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(54) **ORGANIC LIGHT-EMITTING DISPLAY APPARATUS AND METHOD OF MANUFACTURING THE SAME**

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USPC **257/40**; 438/23

(57) **ABSTRACT**

An OLED apparatus including a lower substrate including a display and peripheral area, the peripheral area surrounding the display area; a TFT on the lower substrate; a pixel electrode electrically connected to the TFT; a pixel defining layer covering an edge of the pixel electrode and exposing a central portion of the pixel electrode; an intermediate layer on the pixel electrode and including an emission layer; an opposite electrode overlying the pixel electrode; an upper substrate overlying the lower substrate; a sealing member on the peripheral area and attaching the lower substrate to the upper substrate; and a shock absorption member including a first layer on the peripheral area, the first layer being separated from the sealing member and stacked in a layer stack structure on the lower substrate; and a second layer on the first layer and including a same material as the pixel defining layer.

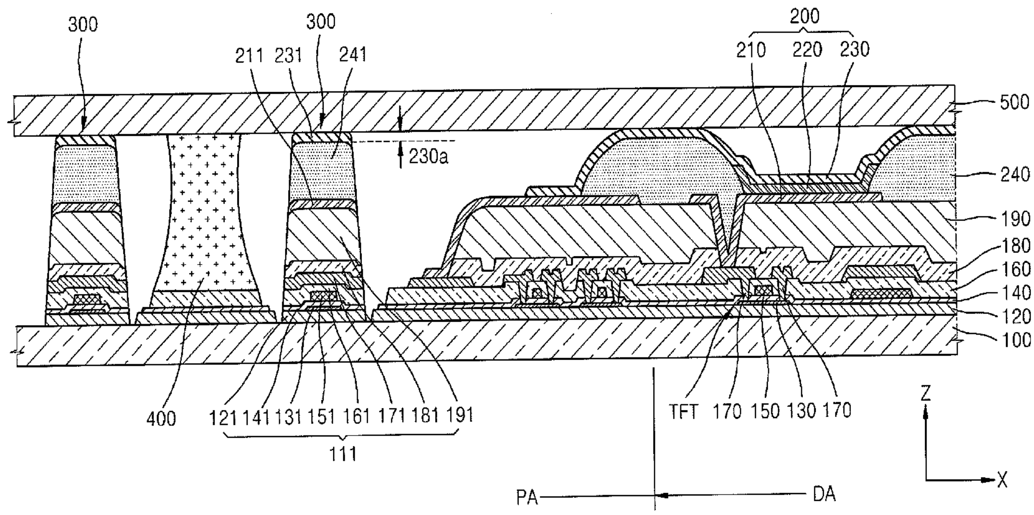
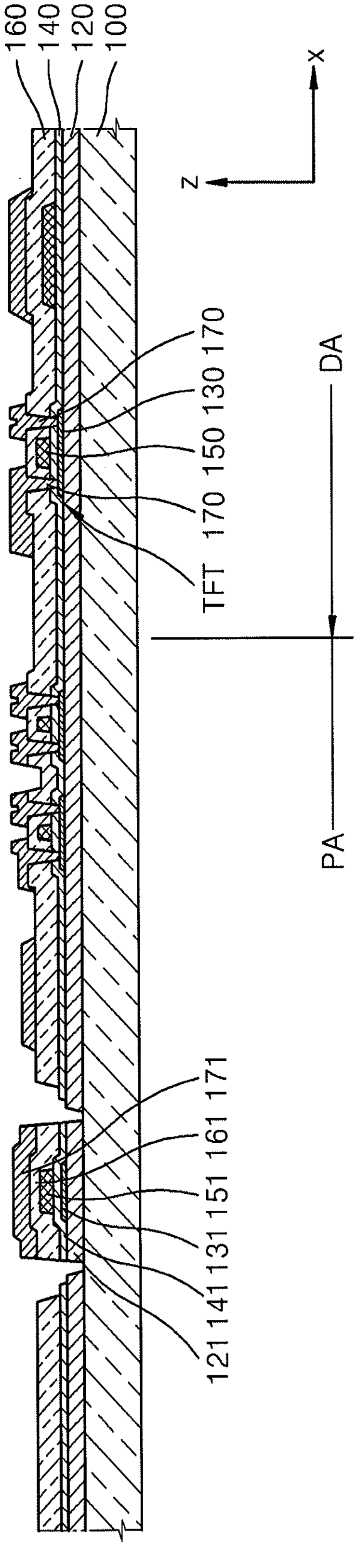


FIG. 1


160
140
120
100
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141
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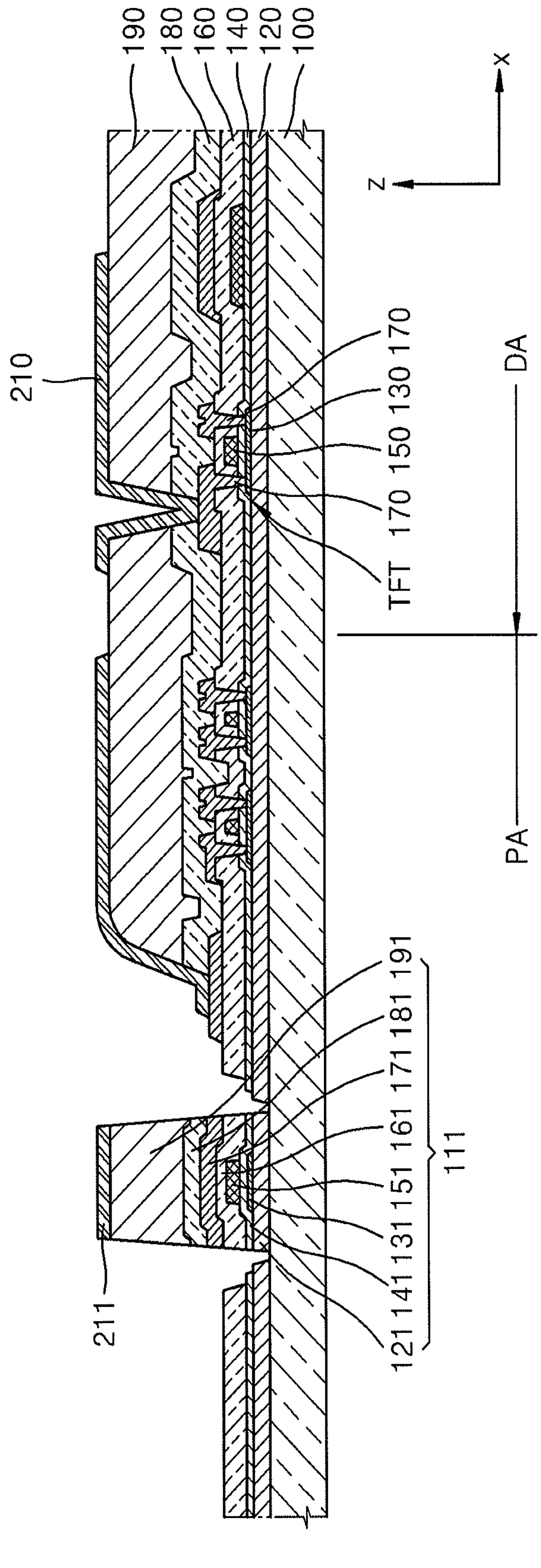
FIG. 2


190
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211

FIG. 3

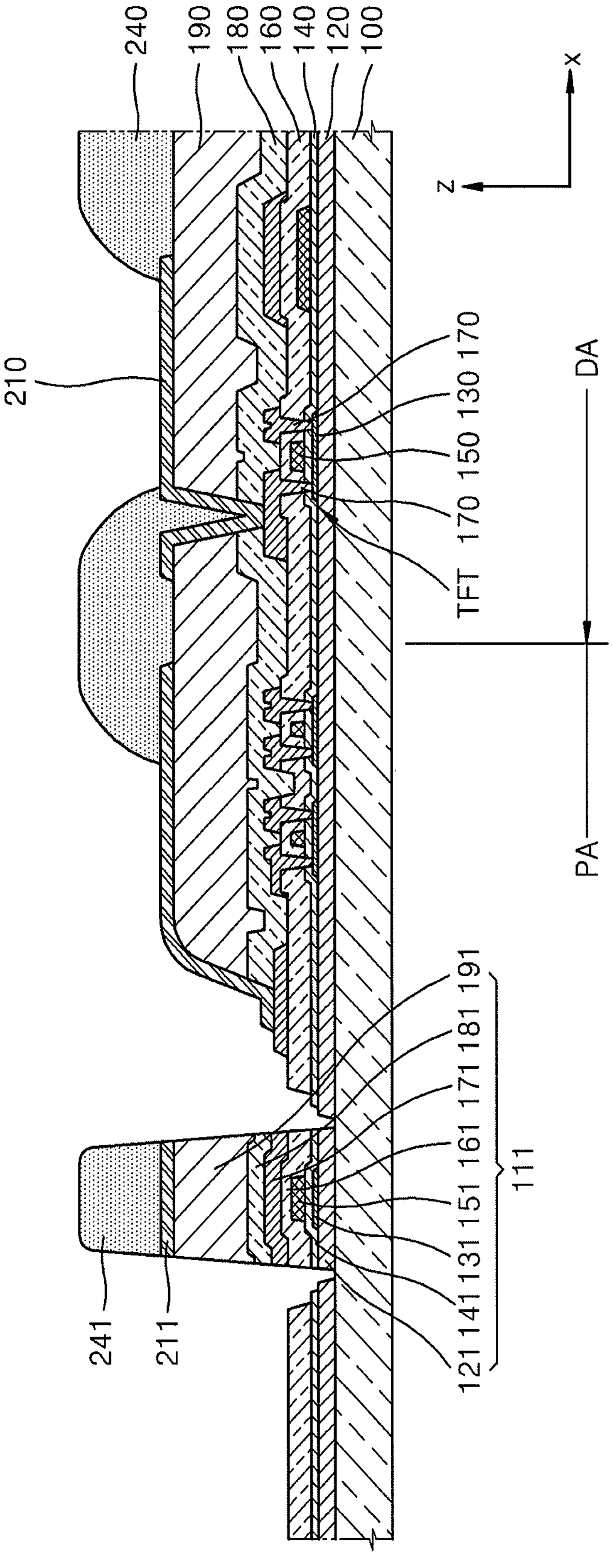
240
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FIG. 4

