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

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This patent is subject to a terminal disclaimer.

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(58) **Field of Classification Search**
None
See application file for complete search history.

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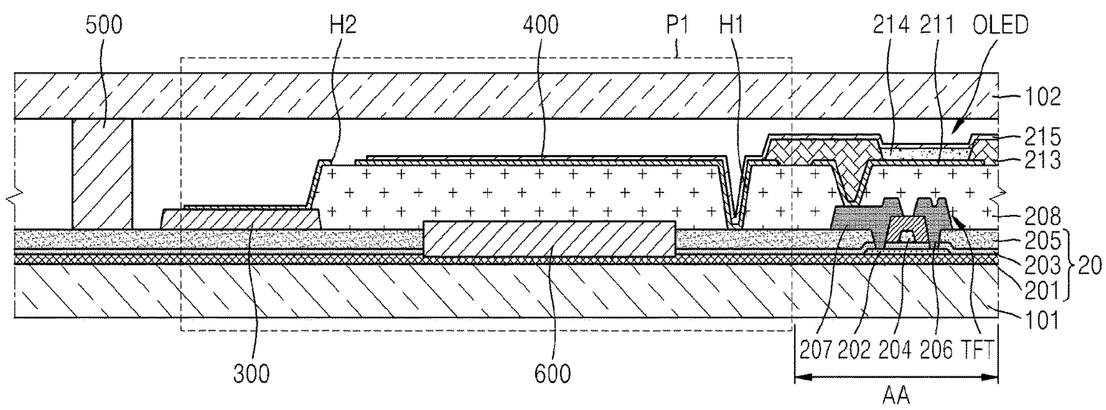
(57) **ABSTRACT**

An organic light-emitting display apparatus includes: a first substrate; an insulating layer on the first substrate; a signal wiring on the insulating layer; an organic light-emitting device on the first substrate, the organic light-emitting device defining an active area and including a first electrode, a second electrode, and an intermediate layer between the first and second electrodes; a passivation layer on the insulating layer; and a metal layer on the passivation layer at an outer region adjacent to the active area, separated from the first electrode, and contacting the second electrode and the signal wiring, wherein a first opening is in the passivation layer at the outer region, and the metal layer contacts the insulating layer at the first opening.

8 Claims, 3 Drawing Sheets



Related U.S. Application Data

continuation of application No. 14/284,355, filed on May 21, 2014, now Pat. No. 9,196,865.

(52) **U.S. Cl.**
CPC ***H01L 27/3262*** (2013.01); ***H01L 27/3276*** (2013.01); ***H01L 51/5246*** (2013.01); ***H01L 51/5253*** (2013.01)

