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(54) ORGANIC LIGHT EMITTING DIODE DISPLAY WITH FLEXIBLE SUBSTRATE AND METHOD OF MANUFACTURING THE SAME

ORGANISCHE LICHTEMITTIERENDE ANZEIGEEINRICHTUNG MIT FLEXIBLEM SUBSTRAT UND VERFAHREN ZUR HERSTELLUNG DAVON

AFFICHAGE A DIODE ELECTROLUMINESCENTE ORGANIQUE AYANT UN SUBSTRAT FLEXIBLE ET SA METHODE DE FABRICATION

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(73) Proprietor: **Samsung Display Co., Ltd.**
Gyeonggi-do (KR)

(72) Inventors:
- **Kim, Yong Jin**
  Chungcheongnam-do (KR)
- **Jun, Sang-Hyun**
  Gyeonggi-Do (KR)

(74) Representative: **Taor, Simon Edward William et al**
Venner Shipley LLP
200 Aldersgate
London EC1A 4HD (GB)

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Description

[0001] Embodiments relate to an organic light emitting diode display comprising a flexible substrate and a method of manufacturing the same. An organic light emitting diode display is a self-light emitting display device that displays an image using an organic light emitting diode emitting light. The organic light emitting diode display does not require a separate light source, unlike a liquid crystal display. Thus, a thickness and a weight of the organic light emitting diode display may be significantly reduced. Further, the organic light emitting diode display may have high quality characteristics such as low power consumption, high luminance, and high reaction speed. Thus, the organic light emitting diode display may be a next generation display device of a portable electronic device.

[0002] US2013062659 discloses an organic light emitting diode display that includes: a base film made of plastic; a thin film transistor and an organic light emitting diode formed on the base film; and a carbon nanotube thin film disposed among the base film, the thin film transistor, and the organic light emitting diode.

[0003] US2006131585 discloses a thin film transistor array panel that includes a substrate; a plurality of semiconductor islands formed on the substrate, the plurality of semiconductor islands including a plurality of first and second extrinsic regions.

[0004] The above information disclosed in this Background section is only for enhancement of understanding of the background of the invention and therefore it may contain information that does not form the prior art that is already known to a person of ordinary skill in the art.

[0005] Embodiments are directed to an organic light emitting diode display comprising a flexible substrate and a method of manufacturing the same. The embodiments may be realized by providing an organic light emitting diode display as set out in claim 1.

[0006] The protrusions may be irregularly disposed on the polysilicon layer.

[0007] The plurality of protrusions may be regularly arranged.

[0008] The plurality of protrusions may have a linear shape or a polygonal shape.

[0009] The polysilicon layer may have a thickness of about 1 nm (10 Å) to about 10 nm (100 Å). A height of each protrusion may be about two times or less of the thickness of the polysilicon layer.

[0010] A height of each protrusion is smaller than a thickness of the second flexible layer.

[0011] The flexible substrate may further include a barrier layer between the polysilicon layer and the first flexible layer.

[0012] The barrier layer may be formed of silicon oxide or silicon nitride.

[0013] The flexible substrate may further include a barrier layer on the second flexible layer, the second flexible layer being between the barrier layer and the polysilicon layer.

[0014] The first flexible layer and the second flexible layer may be formed of polyimide.

[0015] The embodiments may also be realized by providing a method of manufacturing a organic light emitting diode display as set out in claim 9

The first flexible layer and the second flexible layer may be formed by a solution process.

[0016] The crystallization may be performed by an excimer laser annealing method or a sequential lateral solidification method.

[0017] The crystallization may be performed by the excimer laser annealing method such that the plurality of protrusions are irregularly disposed on the polysilicon layer.

[0018] The crystallization may be performed by the sequential lateral solidification method such that the plurality of protrusions are regularly arranged.

[0019] The amorphous silicon layer may be formed to have a thickness of about 1 nm (10 Å) to about 10 nm (100 Å).

[0020] The amorphous silicon layer may be formed by a CVD method.

[0021] 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 cross-sectional view of a flexible substrate according to an exemplary embodiment.

FIGS. 2 to 4 illustrate a schematic top plan view of a protrusion according to the exemplary embodiment.

FIG. 5 illustrates a flowchart of a method of manufacturing a flexible substrate according to an embodiment.

FIGS. 6 and 7 illustrate cross-sectional views sequentially showing a process of manufacturing the flexible substrate according to the exemplary embodiment.

FIGS. 8 to 10 illustrate cross-sectional views of a flexible substrate according to another exemplary embodiment.

FIG. 11 illustrates an equivalent circuit view of one pixel of an organic light emitting diode display according to the exemplary embodiment.

FIG. 12 illustrates a cross-sectional view of the organic light emitting diode display according to the exemplary embodiment.

[0022] The embodiments will be described more fully hereinafter with reference to the accompanying drawings, in which exemplary embodiments are shown. As those skilled in the art would realize, the described embodiments may be modified in various different ways, all without departing from the scope of the embodiments.

[0023] In the drawings, the thickness of layers, films, panels, regions, etc., are exaggerated for clarity. Like reference numerals designate like elements throughout the specification. It will be understood that when an element such as a layer, film, region, or substrate is referred to as being "on" another element, it can be directly on the other element or intervening elements may also be present. In contrast, when an element is referred to as being "directly on" another element, there are no intervening elements present.

[0024] Hereinafter, a flexible substrate according to an exemplary embodiment will be specifically described with reference to the drawings.

[0025] FIG. 1 illustrates a schematic cross-sectional view of a flexible substrate according to an exemplary embodiment, and FIGS. 2 to 4 illustrate a schematic top plan view of a protrusion according to the exemplary embodiment.

[0026] As illustrated in FIG. 1, a flexible substrate 100 according to an exemplary embodiment may include a first flexible layer 10, a polysilicon layer 20 on the first flexible layer 10, and a second flexible layer 30 on the polysilicon layer 20.

[0027] The first flexible layer 10 and the second flexible layer 30 may be formed of polyimide. Each of the first flexible layer 10 and the second flexible layer 20 may have a thickness within about 10 μm, e.g., up to about 10 μm.

[0028] Protrusions 7 may be formed on a surface of the polysilicon layer 20. In some embodiments, the protrusions 7 may have an irregular size on the surface of the polysilicon layer. As illustrated in FIG. 2, the protrusions 7 may be irregularly disposed. In other embodiments, the protrusions 7 may be regularly arranged in a predetermined form. For example, as illustrated in FIGS. 3 and 4, linear protrusions may be arranged at a regular interval or may form a lattice.