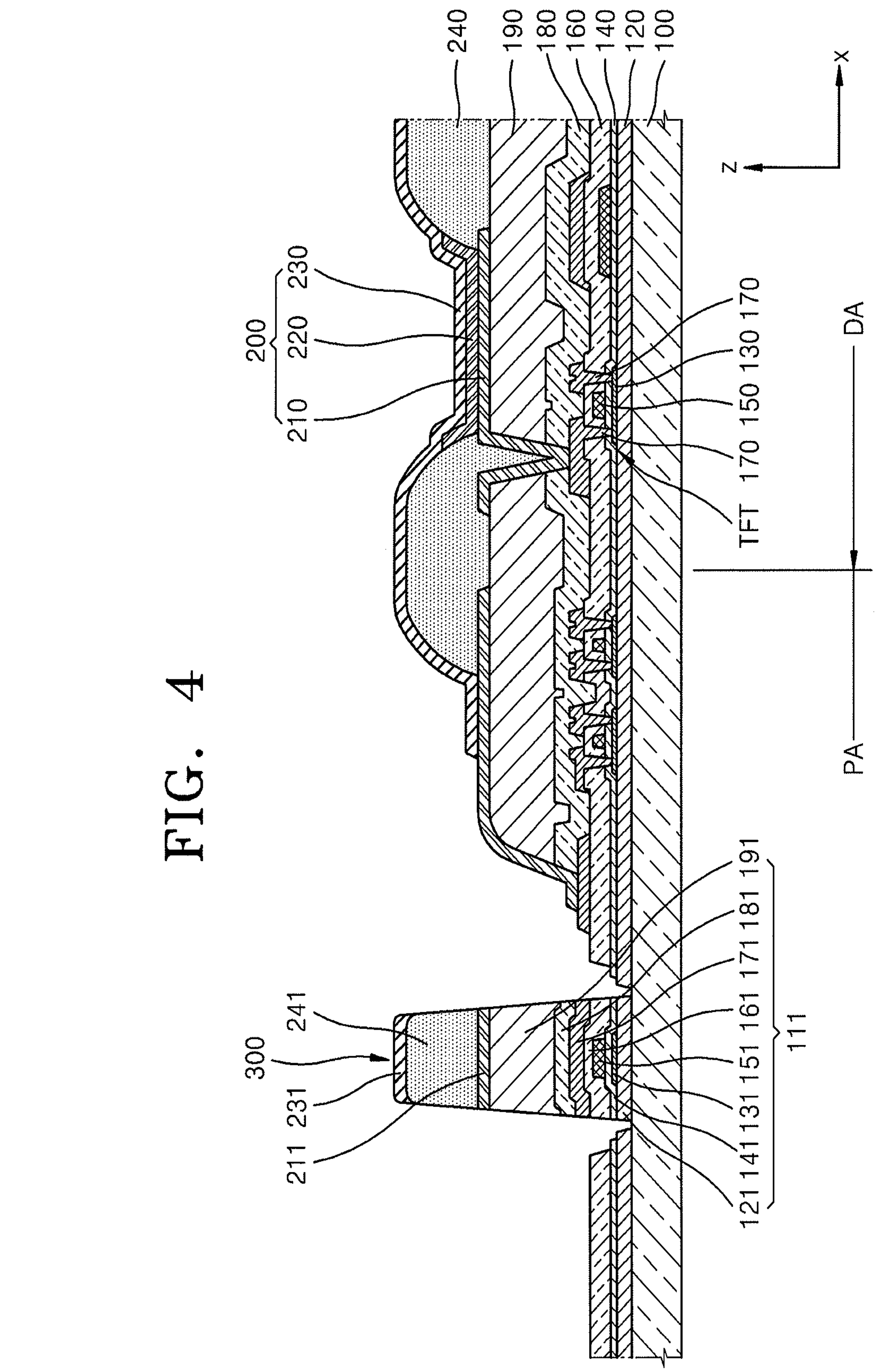
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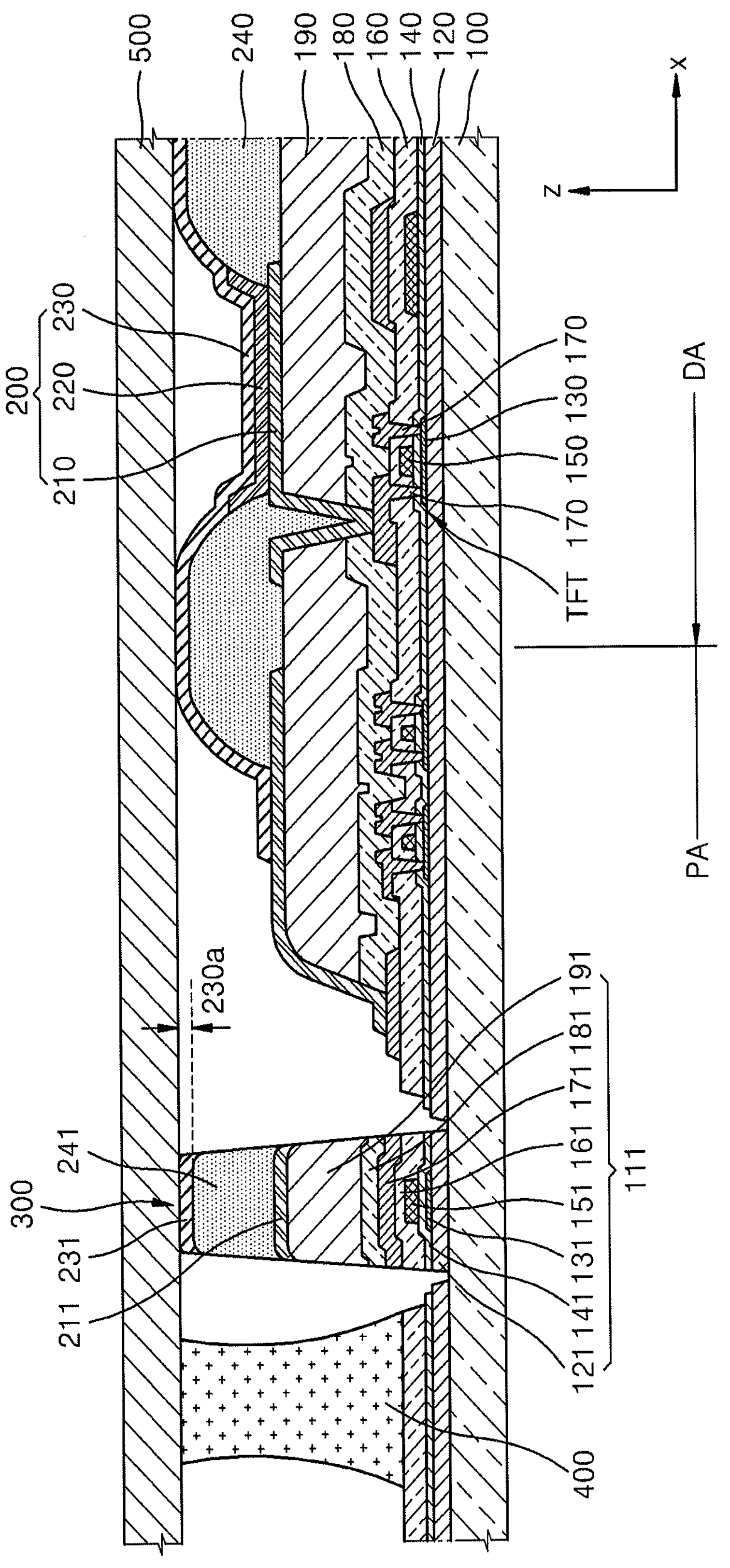
FIG. 5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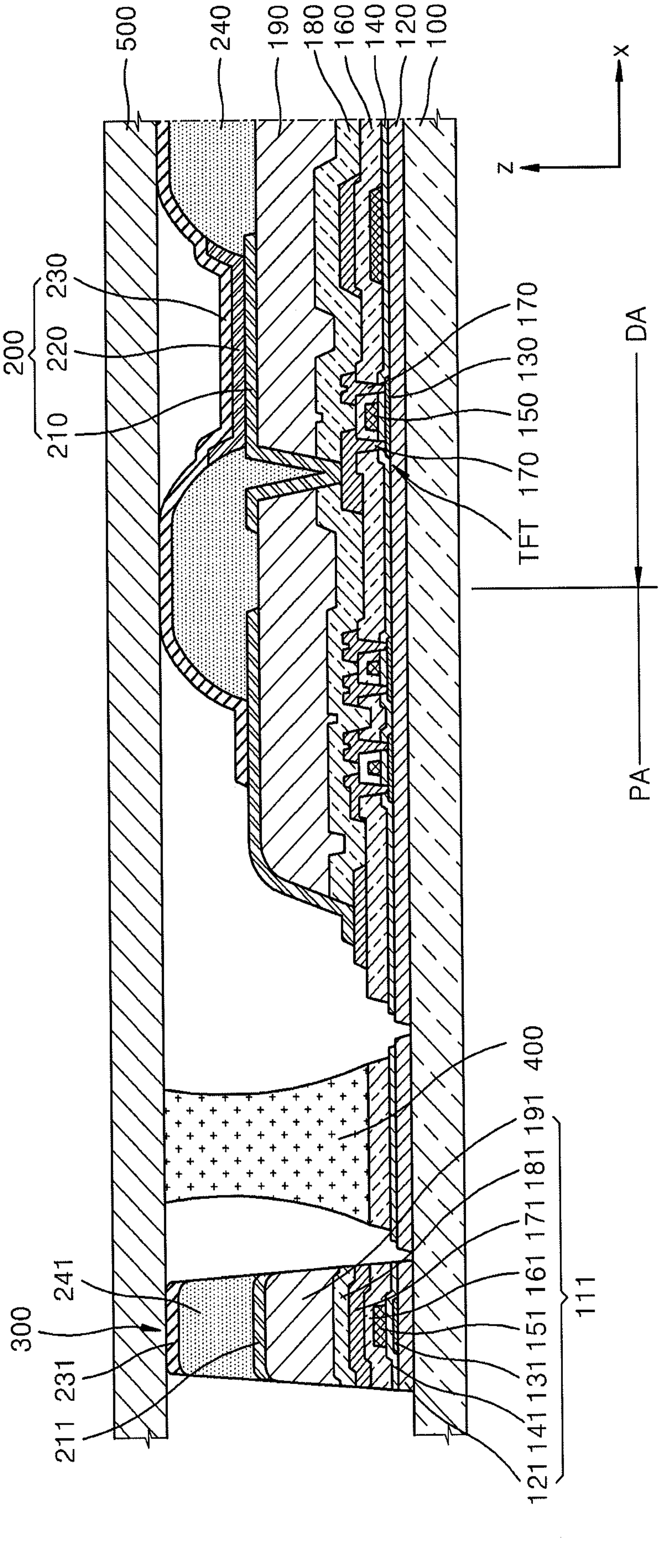
111
400