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FIG. 1

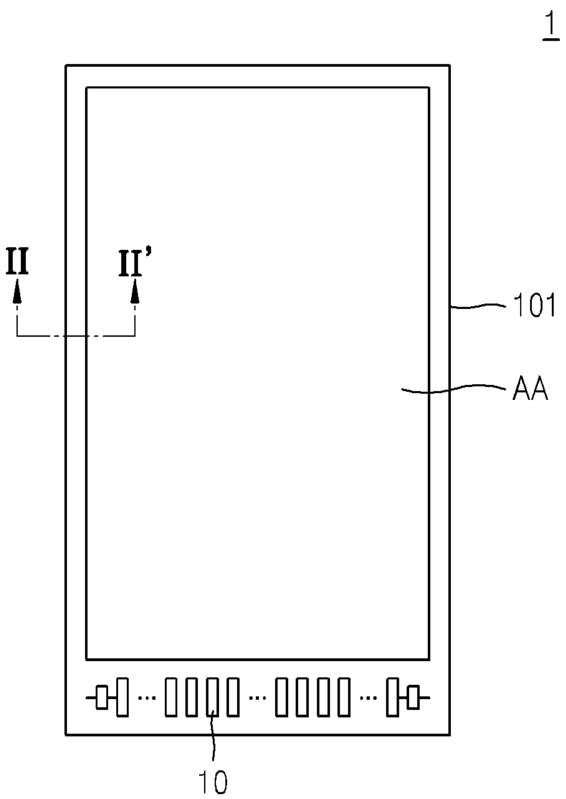


FIG. 2

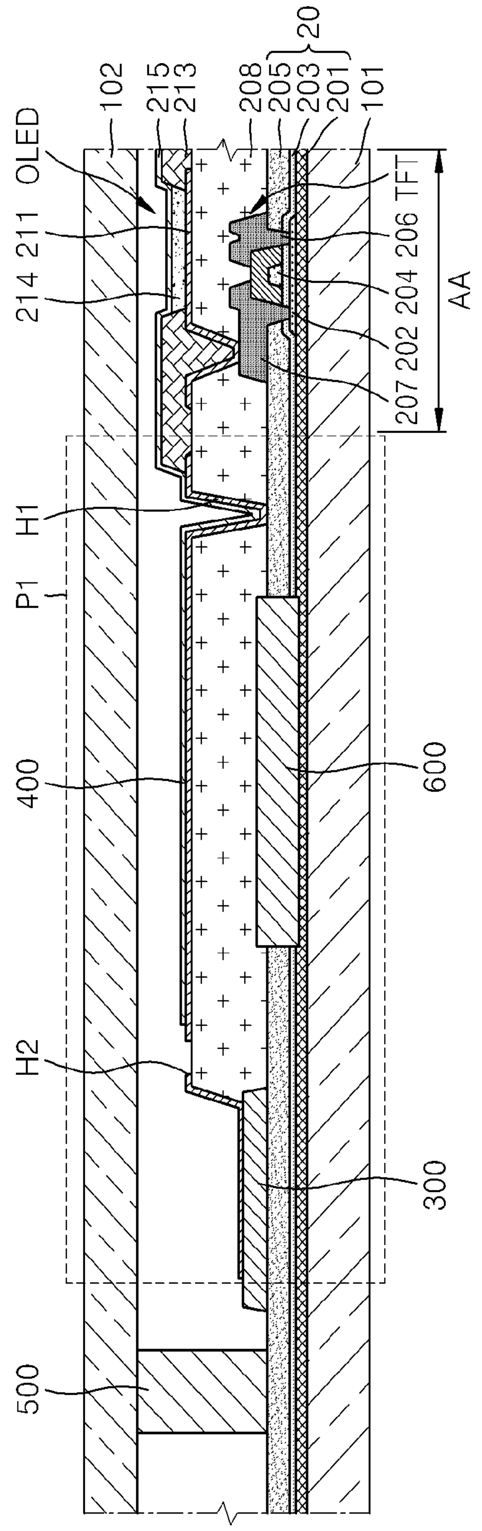
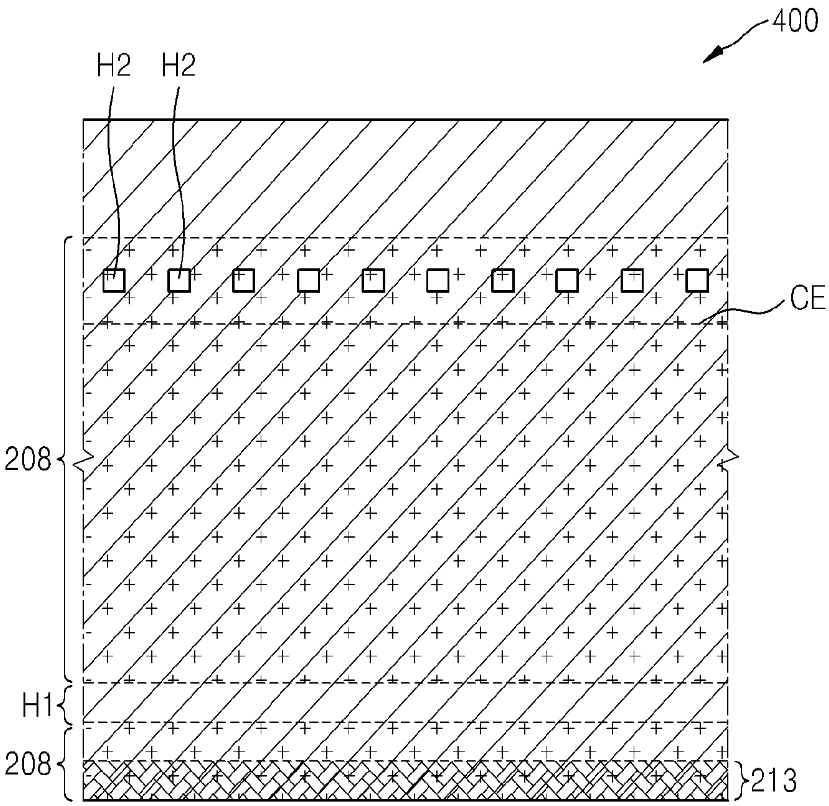