[0029] A height (H) of the protrusions 7 may be about two times or less of a thickness of the polysilicon layer 20. For example, the height H of the protrusions (which are a part of the polysilicon layer 20) may be about two times of less of a thickness of a portion of the polysilicon layer 20 that does not include the protrusions 7 thereon, such as a thickness of a portion in valleys between peaks of the protrusions. In some embodiments, the height H of the protrusions 7 may be smaller than the thickness of the second flexible layer 30.

[0030] Hereinafter, a method of manufacturing the flexible substrate of FIG. 1 will be specifically described.

[0031] FIG. 5 illustrates a flowchart of a method of manufacturing a flexible substrate according to an embodiment, and FIGS. 6 and 7 illustrate cross-sectional views sequentially showing a process of manufacturing the flexible substrate according to the exemplary embodiment.

[0032] As illustrated in FIG. 5, the method may include a step of forming a first flexible layer (S100), a step of forming a polysilicon layer on the first flexible layer (S102), and a step of forming a second flexible layer on the polysilicon layer (S104).

[0033] First, as illustrated in FIGS. 5 and 6, the first flexible layer 10 may be formed on a support substrate 500 (S100).

[0034] The first flexible layer 10 may be formed by applying a polymer material, e.g., PET, PEN, polysulfone, polycarbonate, polybeneimidazole, and/or polyimide, in a solution form and then performing a curing step. The first flexible layer 10 may be formed to have a thickness of about 10 μm or less.

[0035] Next, an amorphous silicon layer 2 may be formed on the first flexible layer 10. The amorphous silicon layer 2 may be formed by being deposited by a chemical vapor deposition method, or the like. The amorphous silicon layer 2 may be formed to have a thickness of about 1 nm (10 Å) to about 10 nm (100 Å).

[0036] Next, as illustrated in FIGS. 5 and 7, a polysilicon layer 20 may be formed by crystallizing the amorphous silicon layer.

[0037] Crystallization may be performed by using a crystallization method using a laser, e.g., excimer laser annealing (ELA) or sequential lateral solidification (SLS).

[0038] In an excimer laser annealing process, crystallization may be performed while scanning the laser along the amorphous silicon layer 2, and the amorphous silicon layer 2 may be melted by the laser and then form crystals. In this case, protrusions 7 may be formed on a surface of the polysilicon layer 20, and may be irregularly arranged while having an irregular size.

[0039] In the sequential lateral solidification, after a mask is disposed, the amorphous silicon layer may be melted by using the laser and then crystallized, and the protrusions 7 may be formed at a boundary of the mask. Accordingly, the protrusions 7 may have a linear or polygon form as illustrated in FIGS. 4, according to a form and disposal of the mask.

[0040] Thereafter, after a second flexible layer 30 may be formed on the polysilicon layer 20, and the support substrate 500 may be removed to prepare a flexible substrate 100. As illustrated in FIGS. 11 and 12, when the organic light emitting diode display is manufactured, after all of a thin film transistor, a light emitting diode, and an encapsulation member are formed on the flexible substrate 100, the support substrate 500 may be removed.

[0041] The second flexible layer 30 may be formed of a same material and by a same method as the first flexible layer 10. In other embodiments, the second flexible layer 30 may be formed of a different material and by a different method as the first flexible layer 10.

[0042] In this embodiment, a close contacting property between the second flexible layer 30 and the polysilicon layer 20 may be improved by forming the protrusions 7 on the surface of the polysilicon layer 20, on which the second flexible layer 30 is formed, to increase a surface roughness of the polysilicon layer 20. In other words, as will be apparent to a person of ordinary skill in the art from the foregoing description and from the drawings, the protrusions 7 of the polysilicon layer 20 may be formed on a surface of the polysilicon layer 20 that faces the second flexible layer 30, and may extend into the second flexible layer 30 (as shown in the inset of FIG. 1).

[0043] FIGS. 8 to 10 illustrate cross-sectional views of a flexible substrate according to another exemplary embodiment.

[0044] As illustrated in FIG. 8, a flexible substrate 200 according to the exemplary embodiment may include a first flexible layer 10, a barrier layer 14 on the first flexible layer 10, a polysilicon layer 20 on the barrier layer 14, and a second flexible layer 30 on the polysilicon layer 20. For example, the barrier layer 14 may be between the first flexible layer 10 and the polysilicon layer 20.

[0045] The barrier layer 14 may help prevent transmission of moisture from the outside, may be formed of silicon oxide or silicon nitride, and may be a single layer or a plurality of layers.

[0046] In some embodiments, the barrier layer 14 may be formed on the second flexible layer 30, as in the flexible substrate 300 of FIG. 9. In some embodiments, the barrier layer 14 and a flexible layer 40 may be repeatedly laminated like in the flexible substrate 400 of FIG. 10. For example, the barrier layer 14 and a flexible layer 40 may be repeatedly and alternately stacked, with the polysilicon layer 20 between the repeated stacks.

[0047] Hereinafter, an organic light emitting diode display including the flexible substrate of FIGS. 1 to 10 will be specifically described.

[0048] FIG. 11 illustrates an equivalent circuit view of one pixel of an organic light emitting diode display according to the exemplary embodiment.

[0049] As illustrated in FIG. 11, the organic light emitting diode display according to the exemplary embodiment may include a plurality of signal lines 121, 171, and 172 and a plurality of pixels (PX) connected thereto and arranged in an approximate matrix form.

[0050] The signal lines may include a plurality of gate lines 121 transferring a gate signal (or a scan signal), a plurality of data lines 171 transferring a data signal, and a plurality of driving voltage lines 172 transferring a driving voltage (Vdd). The gate lines 121 may extend in an approximate row direction and may be almost parallel to each other, and vertical direction portions of the data line 171 and the driving voltage line 172 may extend in an approximate column direction and may be almost parallel to each other.

[0051] Each pixel PX may include a switching thin film transistor (Qs), a driving thin film transistor (Qd), a storage capacitor (Cst), and an organic light emitting diode (OLED) (LD).

[0052] The switching thin film transistor (Qs) may have a control terminal, an input terminal, and an output terminal, the control terminal may be connected to the gate line 121, the input terminal may be connected to the data line 171, and the output terminal may be connected to the driving thin film transistor (Qd). The switching thin film transistor (Qs) may respond to the scan signal applied to the gate line 121 to transfer the data signal applied to the data line 171 to the driving thin film transistor (Qd).

