line.

9 Claims, 3 Drawing Sheets



(56)

References Cited

U.S. PATENT DOCUMENTS

2017/0170206	A1	6/2017	Lee et al.
2017/0179423	A1	6/2017	Kwon et al.
2017/0288005	A1	10/2017	Kawata
2017/0301266	A1	10/2017	Zhang et al.
2017/0302772	A1	10/2017	Zhang et al.
2017/0323779	A1	11/2017	Um et al.
2018/0331309	A1	11/2018	Minami et al.
2019/0157312	A1	5/2019	Lee et al.
2019/0189639	A1*	6/2019	Zuo H01L 27/1248
2019/0214588	A1	7/2019	Minami et al.
2019/0333981	A1	10/2019	Kawata

FOREIGN PATENT DOCUMENTS

JP	2016-031499	A	3/2016
JP	2017-111435	A	6/2017
JP	2017-111437	A	6/2017
JP	2017-187580	A	10/2017
JP	2018-180413	A	11/2018
KR	2014-0099139	A	8/2014

* cited by examiner

FIG. 1

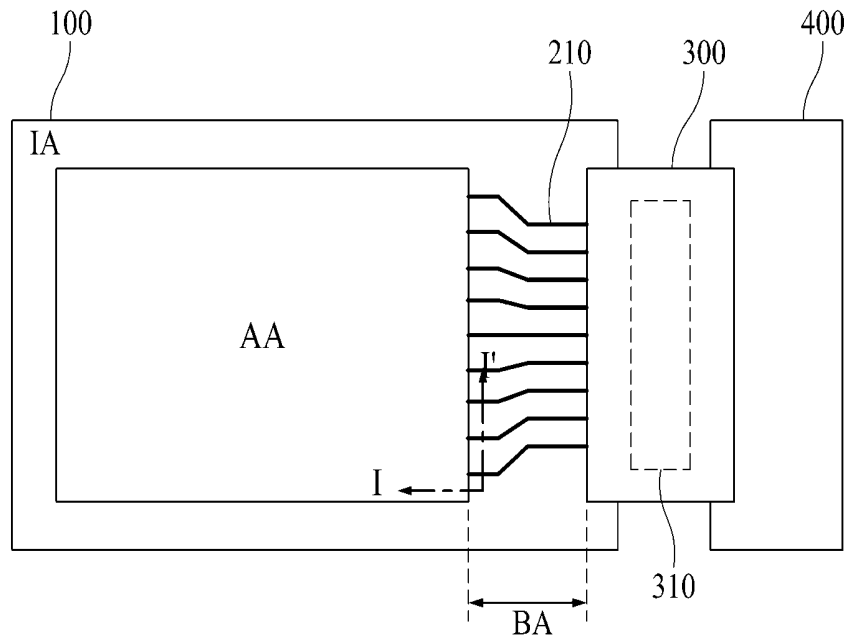


FIG. 2

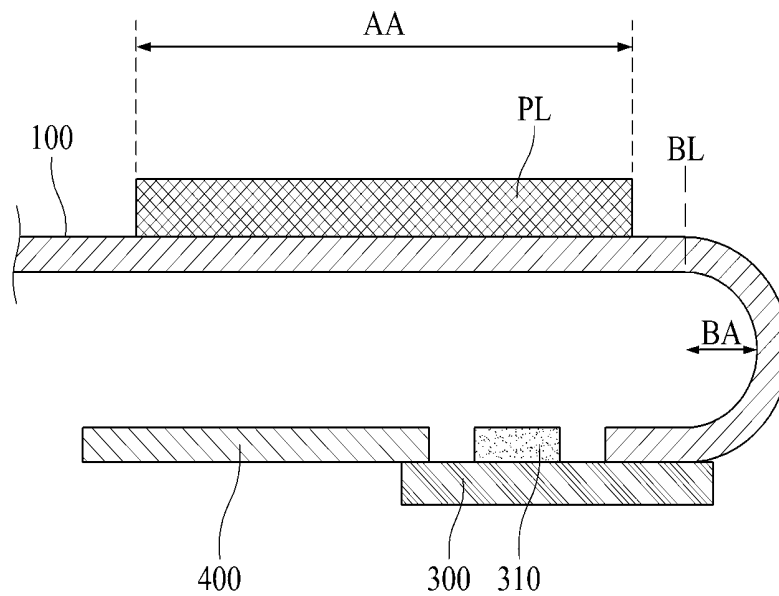


FIG. 3

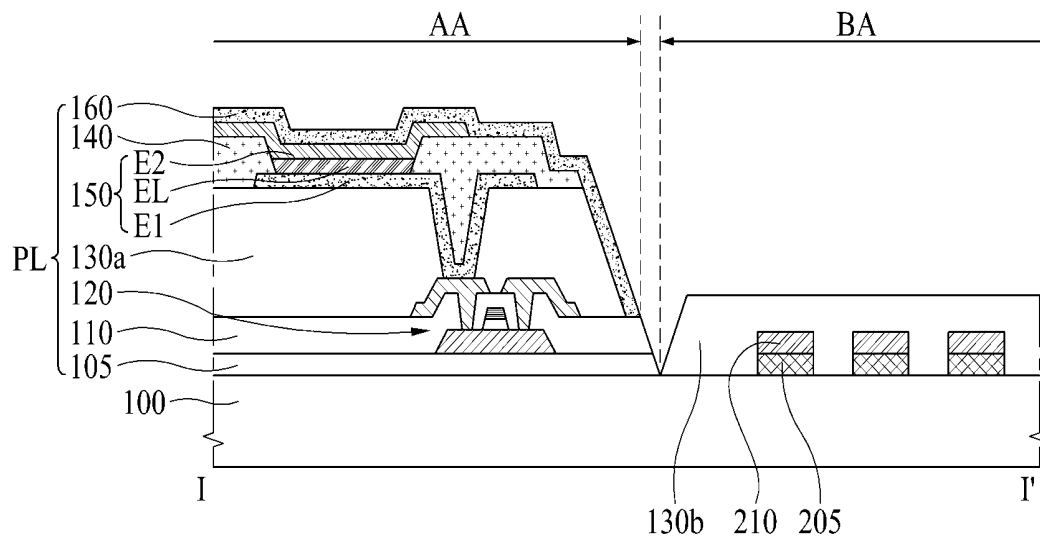


FIG. 4

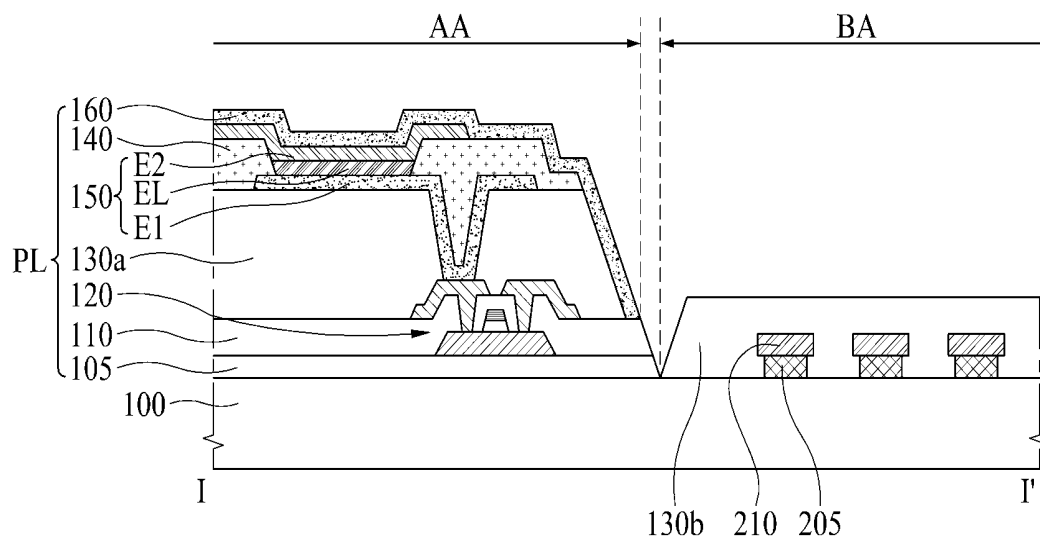


FIG. 5

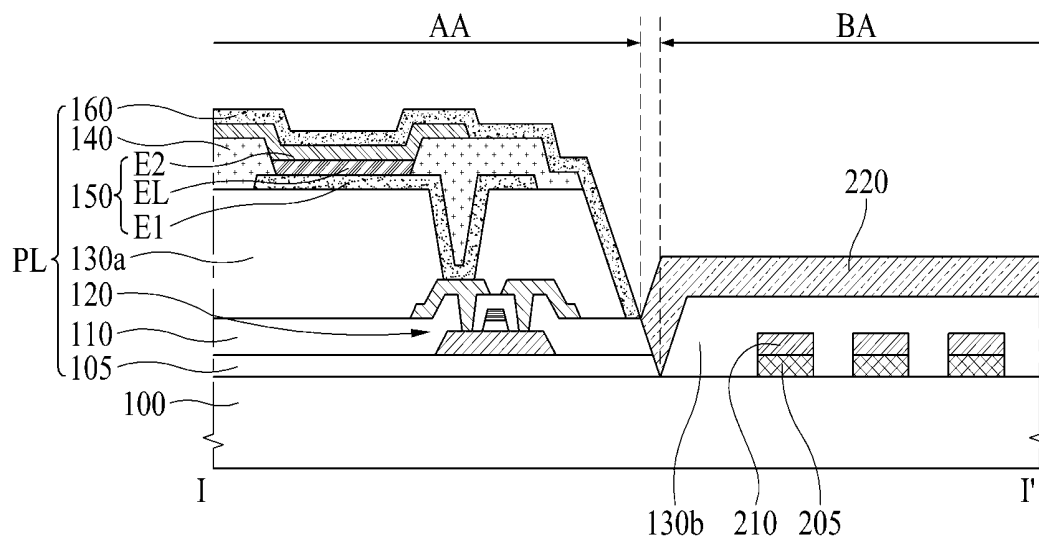
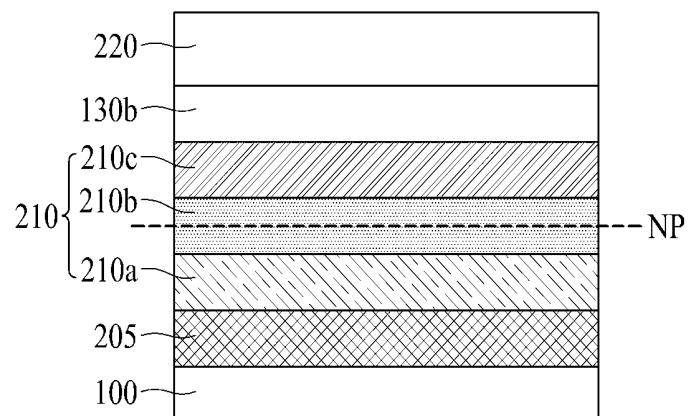


FIG. 6



1

ORGANIC LIGHT EMITTING DISPLAY DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to Republic of Korea Patent Application No. 10-2017-0162454 filed on Nov. 30, 2017, which is hereby incorporated by reference in its entirety.

BACKGROUND

Technical Field

The present disclosure relates to an organic light emitting display device.

Description of the Related Art

With the advancement of the information age, a demand for a display device for displaying an image has been increased in various forms. Among display devices, an organic light emitting display device is a self-light emitting device, and has received attention as a next generation display device owing to advantages such as a wide viewing angle, an excellent contrast ratio and a fast response speed. Recently, an organic light emitting display device of a slimmer size has been realized. Particularly, a flexible organic light emitting display device has many advantages in that it is easy to carry and may be applied to various shaped devices.

