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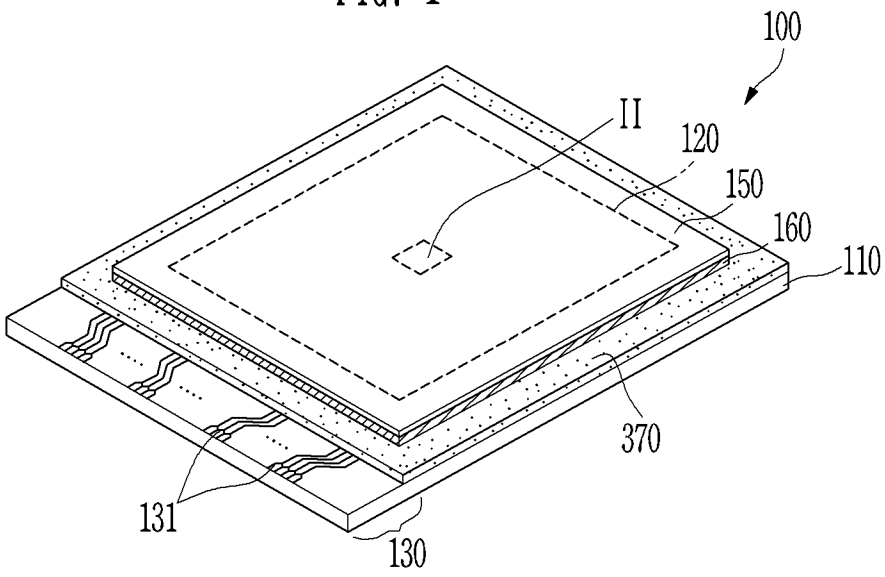
(54) Light emitting display and method of manufacturing the same

(57) A method of manufacturing a light emitting display including an image display part (120) formed on a substrate (110) and a pad part (130) including at least one terminal (131) electrically connected to the image display part. The method includes forming thin film transistors and at least one electroluminescent device electrically connected to the thin film transistors and including a first electrode layer, an emission layer, and a second electrode layer on the image display part, forming a protection layer (370) on the second electrode layer of the electroluminescent device and the pad part, sealing the image display part on the protection layer (150,160), and removing the protection layer formed at least on the pad part to expose the terminals. Therefore, it is possible to easily remove the protection layer formed of organic material or inorganic material formed on the pad part without an additional mask.

FIG. 1



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Description

BACKGROUND

1. Field of the Invention

[0001] The present invention relates to a light emitting display and a method of manufacturing the same, and more particularly to, a light emitting display capable of removing a protection layer formed on a pad part without using an additional mask and a method of manufacturing the same.

2. Discussion of Related Art

[0002] To manufacture a light emitting display, a semiconductor layer is formed by performing processes of providing a substrate, forming a buffer layer on the provided substrate, and forming an amorphous silicon layer on the buffer layer to crystallize the amorphous silicon layer. When the semiconductor layer is formed, a gate insulating layer is formed on the semiconductor layer, a metal layer is stacked on the gate insulating layer to form a gate electrode, and an interlayer insulating layer is formed on the gate electrode. After the interlayer insulating layer is formed, source and drain electrodes are formed on the interlayer insulating layer and an OLED is formed on the source and drain electrodes to be electrically connected to the source and drain electrodes.

[0003] In general, the OLED includes an anode electrode, an organic emission layer, and a cathode electrode. The anode electrode of the OLED is formed on the source and drain electrodes to be electrically connected to the source and drain electrodes. Next, the organic emission layer is formed on the anode electrode and the cathode electrode is formed on the organic emission layer. A passivation layer is formed on the cathode electrode in order to seal up the emission layer. When the passivation layer is used in order to seal up the emission layer, a terminal adjacent to the image display part of the light emitting display must be exposed for the module interface of the light emitting display. In order to expose the terminal, an additional mask or patterning process is required.

