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

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H01L 51/52 (2006.01)

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(58) **Field of Classification Search**
CPC H01L 27/3276; H01L 27/3225
See application file for complete search history.

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(57) **ABSTRACT**

An organic light-emitting display apparatus includes a first substrate, a display unit that defines an active area on the first substrate, a second substrate on the display unit, a circuit pattern on outer sides of the active area on the first substrate, a sealant between the first substrate and the second substrate, the sealant adhering the first substrate to the second substrate and overlapping at least a part of the circuit pattern, and a detecting unit that overlaps the at least a part of the circuit pattern and detects whether the circuit pattern is damaged.

9 Claims, 6 Drawing Sheets

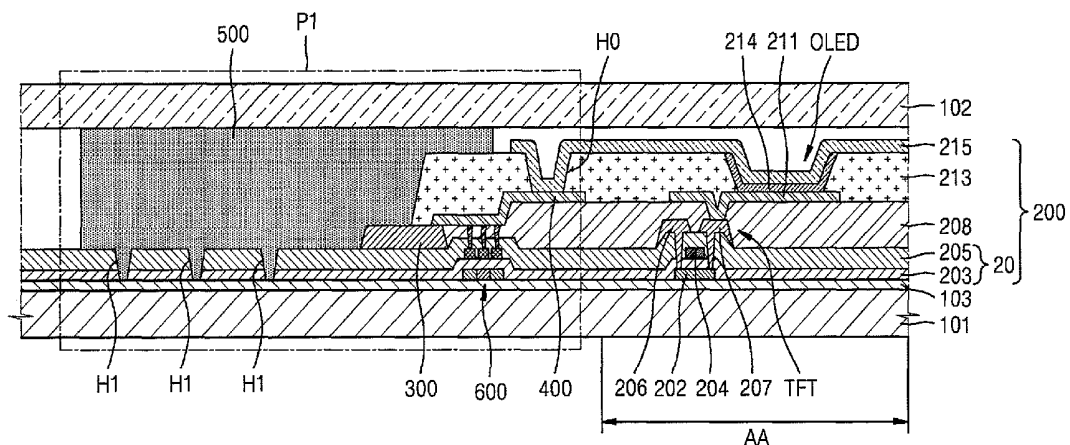


FIG. 1

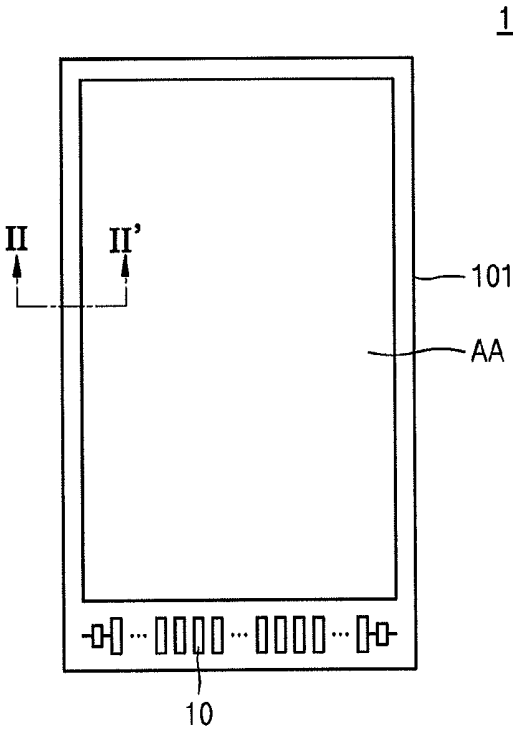


FIG. 2

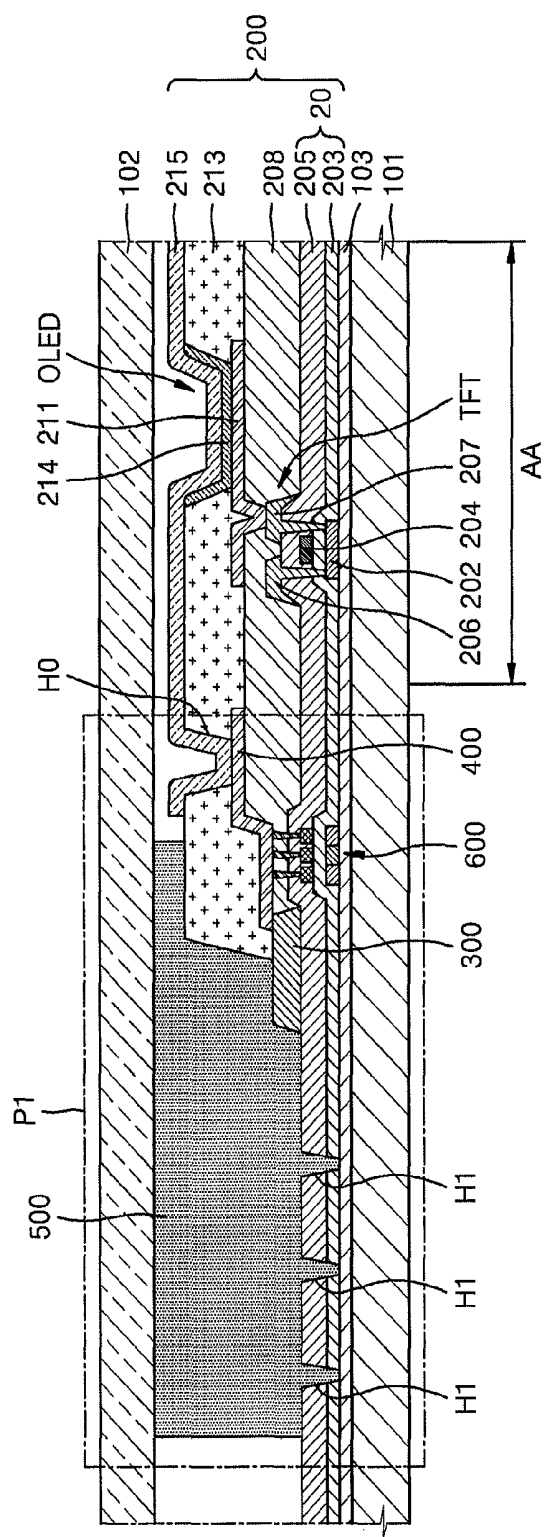


FIG. 3

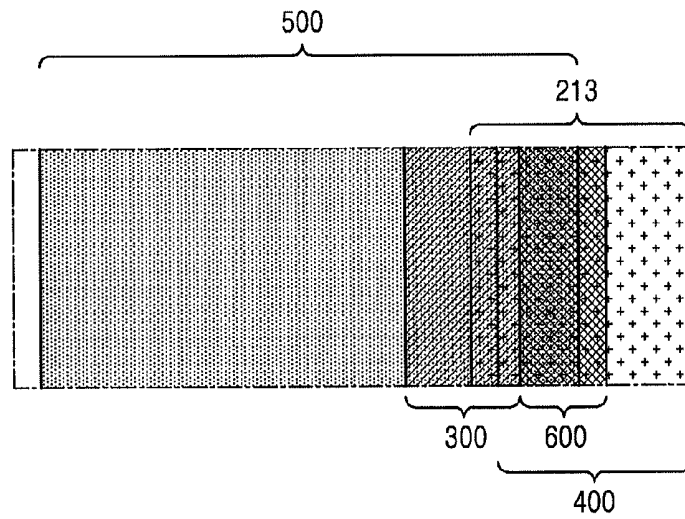


FIG. 4

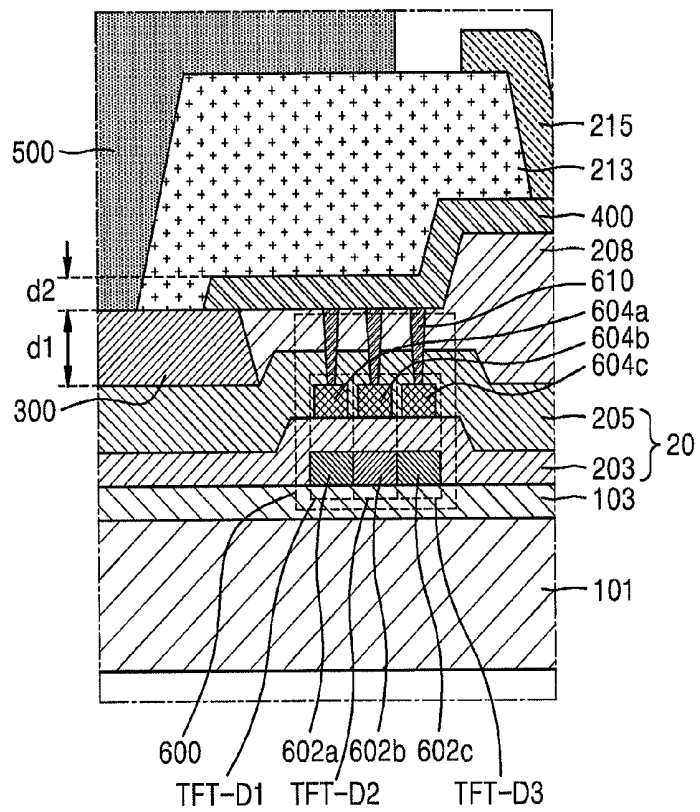


FIG. 5

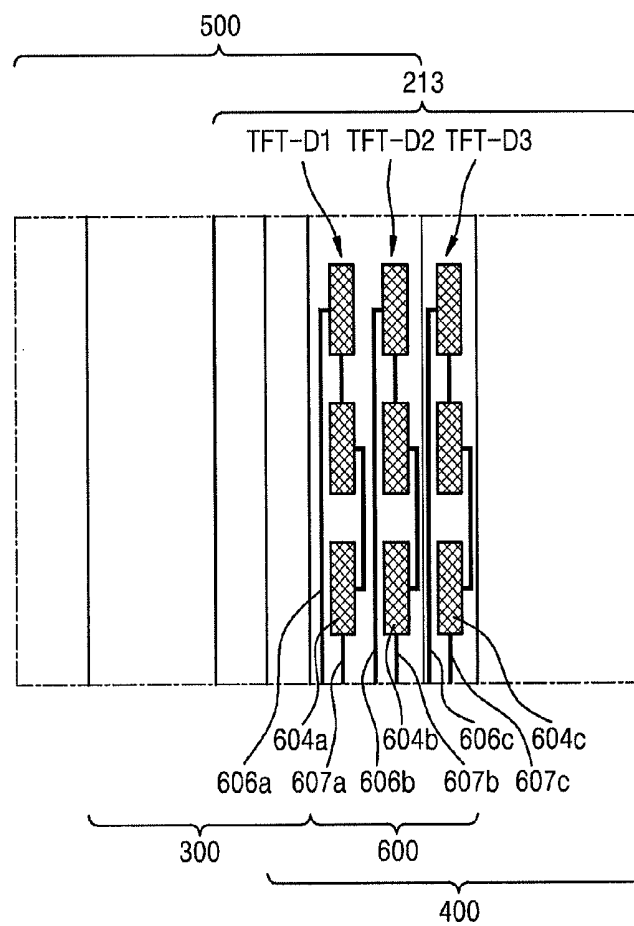


FIG. 6

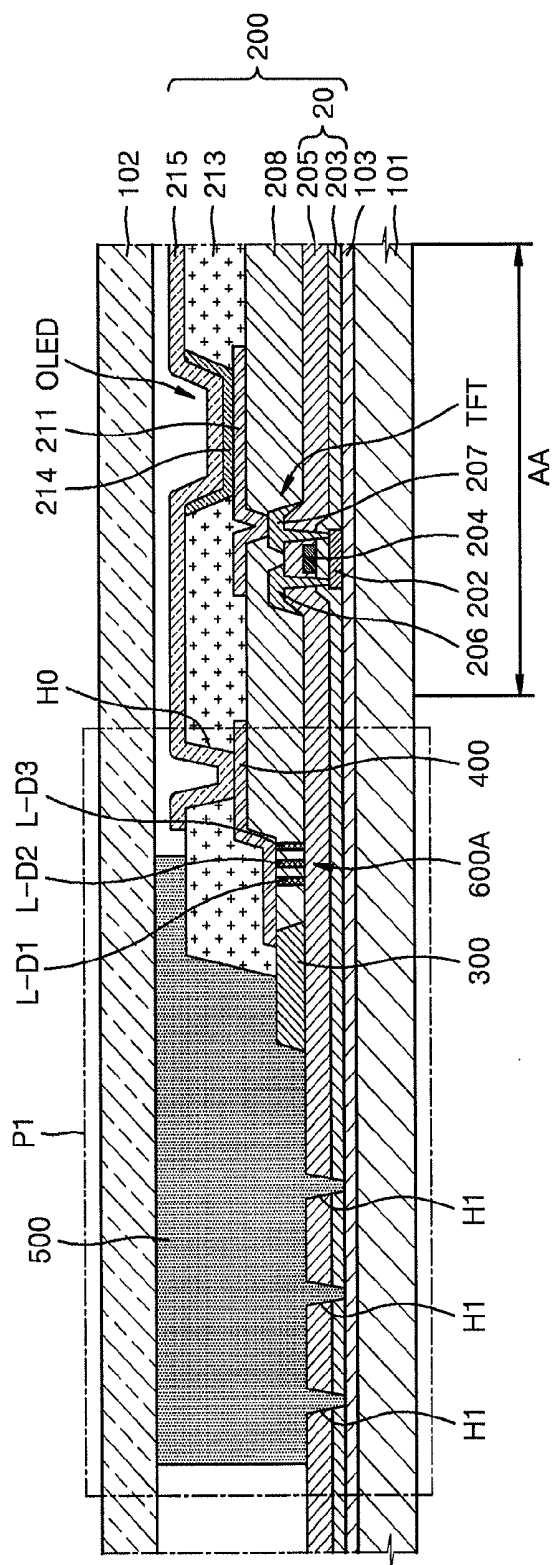
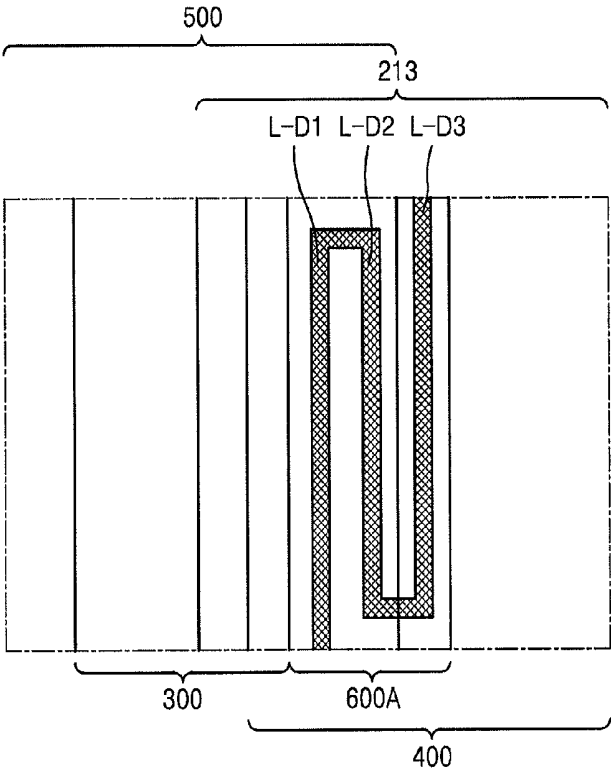


FIG. 7



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ORGANIC LIGHT-EMITTING DISPLAY APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

Korean Patent Application No. 10-2014-0141194, filed on Oct. 17, 2014, in the Korean Intellectual Property Office, and entitled: "Organic Light-Emitting Display Apparatus," is incorporated by reference herein in its entirety.

BACKGROUND

1. Field

Embodiments relate to an organic light-emitting display apparatus.

2. Description of the Related Art

In general, display devices such as an organic light-emitting display apparatus including a thin film transistor (TFT) may be used in mobile devices such as smartphones, tablet personal computers, ultra-slim laptops, digital cameras, video cameras, or portable information terminals and electronic/electric products such as ultra-thin televisions.