Since a flexible organic light emitting display device includes a bending area that may a foldable substrate and may reduce a bezel size by folding the substrate at the bending area, an organic light emitting display device having a narrow bezel may be realized. However, if bending is increased, a buffer layer and an insulating layer, which are vulnerable to stress, are broken, and a crack is generated in a routing line, whereby a problem occurs with disconnection.

To solve the problem, when the buffer layer and the insulating layer are removed from the bending area, the bending of the flexible display may easily be performed but problems occurs such as a film gap generated due to a low adhesion between the routing line and the substrate.

SUMMARY

The present disclosure has been made in view of the above problems, and it is an object of the present disclosure to provide an organic light emitting display device that enhances adhesion between a substrate and a routing line and minimizes occurrence of cracks in the routing line.

In accordance with an aspect of the present disclosure, the above and other aspects can be accomplished by an organic light emitting display device comprising a substrate having a display area and a bending area; a routing line arranged on the bending area of the substrate; and a lower layer formed between the substrate and the routing line.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

The above and other objects, features and other advantages of the present disclosure will be more clearly under-

2

stood from the following detailed description taken in conjunction with the accompanying drawings.

FIG. 1 is a plane view illustrating an organic light emitting display device according to an embodiment of the present disclosure.

FIG. 2 is a cross-sectional view illustrating the organic light emitting display device of FIG. 1 being bent.

FIG. 3 is a cross-sectional view taken along line I-I' of FIG. 1 according to the first embodiment of the present disclosure;

FIG. 4 is a cross-sectional view taken along line I-I' of FIG. 1 according to the second embodiment of the present disclosure.

FIG. 5 is a cross-sectional view taken along line I-I' of FIG. 1 according to the third embodiment of the present disclosure.

FIG. 6 is an enlarged view illustrating a structure of an area where a routing line is formed in FIG. 5.

DETAILED DESCRIPTION DISCLOSURE

Advantages and features of the present disclosure, and implementation methods thereof will be clarified through following embodiments described with reference to the accompanying drawings. The present disclosure may, however, be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the present disclosure to those skilled in the art. Further, the present disclosure is only defined by scopes of claims.

A shape, a size, a ratio, an angle, and a number disclosed in the drawings for describing embodiments of the present disclosure are merely an example, and thus, the present disclosure is not limited to the illustrated details. Like reference numerals refer to like elements throughout the specification. In the following description, when the detailed description of the relevant known function or configuration is determined to unnecessarily obscure the important point of the present disclosure, the detailed description will be omitted.