FIG. 6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211

FIG. 7

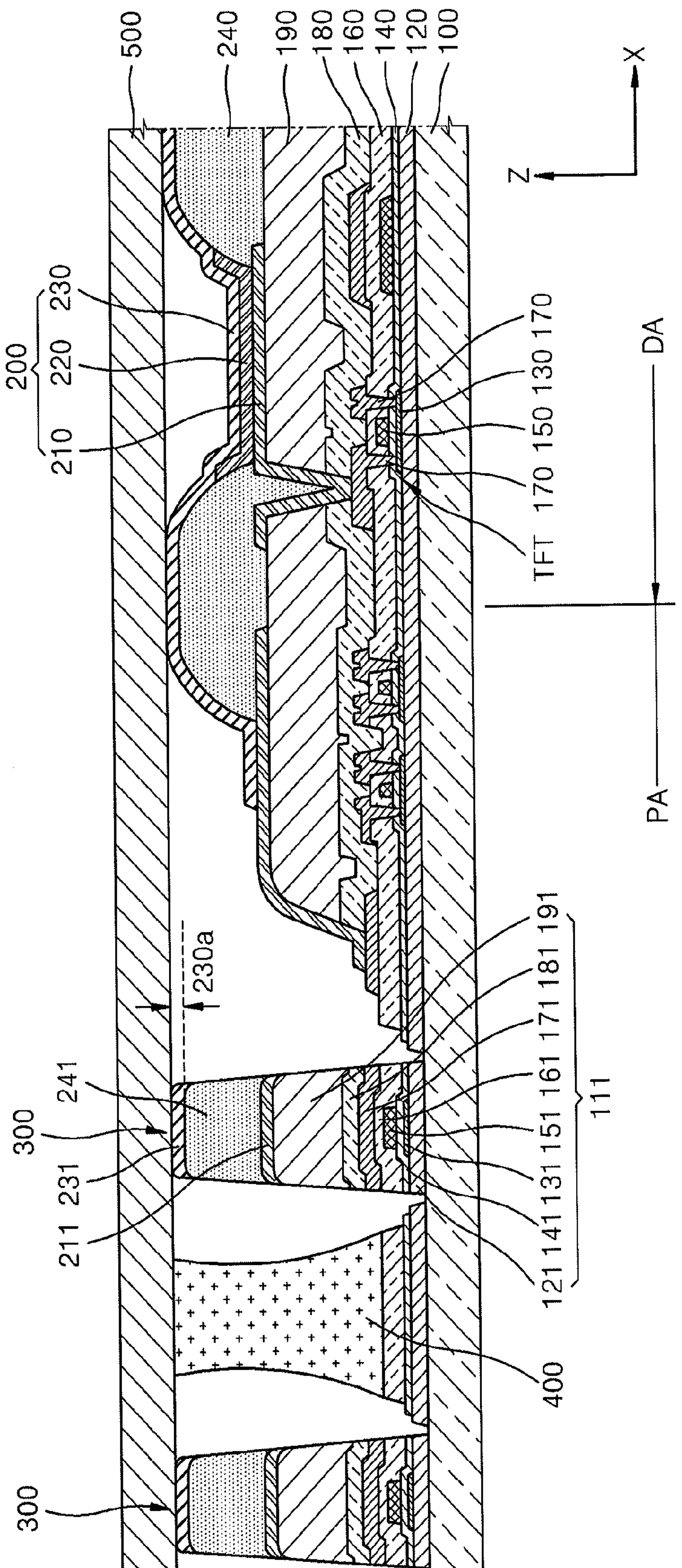
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FIG. 8