20
102
215
213
208
205
203
201
101
OLED
214
211
206
TFT
204
202
207
AA
H1
P1
400
600
H2
300
500

FIG. 3



ORGANIC LIGHT-EMITTING DISPLAY APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation of U.S. patent application Ser. No. 14/921,293, filed Oct. 23, 2015, which is a continuation of U.S. patent application Ser. No. 14/284,355, filed May 21, 2014 (Now U.S. Pat. No. 9,196,865), which claims priority to and the benefit of Korean Patent Application No. 10-2014-0001495, filed on Jan. 6, 2014 in the Korean Intellectual Property Office, the entire contents of which are incorporated herein by reference.

BACKGROUND

1. Field

One or more embodiments of the present invention relate to an organic light-emitting display apparatus.

2. Description of the Related Art

An organic light-emitting display apparatus using an organic light-emitting device has a faster response time than a liquid crystal display (LCD) that is currently widely used and thus, is capable of better displaying or realizing a moving image. Also, because the organic light-emitting display apparatus is self-emitting, has a wide viewing angle, and has high luminance, the organic light-emitting display apparatus is receiving attention as a next generation display apparatus.

The organic light-emitting device includes a pixel electrode and a counter electrode, which face each other, and an emission layer including an organic material disposed between the pixel electrode and the counter electrode. The organic material is very sensitive to moisture, oxygen, and light, and thus, when it comes into contact with any of them, a pixel shrinkage phenomenon wherein an emission region is gradually reduced in size may occur or a dark spot may be generated in the emission region. Thus, a lifespan and/or quality of the organic light-emitting device may be affected.

SUMMARY

One or more embodiments of the present invention relate to an organic light-emitting display apparatus.

Additional aspects will be set forth in part in the description which follows and, in part, will be apparent from the description or may be learned by practice of the presented embodiments.

According to an embodiment of the present invention, an organic light-emitting display apparatus includes: a first substrate; an insulating layer on the first substrate; a signal wiring on the insulating layer; an organic light-emitting device (OLED) on the first substrate, the OLED defining an active area and including a first electrode, a second electrode, and an intermediate layer between the first and second electrodes; a passivation layer on the insulating layer; and a metal layer on the passivation layer at an outer region adjacent to the active area, separated from the first electrode, and contacting the second electrode and the signal wiring, wherein a first opening is in the passivation layer at the outer region, and the metal layer contacts the insulating layer at the first opening.

The first opening may extend across the passivation layer, and the passivation layer may include two portions separated at the first opening.

The metal layer may have a second opening outside the second electrode.

The metal layer may have a plurality of the second openings.

The plurality of the second openings may be arranged along a line parallel to an end of the second electrode.

The plurality of the second openings may be arranged at an interval.

The second openings may be configured to allow impurities in the passivation layer to pass therethrough.