[0004] However, when the mask or the patterning process is used in order to expose the terminal, the increase in the components for arranging the mask to expose the electrode may make the equipment complicated. Also, because the mask for exposing the electrode is used, additional processes are required for providing the mask (such as cleansing, etching, and stripping processes) must be performed. Therefore, the number of processes increases so that productivity decreases.

SUMMARY OF THE INVENTION

[0005] A light emitting display capable of reducing the number of processes so that it is possible to improve productivity by performing processes simpler than conventional processes is provided and a method of manufacturing the same are provided.

[0006] According to an aspect of the present invention, there is provided a method of manufacturing a light emitting display including an image display part formed on a substrate and a pad part including at least one terminal electrically connected to the image display part. The method comprises: forming thin film transistors and at least one electroluminescent device electrically connected to the thin film transistors including a first electrode layer, an emission layer, and a second electrode layer on the image display part, forming a protection layer on the second electrode layer of the electroluminescent device and the pad part, sealing the image display part on the protection layer, and removing the protection layer formed at least on the pad part to expose the terminals.

[0007] During the removing of the protection layer, the protection layer formed in the region excluding the sealing region is preferably removed together with the protection layer formed on the pad part.

[0008] The protection layer is preferably formed of at least one of an inorganic layer and an organic layer. The thickness of the protection layer is preferably selected from the range of 600 to 1,300 angstroms (Å). In a very preferred embodiment the thickness of the protection layer is selected from the range of 800 to 1,100 angstroms (Å). An angstrom is a unit of length equal to one hundred-millionth of a centimeter. During the exposing of the terminals, the protection layer is preferably removed deeper than the selected thickness of the protection layer using an etching process. In a very preferred embodiment the protection layer is removed at least 10% deeper than the selected thickness of the protection layer using an etching process.

[0009] During the removing of the protection layer, the etching process is preferably wet etching. Buffer oxide etchant (BOE) is preferably used during the wet etching.

[0010] The method preferably further comprises a cleansing step after the protection layer is removed. In the cleansing step, cleansing solution including at least one from among a group including de-ionized water, alcoholic cleansing solution, and neutral detergent is preferably used.

[0011] According to another aspect of the present invention, there is provided a light emitting display including an image display part formed on a substrate and a pad part including at least one terminal electrically connected to the image display part, the light emitting display comprising thin film transistors formed on the image display part and at least one electroluminescent device electrically connected to the thin film transistors and including a first electrode layer, an emission layer, and a second electrode layer, a protection layer formed on the electroluminescent device and the pad part to expose the terminals, and a sealing panel formed on the image display part to surround the electroluminescent device.

Preferably the protection layer is formed of an inorganic

layer and/or an organic layer. Preferably the light emitting display further comprises a sealing member. Preferably the sealing member is disposed between the sealing panel and the protection layer. Preferably the thickness of the protection layer is in the range of 600 to 1,300 Å. In a very preferred embodiment the thickness of the protection layer is selected from the range of 800 to 1,100 angstroms (Å).

According to still another aspect of the present invention, there is provided a method of forming a light emitting display, the method comprising: forming a thin film transistor and an electroluminescent device electrically connected to the thin film transistor in an image display part; forming a protection layer over the image display part after the thin film transistor and the electroluminescent device are formed; sealing the image display part with a panel, the image display part including the thin film transistor and the electroluminescent device, after the protection layer is formed; and removing the protection layer from a pad part coupled to the image display part after the image display part is sealed.

[0012] Preferably the method further comprises: performing a cleansing process after the protection layer is removed. Preferably the step of removing the protection layer comprises removing a thickness of material greater than a thickness of the protection layer. In a very preferred embodiment the protection layer is removed at least 10% deeper than the selected thickness of the protection layer using an etching process.