In a case where 'comprise', 'have', and 'include' described in the present specification are used, another part may be added unless 'only' is used. The terms of a singular form may include plural forms unless referred to the contrary.

In construing an element, the element is construed as including an error range although there is no explicit description.

In describing a positional relationship, for example, when the positional relationship is described as 'upon', 'above', 'below', and 'next to', one or more portions may be arranged between two other portions unless 'just' or 'direct' is used.

In describing a time relationship, for example, when the temporal order is described as 'after', 'subsequent', 'next', and 'before', a case which is not continuous may be included unless 'just' or 'direct' is used.

It will be understood that, although the terms "first", "second", etc. may be used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another. For example, a first element could be termed a second element, and, similarly, a second element could be termed a first element, without departing from the scope of the present disclosure.

“A first horizontal-axis direction”, “a second horizontal-axis direction” and “a vertical-axis direction” should not be construed by a geometric relation only of a mutual vertical relation, and may have broader directionality within the range that elements of the present disclosure may act functionally.

The term “at least one” should be understood as including any and all combinations of one or more of the associated listed items. For example, the meaning of “at least one of a first item, a second item, and a third item” denotes the combination of all items proposed from two or more of the first item, the second item, and the third item as well as the first item, the second item, or the third item.

Features of various embodiments of the present disclosure may be partially or overall coupled to or combined with each other, and may be variously inter-operated with each other and driven technically as those skilled in the art can sufficiently understand. The embodiments of the present disclosure may be carried out independently from each other, or may be carried out together in co-dependent relationship.

Hereinafter, the embodiments of the present disclosure of a multi-film and an organic light emitting display device according to the present disclosure will be described in detail with reference to the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

FIG. 1 is a plane view illustrating an organic light emitting display device according to one embodiment of the present disclosure, and FIG. 2 is a cross-sectional view illustrating that an organic light emitting display device of FIG. 1 is bent.

Referring to FIGS. 1 and 2, the organic light emitting display device according to one embodiment of the present disclosure includes a substrate 100, a pixel array layer PL, a driver 300, and a circuit board 400.

The substrate 100 is a thin film transistor array substrate, and may be made of a glass or plastic material. The substrate 100 includes a display area AA and a non-display area IA.

The display area AA is provided at the middle portions excluding an edge portion of the substrate 100. The display area AA may be defined as an area where a pixel array layer PL for displaying an image is arranged.

The non-display area IA is provided at the circumference portions excluding the display area AA provided in the substrate 100, and may be defined as the edge portions of the substrate 100 surrounding the display area AA. The non-display area IA is in the periphery outside the display area AA, does not display an image unlike the display area AA, and includes a bending area BA connected with the driver 300.

The bending area BA is an area arranged within the non-display area IA, and is an area where a routing line 210 for connecting the driver 300 with the pixel array layer PL is arranged. The bending area BA is an area provided to fold a part of the non-display area IA in one direction, and serves to reduce a bezel of the organic light emitting display device according to the present disclosure. The bending area BA has a structure for facilitating bending, which will be described later.

The pixel array layer PL is provided on the display area AA of the substrate 100. The pixel array layer PL is connected with the driver 300 through the routing line 210, and displays an image by receiving image data supplied from a display driving system. A detailed structure of the pixel array layer PL will be described later.

The driver 300 is connected to a pad portion provided in the non-display area IA of the substrate 100, and displays an

image corresponding to the image data supplied from the display driving system. The driver 300 includes a driving circuit 310, and may be a chip on film structure. For example, the driver 300 may comprise a flexible film, a driving circuit 310 on the flexible film, and a plurality of driving terminals arranged at one edge of the flexible film.

The circuit board 400 is electrically connected with the driver 300. The circuit board 400 serves to transfer signals and power sources between elements of the driver 300. The circuit board 400 may be a printed circuit board having flexibility.

Referring to FIG. 2 again, the substrate 100 may fold at the bending area BA in one direction. In this case, a bending line BL may be arranged at an interval spaced apart from the edge of the pixel array layer PL formed on the substrate 100. The bending line BL may be a line for folding the substrate 100. The organic light emitting display device according to the present disclosure has a minimized bezel as the bending line BL is arranged to adjoin the edge of the pixel array layer PL. The non-display area shown in front of the display is defined as the bezel. The bending area BA including the non-display area IA is not shown in front of the display. As the bending line BL is getting closer to the edge of the pixel array layer PL, the area of bezel is getting smaller.

FIG. 3 is a cross-sectional view taken along line I-I' of FIG. 1 according to the first embodiment of the present disclosure.

Referring to FIG. 3, the organic light emitting display device according to the first embodiment includes a substrate 100, a pixel array layer PL, a routing line 210, a lower layer 205, and a second planarization layer 130b.