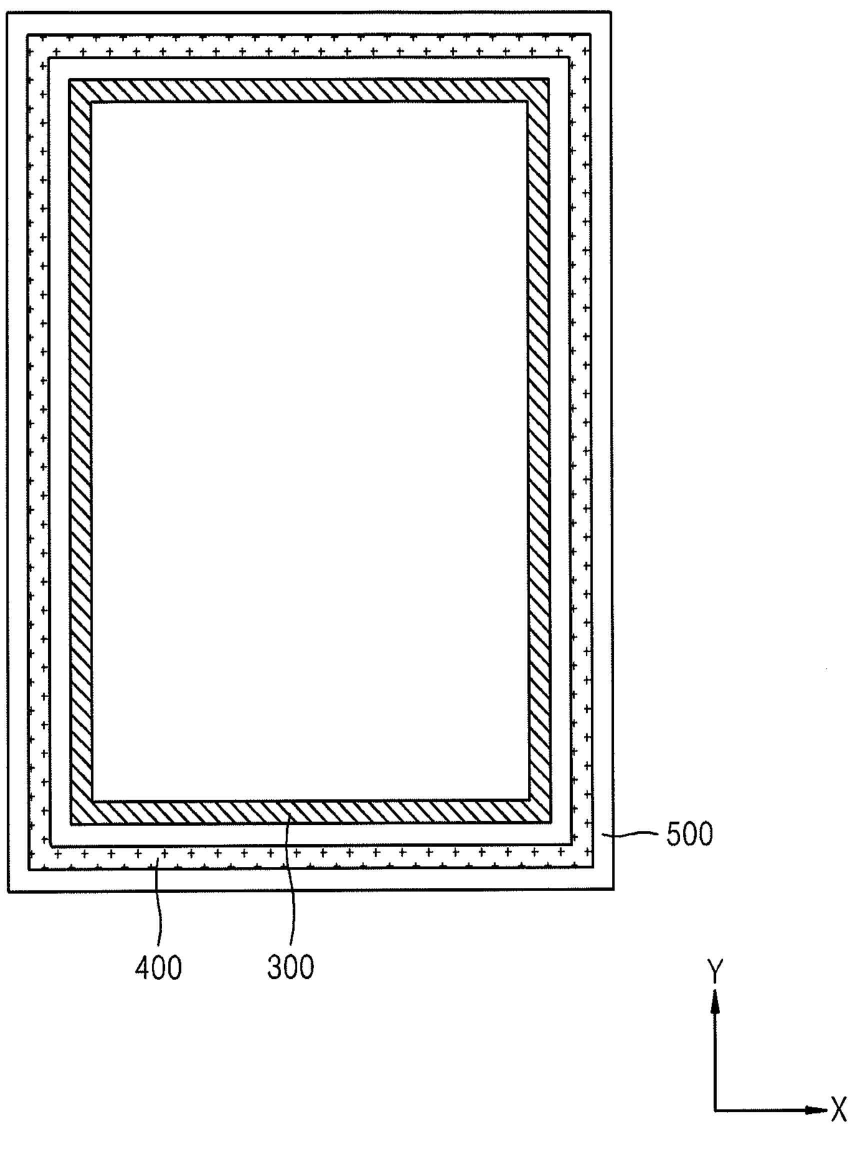


FIG. 9

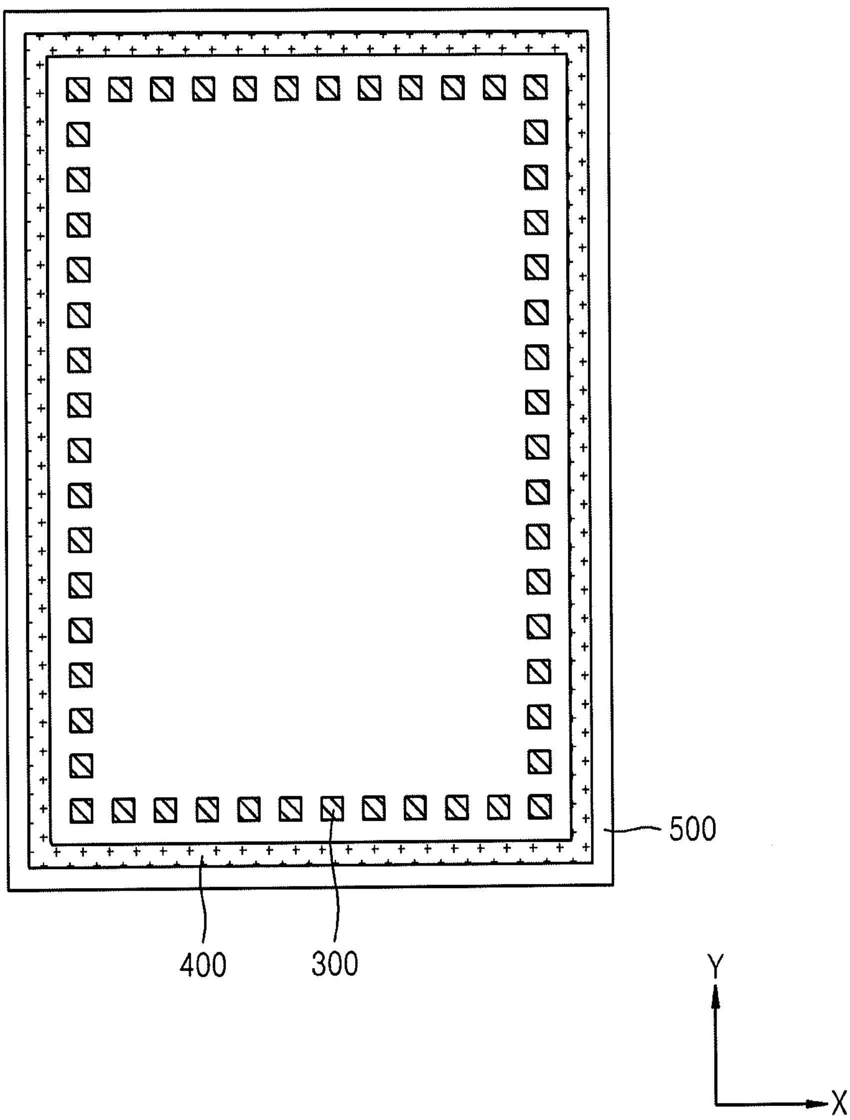


FIG. 10

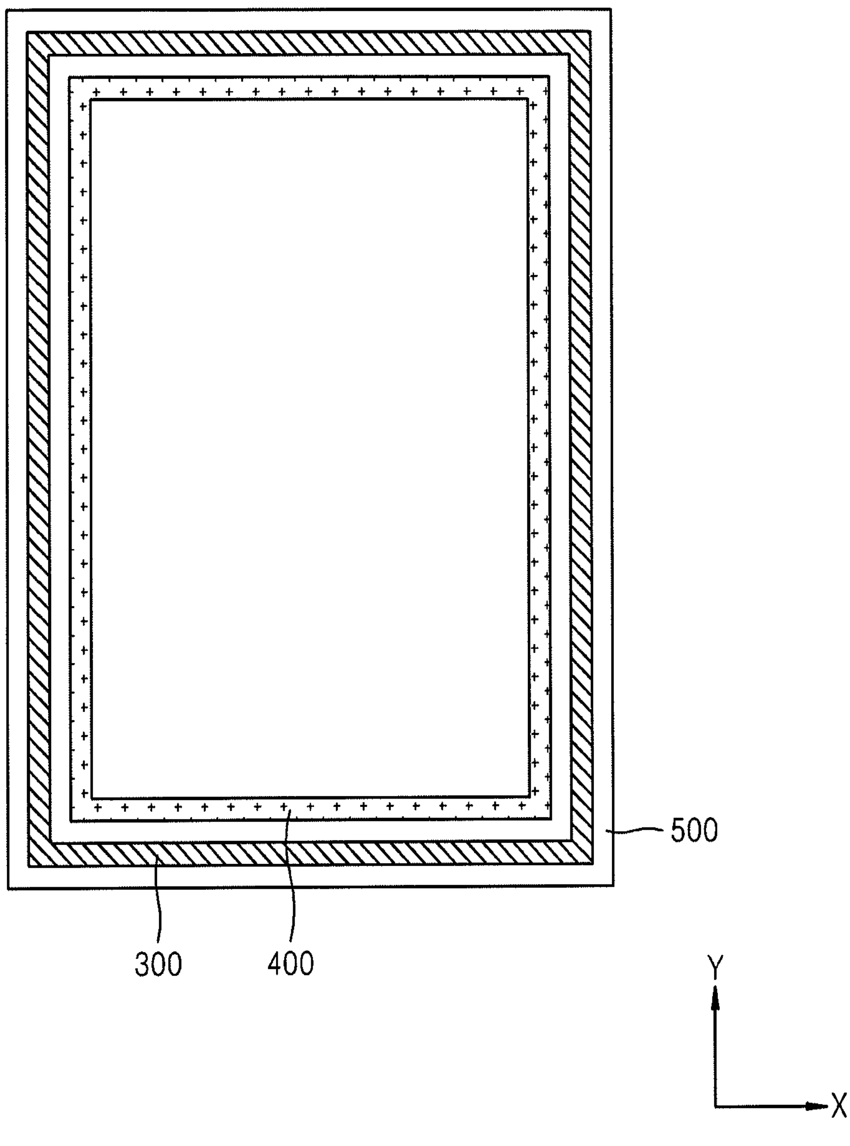


FIG. 11

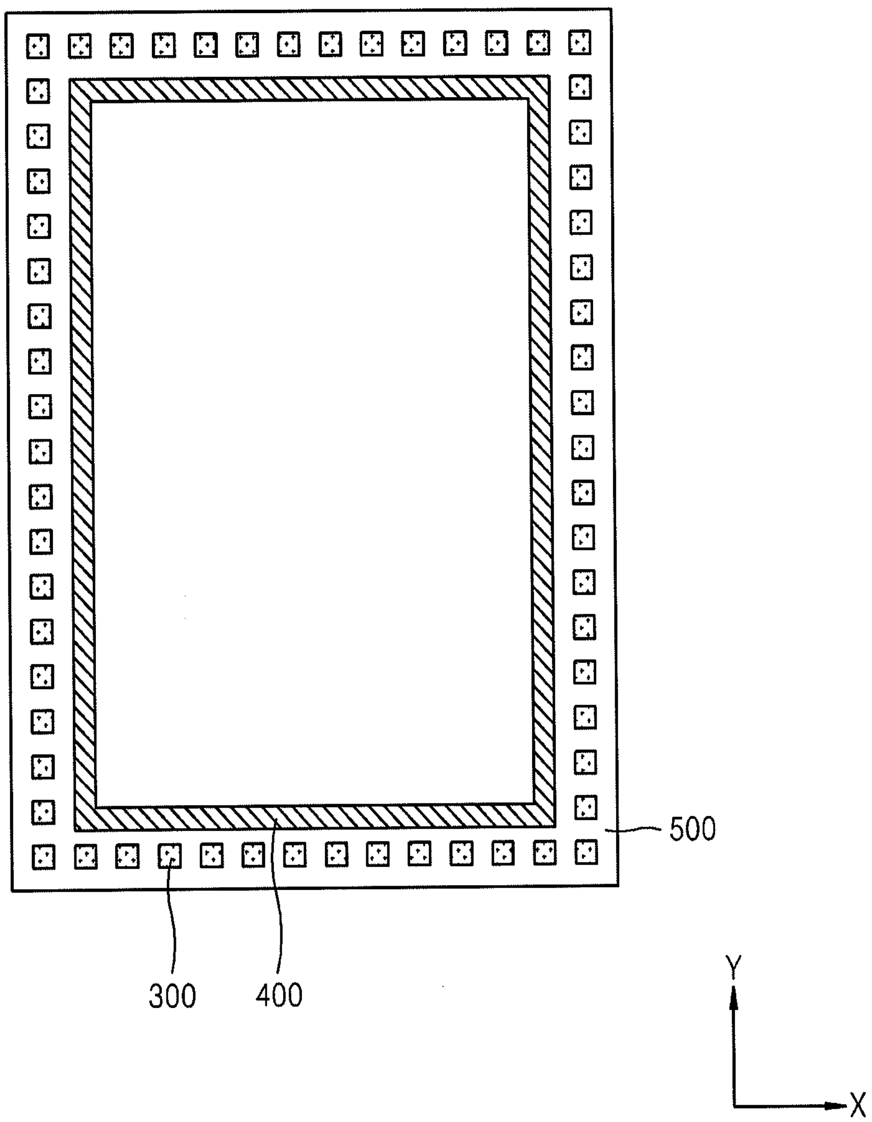


FIG. 12

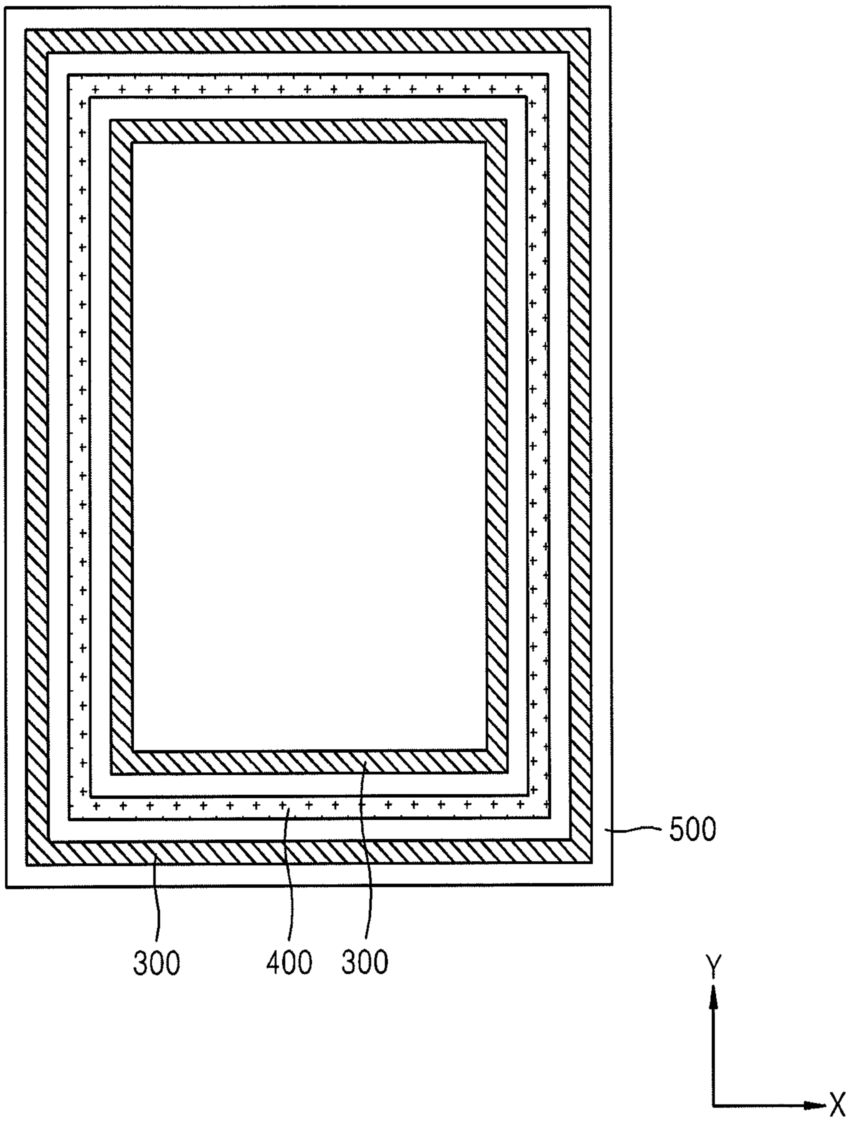
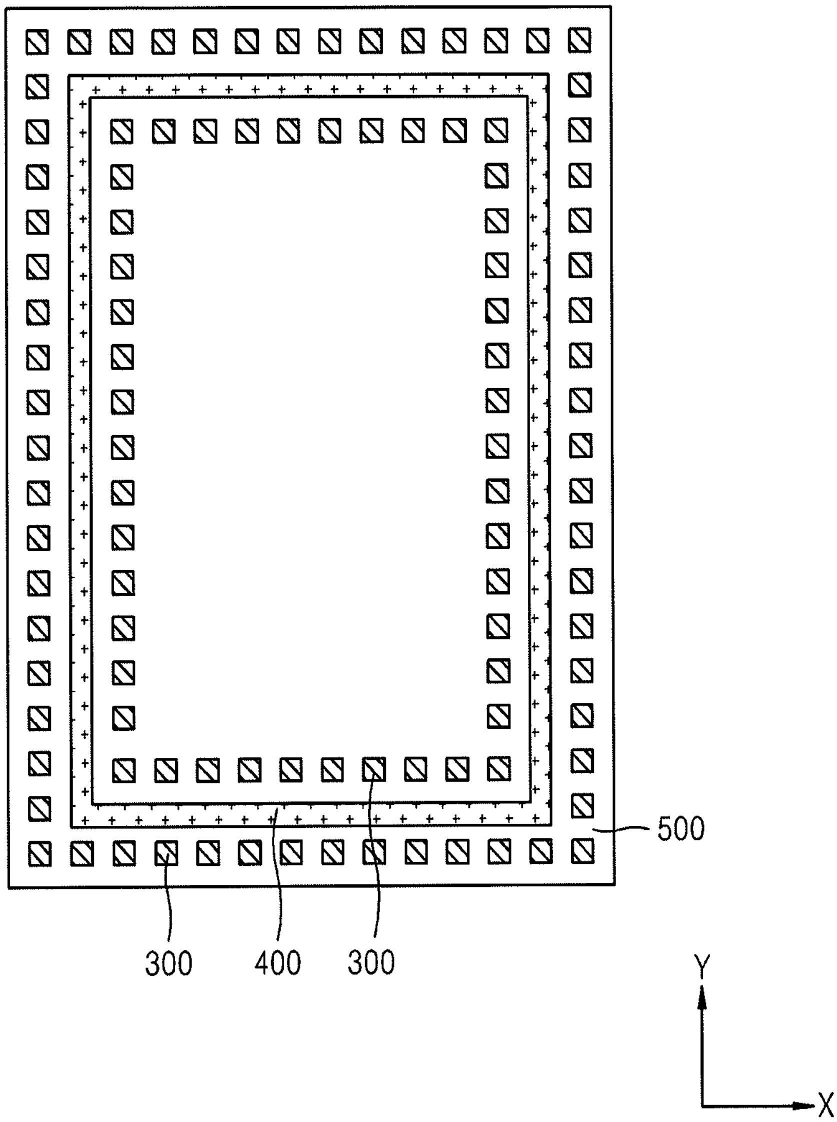