In an organic light-emitting display apparatus, sealing between an upper substrate and a lower substrate is needed to protect an organic light-emitting device from external factors. In this regard, a sealing member is applied between the upper and lower substrates, and the sealing member is hardened to adhere the upper and lower substrates to each other. Accordingly, the lifespan and reliability of a display device including the organic light-emitting display apparatus are dependent upon the adhesion degree between the upper and lower substrates.

SUMMARY

Embodiments are directed to an organic light-emitting display apparatus including a first substrate, a display unit that defines an active area on the first substrate, a second substrate on the display unit, a circuit pattern on outer sides of the active area on the first substrate, a sealant between the first substrate and the second substrate, the sealant adhering the first substrate to the second substrate and overlapping at least a part of the circuit pattern, and a detecting unit that overlaps the at least a part of the circuit pattern and detects whether the circuit pattern is damaged.

The circuit pattern may include a signal line and a connection line that electrically connects the signal line and the display unit.

The display unit may include a first electrode, a second electrode, and an intermediate layer between the first electrode and the second electrode. The signal line may be electrically connected to the second electrode via the connection line.

The sealant may overlap a part of the connection line.

At least a part of the detecting unit may be under an area where the connection line overlaps the sealant. The detecting unit may be electrically connected to the connection line. The detecting unit may detect whether the connection line is damaged.

The detecting unit may include a plurality of thin film transistors that are respectively electrically connected to a plurality of points of the connection line.

The detecting unit may include a plurality of lines that respectively contact a plurality of points on the connection line.

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The connection line and the signal line may be positioned on different layers from each other. At least a part of the connection line may overlap the signal line.

The organic light-emitting display apparatus may further include an insulating layer between the sealant and the signal line.

A thickness of the connection line may be in a range of about 10% to about 30% of a thickness of the signal line.

The connection line may be formed of a same material as the first electrode.

BRIEF DESCRIPTION OF THE DRAWINGS

Features will become apparent to those of skill in the art by describing in detail exemplary embodiments with reference to the attached drawings in which:

FIG. 1 illustrates a schematic plan view depicting an organic light-emitting display apparatus according to an embodiment;

FIG. 2 illustrates a cross-sectional view of the organic light-emitting display apparatus taken along the line II-II' in FIG. 1;

FIG. 3 illustrates a plan view of the part P1 in FIG. 2;

FIG. 4 illustrates a cross-sectional view of an enlarged part of FIG. 2;

FIG. 5 illustrates a plan view schematically depicting a detecting unit in FIG. 4;

FIG. 6 illustrates a cross-sectional view schematically depicting a part of an organic light-emitting display apparatus according to another embodiment; and

FIG. 7 illustrates a plan view schematically depicting a detecting unit in FIG. 6.

DETAILED DESCRIPTION

Example embodiments will now be described more fully hereinafter with reference to the accompanying drawings; however, they may 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 exemplary implementations to those skilled in the art.

In the drawing figures, the dimensions of layers and regions may be exaggerated for clarity of illustration. Like reference numerals refer to like elements throughout. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items. 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. It will be understood that although the terms "first," "second," etc. may be used herein to describe various components, these components should not be limited by these terms. These components are only used to distinguish one component from another.

As used herein, the singular forms "a," "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise.

FIG. 1 illustrates a schematic plan view of an organic light-emitting display apparatus 1 according to an embodiment. FIG. 2 illustrates a cross-sectional view of the organic light-emitting display apparatus 1 taken along the line II-II' in FIG. 1; and FIG. 3 is a plan view of the part P1 in FIG. 2.

Referring to FIGS. 1 and 2, the organic light-emitting display apparatus 1 according to an embodiment includes a

first substrate **101**, a display unit **200** that defines an active area AA on the first substrate **101**, a signal line **300** and a connection line **400** (collectively referred to as “circuit pattern **300** and **400**”) formed on outer sides of the active area AA, a second substrate **102** disposed on the display unit **200**, a sealant **500** adhering the first substrate **101** and the second substrate **102**, and a detector **600** that detects damage to the circuit pattern **300** and **400**.

The first substrate **101** may be a glass substrate having rigidity, a polymer substrate, a film having flexibility, a metal substrate, or a composite substrate thereof. In some embodiments, the first substrate **101** may be a bendable substrate and may be formed of plastic with excellent heat-resistance and durability.

The display unit **200** defines the active area AA on the first substrate **101**. The display unit **200** includes a thin film transistor TFT and an organic light-emitting device OLED that are electrically connected to each other. Pad units **10** are disposed on outer sides of the active area AA. The pad units **10** may transmit an electrical signal received from a power supply device (not shown) or a signal generating device (not shown) to the active area AA.

Hereinafter, the display unit **200** is described in detail by referring to FIG. 2.

A buffer layer **103** may be disposed on the first substrate **101**. The buffer layer **103** may be disposed on the whole surface of the first substrate **101**, for example, on both the active area AA and the outer sides of the active area AA. The buffer layer **103** may prevent penetration of impurity elements through the first substrate **101** and may provide a flat surface on the first substrate **101**. A suitable material for preventing or hindering such penetration of impurity elements may be used to form the buffer layer **103**.

An insulating layer **20** may be disposed on the first substrate **101**. The insulating layer **20** may include a gate insulating layer **203** and an interlayer insulating layer **205**.