[0053] Further, the driving thin film transistor (Qd) may have the control terminal, the input terminal, and the output terminal, and the control terminal may be connected to the switching thin film transistor (Qs), the input terminal may be connected to the driving voltage line 172, and the output terminal may be connected to the organic light emitting diode (LD). The driving thin film transistor (Qd) may allow an output current (ILD) having a magnitude varying according to a voltage applied between the control terminal and the output terminal to flow.

[0054] The capacitor (Cst) may be connected between the control terminal and the input terminal of the driving thin film transistor (Qd). This capacitor (Cst) may charge the data signal applied to the control terminal of the driving thin film transistor (Qd) and may maintain the data signal after the switching thin film transistor (Qs) is turned off.

[0055] The organic light emitting diode (LD) may have an anode connected to the output terminal of the driving thin film transistor (Qd), and a cathode connected to a common voltage (Vss). The organic light emitting diode (LD) may display an image by emitting light while changing the intensity thereof according to the output current (ILD) of the driving thin film transistor (Qd).

[0056] Further, the connection relationship of the thin film transistors (Qs, Qd), the capacitor (Cst), and the organic light emitting diode (LD) may be changed.

[0057] FIG. 12 illustrates a cross-sectional view of the organic light emitting diode display according to the exemplary embodiment.

[0058] Since interlayer constitutions of the switching transistor and the driving thin film transistor of the organic light emitting diode display according to one exemplary embodiment are similar to each other, the driving transistor will be mainly described.

[0059] The organic light emitting diode display according to the exemplary embodiment may include a substrate 110, a buffer layer 120 on the substrate 110, and a semiconductor 135 on the buffer layer 120.

[0060] The substrate 110 may be a flexible substrate, and may be a flexible substrate of the like shown in FIGS. 1 to 10, e.g., according to an embodiment. In other words, the substrate 110 is according to an embodiment of the invention.

[0061] The buffer layer 120 may be formed on the substrate 110, and when the substrate is formed of the flexible substrate of FIG. 10, the buffer layer 120 may be a barrier layer 14 of FIG. 10.

[0062] Accordingly, the barrier layer 120 may be formed to have a single layer of silicon nitride (SiN_x) or a plurality of layers where silicon nitride (SiN_x) and silicon oxide (SiO_2) are laminated. The barrier layer 120 may help prevent unnecessary or undesirable components such as an impurity or moisture from permeating and may planarize the surface.

[0063] A semiconductor 135 formed of polysilicon may be formed on the buffer layer 120. The semiconductor 135 may have a thickness of about 45 nm (450 Å) or more.

[0064] The semiconductor 135 may be divided into a channel region 1355, and a source region 1356 and a drain region 1357 formed at both sides of the channel region 1355. The channel region 1355 of the semiconductor 135 may be polysilicon not doped with the impurity, e.g., an intrinsic semiconductor. The source region 1356 and the drain region 1357 of the semiconductor 135 may be polysilicon doped with a conductive impurity, e.g., an impurity semiconductor.

[0065] The impurity doped on the source region 1356 and the drain region 1357 may include any one of a p-type impurity and an n-type impurity.

[0066] A gate insulating layer 140 may be formed on the semiconductor 135.

[0067] The gate insulating layer 140 may be a single layer or a plurality of layers including at least one of tetraethoxysilane (tetraethyl orthosilicate, TEOS), silicon nitride, and silicon oxide.

[0068] A gate electrode 155 may be formed on the gate insulating layer 140.

[0069] The gate electrode 155 may be formed of a single layer or a plurality of layers of a low resistance material, e.g., Al, Ti, Mo, Cu, Ni, or an alloy thereof, or a material having strong corrosion resistance. For example, the gate electrode may be a triple layer of Ti/Cu/Ti, Ti/Ag/Ti, or Mo/Al/Mo.

[0070] A first interlayer insulating layer 160 may be formed on the gate line 155.

[0071] The first interlayer insulating layer 160 may be formed of a single layer or a plurality of layers of tetraethoxysilane (tetraethyl orthosilicate, TEOS), silicon nitride, or silicon oxide, like the gate insulating layer 140.

[0072] A source electrode 176 and a drain electrode 177 may be formed on the first interlayer insulating layer 160, and the source electrode 176 and the drain electrode 177 may be connected through contact holes 166 and 167 to the source region 1356 and the drain region 1357, respectively.

[0073] The source electrode 176 and the drain electrode 177 may be formed of a single layer or a plurality of layers of a low resistance material, e.g., Al, Ti, Mo, Cu, Ni, or an alloy thereof, or a material having strong corrosion resistance. For example, the source electrode and the drain electrode may be a triple layer of Ti/Cu/Ti, Ti/Ag/Ti, or Mo/Al/Mo.

[0074] The gate electrode 155, the source electrode 176, and the drain electrode 177 may each form a thin film transistor (TFT) together with the semiconductor 135. Channels of the thin film transistor may each be formed in the semiconductor 135 between the source electrode 176 and the drain electrode 177.

[0075] A second interlayer insulating layer 180 may be formed on the source electrode 176 and the drain electrode 177.

[0076] The second interlayer insulating layer 180 may be formed of a single layer or a plurality of layers of tetraethoxysilane (tetraethyl orthosilicate, TEOS), silicon nitride, or silicon oxide like the first interlayer insulating layer.

[0077] A first electrode 710 may be formed on the second interlayer insulating layer 180. The first electrode 710 may be an anode of the organic light emitting diode of FIG. 11.

[0078] A pixel defining layer 190 (having an opening 195 through which the first electrode 710 is exposed) may be formed on the second interlayer insulating layer 180.

[0079] The pixel defining layer 190 may have the opening 195 through which the first electrode 710 is exposed. The pixel defining film 190 may include a resin, e.g., polyacrylates or polyimides, silica-based inorganic materials, or the like.

[0080] An organic emission layer 720 may be formed on the first electrode 710 in the opening 195.

[0081] The organic emission layer 720 may be formed of a plurality of layers including one or more of an emission layer, a hole injection layer (HIL), a hole transport layer (HTL), an electron transport layer (ETL), and an electron injection layer (EIL).

[0082] In the case where the organic emission layer 720 includes all of the above-described layers, the hole injection layer (HIL) may be disposed on the first electrode 710 that is the anode, and the hole transport layer (HTL), the emission layer, the electron transport layer (ETL), and the electron injection layer (EIL) may be sequentially laminated thereon.