The substrate 100 is a thin film transistor array substrate, and may be made of a glass or plastic material. The substrate 100 includes a display area AA and a bending area BA.

The pixel array layer PL is provided on the display area AA. The pixel array layer PL includes a buffer layer 105, a thin film transistor 120, a first planarization layer 130a, a bank layer 140, a light emitting diode layer 150, and an encapsulation layer 160.

The buffer layer 105 is provided on the display area AA of the substrate 100. The buffer layer 105 serves to prevent water from being permeated into the pixel array layer PL. The buffer layer 105 may be made of, but not limited to, an inorganic insulating material, for example, SiO₂ (silicon dioxide), SiN_x (silicon nitride), or multiple layer of SiO₂ and SiN_x.

The thin film transistor 120 is provided on the buffer layer 105. The thin film transistor 120 controls the amount of a current flowing from the driver 300 to the light emitting diode. To this end, the thin film transistor 120 includes a gate electrode, a drain electrode, and a source electrode. The thin film transistor 120 may drive the light emitting diode to emit light at the brightness proportional to a data signal supplied from a data line by controlling a data current flowing from the driver 300 to the light emitting diode.

The thin film transistor 120 may include an insulating layer 110 covering the gate electrode. The insulating layer 110 may be made of a single layer or multiple layers of an inorganic material, for example, SiO_x (silicon oxide), SiN_x (silicon nitride), etc.

The first planarization layer 130a is provided on the display area AA of the substrate 100 to cover the thin film transistor 120. The first planarization layer 130a provides a planarization surface on the thin film transistor 120 while protecting the thin film transistor 120. The first planarization layer 130a may be made of an organic material such as

benzocyclobutene and photo acryl, but may preferably be made of a photo acrylic material for convenient of processing.

The bank layer **140** is provided on the first planarization layer **130a** to define an opening area. The bank layer **140** may include an organic material such as benzocyclobutadiene, acryl, or polyimide. Additionally, the bank layer **140** may be formed of a photoresist material containing a black pigment. In this case, the bank layer **140** serves as a light-shielding member (or black matrix).

The light emitting diode layer **150** emits light in accordance with the data signal supplied from the thin film transistor. The light emitted from the light emitting diode layer **150** is extracted to the outside by passing through the substrate **100**. The light emitting diode layer **150** may include a first electrode **E1** connected to the thin film transistor, a light emitting layer **EL** formed on the first electrode **E1**, and a second electrode **E2** formed on the light emitting layer **EL**.

The first electrode **E1** is an anode electrode, and is provided on the first planarization layer **130a** in a patterned shape. The first electrode **E1** receives the data current output from the thin film transistor by being electrically connected with source/drain electrodes of the thin film transistor through a contact hole provided in the first planarization layer **130a**. The first electrode **E1** may be made of a metal material having high reflectivity, and for example, may include, but is not limited to, a material such as Au, Ag, Al, Mo, Mg, or their alloy.

The light emitting layer **EL** is provided on the first electrode **E1** of the opening area defined by the bank layer **140**. The light emitting layer **EL** may include a hole injecting layer, a hole transporting layer, an organic light emitting layer, an electron transporting layer, and an electron injecting layer, which are sequentially deposited on the first electrode **E1**. In this case, one or more of the hole injecting layer, the hole transporting layer, the electron transporting layer and the electron injecting layer may be omitted. Also, the light emitting layer **EL** may further include at least one function layer for controlling electrons and/or holes injected into the organic light emitting layer.

The second electrode **E2** is provided on the substrate **100** to cover the light emitting layer **EL** and the bank layer **140**, and is connected with the light emitting layer **EL**. The second electrode may be defined as a cathode electrode or a common electrode (which is commonly connected to all light emitting diodes) in accordance with a direction of a current flowing to the light emitting layer **EL**. The second electrode **E2** receives a cathode power source supplied from the driver **300**. In this case, the cathode power source may be a ground voltage or a direct current voltage having a predetermined level.

The second electrode **E2** may be made of a transparent metal material having high light transmittance. For example, the second electrode **E2** may include ITO (indium tin oxide), IZO (indium zinc oxide), IZTO (indium zinc tin oxide), ICO (indium cesium oxide) or IWO (indium tungsten oxide), which is a transparent conductive material such as TCO (transparent conductive oxide). Selectively, in this embodiment, to minimize damage of the light emitting layer **EL** due to a process temperature when the second electrode **E2** is formed, the second electrode **E2** may be formed of an amorphous transparent conductive material by a low temperature metal deposition process having a process temperature less than 100° C. That is, when the second electrode **E2** is formed of a crystalline transparent conductive material, a problem occurs in that the light emitting layer **EL** is dam-

aged by a high temperature heat treatment process performed for the second electrode **E2** to obtain a low resistance value. Therefore, it is preferable that the second electrode **E2** is formed of an amorphous transparent conductive material by a low pressure metal deposition process.