The thin film transistor TFT may be disposed on the buffer layer **103**. 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 includes a source area, a drain area, and a channel area.

The gate insulating layer **203** may be disposed on the active layer **202**. The gate insulating layer **203** may be disposed to correspond to the whole area of the first substrate **101**. For example, the gate insulating layer **203** may be disposed to correspond to both the active area AA and the outer sides of the active area AA on the first substrate **101**. The gate insulating layer **203** may be disposed on the first substrate **101** to insulate the active layer **202** from the gate electrode **204**. The gate insulating layer **203** may be formed of an organic material or an inorganic material such as SiN_x or SiO_2 .

The gate electrode **204** may be disposed on the gate insulating layer **203**. The gate electrode **204** may be formed of a suitable material in consideration of its design conditions. For example, the gate electrode **204** may contain Au, Ag, Cu, Ni, Pt, Pd, Al, Mo, or an alloy such as an Al—Nd alloy or a Mo—W alloy.

The interlayer insulating layer **205** may be disposed on the gate electrode **204**. The interlayer insulating layer **205** may be disposed to correspond to the whole area of the first substrate **101**. For example, the interlayer insulating layer

205 may be disposed to correspond to both the active area AA and the outer sides of the active area AA on the first substrate **101**.

The interlayer insulating layer **205** may be disposed between the gate electrode **204** and the source electrode **206** and between the gate electrode **204** and the drain electrode **207** for insulation therebetween. The interlayer insulating layer **205** may be formed of an inorganic material such as SiN_x or SiO_2 .

The circuit pattern **300** and **400** may be disposed on the outer sides of the active area AA and include a signal line **300** and a connection line **400**, which electrically connects the signal line **300** to the display unit **200**. A thickness of the connection line **400** may be about 10% to about 30% of a thickness of the signal line **300**.

The signal line **300** may be disposed on the interlayer insulating layer **205**. The signal line **300** may be disposed on the outer sides of the active area AA. The signal line **300** may be electrically connected to a second electrode **215** via the connection line **400** and thus may transmit a signal to the second electrode **215**.

The signal line **300** may be a cathode power line (ELVSS). When the signal line **300** is a cathode power line (ELVSS), the cathode power line (ELVSS) may be connected to a cathode power source having a voltage that is lower than a common power voltage, for example, a ground voltage or a negative (−) voltage. The signal line **300** may be formed in the same manner and with the same material as is used in formation of the source electrode **206** or the drain electrode **207**. For example, the signal line **300** may have a structure in which a Ti layer, an Al layer, and a Ti layer are stacked.

A first hole H1 may be formed in the insulating layer **20**. The first hole H1 may be formed in the outer sides of the active area AA. A plurality of the first holes H1 may be formed in the insulating layer **20**. The first holes H1 may be formed in the insulating layer **20** and a sealant **500** may be formed on the insulating layer **20** by filling the first holes H1. Accordingly, a contact area of the sealant **500** and the insulating layer **20** may be increased, and an adhesive strength between the first substrate **101** and the second substrate **102** may be increased.

The source electrode **206** and the drain electrode **207** may be disposed on the interlayer insulating layer **205**. The interlayer insulating layer **205** and the gate insulating layer **203** may be formed as to expose the source area and the drain area of the active layer **202**. The source electrode **206** and the drain electrode **207** may be formed as to contact the exposed source and drain areas of the active layer **202**.

FIG. 2 illustrates the thin film transistor TFT as being a top gate type that includes the active layer **202**, the gate electrode **204**, and the source and drain electrodes **206** and **207** that are sequentially stacked in the stated order. In other implementations, the gate electrode **204** may be disposed under the active layer **202**.

The thin film transistor TFT may be electrically connected to the organic light-emitting device OLED to operate the organic light-emitting device OLED. The TFT may be covered by a passivation layer **208** to be protected from the external environment.

The passivation layer **208** may be an inorganic insulating layer and/or an organic insulating layer.

The connection line **400** may be disposed on the passivation layer **208**. The connection line **400** may contact the signal line **300** such that the second electrode **215** and the signal line **300** are electrically connected. The connection line **400** may be formed in the same manner and with the

same material as is used in formation of the first electrode **211**. For example, the connection line **400** may have a stack structure of ITO layer/Ag layer/ITO layer.

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

The first electrode **211** may be disposed on the passivation layer **208**. For example, the passivation layer **208** may be formed to expose a predetermined area of the drain electrode **207** and not to cover the whole surface of the drain electrode **207**, and the first electrode **211** may be formed to contact the exposed area of the drain electrode **207**.

The first electrode **211** may be a reflective electrode. For example, the first electrode **211** may have a stack structure of ITO layer/Ag layer/ITO layer.

The second electrode **215** disposed opposite to the first electrode **211** may be a transparent electrode or a semitransparent electrode.

The second electrode **215** may transmit light emitted from an organic light-emitting layer included in the intermediate layer **214**. For example, the organic light-emitting display apparatus **1** may be a top-emitting type in which light emitted from the organic light-emitting layer is directly reflected or reflected by the first electrode **211** formed of a reflective electrode and is emitted in a direction toward the second electrode **215**.

In other implementations, the organic light-emitting display apparatus **1** may be a bottom-emission type, in which light emitted from the organic light-emitting layer is emitted in a direction toward the first substrate **101**. In this case, the first electrode **211** may be a transparent electrode or a semitransparent electrode, and the second electrode **215** may be a reflective electrode. Also, the organic light-emitting display apparatus **1** may be a both sides emission type, in which light is emitted in both directions toward the top and bottom of the organic light-emitting display apparatus **1**.