[0083] A second electrode 730 may be formed on the organic emission layer 720 and the pixel defining layer 190. The second electrode 730 may be a cathode of the organic light emitting diode of FIG. 11.

[0084] The first electrode 710, the organic emission layer 720, and the second electrode 730 may form an organic light emitting diode 70.

[0085] The organic light emitting diode display may have a structure of a front surface display type, a rear surface display type, and a double-sided display type, according to a direction of light emitted by the organic light emitting diode 70.

[0086] In the front surface display type, the first electrode 710 may be formed of a reflective layer, and the second electrode 730 may be formed of a semi-transmission layer or a transmission layer. In the case of the rear surface display type, the first electrode 710 may be formed of the semi-transmission layer, and the second electrode 730 may be formed of the reflective layer. In addition, in the case of the double-sided display type, the first electrode 710 and the second electrode 730 may both be formed of a transparent layer or the semi-transmission layer.

[0087] The reflective layer and the semi-transmission layer may be made by using one or more metals of magnesium (Mg), silver (Ag), gold (Au), calcium (Ca), lithium (Li), chromium (Cr), and aluminum (Al), or an alloy thereof. The reflective layer and the semi-transmission layer may be determined by the thickness, and the semi-transmission layer may be formed to have a thickness of about 200 nm or less. Transmittance of light may be increased as the thickness is reduced, but if the thickness is very small, resistance may be increased.

[0088] The transparent layer may be formed of a material such as ITO (indium tin oxide), IZO (indium zinc oxide), ZnO (zinc oxide), or In_2O_3 (indium oxide).

[0089] An encapsulation member (not illustrated) may be formed on the second electrode 730. The encapsulation member may be an inorganic layer or an organic layer, and may be alternately laminated. The encapsulation member may protect a pixel from the external air.

[0090] One or more organic layers and one or more inorganic layers may be alternately laminated. The inorganic layer or the organic layer may be each provided in plural.

[0091] The organic layer may be formed of a polymer. For example, the organic layer may be a single layer or a laminated layer formed of any one of polyethylene terephthalate, polyimide, polycarbonate, epoxy, polyethylene, and polyacrylate. In some embodiments, the organic layer may be formed of polyacrylate, and specifically, includes a matter where a monomer composition including a diacrylate-based monomer and a triacrylate-based monomer is polymerized. A monoacrylate-based monomer may be further included in the monomer composition. Further, a suitable photoinitiator such as TPO may be further included in the monomer composition, but is not limited thereto.

[0092] The inorganic layer may be a single layer or a laminated layer including metal oxide or metal nitride. For example, the inorganic layer may include any one of SiN_x, Al_2O_3, SiO_2, and TiO_2.

[0093] The uppermost layer, which is exposed to the outside, of the encapsulation member may be formed of the inorganic layer in order to help prevent permeation of moisture to the organic light emitting diode.

[0094] The encapsulation member may include at least one sandwich structure in which at least one organic layer is inserted between at least two inorganic layers. Further, the encapsulation member may include at least one sandwich structure in which at least one inorganic layer is inserted between at least two organic layers.

[0095] A halogenated metal layer (including, e.g., LiF) may be further included between the second electrode 730 and the inorganic layer. The halogenated metal layer may help prevent a display portion including the second electrode 730 from being damaged when the inorganic layer is formed by a sputtering manner or a plasma deposition manner.

[0096] The encapsulation member may be replaced by an encapsulation substrate such as a metal substrate or a glass substrate, instead of forming the organic layer and the inorganic layer.

[0097] By way of summation and review, in an organic light emitting diode display market, a flexible display device manufactured so as to be bendable by using a substrate of a flexible material that easily has a large area and is capable of being reduced in thickness and weight, such as plastic or foil, has been considered.

[0098] The flexible substrate may have a single layer or a plurality of layers. However, the flexible substrate may be exposed to repeated bending, due to a characteristic thereof. Thus, a rift may be formed between the flexible substrates formed of a plurality of layers due to the repeated bending.

[0099] The embodiments provide a flexible substrate, a method of manufacturing the same, and an organic light emitting diode display, in which a rift is not generated between flexible substrates formed of a plurality of layers due to repeated bending.

[0100] Manufacturing a flexible substrate according to an embodiment may help ensure that even though the flexible substrates formed of a plurality of layers are repeatedly bent, a rift may not be formed between the flexible substrates. Accordingly, it is possible to provide a high-quality organic light emitting diode display.

[0101] As discussed, embodiments of the invention provide a flexible substrate, comprising: a first flexible layer; a polysilicon layer on the first flexible layer, the polysilicon layer having a plurality of protrusions on a surface thereof; and a second flexible layer on the polysilicon layer.

[0102] Embodiments of the invention can also provide an organic light emitting diode display, comprising: a flexible substrate according to any of the above mentioned embodiments; a thin film transistor array over the flexible substrate; an organic light emitting diode connected to the thin film transistor array; and an encapsulation member over the organic light emitting diode.

[0103] Embodiments of the invention can also provide a method of manufacturing a flexible substrate, the method comprising: forming a first flexible layer on a support substrate; forming an amorphous silicon layer on the first flexible layer; crystallizing the amorphous silicon layer to form a polysilicon layer having a plurality of protrusions on a surface thereof; and forming a second flexible layer on the polysilicon layer.

[0104] 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 scope of the present invention as set forth in the following claims.

Claims

1. An organic light emitting diode display, comprising:

a flexible substrate;
a thin film transistor array comprising a semiconductor layer formed over the flexible substrate;
an organic light emitting diode (70) connected to the thin film transistor array; and
an encapsulation member over the organic light emitting diode (70); **characterized in that**: the flexible substrate comprises:

a first flexible layer (10);
a polysilicon layer (20) over the first flexible layer (10), the polysilicon layer (20) having a plurality of protrusions (7) on a surface thereof; and
a second flexible layer (30) directly on the polysilicon layer (20).

2. The organic light emitting diode display as claimed in claim 1, wherein the protrusions (7) are irregularly disposed on the polysilicon layer.

3. The organic light emitting diode display as claimed in claim 1, wherein the plurality of protrusions (7) are regularly arranged.

4. The organic light emitting diode display as claimed in any one of claims 1 to 3, wherein a height of each protrusion (7) is smaller than a thickness of the second flexible layer (30).

5. The organic light emitting diode display as claimed in any one of claims 1 to 4, further comprising a barrier layer (14) between the polysilicon layer (20) and the first flexible layer (10).