The metal layer may include a same material as that of the first electrode.

The organic light-emitting display apparatus may further include a pixel-defining film covering a part of the first electrode and a part of the metal layer and contacting the passivation layer, wherein the first opening may be outside the pixel-defining film.

The second electrode may be electrically coupled to the signal wiring through the metal layer.

A circuit unit may be below the passivation layer.

The first opening may prevent impurities in the passivation layer outside the active area from migrating to the active area.

The organic light-emitting display apparatus may further include: a second substrate on the second electrode; and a sealant between the first and second substrates and coupling the first and second substrates.

BRIEF DESCRIPTION OF THE DRAWINGS

These and/or other aspects will become apparent and more readily appreciated from the following description of example embodiments, taken in conjunction with the accompanying drawings in which:

FIG. **1** is a plan view schematically illustrating a part of an organic light-emitting display apparatus according to an embodiment of the present invention;

FIG. **2** is a cross-sectional view taken along the line II-II' of FIG. **1**; and

FIG. **3** is a plan view of the region P**1** of FIG. **2**.

DETAILED DESCRIPTION

Reference will now be made in detail to embodiments, examples of which are illustrated in the accompanying drawings. In this regard, the present embodiments may have different forms and should not be construed as being limited to the descriptions set forth herein. Accordingly, the embodiments are merely described below, by referring to the figures, to explain aspects of the present description.

In the drawings, like reference numerals refer to like elements throughout and overlapping descriptions may not be repeated.

While terms, such as "first", "second", etc., may be used to describe various components, such components must not be limited to the above terms. The above terms are used only to distinguish one component from another.

An expression used in the singular encompasses the expression of the plural, unless it has a clearly different meaning in the context.

In the present specification, it is to be understood that the terms such as "including," "comprising," or "having," etc., are intended to indicate the existence of the features or components and are not intended to preclude the possibility that one or more other features or components may also exist or may be added.

It will be understood that when a component or layer is referred to as being "on" another component or layer, the component or layer can be directly on the other component or layer or intervening component or layers may also be present.

In the drawings, for convenience of description, sizes and/or thicknesses of components or layers may be exaggerated for clarity. For example, because sizes and/or thicknesses of components or layers in drawings are arbitrarily shown for convenience of description, the sizes and thicknesses are not limited thereto.

Expressions such as "at least one of," when preceding a list of elements, modify the entire list of elements and do not modify the individual elements of the list. Further, the use of "may" when describing embodiments of the present invention relates to "one or more embodiments of the present invention."

Hereinafter, one or more embodiments of the present invention will be described in detail with reference to accompanying drawings.

FIG. **1** is a plan view schematically illustrating a part of an organic light-emitting display apparatus **1** according to an embodiment of the present invention, FIG. **2** is a cross-sectional view taken along the line II-II' of FIG. **1**, and FIG. **3** is a plan view of the region P**1** of FIG. **2**.

Referring to FIGS. **1** and **2**, the organic light-emitting display apparatus **1** according to an embodiment of the present invention includes a first substrate **101**, an insulating layer **20** formed on the first substrate **101**, a signal wiring **300** formed on the insulating layer **20**, an organic light-emitting device OLED for defining an active area AA on the first substrate **101**, a passivation layer **208** formed on the insulating layer **20**, and a metal layer **400** formed on the passivation layer **208** at an outer region outside of (e.g., adjacent to) the active area AA.

The first substrate **101** may be a flexible substrate and may be formed of plastic having excellent thermal resistance and excellent durability. However, the first substrate **101** is not limited thereto and may be formed of any one of various materials, such as metal or glass.

The organic light-emitting device OLED defines the active area AA of the first substrate **101** and is electrically coupled (e.g., electrically connected) to a thin-film transistor TFT. A pad unit **10** may be disposed around the active area AA so as to transmit an electric signal from a power supply device or a signal generating apparatus to the active area AA.