FIG. 13



ORGANIC LIGHT-EMITTING DISPLAY APPARATUS AND METHOD OF MANUFACTURING THE SAME

CROSS-REFERENCE TO RELATED APPLICATION

[0001] Korean Patent Application No. 10-2013-0094334, filed on Aug. 8, 2013, in the Korean Intellectual Property Office, and entitled: "Organic Light-Emitting Display Apparatus and Method Of Manufacturing The Same," is incorporated by reference herein in its entirety.

BACKGROUND

[0002] 1. Field

[0003] Embodiments relate to an organic light-emitting display apparatus and a method of manufacturing the same.

[0004] 2. Description of the Related Art

[0005] An organic light-emitting display apparatus has high-grade characteristics, such as wide viewing angles, high contrast, and fast response times. Therefore, the organic light-emitting display apparatus is considered as a next-generation display apparatus.

SUMMARY

[0006] Embodiments are directed to an organic light-emitting display apparatus and a method of manufacturing the same.

[0007] The embodiments may be realized by providing an organic light-emitting display apparatus including a lower substrate including a display area and a peripheral area, the peripheral area surrounding the display area; a thin film transistor (TFT) on the lower substrate; a pixel electrode electrically connected to the TFT; a pixel defining layer covering an edge of the pixel electrode so that a central portion of the pixel electrode is exposed; an intermediate layer on the pixel electrode, the intermediate layer including an emission layer; an opposite electrode overlying the pixel electrode; an upper substrate overlying the lower substrate; a sealing member on the peripheral area of the lower substrate, the sealing member attaching the lower substrate to the upper substrate; and a shock absorption member, the shock absorption member including a first layer on the peripheral area of the lower substrate, the first layer being separated from the sealing member and being stacked in a layer stack structure on the lower substrate; and a second layer on the first layer, the second layer including a same material as the pixel defining layer.

[0008] The first layer of the shock absorption member may have a layer stack structure including layers formed of the same materials as layers included in the TFT, and the shock absorption member may further include a metal layer between the first layer and the second layer, the metal layer including a same material as the pixel electrode.

[0009] The shock absorption member may further include a third layer on the second layer, the third layer including a same material as the opposite electrode.

[0010] The shock absorption member may be between the sealing member and the display area.

[0011] The sealing member may be between the shock absorption member and the display area.

[0012] The shock absorption member may include a pair of shock absorption members, the sealing member may be between the pair of shock absorption members, and one of the shock absorption members may be between the sealing member and the display area.

[0013] The shock absorption member may surround the display area of the lower substrate.

[0014] The shock absorption member may be discontinuously disposed around the display area of the lower substrate.

[0015] The embodiments may be realized by providing an organic light-emitting display apparatus including a lower substrate including a display area and a peripheral area, the peripheral area surrounding the display area; an upper substrate overlying the lower substrate; a sealing member on the peripheral area of the lower substrate, the sealing member attaching the lower substrate to the upper substrate; and a shock absorption member on the peripheral area of the lower substrate, the shock absorption member being separated from the sealing member, contacting the upper substrate, and having a same layer structure as a layer structure between the lower substrate and the upper substrate within the display area of the lower substrate.

[0016] The shock absorption member may have a same layer structure as a structure of a portion having a maximum layer structure between the lower substrate and the upper substrate within the display area of the lower substrate.

[0017] The embodiments may be realized by providing a method of manufacturing an organic light-emitting display apparatus, the method including preparing a lower substrate including a display area and a peripheral area such that the peripheral area surrounds the display area; forming a thin film transistor (TFT) on the lower substrate; forming a pixel electrode electrically connected to the TFT; forming a pixel defining layer covering an edge of the pixel electrode such that a central portion of the pixel electrode is exposed; forming an intermediate layer on the pixel electrode such that the intermediate layer includes an emission layer; forming an opposite electrode corresponding to the pixel electrode; forming a sealing member in the peripheral area of the lower substrate; forming a shock absorption member such that the shock absorption member includes a first layer on the peripheral area of the lower substrate, the first layer being separated from the sealing member and having a layer stack structure; and a second layer on the first layer, the second layer including a same material as the pixel defining layer; and attaching the upper substrate to the lower substrate through the sealing member.

[0018] Forming the shock absorption member may include forming the first layer having a layer stack structure; and forming the second layer on the first layer, wherein forming the first layer is performed simultaneously with forming the TFT on the lower substrate.

[0019] Forming the shock absorption member may further include forming a metal layer simultaneously with the pixel electrode, between forming the first layer and forming the second layer.

[0020] Forming the shock absorption member may further include forming a third layer on the second layer simultaneously with forming the opposite electrode.

[0021] The second layer may be formed simultaneously with the pixel defining layer by using a half-tone mask.

[0022] The shock absorption member may be formed at an inner side of the sealing member such that the shock absorption member is between the sealing member and the display area.

[0023] The shock absorption member may be formed at an outer side of the sealing member such that the sealing member is between the shock absorption member and the display area.

[0024] Forming the shock absorption member may include forming a pair of shock absorption members, such that the sealing member is between the pair of shock absorption members, and one of the shock absorption members is between the sealing member and the display area.

[0025] The shock absorption member may surround the display area of the lower substrate.

[0026] The shock absorption member may be discontinuously disposed around the display area of the lower substrate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] Features will be apparent to those of skill in the art by describing in detail exemplary embodiments with reference to the attached drawings in which:

[0028] FIGS. **1** to **5** illustrate cross-sectional views of stages in a method of manufacturing an organic light-emitting display apparatus according to an embodiment;

[0029] FIGS. **6** and **7** illustrate cross-sectional views of organic light-emitting display apparatuses according to embodiments; and

[0030] FIGS. **8** to **13** illustrate plan views of organic light-emitting display apparatuses according to embodiments.

DETAILED DESCRIPTION

[0031] 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.

[0032] 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.

[0033] In the following examples, the x-axis, the y-axis, and the z-axis are not limited to three axes of the rectangular coordinate system, and may be interpreted in a broader sense. For example, the x-axis, the y-axis, and the z-axis may be perpendicular to one another, or may represent different directions that are not perpendicular to one another.

[0034] It will be understood that when a layer, region, or component is referred to as being "formed on," another layer, region, or component, it can be directly or indirectly formed on the other layer, region, or component. For example, intervening layers, regions, or components may be present.

[0035] 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.

[0036] FIGS. **1** to **5** illustrate cross-sectional views of stages in a method of manufacturing an organic light-emitting display apparatus according to an embodiment.

[0037] A lower substrate **100** may be prepared. The lower substrate **100** may have a display region DA and a peripheral area PA that surrounds the display area DA. The display area DA may be an area where organic light-emitting devices **200** are disposed, and the peripheral area PA (surrounding the display area DA) may be a dead space where no display is performed. A driving unit (that applies electric signals to the display area DA) may be disposed in the peripheral area PA. The lower substrate **100** may be formed of, e.g., a glass material, a metal material, and/or a plastic material. An upper substrate **500**, which is to be described below, may also be formed of the same material as the lower substrate **100**.

[0038] As illustrated in FIG. **1**, a thin film transistor (TFT) may be formed on the lower substrate **100**. In the forming of the TFT, after a buffer layer **120** is formed of, e.g., silicon oxide or silicon nitride, on the lower substrate **100**, a semiconductor layer **130** may be formed on the buffer layer **120** so as to planarize a surface of the lower substrate **100** and/or to help reduce the likelihood of or prevent foreign substances from penetrating into the semiconductor layer **130**.

[0039] A gate insulating film **140** may be formed of, e.g., silicon oxide and/or silicon nitride, on the semiconductor layer **130**. The gate insulating film **140** may insulate between the semiconductor layer **130** and a gate electrode **150** (to be described below). A gate electrode **150** may be formed on the semiconductor layer **130**. Source and drain electrodes **170** may be electrically connected according to a signal applied to the gate electrode **150**. In consideration of adhesion to an adjacent layer, surface flatness of a stacked layer, and processability, the gate electrode **150** may be a single layer or a layer stack formed of or including at least one of, e.g., aluminum (Al), platinum (Pt), palladium (Pd), silver (Ag), magnesium (Mg), gold (Au), nickel (Ni), neodymium (Nd), iridium (Ir), chromium (Cr), lithium (Li), calcium (Ca), molybdenum (Mo), titanium (Ti), tungsten (W), or copper (Cu).