A pixel defining layer **213** is disposed on the first electrode **211**. The pixel defining layer **213** may be an insulating layer that includes an insulating material.

The pixel defining layer **213** may be disposed on the signal line **300**. The pixel defining layer **213** may cover the connection line **400**. A contact hole H0 may be formed in the pixel defining layer **213**. The second electrode **215** may be disposed on the pixel defining layer **213** and may contact the connection line **400** via the contact hole H0. The second electrode **215** may be electrically connected to the signal line **300** through the connection line **400**.

The pixel defining layer **213** may expose a predetermined area of the first electrode **211**. The intermediate layer **214** may be disposed on the exposed area of the first electrode **211**.

The intermediate layer **214** may include an organic light-emitting layer. In some implementations, the intermediate layer **214** may include an organic light-emitting layer and may further include one or more functional layers in addition to the organic light-emitting layer. For example, the intermediate layer **214** may include an organic light-emitting layer (an 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 an electron injection layer (EIL) in addition to the organic light-emitting layer.

The second substrate **102** may be disposed on the second electrode **215**. The second substrate **102** may be formed of a suitable material, such as metal or glass. In some implementations, the second substrate **102** may be a flexible or

bendable substrate and may be formed of plastic having excellent heat-resistance and durability.

The sealant **500** may be disposed between the first substrate **101** and the second substrate **102**. The sealant **500** may adhere to or attach the first substrate **101** and the second substrate **102**. The sealant **500** may be formed on the outer sides of the active area AA. The sealant **500** may include a glass frit. The sealant **500** may serve as a main blocking layer that protects an organic material of the display unit **200** from impurities, such as oxygen and moisture from the outside.

The sealant **500** may be disposed on the insulating layer **20**. The sealant **500** may be formed while filling the first holes H1 in the insulating layer **20**, which may improve the adhesive strength between the first substrate **101** and the second substrate **102**.

The sealant **500** may cover at least a part of the circuit pattern **300** and **400**. For example, a formation area of the sealant **500** may extend to an area where the circuit pattern **300** and **400** is formed such that adhesive strength between the first substrate **101** and the second substrate **102** may be improved.

Hereinafter, the formation area of the sealant **500** is described in detail by referring to FIG. 3.

Referring to FIGS. 2 and 3, the sealant **500** may overlap the signal line **300** and at least a part of the connection line **400**. A part of the signal line **300** may be overlapped by a part of the connection line **400** such that the signal line **300** contacts the connection line **400**. The connection line **400** may be covered by the pixel defining layer **213**.

The sealant **500** may cover at least a part of the signal line **300** and may be formed to cover a part of the pixel defining layer **213**, which covers the connection line **400**. The sealant **500** may contact the signal line **300**. As described above, when the formation area of the sealant **500** is increased so as to overlap the circuit pattern **300** and **400**, adhesive strength between the first substrate **101** and the second substrate **102** may be improved, and thus apparatus reliability may be improved.

However, when the formation area of the sealant is extended to overlap the circuit pattern **300** and **400**, there is a possibility that damage could occur to the circuit pattern **300** and **400** due to heat applied to the sealant **500** or by the heated sealant **500** during a process of forming the sealant **500**.

In order to adhere the first substrate **101** and the second substrate **102** by using the sealant **500**, the sealant **500** may be melted and cured. A laser may be directed to the sealant **500** to melt the sealant **500**. When heating of the sealant **500** is performed by using a laser, the sealant **500** may be heated up to a temperature of about 650° C. There is a possibility that the circuit pattern **300** and **400** adjacent to the sealant **500** could be damaged due to the heated sealant **500**.

In the current embodiment, the organic light-emitting display apparatus **1** includes a detecting unit **600** that overlaps at least a part of the circuit pattern **300** and **400** and detects damage to the circuit pattern **300** and **400**. A range within which the sealant **500** may overlap the circuit pattern **300** and **400** without damaging the circuit pattern **300** and **400** may be calculated using the detecting unit **600**.

FIG. 4 illustrates a cross-sectional view that is an enlarged view of a portion of FIG. 2. FIG. 5 illustrates a plan view schematically depicting the detecting unit **600** shown in FIG. 4. In FIG. 5, although gate electrodes **604a**, **604b**, and **604c** and source/drain electrodes **606a**, **606b**, and **606c**/**607a**, **607b**, and **607c** appear to be connected, this is only because of the plan view perspective. It is to be understood

that the gate electrodes **604a**, **604b**, and **604c** and source/drain electrodes **606a**, **606b**, and **606c/607a**, **607b**, and **607c** are electrically insulated. Referring to FIGS. 4 and 5, an example of the detecting unit **600** according to an embodiment is described in detail.

A thickness of the connection line **400** may be thinner than that of the signal line **300**. For example, a thickness of the connection line **400** (d2) may be in a range of about 10% to about 30% of a thickness of the signal line **300** (d1). Compared to the signal line **300**, the relatively thin connection line **400** may be easily damaged when the connection line **400** is overlapped by the sealant **500**. Even when the pixel defining layer **213**, which is an insulating layer, is disposed between the connection line **400** and the sealant **500**, the connection line **400** may be easily damaged compared to the signal line **300** due to heat transferred by the pixel defining layer **213**.