6. The organic light emitting diode display as claimed in claim 5, wherein the barrier layer (14) is formed of silicon oxide or silicon nitride.

7. The organic light emitting diode display as claimed in any one of claims 1 to 6, further comprising a barrier layer (14) on the second flexible layer (30), the second flexible layer (30) being between the barrier layer (14) and the polysilicon layer (20).

8. The organic light emitting diode display as claimed in any one of claims 1 to 7, wherein the first flexible layer (10) and the second flexible layer (20) are formed of polyimide.

9. A method of manufacturing an organic light emitting diode display, the method comprising:

forming a first flexible layer (10) on a support substrate;
forming an amorphous silicon layer on the first flexible layer (10);
crystallizing the amorphous silicon layer to form a polysilicon layer (20) having a plurality of protrusions on a surface thereof; and
forming a second flexible layer (30) directly on the polysilicon layer (20);
forming a thin film transistor array comprising a semiconductor layer over the second flexible layer (30);
forming an organic light emitting diode (70) connected to the thin film transistor array; and
forming an encapsulation member over the organic light emitting diode (70).

10. The method of manufacturing a flexible substrate as claimed in claim 9, wherein the first flexible layer (10) and the second flexible layer (30) are formed by a solution process.

11. The method of manufacturing a flexible substrate as claimed in claim 9, wherein the crystallization is performed by an excimer laser annealing method or a sequential lateral solidification method.

12. The method of manufacturing a flexible substrate as claimed in claim 11, wherein the crystallization is performed by the excimer laser annealing method such that the plurality of protrusions are irregularly disposed on the polysilicon layer.

13. The method of manufacturing a flexible substrate as claimed in claim 11, wherein the crystallization is performed by the sequential lateral solidification method such that the plurality of protrusions are regularly arranged.

Patentansprüche

1. Anzeigeeinrichtung mit organischer lichtemittierender Diode, umfassend:

ein flexibles Substrat;
eine Dünnschichttransistoranordnung, die eine Halbleiterschicht umfasst, die über dem flexiblen Substrat ausgebildet ist;
eine organische lichtemittierende Diode (70), die mit der Dünnschichttransistoranordnung verbunden ist; und
ein Verkapselungselement über der organischen lichtemittierenden Diode (70);
dadurch gekennzeichnet, dass das flexible Substrat umfasst:

eine erste flexible Schicht (10);
eine Polysiliciumschicht (20) über der ersten flexiblen Schicht (10), wobei die Polysiliciumschicht (20) auf einer Oberfläche eine Mehrzahl von Vorsprüngen (7) aufweist;

und
eine zweite flexible Schicht (30) direkt auf der Polysiliciumschicht (20).

2. Anzeigeeinrichtung mit organischer lichtemittierender Diode nach Anspruch 1, wobei die Vorsprünge (7) unregelmäßig auf der Polysiliciumschicht angeordnet sind.

3. Anzeigeeinrichtung mit organischer lichtemittierender Diode nach Anspruch 1, wobei die Mehrzahl von Vorsprüngen (7) regelmäßig angeordnet ist.

4. Anzeigeeinrichtung mit organischer lichtemittierender Diode nach einem der Ansprüche 1 bis 3, wobei eine Höhe jedes Vorsprungs (7) geringer ist als eine Dicke der zweiten flexiblen Schicht (30).

5. Anzeigeeinrichtung mit organischer lichtemittierender Diode nach einem der Ansprüche 1 bis 4, die ferner zwischen der Polysiliciumschicht (20) und der ersten flexiblen Schicht (10) eine Barriereschicht (14) umfasst.

6. Anzeigeeinrichtung mit organischer lichtemittierender Diode nach Anspruch 5, wobei die Barriereschicht (14) aus Siliciumoxid oder Siliciumnitrid ausgebildet ist.

7. Anzeigeeinrichtung mit organischer lichtemittierender Diode nach einem der Ansprüche 1 bis 6, die ferner auf der zweiten flexiblen Schicht (30) eine Barriereschicht (14) umfasst, wobei die zweite flexible Schicht (30) sich zwischen der Barriereschicht (14) und der Polysiliciumschicht (20) befindet.

8. Anzeigeeinrichtung mit organischer lichtemittierender Diode nach einem der Ansprüche 1 bis 7, wobei die erste flexible Schicht (10) und die zweite flexible Schicht (20) aus Polyimid ausgebildet sind.

9. Verfahren zur Herstellung einer Anzeigeeinrichtung mit organischer lichtemittierender Diode, wobei das Verfahren umfasst:

Ausbilden einer ersten flexiblen Schicht (10) auf einem Trägersubstrat;
Ausbilden einer Schicht aus amorphem Silicium auf der ersten flexiblen Schicht (10);
Kristallisieren der Schicht aus amorphem Silicium, um eine Polysiliciumschicht (20) auszubilden, die auf einer Oberfläche eine Mehrzahl von Vorsprüngen aufweist; und
Ausbilden einer zweiten flexiblen Schicht (30) direkt auf der Polysiliciumschicht (20);
Ausbilden einer Dünnschichttransistoranordnung, die eine Halbleiterschicht umfasst, über der zweiten flexiblen Schicht (30);
Ausbilden einer organischen lichtemittierenden Diode (70), die mit der Dünnschichttransistoranordnung verbunden ist; und
Ausbilden eines Verkapselungselements über der organischen lichtemittierenden Diode (70).

10. Verfahren zur Herstellung eines flexiblen Substrats nach Anspruch 9, wobei die erste flexible Schicht (10) und die zweite flexible Schicht (30) durch einen Lösungsprozess ausgebildet werden.

11. Verfahren zur Herstellung eines flexiblen Substrats nach Anspruch 9, wobei die Kristallisation mit einem Excimerlaser-Ausheilverfahren oder einem Verfahren des sequenziellen lateralen Wachstums erfolgt.

12. Verfahren zur Herstellung eines flexiblen Substrats nach Anspruch 11, wobei die Kristallisation mit dem Excimerlaser-Ausheilverfahren derart erfolgt, dass die Mehrzahl von Vorsprüngen unregelmäßig auf der Polysiliciumschicht angeordnet wird.

13. Verfahren zur Herstellung eines flexiblen Substrats nach Anspruch 11, wobei die Kristallisation mit dem Verfahren des sequenziellen lateralen Wachstums derart erfolgt, dass die Mehrzahl von Vorsprüngen regelmäßig angeordnet wird.