An internal structure of the organic light-emitting display apparatus **1** will now be described in further detail with reference to FIG. **2**.

The insulating layer **20** may be formed on the first substrate **101**. The insulating layer **20** may include a buffer layer **201**, a gate insulating film **203**, and an interlayer insulating film **205**.

The buffer layer **201** may be formed directly on the first substrate **101**. The buffer layer **201** may be formed on an entire surface of the first substrate **101** (e.g., at the active area AA and at the outer region). The buffer layer **201** may be formed of any material capable of preventing impure elements from penetrating through the first substrate **101** and providing a flat surface on the first substrate **101**.

The thin-film transistor TFT may be formed on the buffer layer **201**. The thin-film transistor TFT may include an active layer **202**, a gate electrode **204**, a source electrode **206**, and a drain electrode **207**.

The active layer **202** may be formed of an inorganic semiconductor, such as amorphous silicon or polysilicon, an organic semiconductor, or an oxide semiconductor and may include a source region, a drain region, and a channel region.

The gate insulating film **203** is formed on the active layer **202**. The gate insulating film **203** may be formed to correspond to (e.g., may be formed on) the entire first substrate **101**. For example, the gate insulating film **203** may be formed to correspond to the active area AA and the outer region of the first substrate **101**. The gate insulating film **203** is used to insulate the active layer **202** and the gate electrode **204** from each other and may be formed of an organic material or an inorganic material, such as SiN_x or SiO_2.

The gate electrode **204** is formed on the gate insulating film **203**. The gate electrode **204** may include gold (Au), silver (Ag), copper (Cu), nickel (Ni), platinum (Pt), palladium (Pd), aluminum (Al), or molybdenum (Mo), or may include an alloy, such as aluminum:neodymium (Al:Nd) or molybdenum:tungsten (Mo:W), but is not limited thereto and may be formed of any suitable material considering design conditions.

The interlayer insulating film **205** is formed on the gate electrode **204**. The interlayer insulating film **205** may be formed to correspond to an entire surface of the first substrate **101**. For example, the interlayer insulating film **205** may be formed to correspond to the active area AA and the outer region.

The interlayer insulating film **205** is disposed between the gate electrode **204** and the source electrode **206** and between the gate electrode **204** and the drain electrode **207** to insulate them and may be formed of an inorganic material, such as SiN_x or SiO_2.

The signal wiring **300** may be formed on the insulating layer **20**. The signal wiring **300** may be formed on the interlayer insulating film **205**. The signal wiring **300** may be formed at the outer region. The signal wiring **300** may be electrically coupled to a second electrode **215** to supply a signal to the second electrode **215**. The signal wiring **300** may be a cathode power supply line ELVSS. When the signal wiring **300** is the cathode power supply line ELVSS, the cathode power supply line ELVSS may be coupled to (e.g., connected to) a cathode power source having (e.g., supplying) a lower voltage than a common power supply voltage; for example, the cathode power supply line ELVSS may be a ground voltage or a negative (−) voltage. The signal wiring **300** may be formed of the same material as the source or drain electrode **206** or **207** and may be formed during the same act or process.

The source and drain electrodes **206** and **207** are formed on the interlayer insulating film **205**. For example, the interlayer insulating film **205** and the gate insulating film **203** are formed to expose the source and drain regions of the active layer **202**, and the source and drain electrodes **206** and **207** are formed to contact the exposed source and drain regions of the active layer **202**.

The thin-film transistor TFT of FIG. **2** is a top-gate transistor sequentially including the active layer **202**, the gate electrode **204**, and the source and drain electrodes **206** and **207**, but alternatively, the gate electrode **204** may be disposed below the active layer **202**.

The thin-film transistor TFT is electrically coupled to the organic light-emitting device OLED to drive the organic light-emitting device OLED and is covered and protected by the passivation layer **208**.