The sealant **500** may be formed to overlap a part of the connection line **400**. At least a part of the detecting unit **600** may be disposed under an area where the connection line **400** overlaps the sealant **500**.

The detecting unit **600** may be electrically connected with the connection line **400** and may detect whether the connection line **400** is damaged. The detecting unit **600** may be electrically connected to the connection line **400** via metal rods **610**.

When the connection line **400** is damaged, for example, when the connection line **400** is detached from the signal line **300** or when a part of the connection line **400** is disconnected, a voltage applied to the signal line **300** may not be transferred to the connection line **400** in a normal manner. In this regard, the detecting unit **600** electrically connected to the connection line **400** may detect different signals depending on whether the connection line **400** is damaged or is not damaged. The detecting unit **600** may detect whether the connection line **400** is damaged.

For example, the detecting unit **600** may include a plurality of thin film transistors TFT-D1, TFT-D2, and TFT-D3 that electrically contact a plurality of points of the connection line **400**, respectively.

The plurality of thin film transistors TFT-D1, TFT-D2, and TFT-D3 may include an active layer **602a**, **602b**, and **602c**, the gate electrodes **604a**, **604b**, and **604c**, the source electrodes **606a**, **606b**, and **606c**, and the drain electrodes **607a**, **607b**, and **607c**.

The gate electrodes **604a**, **604b**, and **604c** of the plurality of thin film transistors TFT-D1, TFT-D2, and TFT-D3 may be separated from each other and may be electrically connected to the plurality of points of the connection line **400** via the metal rods **610**.

A voltage of each of the drain electrodes **607a**, **607b**, and **607c** of the plurality of thin film transistor TFT-D1, TFT-D2, and TFT-D3 which are electrically in contact with the plurality of points of the connection line **400** may be measured, and thus, whether the connection line **400** electrically connected to the gate electrodes **604a**, **604b**, and **604c** is damaged may be detected. When damage of the connection line **400** is detected, a location of the damage may be detected.

When the connection line **400** is damaged by heating of the sealant **500**, the damage may occur at various locations. For example, a part of the connection line **400** in contact with the signal line **300** may be damaged, and thus the connection line **400** and the signal line **300** may be detached. As another example, the connection line **400** may be dis-

connected due to damage to the connection line **400** at a location other than the part in contact with the signal line **300**.

When the connection line **400** and the signal line **300** are detached, a voltage applied from the signal line **300**, for example, a negative (−) voltage, may not be delivered to the gate electrodes **604a**, **604b**, and **604c**. Thus, a predetermined voltage may not be measured at the drain electrodes **607a**, **607b**, and **607c**. Accordingly, it may be determined that damage has occurred at the part where the connection line **400** contacts the signal line **300**.

When the connection line is damaged somewhere between a point where the connection line **400** is electrically connected to the thin film transistor TFT-D2 and a point where the connection line **400** is electrically connected to the thin film transistor TFT-D3, a voltage applied from the signal line **300**, for example, a negative (−) voltage, may be transferred to the gate electrodes **604a** and **604b**, but not to the gate electrode **604c**. Accordingly, a predetermined voltage may be detected in the drain electrode **607a** and **607b**, but the predetermined voltage may not be detected in the drain electrode **607c**. Accordingly, it may be determined that the connection line **400** is damaged somewhere between a point where the connection line **400** is electrically connected to the thin film transistor TFT-D2 and a point where the connection line **400** is electrically connected to the thin film transistor TFT-D3 is damaged.

When the connection line **400** is not damaged, a voltage applied from the signal line **300**, for example, a negative (−) voltage, may be transferred to the plurality of gate electrodes **604a**, **604b**, and **604c**, and thus a predetermined voltage may be measured from the plurality of drain electrodes **607a**, **607b**, and **607c**. Accordingly, it may be determined that the connection line **400** is not damaged.

As described above, the detecting unit **600** may be used when disposing the sealant **500** to overlap the connection line **400** to accurately confirm a region where the connection line **400** is not damaged by the sealant **500**. The adhering performance of the sealant **500** may be improved while avoiding damage the connection line **400**.

The embodiment described above is described based on an example of the pixel defining layer **213**, which is an insulating layer, being disposed between the connection line **400** and the sealant **500**. In some implementations, disposition of the pixel defining layer **213** between the connection line **400** and the sealant **500** may be omitted. For example, the connection line **400** may directly contact the sealant **500**. In this case, the detecting unit **600** may detect whether the connection line **400** is damaged or not in the same manner described above.

FIG. 6 illustrates a cross-sectional view schematically depicting a part of an organic light-emitting display apparatus **1** according to another embodiment, and FIG. 7 illustrates a plan view of a detecting unit shown in FIG. 6.

Hereinafter, the current embodiment is described based on differences with the previous embodiment of FIG. 4. Like reference numerals in FIG. 6 and FIG. 7 denote like elements in the previous FIG. 2 and FIG. 5.

Referring to FIG. 6, the organic light-emitting display apparatus **1** includes a first substrate **101**, a circuit pattern **300** and **400** formed on outer sides of a active area AA of a first substrate **101**, a second substrate **102** disposed on a display unit **200**, a sealant **500** that adheres the first substrate **101** and the second substrate **102**, and a detecting unit **600A** that detects whether the sealant **500** and the circuit pattern **300** and **400** are damaged.

The sealant **500** may include a glass frit. A laser may be directed to the sealant **500** to melt and cure the sealant **500**. The sealant **500** may serve as a main blocking layer that protects an organic material of the display unit **200** from impurities, such as oxygen and moisture from the outside.