Revendications

1. Dispositif d'affichage à diodes électroluminescentes organiques comprenant :

un substrat flexible ;
un réseau de transistors à film mince comprenant une couche de semi-conducteur formé audessus du substrat flexible ;
une diode électroluminescente organique (70) connectée au réseau de transistors à film mince ; et
une chambre d'encapsulation au-dessus de la diode électroluminescente organique (70) ;
caractérisé en ce que le substrat flexible comprend :

une première couche flexible (10) ;
une couche de polysilicium (20) au-dessus de la première couche flexible (10), la couche de polysilicium (20) ayant une pluralité de saillies (7) sur une surface de celle-ci ; et
une deuxième couche flexible (30) directement sur la couche de polysilicium (20).

2. Dispositif d'affichage à diodes électroluminescentes organiques selon la revendication 1, dans lequel les saillies (7) sont disposées irrégulièrement sur la couche de polysilicium.

3. Dispositif d'affichage à diodes électroluminescentes organiques selon la revendication 1, dans lequel la pluralité de saillies (7) sont disposées régulièrement.

4. Dispositif d'affichage à diodes électroluminescentes organiques selon l'une quelconque des revendications 1 à 3, dans lequel la hauteur de chaque saillie (7) est inférieure à l'épaisseur de la deuxième couche flexible (30).

5. Dispositif d'affichage à diodes électroluminescentes organiques selon l'une quelconque des revendications 1 à 4, comprenant en outre une couche de barrière (14) entre la couche de polysilicium (20) et la première couche flexible (10).

6. Dispositif d'affichage à diodes électroluminescentes organiques selon la revendication 5, dans lequel la couche de barrière (14) est formée d'oxyde de silicium ou de nitrure de silicium.

7. Dispositif d'affichage à diodes électroluminescentes organiques selon l'une quelconque des revendications 1 à 6, comprenant en outre une couche de barrière (14) sur la deuxième couche flexible (30), la deuxième couche flexible (30) étant située entre la couche de barrière (14) et la couche de polysilicium (20).

8. Dispositif d'affichage à diodes électroluminescentes organiques selon l'une quelconque des revendications 1 à 7, dans lequel la première couche flexible (10) et la deuxième couche flexible (20) sont formées de polyimide.

9. Procédé de fabrication d'un dispositif d'affichage à diodes électroluminescentes organiques, le procédé comprenant :

   la formation d'une première couche flexible (10) sur un substrat de support ;
   la formation d'une couche de silicium amorphe sur la première couche flexible (10) ;
   la cristallisation de la couche de silicium amorphe pour former une couche de polysilicium (20) ayant une pluralité de saillies sur une surface de celle-ci ; et
   la formation d'une deuxième couche flexible (30) directement sur la couche de polysilicium (20) ;
   la formation d'un réseau de transistors à film mince comprenant une couche de semi-conducteur au-dessus de la deuxième couche flexible (30) ;
   la formation d'une diode électroluminescente organique (70) connectée au réseau de transistors à film mince ; et
   la formation d'un élément d'encapsulation au-dessus de la diode électroluminescente organique (70).

10. Procédé de fabrication d'un substrat flexible selon la revendication 9, dans lequel la première couche flexible (10) et la deuxième couche flexible (30) sont formées par un procédé en solution.

11. Procédé de fabrication d'un substrat flexible selon la revendication 9, dans lequel la cristallisation est effectuée au moyen d'un procédé de recuit à laser excimère ou un procédé de solidification latérale séquentielle.

12. Procédé de fabrication d'un substrat flexible selon la revendication 11, dans lequel la cristallisation est effectuée au moyen du procédé de recuit à laser excimère de façon que la pluralité de saillies soient disposées irrégulièrement sur la couche de polysilicium.

13. Procédé de fabrication d'un substrat flexible selon la revendication 11, dans lequel la cristallisation est effectuée au moyen du procédé de solidification latérale séquentielle de façon que la pluralité de saillies soient disposées régulièrement.