[0040] An interlayer insulating film **160** may be formed on the gate electrode **150**. The interlayer insulating film **160** may be a single layer or a layer stack formed of or including any one of silicon oxide or silicon nitride.

[0041] Source and drain electrodes **170** may be formed on the interlayer insulating film **160**. The source and drain electrodes **170** may be electrically connected to the semiconductor layer **130** through contact holes in the interlayer insulating film **160** and the gate insulating film **140**. In consideration of conductivity, the source and drain electrodes **170** may be a single layer or a layer stack formed of or including at least one of, e.g., aluminum (Al), platinum (Pt), palladium (Pd), silver (Ag), magnesium (Mg), gold (Au), nickel (Ni), neodymium (Nd), iridium (Ir), chromium (Cr), lithium (Li), calcium (Ca), molybdenum (Mo), titanium (Ti), tungsten (W), or copper (Cu).

[0042] A shock absorption member **300** may be formed on the peripheral area PA (surrounding the display area DA) of the lower substrate **100** at the same time as the formation of the TFT on the display area DA of the lower substrate **100**. This will be described below in detail.

[0043] As illustrated in FIG. **2**, a first insulating film **180** may be formed on the TFT as a protection film that covers the TFT, so as to protect the TFT having the above-described structure. The first insulating film **180** may be formed of or may include an inorganic material, e.g., silicon oxide, silicon nitride, or silicon oxynitride. In an implementation, the first insulating film **180** may have a single layer as shown in FIG. **2**. In an implementation, the first insulating film **180** may have a layer stack structure.

[0044] After the first insulating film **180** is formed, a second insulating film **190** may be formed on the first insulating film **180**, if desired. In this case, the second insulating film **190** may be a planarization film or a protection film. For example, when an organic light-emitting device **200** is disposed on the TFT as illustrated, the second insulating film **190** may be a planarization film for planarizing a top surface of the first insulating film **180** that covers the TFT. The second insulating film **190** may be formed of or may include, e.g., an acryl-based organic material or benzocyclobutene (BCB). In an implementation, the second insulating film **190** may have a single layer as shown in FIG. **2**. In an implementation, the first insulating film **180** may have a layer stack. After the first insulating film **180** and the second insulating film **190** are formed, the first insulating film **180** and the second insulating film **190** may be patterned to form via holes connected to the source and drain electrodes **170** of the TFT. In this manner, a pixel electrode **210** may be electrically connected to the electrode of the TFT.

[0045] In the display area DA of the lower substrate **100**, a pixel electrode **210** may be formed on the second insulating film **190** to cover and/or fill the via holes on the first insulating film **180** and the second insulating film **190**. The pixel electrode **210** may be formed as a translucent or transparent electrode or as a reflective electrode. When the pixel electrode **210** is the translucent or transparent electrode, the pixel electrode **210** may be formed of or may include, e.g., any one of indium thin oxide (ITO), indium zinc oxide (IZO), zinc oxide (ZnO), indium oxide (In_2O_3), indium gallium oxide (IGO), and aluminum zinc oxide (AZO). When the pixel electrode **210** is the reflective electrode, the pixel electrode **210** may include a reflection film formed of or including, e.g., any one of silver (Ag), magnesium (Mg), aluminum (Al), platinum (Pt), palladium (Pd), gold (Au), nickel (Ni), neodymium (Nd), iridium (Ir), chromium (Cr), and alloys thereof, and a layer formed of or including, e.g., any one of indium thin oxide (ITO), indium zinc oxide (IZO), zinc oxide (ZnO), indium oxide (In_2O_3), indium gallium oxide (IGO), and aluminum zinc oxide (AZO). In an implementation, the pixel electrode **210** may be formed of or may include various suitable materials. In an implementation, the pixel electrode **210** may be a single layer or a layer stack.

[0046] As described above, the shock absorption member **300** may be formed on the peripheral area PA (surrounding the display area DA) of the lower substrate **100** at the same time as the formation of the first insulating film **180** and the second insulating film **190** covering the TFT on the display area DA of the lower substrate **100**. The forming of the shock absorption member **300** may include forming a first layer **111** having a layer stack structure, and forming a second layer **241** on the first layer **111**. The shock absorption member **300** may be formed on the lower substrate **100** such that the shock absorption member **300** is separated or spaced apart from a sealing member (**440** in FIG. **5**) by a predetermined distance. The first layer **111** may be formed at the same time as the formation of the TFT. Therefore, the first layer **111** may include layers that are the same as or analogous to those formed in the display area DA.

[0047] For example, as illustrated in FIG. **2**, the first layer **111** of the shock absorption member **300** may include a buffer layer **121**, a semiconductor layer **131**, a gate insulating film **141**, a gate electrode layer **151**, an interlayer insulating film **161**, source and drain electrode layers **171**, a first insulating film **181**, and a second insulating film **191**. The buffer layer **121** may be formed simultaneously with the buffer layer **120** of the display area DA. The semiconductor layer **131** may be formed simultaneously with the semiconductor layer **130** of the display area DA. The gate insulating film **141** may be formed simultaneously with the gate insulating film **140** of the display area DA. The gate electrode layer **151** may be formed simultaneously with the gate electrode **150** of the display area DA. The interlayer insulating film **161** may be formed simultaneously with the interlayer insulating film **160** of the display area DA. The source and drain electrode layers **171** may be formed simultaneously with the source and drain electrodes **170** of the display area DA. The first insulating film **181** and the second insulating film **191** may be formed simultaneously with the first insulating film **180** and the second insulating film **190** of the display area DA. For example, the buffer layers **120** and **121**, the gate insulating films **140** and **141**, the interlayer insulating films **160** and **161**, the first insulating films **180** and **181**, and the second insulating films **190** and **191** may be formed on an entire surface of the lower substrate **100**, and then may be patterned to form the buffer layer **121**, the interlayer insulating film **161**, the first insulating film **181**, and the second insulating film **191** that are physically separated from the buffer layer **120**, the interlayer insulating film **160**, the first insulating film **180**, and the second insulating film **190** within the display area DA. In this manner, the first layer **111** of the shock absorption member **300** may be formed. A metal layer **211** may be formed on the first layer **111** at the same time as the formation of the pixel electrode **210**.

[0048] Referring to FIGS. **3** and **4**, a pixel defining layer **240** may be formed on the pixel electrode **210** in the display area DA of the lower substrate **100**. The pixel defining layer **240** may define pixels by including openings corresponding to sub-pixels, e.g., openings covering edges of the pixel electrode **210** and exposing at least central portions thereof. In addition, as illustrated in FIG. **4**, the pixel defining layer **240** may increase a distance between or may space apart an end portion of the pixel electrode **210** and an opposite electrode **230** on the pixel electrode **210**, thereby reducing the likelihood of and/or preventing an arc or the like from occurring at the end portion of the pixel electrode **210**. The pixel defining layer **240** may be formed of or may include, e.g., an inorganic material such as polyimide.

[0049] As described above, the pixel defining layer **240** may define a pixel region and may be formed in the display area DA of the lower substrate **100**. As illustrated in FIG. **3**, when the pixel defining layer **240** is formed in the display area DA, a second layer **241** may be simultaneously formed as part of the shock absorption member **300**. The second layer **241** may include the same material as the pixel defining layer **240**. In an implementation, a height of the second layer **241** of the shock absorption member **300** may be different from a height of the pixel defining layer **240**. In the case of forming layers included in the first layer **111** of the shock absorption member **300**, except for at least one layer, the height of the second layer **241** of the shock absorption member **300** may need to be higher than the height of the pixel defining layer **240**, so that a distance from the lower substrate **100** to a top surface of the second layer **241** is about equal to or similar to a distance from the lower substrate **100** to a top surface of the pixel defining layer **240**. Thus, in this case, the second layer **241** and the pixel defining layer **240** may be simultaneously formed using a half-tone mask.

[0050] As illustrated in FIG. **4**, an organic light-emitting device **200** may be formed. The organic light-emitting device **200** may include the pixel electrode **210**, the opposite electrode **230**, and an intermediate layer **220** (including an emission layer) therebetween. The forming of the organic light-emitting device **200** may include forming the intermediate layer **220** (that includes the emission layer) on the pixel electrode **210**, and forming the opposite electrode **230** corresponding to or overlying the pixel electrode **210**.

[0051] The intermediate layer **220** of the organic light-emitting device **200** may include a low-molecular-weight material or a high-molecular-weight (e.g., polymeric) material. When the intermediate layer **220** includes the low-molecular-weight material, the intermediate layer **200** may be a single layer or a layer stack including, e.g., a hole injection layer (HIL), a hole transport layer (HTL), an emission layer (EML), an electron transport layer (ETL), and/or an electron injection layer (EIL) in a single or multiple structure. The intermediate layer **220** may be formed of various materials including an organic or organometallic material. Examples of the organic or organometallic material may include copper phthalocyanine (CuPc), N,N'-di(naphthalene-1-yl)-N,N'-diphenyl-benzidine (NPB), and tris-8-hydroxyquinoline aluminum (Alq_3). These layers may be formed in, e.g., a vacuum evaporation method.

[0052] When the intermediate layer **220** includes the high-molecular-weight material, the intermediate layer **220** may include, e.g., the HTL and the EML. In this case, e.g., PEDOT may be used as the HTL, and poly-phenylenevinylene (PPV)-based and/or polyfluorene-based polymer materials may be used as the EML. The HTL and the EML may be formed by, e.g., a screen printing or inkjet printing method or a laser induced thermal image (LITI) method.

[0053] The opposite electrode **230** may overlie entire top surfaces of the display area DA and the peripheral area PA (surrounding the display area DA). As illustrated in FIG. **4**, the opposite electrode **230** may be cover the display area DA and the peripheral area PA (surrounding the display area DA). For example, the opposite electrode **230** may be integrally formed in the plurality of organic light-emitting devices **200** and may correspond to or overlie a plurality of pixel electrodes **210**, e.g., different pixel electrodes **210**.