The encapsulation layer **160** is provided on the light emitting diode layer **150** to protect the light emitting layer **EL** which is vulnerable to external water or oxygen by preventing water from permeating into the light emitting layer **EL**. That is, the encapsulation layer **160** is provided on the substrate **100** to cover the second electrode **E2**. The encapsulation layer **160** may be formed of an inorganic layer or organic layer, or may be formed of a multi-layered structure in which the inorganic layer and the organic layer are deposited alternately.

The routing line **210** is provided on the bending area **BA** of the substrate **100**. The routing line **210** serves to electrically connect the driver **300** with the pixel array layer **PL**, and may be formed of a metal line. The routing line **210** may be formed of a linear metal line to have a fine pattern corresponding to UHD (Ultra High Density) design of the organic light emitting display device. Since the routing line **210** should transmit a data signal to the pixel array layer **PL** within a limited space, a line width and a line interval may be 2 μm to 4 μm.

The lower layer **205** is provided on the bending area **BA** of the substrate **100**. The lower layer **205** is formed between the substrate **100** and the routing line **210**. The lower layer **205** may be made of, but not limited to, an inorganic insulating material, for example, SiO₂ (silicon dioxide), SiN_x (silicon nitride), or a multiple layers of SiO₂ and SiN_x. The lower layer **205** serves to prevent water from being permeated into the routing line **210**.

The lower layer **205** may enhance adhesion between the substrate **100** and the routing line **210**. The substrate **100** may be formed of a plastic based material having nitrogen. At this time, since nitrogen does not have a good adhesion with the routing line **210** made of a metal material, a problem occurs in that decoupling may occur during a later process. However, the lower layer **205** is formed of an inorganic insulating material such as SiO₂ and SiN_x, and the inorganic insulating material has a good adhesion with nitrogen and also has a good adhesion with the routing line **210** made of a metal material. Since the lower layer **205** is interposed between the substrate **100** and the routing line **210**, the substrate **100** is indirectly coupled with the routing line **210** through the lower layer **205** formed on the substrate **100**, and adhesion may be enhanced.

The lower layer **205** is formed such that its front surface (or upper surface) is overlapped (or contacted) with a rear surface (or lower surface) of the routing line **210**. When the lower layer **205** is formed to be provided on an entire surface of the bending area **BA**, a crack may be generated in the lower layer **205** by stress applied to the lower layer **205** during bending. In the organic light emitting display device according to the present disclosure, since the lower layer **205** is formed in an area overlapped with the routing line **210** and not on the entire surface of the bending area **BA**, but in a patterned shape, relatively less stress is applied to the lower layer **205**, and a crack may be prevented from being generated in the lower layer **205** during the bending process.

The lower layer **205** may be formed to have the same width as that of the routing line **210**. Since the lower layer **205** is formed of an inorganic insulating material, a crack may be generated by external impact. In the organic light emitting display device according to the present disclosure, since the lower layer **205** is formed to have the same width

as that of the routing line **210**, the upper portion of the lower layer **205** is overlapped with the routing line **210**. In this case, since the routing line **210** is formed of a metal material, the routing line **210** easily tolerates external impact and serves as a buffering member that absorbs impact applied to the lower layer **205**, whereby a crack may be prevented from being generated in the lower layer **205**.

In the organic light emitting display device according to the present disclosure, since the lower layer **205** is formed in only the area overlapped with the routing line **210**, impact applied to the lower layer **205** may be absorbed by the routing line **210**, and a disconnection of the routing line **210**, which is caused by a crack generated in the lower layer **205**, may be avoided. Also, the lower layer **205** is formed of an inorganic insulating material that may enhance adhesion between the substrate **100** and the routing line **210**. Therefore, a peeling-off of the routing line **210** caused by bad adhesion when the routing line **210** is formed on the substrate **100** may be prevented.

The second planarization layer **130b** is provided to cover the routing line **210**. The second planarization layer **130b** provides a planarization surface on the routing line **210** while protecting the routing line **210**. The second planarization layer **130b** according to one embodiment is made of the same organic material as that of the first planarization layer **130a**, and is patterned during a deposition process for forming the first planarization layer **130a** and thus formed together with the first planarization layer **130a**.

The second planarization layer **130b** may prevent a crack from being generated during bending by providing a planarization surface on the routing line **210**. Since the routing line **210** is formed to be spaced apart from another routing line **210**, a step difference is generated in the bending area BA due to formation of the routing line **210**, whereby stress generated during bending may be increased. Since the second planarization layer **130b** provides the planarization surface on the routing line **210**, the step difference may be prevented from being generated in the bending area BA and a crack may be prevented from being generated in the bending area BA.