The passivation layer **208** may be an organic insulating film. Impurities may be generated in and/or may be present in the passivation layer **208**. The impurities may be, for example, remaining moisture generated during operations (e.g., during manufacture).

The passivation layer **208** may be formed on the insulating layer **20**. The passivation layer **208** may be formed on the interlayer insulating film **205**. The passivation layer **208** may cover a part of the signal wiring **300**.

A first opening H**1** (e.g., a first hole) may be formed in the passivation layer **208**. The first opening H**1** may be formed at the outer region. The first opening H**1** may have a valley shape. By forming the first opening H**1**, impurities generated in and/or present in the passivation layer **208** formed outside the first opening H**1** or generated in and/or present in the passivation layer **208** formed at the outer region (e.g., a portion of the passivation layer **208** at a side of the first opening H**1** opposite to the active area AA) may be prevented from being transmitted to (e.g., from migrating to) the active area AA. Accordingly, a pixel shrinkage phenomenon may be prevented, thereby increasing a lifespan and reliability of the organic light-emitting display apparatus **1**.

The metal layer **400** may be formed on the passivation layer **208**. The metal layer **400** may contact the second electrode **215**. The metal layer **400** may contact the signal wiring **300**. When the metal layer **400** contacts the signal wiring **300**, the second electrode **215** and the signal wiring **300** may be electrically coupled to each other. The metal layer **400** may be formed of the same material as a first electrode **211** and during the same act or process.

The metal layer **400** may contact the insulating layer **20** through the first opening H**1**. The metal layer **400** may contact the interlayer insulating film **205** through the first opening H**1**. Accordingly, the passivation layer **208** may be separated (e.g., separated into two portions) by the first opening H**1** (e.g., the first opening H**1** may extend across the entire passivation layer **208**).

A second opening H**2** (e.g., a second hole) may be formed in the metal layer **400**. The second opening H**2** may be formed outside the second electrode **215**. A plurality of second openings H**2** may be formed. The impurities generated in the passivation layer **208** below the metal layer **400** are discharged through (e.g., emitted through) the second opening H**2** and thus, are prevented from being transmitted into (e.g., migrating to) the active area AA. Accordingly, a pixel shrinkage phenomenon is reduced or prevented, thereby increasing the lifespan and reliability of the organic light-emitting display apparatus **1**.

The organic light-emitting device OLED is formed on the passivation layer **208**, and the organic light-emitting device OLED may include the first electrode **211**, an intermediate layer **214**, and the second electrode **215**.

The first electrode **211** is formed on the passivation layer **208**. For example, the passivation layer **208** does not cover the entire drain electrode **207** but exposes a region (e.g., a predetermined region) of the drain electrode **207**, and the first electrode **211** may be formed to be coupled (e.g., connected) to the exposed region of the drain electrode **207**.

In the current embodiment, the first electrode **211** may be a reflective electrode.

The second electrode **215**, disposed to face the first electrode **211**, may be a transparent or semi-transparent electrode.

Accordingly, the second electrode **215** may allow light emitted from an organic emission layer included in the intermediate layer **214** to penetrate therethrough. For example, the light emitted from the organic emission layer may be reflected at or by the first electrode **211** that is a reflective electrode and be transmitted towards the second electrode **215** or may be directly discharged or emitted towards the second electrode **215**.

However, the organic light-emitting display apparatus **1** according to the current embodiment is not limited to a top emission apparatus but may be a bottom emission apparatus wherein the light emitted from the organic emission layer is discharged or emitted towards the first substrate **101**. In this case, the first electrode **211** may be a transparent or semi-transparent electrode, and the second electrode **215** may be a reflective electrode. Alternatively, the organic light-emitting display apparatus **1** may be a dual emission apparatus wherein the light is discharged or emitted in two directions, towards both front and rear surfaces thereof.

A pixel-defining film **213** is formed of an insulating material and on the first electrode **211**.