[0054] The opposite electrode **230** may be formed as a translucent or transparent electrode or as a reflective electrode. When the opposite electrode **230** is the translucent or transparent electrode, the opposite electrode **230** may include a layer formed of or including, e.g., a metal having a small work function, such as Li, Ca, LiF/Ca, LiF/Al, Al, Ag, Mg, or compounds thereof, and a translucent or transparent conductive layer formed of or including, e.g., any one of ITO, IZO, ZnO, or In_2O_3. When the opposite electrode **230** is the reflective electrode, the opposite electrode **230** may include a layer formed of or including, e.g., any one of Li, Ca, LiF/Ca, LiF/Al, Al, Ag, Mg, or compounds thereof.

[0055] As described above, as the intermediate layer **220** and the opposite electrode **230** are formed in the display area DA, the shock absorption member **300** may be simultaneously formed. A third layer **231** may be further formed on the second layer **241** of the shock absorption member **300** at the same time as the formation of the opposite electrode **230**. For example, the third layer **231** may be formed of the same material as the opposite electrode **230**.

[0056] After a sealing member **400** is formed in the peripheral area PA of the lower substrate **100**, the upper substrate **500** may be attached to the lower substrate **100** through the sealing member **400**. The upper substrate **500** may correspond to the lower substrate **100** (e.g., may overlie or may be opposite to the lower substrate **100**) and may be formed of or may include various materials, e.g., a glass material, a metal material, or a plastic material. The lower substrate **100** and the upper substrate **500** may be attached to each other through the sealing member **400**. The sealing member **400** may be formed of or may include, e.g., frit or epoxy.

[0057] Like the sealing member **400**, the shock absorption member **300** may be in the peripheral area PA of the lower substrate **100**, and may protrude or extend from the lower substrate **100** in a direction (+z) of or toward the upper substrate **500**. In an implementation, the shock absorption member **300** may be separated or spaced apart from the sealing member **400**.

[0058] In an implementation, an end portion of the shock absorption member **300** (in the direction of or facing the upper substrate **500**) may contact the upper substrate **500** as illustrated in FIG. **5**. In an implementation, the end portion of the shock absorption member **300** (in the direction of or facing the upper substrate **500**) may not contact or may be spaced apart from the upper substrate **500**. For example, the third layer **231** (which is otherwise formable simultaneously with the opposite electrode **230**) may not be provided, and a space **230***a* may exist between the upper substrate **500** and the end portion of the shock absorption member **300** (in the direction of or facing the upper substrate **500**).

[0059] As described above, the pixel defining layer **240** may be in the display area DA, and the shock absorption member **300** may have the second layer **241** as the uppermost layer, the second layer **241** being formed simultaneously with the pixel defining layer **240**.

[0060] A distance from the lower substrate **100** to the end portion of the shock absorption member **300** (in the direction of or facing the upper substrate **500**) may be equal to or about equal to a distance from the lower substrate **100** to an end portion of the pixel defining layer **240** (in the direction of or facing the upper substrate **500**). In this case, the opposite electrode **230** on the pixel defining layer **240** may contact the upper substrate **500**, and the space **230***a* (corresponding to a thickness of the opposite electrode **230**) may exist between the upper substrate **500** and the end portion of the shock absorption member **300** (in the direction of or facing the upper substrate **500**). The lower substrate **100** or the upper substrate **500** may have a thickness of, e.g., several hundred μm, and the opposite electrode **230** may have a relatively small thickness, e.g., of about 1,000 Å. Therefore, even when the space **230***a* exists as described above, the end portion of the shock absorption member **300** (in the direction of or facing the upper substrate **500**) may be considered as almost or substantially contacting or actually contacting the upper substrate **500** in terms of an entire surface of the organic light-emitting display apparatus.

[0061] The shock absorption member **300** in the organic light-emitting display apparatus may absorb external shocks applied to the organic light-emitting display apparatus.

[0062] For example, in a case where the organic light-emitting display apparatus is mounted and used in a portable mobile device, when the portable mobile device falls down to the ground, a shock may occur in an edge of the organic light-emitting display apparatus. The shock may cause cracks from the peripheral area PA to the upper substrate **500**, resulting in an extension of cracks from the upper substrate **500** to the display area DA.

[0063] The shock absorption member **300** in the peripheral area PA, e.g., of the organic light-emitting display apparatus of FIG. **5**, may help effectively reduce damage caused by the external shocks. This may significantly reduce a damage rate of the organic light-emitting display apparatus that is caused by external shocks.

[0064] In addition, the shock absorption member **300** may be formed simultaneously with the TFT or the organic light-emitting device of the display area DA. Therefore, the shock absorption member **300** (having a significantly low damage rate with respect to external shocks) may be formed without additional processes.

[0065] The method of manufacturing the organic light-emitting display apparatus has been described. In an implementation, a suitable organic light-emitting display apparatus manufactured by the above-described manufacturing method will also fall within the scope of the present invention.

[0066] FIGS. **6** and **7** illustrate cross-sectional views of organic light-emitting display apparatuses according to embodiments. FIG. **6** illustrates an embodiment in which a shock absorption member **300** is separately disposed at an edge of a lower substrate **10** that is an opposite direction (−x) to the display area DA with reference to a sealing member **400**. For example, FIG. **6** illustrates an embodiment in which the shock absorption member **300** is spaced apart from the display area DA at an outer side of the sealing member **400** such that the sealing member **400** is between the shock absorption member **300** and the display area DA. FIG. **7** illustrates an embodiment in which shock absorption members **300** are disposed at portions in both a direction (+x) of the display area DA and an opposite direction (−x) to the display area DA with reference to a sealing member **400**. For example, FIG. **7** illustrates an embodiment in which the sealing member **400** is between a pair of shock absorption members **300**, and one of the shock absorption members **300** is between the sealing member **400** and the display area DA. Below, the organic light-emitting display apparatus will be described focusing on FIG. **5**.

[0067] Referring to FIG. **5**, the organic light-emitting display apparatus may include a lower substrate **100**, a TFT, a pixel electrode **210**, a pixel defining layer **240**, an intermediate layer **220**, an opposite electrode **230**, a shock absorption member **300**, a sealing member **400**, and an upper substrate **500**.

[0068] In the organic light-emitting display apparatus according to an embodiment, the lower substrate **100** may have a display area DA and a peripheral area PA (that surrounds the display area DA), and the TFT may be on or in the display area DA of the lower substrate **100**. A first insulating film **180** and a second insulating film **190** may be further provided on the TFT so as to protect the TFT or planarize the top surface of the TFT. A pixel electrode **210** may be provided on the second insulating film **190** such that the pixel electrode **210** is electrically connected to source and drain electrodes **170** of the TFT. An intermediate layer **220** (including an emission layer) may be on the pixel electrode **210**, and an opposite electrode **230** (corresponding to or overlying the pixel electrode **210**) may be on the intermediate layer **220**.

[0069] A shock absorption member **300** may be in the peripheral area PA (that surrounds the display area DA) of the lower substrate **100**. The shock absorption member **300** may be separated or spaced apart from the sealing member **400** by a predetermined distance. The shock absorption member **300** may include layers analogous to all layers in the display area DA of the lower substrate **100**, e.g., of the TFT and the pixel. For example, the shock absorption member **300** may include a first layer **111** (having a layer stack structure), a second layer **241** (including the same material as the pixel defining layer **240**), and a third layer **231** (including the same material as the opposite electrode **230**). In an implementation, a metal layer **211** (including the same material as the pixel electrode **210**) may be further provided between the first layer **111** and the second layer **241**.

[0070] For example, the first layer **111** of the shock absorption member **300** may have a layer stack structure. The first layer **111** may include, e.g., a buffer layer **121**, a gate insulating film **141**, and an interlayer insulating film **161** (analogous to those layers constituting the TFT in the display area DA), and may include a semiconductor layer **131** between the buffer layer **112120** and the gate insulating film **141**, a gate electrode **151** on the top surface of the semiconductor layer **131**, a layer **171** including the same material as the source and drain electrodes **170**, and a first insulating film **181** and a second insulating film **191** (analogous to those layers covering the TFT). As described above, the first layer **111** may further include the layers constituting the TFT provided in the display area DA, and the first insulating film **180** and the second insulating film **190** disposed to cover the TFT.

[0071] In an implementation, the end portion of the shock absorption member **300** (in the direction of or facing the upper substrate **500**) may contact the upper substrate **500**, as illustrated in FIG. **5**. In an implementation, the end portion of the shock absorption member **300** (in the direction of or facing the upper substrate **500**) may not contact, e.g., may be spaced apart from, the upper substrate **500**. For example, when the third layer **231** (that is simultaneously formable with the opposite electrode **230**) is not provided or is omitted, a space **230***a* may exist between the upper substrate **500** and the end portion of the shock absorption member **300** (in the direction of or facing the upper substrate **500**).

[0072] As described above, the pixel defining layer **240** may be in the display area DA, and the shock absorption member **300** may have the second layer **241** as the uppermost layer, the second layer **241** being formed simultaneously with the pixel defining layer **240**.

[0073] A distance from the lower substrate **100** to the end portion of the shock absorption member **300** (in the direction of or facing the upper substrate **500**) may be equal to or about equal to a distance from the lower substrate **100** to the end portion of the pixel defining layer **240** (in the direction of or facing the upper substrate **500**). In this case, the opposite electrode **230** on the pixel defining layer **240** may contact the upper substrate **500**, and the space **230***a* corresponding to the thickness of the opposite electrode **230** may exist between the upper substrate **500** and the end portion of the shock absorption member **300** (in the direction of or facing the upper substrate **500**). The lower substrate **100** or the upper substrate **500** may have a thickness of several hundred μm, while the opposite electrode **230** may have a relatively small thickness of about 1,000 Å. Thus, even when the space **230***a* exists as described above, the end portion of the shock absorption member **300** (in the direction of or facing the upper substrate **500**) may be considered as almost or substantially contacting or actually contacting the upper substrate **500** in terms of the entire surface of the organic light-emitting display apparatus.

[0074] A sealing member **400** may be on the lower substrate **100** such that the sealing member **400** is separated or spaced apart from the shock absorption member **300** by a predetermined distance. The sealing member **400** may be in the display area DA and/or in the peripheral area PA along an edge of the lower substrate **100**. The lower substrate **100** and the upper substrate **500** may be attached to each other by the sealing member **400**.

[0075] FIGS. **8** to **13** illustrate plan views of organic light-emitting display apparatuses according to embodiments. Referring to FIGS. **8** to **13**, a sealing member **400** may be provided at edges of the display area DA and/or the peripheral area PA of the lower substrate **100**. A shock absorption member **300** may be separated or spaced apart from the sealing member **400** by a predetermined distance. FIGS. **8** to **13** illustrate embodiments according to positions of the shock absorption member **300**.