Preferably the protection layer is formed with a thickness of 600 to 1300 Å. In a very preferred embodiment the thickness of the protection layer is selected from the range of 800 to 1,100 angstroms (Å). Preferably the protection layer is formed of an inorganic layer and/or an organic layer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] These and/or other aspects and features of the invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

[0014] FIG. 1 is a schematic perspective view of a light emitting display according to an embodiment of the present invention;

[0015] FIG. 2 schematically illustrates a pixel in the part II of the image display part of FIG. 1;

[0016] FIG. 3 is an enlarged side sectional view taken along the line III-III' of FIG. 2;

[0017] FIGs. 4A to 4D are plan views of a light emitting display that schematically illustrate processes of removing a protection layer formed on an organic light emitting diode (OLED) according to one embodiment;

[0018] FIG. 5A is a partially enlarged side sectional view of an embodiment of a pad part region that is taken along the line V-V' of FIG. 4B;

[0019] FIG. 5B is a partially enlarged side sectional view of another embodiment of the pad part region that is taken along a line equivalent to V-V' of FIG. 4B;

[0020] FIG. 6A is a partially enlarged side sectional view of an embodiment of a pad part region that is taken along the line VI-VI' of FIG. 4D; and

[0021] FIG. 6B is a partially enlarged side sectional view of another embodiment of the pad part region that is taken along a line equivalent to VI-VI' of FIG. 4D.

DETAILED DESCRIPTION

[0022] FIG. 1 is a schematic perspective view of a light emitting display according to an embodiment of the present invention. Referring to FIG. 1, a light emitting display 100 includes an image display part 120 including at least one electroluminescent device formed on a substrate 110 and a pad part 130 formed in at least one side outside the image display part 120. The image display part 120 includes transistors, an electroluminescent device, a capacitor, and a power source line (refer to FIG. 2). The pad part 130 includes scan/data drivers (not shown) for transmitting scan and/or data signals to pixels that constitute the image display part 120 and one or more terminals 131 for providing electrical signals to the image display part 120. A panel 150 is formed on the image display part 120 so that the image display part 120 is enclosed between the substrate 110 and the panel 150. The panel 150 and the substrate 110 are sealed to each other using a sealing member 160.

[0023] FIG. 2 schematically illustrates a pixel in part II of the image display part of FIG. 1. Referring to FIG. 2, the pixel includes two thin film transistors (TFT) 210 and 230 and a capacitor 250.

[0024] The first TFT 210 includes a gate electrode 211, a semiconductor layer 213, a source electrode 215, and a drain electrode 217. A data signal input through a data line 270 is transmitted from the source electrode 215 to the drain electrode 217 through the semiconductor layer 213. The expended part of the drain electrode 217 of the first TFT 210 is connected to the first electrode 251 of the capacitor 250. The other end of the first electrode 251 of the capacitor 250 forms the gate electrode 231 of the second TFT 230. The second electrode 253 of the capacitor 250 is electrically connected to a power source line 271 for supplying a power source.

[0025] FIG. 3 is an enlarged side sectional view that is taken along the line III-III' of FIG. 2. In FIG. 3, the sections in which the second TFT 230 is arranged, the part in which an electroluminescent device 290 is arranged, and the power source line 271 for supplying power source are illustrated in detail.

[0026] A buffer layer 320 is formed on the substrate 110 and the semiconductor layer 233 of the second TFT 230 is formed on the buffer layer 320. The semiconductor layer 233 may be formed of an amorphous silicon layer or a polycrystalline silicon layer. The semiconductor layer 233 commonly includes of source and drain regions doped with n+ or p+ type dopants and a channel region

that is not shown in the present embodiment. The gate electrode 231 of the second TFT 230 is formed on the semiconductor layer 233 and a gate insulating layer 330 for insulating the semiconductor layer 233 and the gate electrode 231 from each other is formed between the semiconductor layer 233 and the gate electrode 231. An interlayer insulating layer 340 is formed on the gate insulating layer 330 and the gate electrode 231. The source/drain electrodes 215 and 217 of the second TFT 230 are formed on the interlayer insulating layer 340 so that the source/drain electrodes 215 and 217 are electrically connected to the semiconductor layer 233.