The second planarization layer **130b** is formed to cover the upper surface and the side surface (or side wall) of the lower layer **205**, and is formed to be directly in contact with the substrate **100** in the area where the lower layer **205** and the routing line **210** are not formed. Since the lower layer **205** is formed to have the same width as that of the routing line **210** without being provided on the entire surface of the bending area BA, some areas of the bending area, where the lower layer **205** and the routing line **210** are not formed, are covered by the second planarization layer **130b**. The second planarization layer **130b** may be formed of a material, which may prevent water permeation from occurring, to protect the routing line **210** from external water or particles.

FIG. 4 is a cross-sectional view taken along line I-I' of FIG. 1 according to the second embodiment of the present disclosure. FIG. 4 corresponds to a structure that a width of the lower layer is different from that of FIG. 3, and thus a description repeated with FIG. 3 will be omitted.

Referring to FIG. 4, the lower layer **205** may be formed to have a width smaller than that of the routing line **210**.

Since the lower layer **205** is formed of an inorganic insulating material, the lower layer **205** may be vulnerable to stress and a crack may be generated in the lower layer **205** by external impact. In the embodiment illustrated in FIG. 4, since the routing line **210** is formed of a metal material, the routing line **210** may serve as a buffering member that is easy to tolerate external impact and absorbs impact applied

to the lower layer **205**. Since the lower layer **205** is formed to have a width smaller than that of the routing line **210**, the routing line **210** may primarily absorb impact transferred from the side. When the lower layer **205** is formed to have a width smaller than that of the routing line **210** as above, since the routing line **210** may absorb impact transferred from the side as well as impact transferred up and down, a crack may be prevented from being generated in the lower layer **205**.

FIG. 5 is a cross-sectional view taken along line I-I' of FIG. 1 according to the third embodiment of the present disclosure, and FIG. 6 is an enlarged view illustrating a structure of an area where a routing line is formed in FIG. 5. FIG. 5 relates to a structure where a micro-coating layer is added to a structure of FIG. 4, and thus a description describing features already discussed from FIG. 4 may be omitted.

Referring to FIGS. 5 and 6, the organic light emitting display device according to the third embodiment of the present disclosure includes a routing line **210**, and a micro-coating layer **220**.

The routing line **210** is provided on the bending area BA of the substrate **100**. The routing line **210** includes a first metal **210a**, a second metal **210b** and a third metal **210c**.

The first metal **210a** is provided to be directly in contact with the lower layer **205** at the lowest portion of the routing line **210**. The first metal **210a** may be formed of a metal such as Ti having high strength, and may protect the routing line **210** from external impact.

The second metal **210b** is provided on the first metal **210a**. The second metal **210b** may be formed of a metal such as Al having good ductility and flexibility. The second metal **210b** is formed to be thicker than the first metal **210a** and the third metal **210c**.

The third metal **210c** is provided on the second metal **210b**. The third metal **210c** may be formed of the same material as that of the first metal **210a** to protect the routing line **210** from external impact, and is preferably formed of the same thickness as that of the first metal **210a**.

The micro-coating layer **220** is provided on the entire surface of the bending area BA of the substrate **100** to cover the second planarization layer **130b**. The micro-coating layer **220** may be provided as a photo-hardening resin, and may be coated on target areas of the organic light emitting display device according to the present disclosure. In this respect, the micro-coating layer **220** may be coated on the entire surface of the bending area BA.

The micro-coating layer **220** may be coated at a predetermined thickness to adjust the position of a neutral plane NP at the bending area BA of the substrate **100** in the organic light emitting display device according to the present disclosure. In detail, in the organic light emitting display device, the neutral plane NP of the bending area BA may be adjusted to be disposed on the routing line **210**. One surface of the substrate **100** is stretched and the other surface is shrunk as the substrate **100** is bent. At this time, the surface which is neither stretched nor shrunk, and which is defined at the center of the substrate **100**, is defined as the middle plane or the neutral plane. In this case, the neutral plane NP is formed or defined on the bending area BA of the organic light emitting display device.

For example, as the micro-coating layer **220** is thickly coated, the neutral plane NP ascends toward the upper portion from the substrate **100**, whereby the neutral plane NP may be arranged at (on or in) the routing line **210**. Since the routing line **210** is formed of a metal material, the routing line **210** is vulnerable to bending stress generated during

bending, whereby disconnection may be occurred. In this case, when the neutral plane NP is arranged at the routing line **210**, bending stress applied to the routing line **210** is minimized, because the neutral plane NP is neither stretched nor shrunk. Therefore, a disconnection defect on the routing line **210** does not occur. As a result, the extreme bending of the organic light emitting display device may be acquired and a narrow bezel may be realized.