[0076] Referring to FIGS. **8** and **9**, the shock absorption member **300** may be disposed in a direction (+x) of the display area DA with reference to the sealing member **400**. For example, the shock absorption member **300** may be at an inner side of the sealing member **400** such that the shock absorption member **300** is between the sealing member **400** and the display area DA. In an implementation, the shock absorption member **300** may be discontinuously provided, as illustrated in FIG. **9**.

[0077] Referring to FIGS. **10** and **11**, the shock absorption member **300** may be disposed in an opposite direction (−x) of the display area DA with reference to the sealing member **400**. For example, the shock absorption member **300** may be at an outer side of the sealing member **400** such that the sealing member **400** is between the shock absorption member **300** and the display area DA. In an implementation, the shock absorption member **300** may be disposed at an endmost or outermost portion of the lower substrate **100**. In an implementation, the shock absorption member **300** may be discontinuously provided, as illustrated in FIG. **11**.

[0078] Referring to FIGS. **12** and **13**, shock absorption members **300** may be disposed in both a direction (+x) of the display area DA and an opposite direction (−x) to the display area DA with reference to the sealing member **400**. For example, a pair of the shock absorption members **300** may respectively be at inner and outer sides of the sealing member **400** such that the sealing member **400** is between the pair of shock absorption members **300**, and one of the shock absorption members **300** is between the sealing member **400** and the display area DA. In an implementation, the shock absorption members **300** may be discontinuously provided as illustrated in FIG. **13**.

[0079] The organic light-emitting display apparatus according to another embodiment may include a lower substrate **100**, an upper substrate **500**, a sealing member **400**, and a shock absorption member **300**.

[0080] The lower substrate **100** may include a display area DA and a peripheral area PA (that surrounds the display area DA). A TFT and an organic light-emitting device **200** may be on the display area DA. The upper substrate **500** may correspond to or overlie the lower substrate **100**, and the upper substrate **500** and the lower substrate **100** may be attached to each other by the sealing member **400** therebetween. The sealing member **400** may be in the display area DA and/or the peripheral area PA of the lower substrate **100**.

[0081] A shock absorption member **300** may be provided such that the shock absorption member **300** is separated or spaced apart from the sealing member **400** by a predetermined distance. The shock absorption member **300** may be in the display area DA and/or the peripheral area PA of the lower substrate **100** and may contact the upper substrate **500**. In this case, the shock absorption member **300** may include the same layer structure as that between the lower substrate **100** and the upper substrate **500** within the display area DA of the lower substrate **100**. In an implementation, the shock absorption member **300** may include the same layer structure as that of a portion having a maximum layer structure between the lower substrate **100** and the upper substrate **500** within the display area DA of the lower substrate **100**.

[0082] The shock absorption member **300** of the organic light-emitting display apparatus may absorb external shocks applied to the organic light-emitting display apparatus.

[0083] For example, in a case where the organic light-emitting display apparatus is mounted and used in a portable mobile device, when the portable mobile device falls to the ground, a shock may occur in the edge of the organic light-emitting display apparatus. The shock may cause cracks from the peripheral area PA to the upper substrate **500**, resulting in an extension of cracks from the upper substrate **500** to the display area DA.

[0084] However, the organic light-emitting display apparatus according to the present embodiment may help effectively reduce damage caused by the external shocks due to the presence of the shock absorption member **300** in the peripheral area PA. This may significantly reduce a damage rate of the organic light-emitting display apparatus which is caused by external shocks.

[0085] In addition, the shock absorption member **300** may be formed simultaneously with the TFT or the organic light-emitting device of the display area DA. Therefore, the shock absorption member **300** having a significantly low damage rate with respect to external shocks may be formed without additional processes.

[0086] By way of summation and review, an organic light-emitting display apparatus may be manufactured by forming organic light-emitting devices on a lower substrate and attaching the lower substrate to an upper substrate such that the organic light-emitting devices are disposed inside therebetween. The organic light-emitting display apparatus may be used as a display unit of a small product such as a mobile phone, or may be used as a display unit of a large product such as a television.

[0087] In the organic light-emitting display apparatus, a sealing member may be used to attach the lower substrate to the upper substrate. Some organic light-emitting display apparatuses may be easily damaged by external shocks.

[0088] The embodiments may provide an organic light-emitting display apparatus capable of reducing damage caused by external shocks.

[0089] As described above, according to the one or more of the above embodiments, it is possible to implement the organic light-emitting display apparatuses capable of reducing a damage rate caused by external shocks, and the methods for manufacturing the same.

[0090] 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 of the present invention as set forth in the following claims.

What is claimed is:

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

a lower substrate including a display area and a peripheral area, the peripheral area surrounding the display area;

a thin film transistor (TFT) on the lower substrate;

a pixel electrode electrically connected to the TFT;

a pixel defining layer covering an edge of the pixel electrode so that a central portion of the pixel electrode is exposed;

an intermediate layer on the pixel electrode, the intermediate layer including an emission layer;

an opposite electrode overlying the pixel electrode;

an upper substrate overlying the lower substrate;

a sealing member on the peripheral area of the lower substrate, the sealing member attaching the lower substrate to the upper substrate; and

a shock absorption member, the shock absorption member including:

a first layer on the peripheral area of the lower substrate, the first layer being separated from the sealing member and being stacked in a layer stack structure on the lower substrate; and

a second layer on the first layer, the second layer including a same material as the pixel defining layer.

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

the first layer of the shock absorption member has a layer stack structure including layers formed of the same materials as layers included in the TFT, and

the shock absorption member further includes a metal layer between the first layer and the second layer, the metal layer including a same material as the pixel electrode.

3. The organic light-emitting display apparatus as claimed in claim 2, wherein the shock absorption member further includes a third layer on the second layer, the third layer including a same material as the opposite electrode.

4. The organic light-emitting display apparatus as claimed in claim 1, wherein the shock absorption member is between the sealing member and the display area.

5. The organic light-emitting display apparatus as claimed in claim 1, wherein the sealing member is between the shock absorption member and the display area.

6. The organic light-emitting display apparatus as claimed in claim 1, wherein:

the shock absorption member includes a pair of shock absorption members,

the sealing member is between the pair of shock absorption members, and

one of the shock absorption members is between the sealing member and the display area.

7. The organic light-emitting display apparatus as claimed in claim 1, wherein the shock absorption member surrounds the display area of the lower substrate.

8. The organic light-emitting display apparatus as claimed in claim 7, wherein the shock absorption member is discontinuously disposed around the display area of the lower substrate.

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

a lower substrate including a display area and a peripheral area, the peripheral area surrounding the display area;

an upper substrate overlying the lower substrate;

a sealing member on the peripheral area of the lower substrate, the sealing member attaching the lower substrate to the upper substrate; and

a shock absorption member on the peripheral area of the lower substrate, the shock absorption member being separated from the sealing member, contacting the upper substrate, and having a same layer structure as a layer structure between the lower substrate and the upper substrate within the display area of the lower substrate.

10. The organic light-emitting display apparatus as claimed in claim 9, wherein the shock absorption member has a same layer structure as a structure of a portion having a maximum layer structure between the lower substrate and the upper substrate within the display area of the lower substrate.

11. A method of manufacturing an organic light-emitting display apparatus, the method comprising:

preparing a lower substrate including a display area and a peripheral area such that the peripheral area surrounds the display area;

forming a thin film transistor (TFT) on the lower substrate;

forming a pixel electrode electrically connected to the TFT;

forming a pixel defining layer covering an edge of the pixel electrode such that a central portion of the pixel electrode is exposed;

forming an intermediate layer on the pixel electrode such that the intermediate layer includes an emission layer;

forming an opposite electrode corresponding to the pixel electrode;

forming a sealing member in the peripheral area of the lower substrate;

forming a shock absorption member such that the shock absorption member includes:

a first layer on the peripheral area of the lower substrate, the first layer being separated from the sealing member and having a layer stack structure; and

a second layer on the first layer, the second layer including a same material as the pixel defining layer; and

attaching the upper substrate to the lower substrate through the sealing member.

12. The method as claimed in claim 11, wherein forming the shock absorption member includes:

forming the first layer having a layer stack structure; and

forming the second layer on the first layer,

wherein forming the first layer is performed simultaneously with forming the TFT on the lower substrate.

13. The method as claimed in claim 12, wherein forming the shock absorption member further includes forming a metal layer simultaneously with the pixel electrode, between forming the first layer and forming the second layer.

14. The method as claimed in claim 12, wherein forming the shock absorption member further includes forming a third layer on the second layer simultaneously with forming the opposite electrode.

15. The method as claimed in claim 12, wherein the second layer is formed simultaneously with the pixel defining layer by using a half-tone mask.

16. The method as claimed in claim 11, wherein the shock absorption member is formed at an inner side of the sealing member such that the shock absorption member is between the sealing member and the display area.

17. The method as claimed in claim 11, wherein the shock absorption member is formed at an outer side of the sealing member such that the sealing member is between the shock absorption member and the display area.

18. The method as claimed in claim **11**, wherein forming the shock absorption member includes forming a pair of shock absorption members, such that:

the sealing member is between the pair of shock absorption members, and

one of the shock absorption members is between the sealing member and the display area.

19. The method as claimed in claim **11**, wherein the shock absorption member surrounds the display area of the lower substrate.

20. The method as claimed in claim **19**, wherein the shock absorption member is discontinuously disposed around the display area of the lower substrate.

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专利名称(译)	有机发光显示装置及其制造方法		
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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.		
当前申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
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发明人	HAN, BYUNG-UK		
IPC分类号	H01L27/32 H01L51/56		
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摘要(译)

一种OLED装置，包括下基板，所述下基板包括显示器和外围区域，所述外围区域围绕所述显示区域;下基板上的TFT;像素电极，与TFT电连接;像素限定层，覆盖像素电极的边缘并暴露像素电极的中心部分;像素电极上的中间层，包括发光层;覆盖像素电极的相对电极;覆盖下基板的上基板;外围区域上的密封构件并将下基板附接到上基板;以及在所述周边区域上包括第一层的减震构件，所述第一层与所述密封构件分离并且在所述下基板上堆叠成层堆叠结构;第一层上的第二层，包括与像素定义层相同的材料。