[0027] A passivation layer 350 for protecting and/or planarizing the source/drain electrodes 215 and 217 is formed on the source/drain electrodes 215 and 217. The first electrode layer (anode electrode) 291 of the electroluminescent device 290 is formed on the passivation layer 350. The first electrode layer 291 is electrically connected to the source/drain electrodes 215 and 217 through a via hole 351 formed in the passivation layer 350. The first electrode layer 291 may be formed of a transparent electrode or a reflection electrode and a transparent electrode in accordance with top or bottom surface emission. The passivation layer 350 may be formed of inorganic or organic material as a single layer or a multi-layer. A pixel defining layer 360 in which an aperture 361 for at least partially exposing the first electrode layer 291 is formed on the passivation layer 350 and the first electrode layer 291 of the electroluminescent device 290.

[0028] An emission layer 293 is formed on the first electrode layer 291 exposed through the aperture 361. The emission layer 293 may be formed of a low molecule or high molecule organic film. When the emission layer 293 is formed of the low molecule organic film, the emission layer 293 may be used as a hole injecting layer (HIL), a hole transfer layer (HTL), an organic emission layer (EML), an electron transfer layer (ETL), and an electron injecting layer (EIL). When the emission layer 293 is formed of the high molecule organic film, the emission layer 293 may be commonly used as the HTL and the EML. A second electrode layer (cathode electrode) 295 is formed on the emission layer 293. In general, the second electrode layer 295 is deposited on the entire surface. However, it is not limited to the above. The second electrode layer 295 may be formed of Al, Ca, MgAg, Ag, and ITO in different manners in accordance with emission type.

[0029] On the other hand, a protection layer 370 for protecting the image display part 120 is formed on the second electrode layer 295. The protection layer 370 may be formed of organic material other than inorganic material such as SiO_2 and SiNx and may be formed of a single layer or a double layer including a SiNx layer in the lower part and an organic layer such as benzocyclobutene and acryl in the upper part. The thickness of the protection layer 370 may be selected in the range of 600 to 1,300 Å. According to the present embodiment, the protection layer 370 has one layer (such as SiO_2). However, it is not limited to the above. The protection layer 370 may be formed of a plurality of layers and may have various structures.

[0030] FIGs. 4A to 4D are plan views of a light emitting display that schematically illustrate processes of removing the protection layer formed on the image display part of the light emitting display according to one embodiment.

[0031] Referring to FIGs. 4A and 4B, the light emitting display 100 includes the image display part 120 formed on the substrate 110 and the pad part 130 including the plurality of terminals 131. The protection layer 370 is formed on the image display part 120 including the electroluminescent device 290 (refer to FIG. 3) formed on the substrate 110. The protection layer 370 is also formed on the pad part 130 of the light emitting display 100. That is, the protection layer 370 is formed on the entire surface of the substrate 110.

[0032] Referring to FIG. 4C, after the protection layer 370 is formed on the image display part 120 and the pad part 130, the sealing panel 150 formed to surround the image display part 120 is provided on the image display part 120 to seal the image display part 120. Referring to FIG. 4D, after the sealing panel 150 is provided on the image display part 120, the protection layer 370 formed on the pad part 130 is removed using the sealing panel 150 as a mask. The protection layer 370 formed outside the sealed region, that is, the areas on the substrate 110 around the panel 150, including the pad part 130, is removed from each of these areas simultaneously. No less than the selected thickness of the protection layer 370 is removed from the protection layer 370 formed outside the sealing region.

[0033] Hereinafter, the side sectional structures of the pad part region in which the protection layer is formed and the pad part region from which the protection layer is removed will be described in detail with reference to the attached drawings. First, the pad part region in which the protection layer is formed will be described.