Also, the neutral plane NP may be arranged in the second metal **210b** even within the routing line **210**. The second metal **210b** is formed of a material having high ductility, and serves to transmit a data signal to the pixel array layer PL. Since the second metal **210b** is a direct factor that may cause disconnection, it is favorable for situations of extreme bending that the neutral plane NP is arranged at (on or in) the second metal **210b**.

In the organic light emitting display device according to the present disclosure, the micro-coating layer **220** may be formed on the bending area BA to adjust the neutral plane NP of the bending area BA. Therefore, stress applied to the bending area BA may be suppressed to enable extreme bending.

As described above, according to the present disclosure, the following effects and advantages may be obtained.

The organic light emitting display device according to the present disclosure may prevent a defect from a film gap between the substrate and the routing line from being generated while facilitating bending.

In addition to the effects of the present disclosure as mentioned above, additional advantages and features of the present disclosure will be clearly understood by those skilled in the art from the above description of the present disclosure.

It will be apparent to those skilled in the art that the present disclosure described above is not limited by the above-described embodiments and the accompanying drawings and that various substitutions, modifications, and variations can be made in the present disclosure without departing from the spirit or scope of the disclosures. Consequently, the scope of the present disclosure is defined by the accompanying claims, and it is intended that all variations or modifications derived from the meaning, scope, and equivalent concept of the claims fall within the scope of the present disclosure.

The various embodiments described above can be combined to provide further embodiments. Aspects of the embodiments can be modified, if necessary to employ concepts of the various patents, applications and publications to provide yet further embodiments.

These and other changes can be made to the embodiments in light of the above-detailed description. In general, in the following claims, the terms used should not be construed to limit the claims to the specific embodiments disclosed in the specification and the claims, but should be construed to include all possible embodiments along with the full scope of equivalents to which such claims are entitled. Accordingly, the claims are not limited by the disclosure.

What is claimed is:

1. An organic light emitting display device comprising:
a substrate having a display area and a bending area;
a routing line arranged on the bending area of the substrate, the routing line having a length along a first direction and a width along a second direction that is different from the first direction, wherein the routing line is separated from another routing line in the second direction; and

a lower layer formed between the substrate and the routing line, the lower layer having a length along the first direction and a width along the second direction, wherein the width of the lower layer in the second direction is less than the width of the routing line in the second direction,

wherein the lower layer has a front surface overlapped with a rear surface of the routing line.

2. The organic light emitting display device according to claim 1, wherein the lower layer includes an inorganic insulating material.

3. The organic light emitting display device according to claim 1, further comprising:

a pixel array layer provided on the display area of the substrate,

wherein the pixel array layer includes:

a thin film transistor for controlling a data current flowing to a light emitting diode;

a first planarization layer for covering the thin film transistor;

a light emitting diode layer provided on the first planarization layer and connected to the thin film transistor; and
an encapsulation layer for covering the light emitting diode layer.

4. The organic light emitting display device according to claim 3, further comprising a second planarization layer for covering a side surface of the lower layer and the routing line, wherein the first planarization layer and the second planarization layer are formed of a same material.

5. The organic light emitting display device according to claim 4, wherein the second planarization layer is directly in contact with the substrate.

6. The organic light emitting display device according to claim 4, further comprising a micro-coating layer provided on the second planarization layer in the bending area without extending to the display area.

7. The organic light emitting display device according to claim 6, wherein a neutral plane of the bending area is arranged on the routing line.

8. The organic light emitting display device according to claim 6, wherein a neutral plane of the bending area is arranged in the routing line.

9. The organic light emitting display device according to claim 7, wherein the routing line includes:

a first metal on the substrate;

a second metal on the first metal; and

a third metal on the second metal,

wherein the neutral plane is arranged on or in the second metal.

* * * * *

专利名称(译)	有机发光显示装置		
公开(公告)号	US10636863	公开(公告)日	2020-04-28
申请号	US16/195455	申请日	2018-11-19
[标]申请(专利权)人(译)	乐金显示有限公司		
申请(专利权)人(译)	LG DISPLAY CO. , LTD.		
当前申请(专利权)人(译)	LG DISPLAY CO. , LTD.		
[标]发明人	KIM EUNAH		
发明人	KIM, EUNAH		
IPC分类号	H01L27/32 H01L51/00 H01L51/52		
CPC分类号	H01L27/3258 H01L51/0097 H01L27/3276 H01L51/5253		
优先权	1020170162454 2017-11-30 KR		
其他公开文献	US20190165077A1		
外部链接	Espacenet		

摘要(译)

公开了一种有机发光显示装置，该有机发光显示装置增强了基板与走线之间的粘附力并且使走线的裂纹最小化。 该有机发光显示装置包括：具有显示区域和弯曲区域的基板；以及设置在基板上的基板。 布置在基板的弯曲区域上的走线；在基板和布线之间形成下层。