FIG. 1

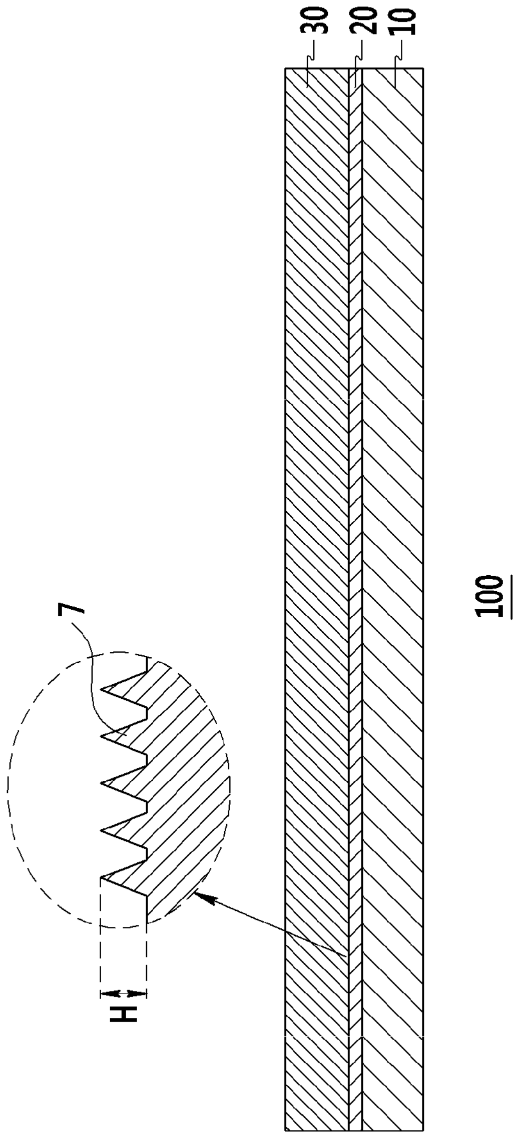


FIG. 2

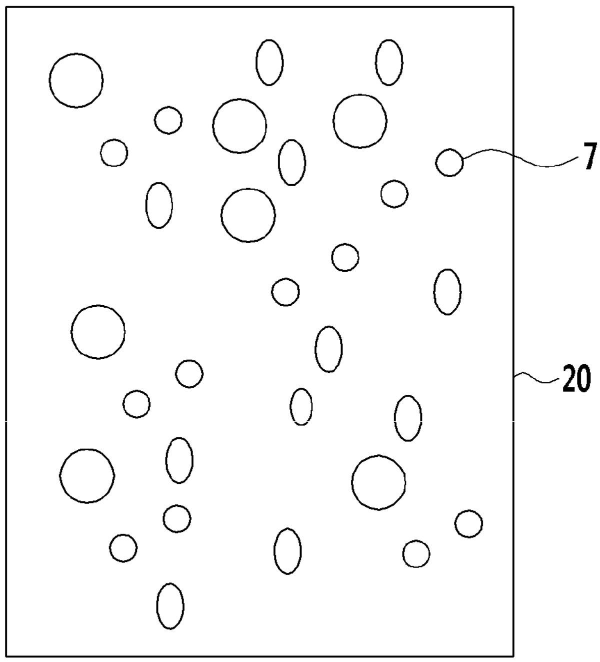


FIG. 3

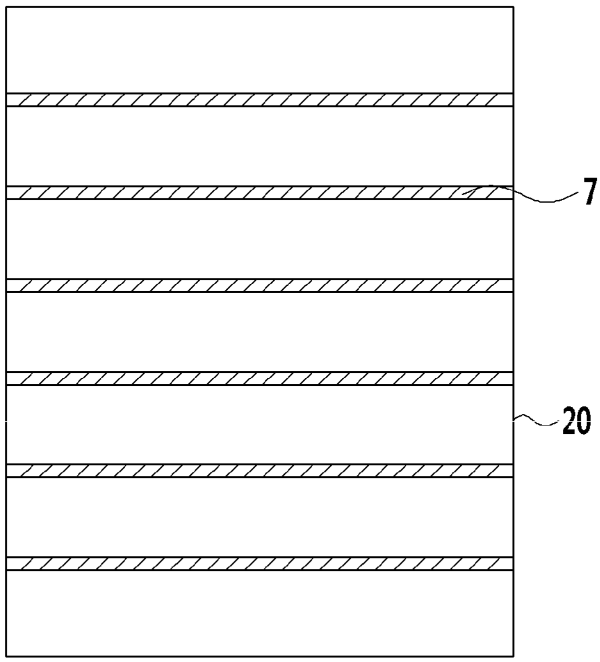


FIG. 4

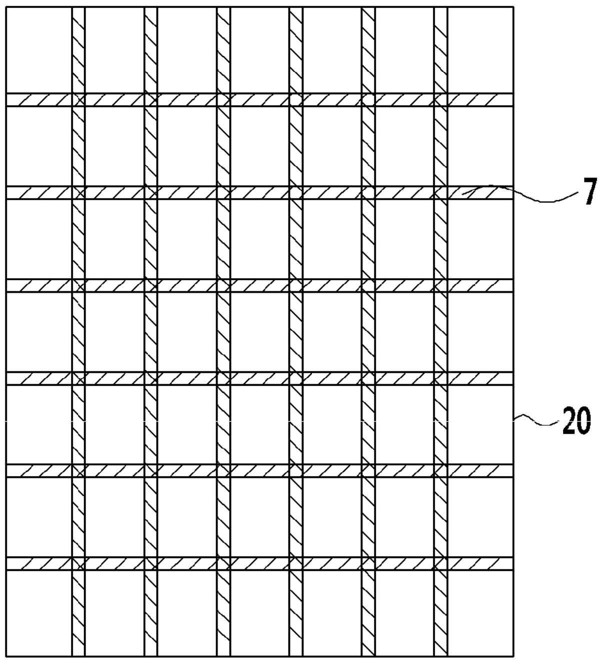


FIG. 5

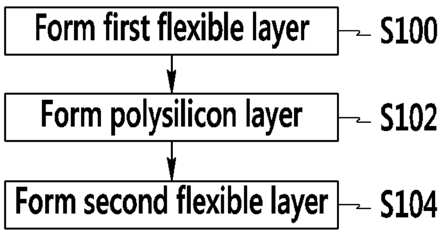

Form first flexible layer
S100
Form polysilicon layer
S102
Form second flexible layer
S104