The pixel-defining film **213** may cover a part of the metal layer **400**. The pixel-defining film **213** may cover a part of the first electrode **211**. The first opening H**1**, formed in the passivation layer **208**, may be formed outside the pixel-defining film **213**. The pixel-defining film **213** may contact the passivation layer **208** therebelow. In this embodiment, the pixel-defining film **213** may contact the passivation layer **208** formed at a side of the first opening H**1** closer to the active area AA. Accordingly, the impurities generated in and/or present in the passivation layer **208** formed outside the first opening H**1** (e.g., at a portion of the passivation layer **208** at a side of the first opening H**1** opposite to the active area AA) may be prevented from being transmitted to (e.g., migrating to) the active area AA through the pixel-defining film **213**.

The second electrode **215** may be electrically coupled to the signal wiring **300** through the metal layer **400**.

The pixel-defining film **213** exposes a region (e.g., a predetermined region) of the first electrode **211**, and the intermediate layer **214** is disposed on the exposed region of the first electrode **211**.

The intermediate layer **214** includes the organic emission layer. Alternatively, the intermediate layer **214** may include the organic emission layer and may further include at least one of a hole injection layer (HIL), a hole transport layer (HTL), an electron transport layer (ETL), and/or an electron injection layer (EIL). However, the current embodiment is not limited thereto, and the intermediate layer **214** may include the organic emission layer and may further include other various functional layers.

A built-in circuit unit **600** may be formed below the passivation layer **208**. The built-in circuit unit **600** may be formed at the outer region. The built-in circuit unit **600** may be formed of a plurality of thin-film transistors TFT.

A second substrate **102** is disposed on or above the second electrode **215**. The second substrate **102** may be a flexible substrate and may be formed of plastic having excellent thermal resistance and excellent durability. However, the second substrate **102** may be formed of any of various materials, such as metal or glass.

A sealant **500** is disposed between the first and second substrates **101** and **102** (e.g., the sealant **500** may extend between corresponding portions of the first and second substrates **101** and **102**). The sealant **500** may be formed on the insulating layer **20**. The sealant **500** couples (e.g., combines) the first and second substrates **101** and **102** to each other. The sealant **500** may be formed at the outer region. The sealant **500** may include frit. The sealant **500** operates as a shielding film (e.g., an important shielding film) for preventing an organic material of the organic light-emitting device OLED from being deformed due to impurities, such as external oxygen and moisture.

The first opening H**1** and the second opening H**2** will now be described in further detail with reference to FIG. **3**.

Referring to FIG. **3**, the metal layer **400** may be formed on the passivation layer **208**. The second opening H**2** may be formed in the metal layer **400**. The second opening H**2** may be formed outside an end line CE of the second electrode **215**. In this embodiment, the plurality of second openings H**2** may be formed (e.g., the plurality of second openings may be arranged parallel to the end line CE and may be arranged at an interval). When the second opening H**2** is formed, the impurities generated in and/or present in the passivation layer **208** may be discharged through (e.g., emitted through) the second opening H**2**. Accordingly, the impurities may be prevented from being transmitted to the active area AA, thereby increasing the lifespan of the organic light-emitting display apparatus **1**.

The first opening H**1** may be formed in the passivation layer **208**. The first opening H**1** may have a valley shape. The passivation layer **208** may have a structure separated by the first opening H**1** (e.g., the passivation layer **208** may be two portions thereof separated by the first opening H**1**), and the impurities generated in the passivation layer **208** outside the first opening H**1** are prevented from penetrating into the organic light-emitting device OLED along or through the pixel-defining film **213** due to the separated structure, thereby increasing the lifespan of the organic light-emitting display apparatus **1**. Also, because the metal layer **400** and the insulating layer **20** contact each other at the first opening H**1**, the passivation layer **208** may have a further sealed and/or separated structure.

As described above, according to one or more of the above embodiments of the present invention, a pixel shrinkage phenomenon may be prevented, thereby increasing a lifespan and reliability of an organic light-emitting display apparatus.