The sealant **500** may overlap a part of the connection line **400**. By extending a formation area of the sealant **500** to an area where the connection line **400** is formed, adhesive strength between the first substrate **101** and the second substrate **102** may be improved.

The detecting unit **600A** detects whether the connection line **400** is damaged. At least part of the detecting unit **600A** is disposed under an area where the connection line **400** overlaps the sealant **500**.

The detecting unit **600A** may include a plurality of lines L-D1, L-D2, and L-D3 in contact with a plurality of points of the connection line **400**. The plurality of lines L-D1, L-D2, and L-D3 may be connected to one another as shown in FIG. 7. In other implementations, the plurality of lines L-D1, L-D2, and L-D3 may not be connected and may be separated from one another.

The plurality of lines may L-D1, L-D2, and L-D3 may be disconnected when the connection line **400** is disconnected due to damage. Accordingly, electrical signals detected from the plurality of lines L-D1, L-D2, and L-D3 may have, for example, different resistance values. For example, when the connection line **400** is not damaged, a predetermined resistance is detected from the plurality of lines L-D1, L-D2, and L-D3 in contact with the connection line **400**. In contrast, when the plurality of lines L-D1, L-D2, and L-D3 are disconnected as well due to damage to the connection line **400**, resistances of the plurality of lines L-D1, L-D2, and L-D3 may increase rapidly. Thus, whether the connection line **400** is damaged may be detected based on the resistance values of the plurality of lines L-D1, L-D2, and L-D3.

By way of summation and review, in an organic light-emitting display apparatus, sealing between an upper substrate and a lower substrate is desirable to protect an organic light-emitting device from external factors. A sealing member may be applied between the upper and lower substrates and hardened to adhere the upper and lower substrates to each other. The lifespan and reliability of a display device including the organic light-emitting display apparatus may be dependent upon the adhesion degree between the upper and lower substrates.

Embodiments provide an organic light-emitting display apparatus in which a sealing member having improved adhesive strength may be applied without damaging a circuit pattern.

According to embodiments, an organic light-emitting display apparatus may accurately detect an extended range of a sealant by using a detecting unit that detects whether a circuit pattern is damaged within the scope of not damaging the circuit pattern. Therefore, operation reliability of the organic light-emitting display apparatus may be improved as well as the adhesive strength between upper and lower substrates.

Example embodiments have been disclosed herein, and although specific terms are employed, they are used and are to be interpreted in a generic and descriptive sense only and not for purpose of limitation. In some instances, as would be apparent to one of ordinary skill in the art as of the filing of the present application, features, characteristics, and/or elements described in connection with a particular embodiment may be used singly or in combination with features, characteristics, and/or elements described in connection with

other embodiments unless otherwise specifically indicated. Accordingly, it will be understood by those of skill in the art that various changes in form and details may be made without departing from the spirit and scope thereof as set forth in the following claims.

What is claimed is:

1. An organic light-emitting display apparatus, comprising:

a first substrate;

a display unit that defines an active area on the first substrate;

a second substrate on the display unit;

a circuit pattern on outer sides of the active area on the first substrate;

a sealant between the first substrate and the second substrate, the sealant adhering the first substrate to the second substrate and overlapping at least a part of the circuit pattern; and

a detecting unit that overlaps at least a part of the circuit pattern and detects whether the circuit pattern is damaged,

wherein the detected unit includes a plurality of thin film transistor that are respectively electrically connected to a plurality of points of the connection line.

2. The organic light-emitting display apparatus as claimed in claim 1, wherein the circuit pattern includes:

a signal line; and

a connection line that electrically connects the signal line and the display unit.

3. The organic light-emitting display apparatus as claimed in claim 2, wherein:

the display unit includes:

a first electrode;

a second electrode; and

an intermediate layer between the first electrode and the second electrode, and

the signal line is electrically connected to the second electrode via the connection line.

4. The organic light-emitting display apparatus as claimed in claim 3, wherein the connection line is formed of a same material as the first electrode.

5. The organic light-emitting display apparatus as claimed in claim 2, wherein the sealant overlaps a part of the connection line.

6. The organic light-emitting display apparatus as claimed in claim 5, wherein:

at least a part of the detecting unit is under an area where the connection line overlaps the sealant, and

the detecting unit is electrically connected to the connection line and detects whether the connection line is damaged.

7. The organic light-emitting display apparatus as claimed in claim 2, wherein:

the connection line and the signal line are positioned on different layers from each other, and

at least a part of the connection line overlaps the signal line.

8. The organic light-emitting display apparatus as claimed in claim 2 further comprising an insulating layer between the sealant and the signal line.

9. The organic light-emitting display apparatus as claimed in claim 2, wherein a thickness of the connection line is in a range of about 10% to about 30% of a thickness of the signal line.

专利名称(译)	有机发光显示装置		
公开(公告)号	US9496320	公开(公告)日	2016-11-15
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[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DISPLAY CO. , LTD.		
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摘要(译)

一种有机发光显示装置，包括第一基板，在第一基板上限定有源区的显示单元，在显示单元上的第二基板，在第一基板上的有源区的外侧上的电路图案，密封剂在第一基板和第二基板之间，密封剂将第一基板粘附到第二基板并与电路图案的至少一部分重叠，以及检测单元，其与电路图案的至少一部分重叠并检测电路是否图案已损坏。