FIG. 6

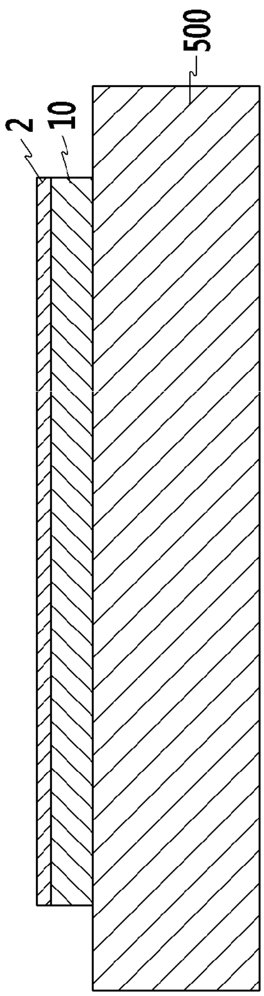


FIG. 7

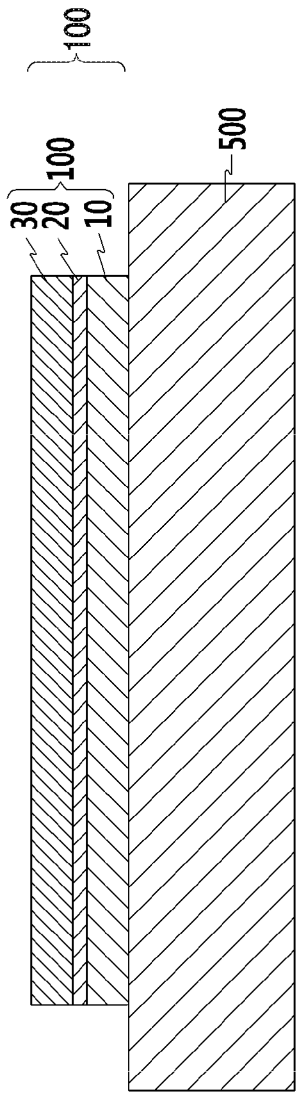


FIG. 8

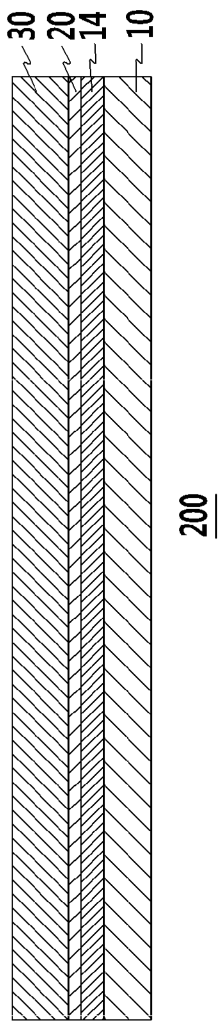


FIG. 9

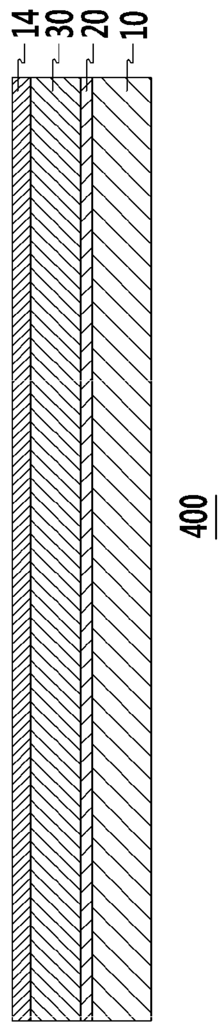


FIG. 10

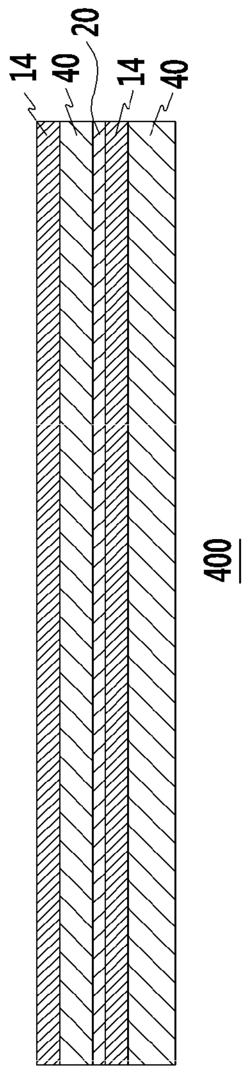


FIG. 11

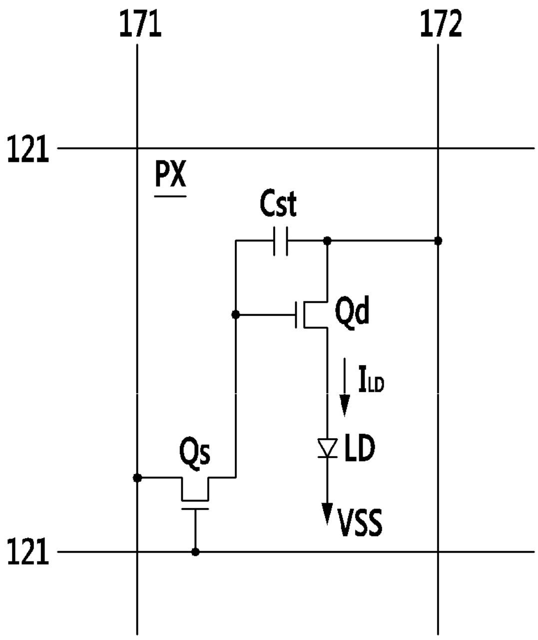
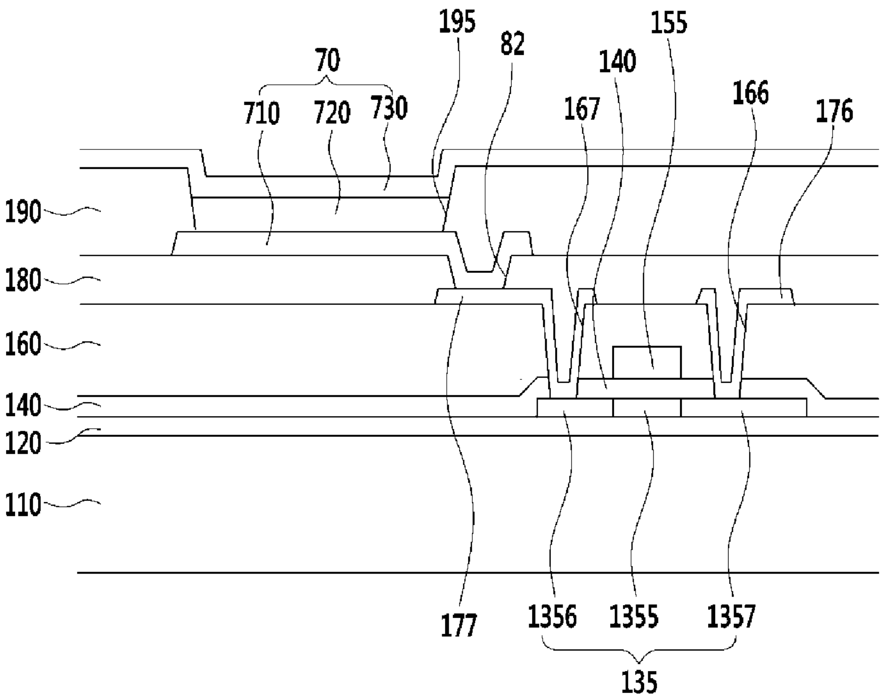


FIG. 12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1357
135

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 2013062659 A **[0002]**
- US 2006131585 A **[0003]**

专利名称(译)	具有柔性基板的有机发光二极管显示器及其制造方法		
公开(公告)号	EP2790237B1	公开(公告)日	2017-11-29
申请号	EP2014152182	申请日	2014-01-22
[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.		
[标]发明人	KIM YONG JIN JUN SANG HYUN		
发明人	KIM, YONG JIN JUN, SANG-HYUN		
IPC分类号	H01L51/52 H01L27/32		
CPC分类号	H01L27/3244 H01L51/0097 H01L2251/5338 Y02E10/549 Y02P70/521 Y10T428/24612 G09F9/301 G09G3/3208 H01L21/02381 H01L21/02595 H01L21/02675 H01L51/56 H01L2227/323 H01L2251/566		
优先权	1020130040651 2013-04-12 KR		
其他公开文献	EP2790237A2 EP2790237A3		
外部链接	Espacenet		

摘要(译)

一种柔性基板（100），其制造方法以及有机发光二极管显示器，所述柔性基板（100）包括第一柔性层（10）;第一柔性层上的多晶硅层（20），多晶硅层（20）在其表面上具有多个突起（7）;多晶硅层上的第二柔性层（30）。

FIG. 1