While one or more embodiments of the present invention have been described with reference to the figures, 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;

an inorganic insulating layer on the substrate;

an organic insulating layer on the inorganic insulating layer and comprising a first opening exposing an upper surface of the inorganic insulating layer, the inorganic insulating layer extending under the first opening;

an organic light-emitting device on the organic insulating layer, the organic light-emitting device defining an active area and comprising a first electrode, a second electrode, and an intermediate layer between the first and second electrodes;

a pixel-defining film covering a part of the first electrode on the organic insulating layer; and

a metal layer on the organic insulating layer at an outer region adjacent to the active area and extending beyond an outer edge of the pixel-defining film in a direction away from the active area toward the outer region, the metal layer contacting the inorganic insulating layer at the first opening,

wherein the second electrode and the metal layer are in contact with each other at an area outside of the first opening with respect to the organic light-emitting device.

2. The organic light-emitting display apparatus of claim **1**, wherein the metal layer comprises a second opening exposing the organic insulating layer.

3. The organic light-emitting display apparatus of claim **2**, wherein the second opening is exposed by the second electrode.

4. The organic light-emitting display apparatus of claim **1**, further comprising a thin film transistor between the substrate and the organic insulating layer,

wherein the organic insulating layer comprises a via opening, and the first electrode is connected with the thin film transistor through the via opening.

5. The organic light-emitting display apparatus of claim **1**, wherein the pixel-defining film covers a part of the metal layer on the organic insulating layer.

6. The organic light-emitting display apparatus of claim **5**, wherein the first opening is exposed by the pixel-defining film.

7. An organic light-emitting display apparatus comprising:

a substrate;

an inorganic insulating layer on the substrate;

an organic insulating layer on the inorganic insulating layer and comprising a first opening exposing an upper surface of the inorganic insulating layer, the inorganic insulating layer extending under the first opening;

an organic light-emitting device on the organic insulating layer, the organic light-emitting device defining an active area and comprising a first electrode, a second electrode, and an intermediate layer between the first and second electrodes; and

a metal layer on the organic insulating layer at an outer region adjacent to the active area, the metal layer contacting the inorganic insulating layer at the first opening,

wherein the metal layer and the first electrode are on the same layer and are separated from each other,

wherein an entire end of the metal layer closest to the first electrode is located on the upper surface of the organic insulation layer, and

wherein the second electrode and the metal layer contact each other at sidewalls of the first opening.

8. An organic light-emitting display apparatus comprising:

a substrate;

an inorganic insulating layer on the substrate;

a signal wiring on the inorganic insulating layer;

an organic insulating layer on the inorganic insulating layer and comprising a first opening exposing an upper surface of the inorganic insulating layer in the first opening and being offset from the signal wiring;

an organic light-emitting device on the organic insulating layer, the organic light-emitting device defining an active area and comprising a first electrode, a second electrode, and an intermediate layer between the first and second electrodes; and

a metal layer on the organic insulating layer at an outer region adjacent to the active area, the metal layer contacting the inorganic insulating layer at the first opening,

wherein the metal layer electrically connects the signal wiring and the second electrode to each other,

wherein the first opening in the organic insulating layer is between an edge of the signal wiring nearest the organic light-emitting device and the organic light-emitting device in a direction parallel to a surface of the substrate, and wherein the edge of the signal wiring contacts the organic insulating layer.

* * * * *

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摘要(译)

一种有机发光显示装置，包括：第一基板;第一基板上的绝缘层;绝缘层上的信号布线;第一基板上的有机发光装置，所述有机发光装置限定有源区，并包括第一电极，第二电极和位于所述第一和第二电极之间的中间层;绝缘层上的钝化层;钝化层上的与有源区相邻的外部区域上的金属层，与第一电极分离，并与第二电极和信号布线接触，其中第一开口位于外部区域的钝化层中，并且金属层在第一开口处接触绝缘层。