[0034] FIG. 5A is a partially enlarged side sectional view of the pad part region taken along the line of V-V' of FIG. 4B according to an embodiment.

FIG. 5B is a partially enlarged side sectional view of a pad part region taken along a line equivalent to V-V' of FIG. 4B according to another embodiment.

[0035] Referring to FIG. 5A, the pad part 130 includes the buffer layer 320 formed on the substrate 110, the gate insulating layer 330, the interlayer insulating layer 340, the terminal units 131, the passivation layer 350, the pixel defining layer 360, and the protection layer 370. To be specific, the gate insulating layer 330 is formed on the buffer layer 320 and the interlayer insulating layer 340 is formed on the gate insulating layer 340. In general, since the terminal units 131 are formed together with source and drain electrodes 235 and 237 when the source and drain electrodes 235 and 237 are formed, the terminal units 131 are formed on the interlayer insulating layer 340. The passivation layer 350, the pixel defining

layer 360, and the protection layer 370 are sequentially stacked on the terminal units 131 and the interlayer insulating layer 340.

[0036] Referring to FIG. 5B, the pad part 130 according to the present embodiment includes the buffer layer 320 formed on the substrate 110, the gate insulating layer 330, the interlayer insulating layer 340, terminal units 531a and 531b, the passivation layer 550, the pixel defining layer 560, and the protection layer 570. To be specific, the gate insulating layer 330 is formed on the buffer layer 320 and the interlayer insulating layer 340 is formed on the gate insulating layer 330. According to the present embodiment, each of the terminal units 531 includes a first terminal unit 531a formed together with the source and drain electrodes 235 and 237 when the source and drain electrodes 235 and 237 are formed and a second terminal unit 531b formed together with an anode electrode.

[0037] The first terminal units 531a are formed on the interlayer insulating layer 341. The passivation layer 550 and the pixel defining layer 560 are formed on the first terminal units 531a and the interlayer insulating layer 341. The second terminal units 531b are formed on the pixel defining layer 560 to be electrically connected to the first terminal units 531a. According to such a structure, the protection layer 570 is formed on the second terminal units 531b.

[0038] FIG. 6A is a partially enlarged side sectional view of the pad part region taken along the line VI-VI' of FIG. 4D according to an embodiment. FIG. 6B is a partially enlarged side sectional view of the pad part region taken along a line equivalent to VI-VI' of FIG. 4D according to another embodiment.

[0039] Referring to FIGs. 6A and 6B, the protection layer 370, 570 formed on the terminal units 131, 531 is removed to expose the terminal units 131, 531. According to one embodiment, in order to remove the protection layer 370, 570, etching, in particular, wet etching is performed on the protection layer 370, 570 using reactant material that reacts to the protection layer 370, 570 formed of SiO_2 and SiNx. To be specific, when wet etching is performed on the protection layer 370, 570 formed of SiO_2, a solvent such as hydrogen fluoride (HF) diluted to predetermined density may be used.

[0040] In general, etching rates vary with the degree of dilution of HF. When the etching rate is excessively high, it is difficult to control an etching process. Therefore, in order to prevent the etching rate from being excessively high, buffered oxide etchant (BOE) that is diluted such as buffered HF is used. Next, in order to remove the etching solvent that resides on the pad part 130, a cleansing process is performed. In the cleansing process, a cleansing solution including at least one among de-ionized water, an alcoholic cleansing solution, and a neutral detergent is used. In FIGs. 6A and 6B, the protection layer 370, 570 is removed using the wet etching process and the terminal units 131, 531 formed in the pad part 130 are exposed. On the other hand, when the protection layer 370, 570 formed on the pad part 130 is etched, the protection layer 370, 570 is etched deeper than the deposition thickness of the protection layer 370, 570 selected in the range of 600 to 1,300 Å so that it is possible to prevent the protection layer 370, 570 from residing on the terminal units 131, 531. On the other hand, in FIG. 6A, the etching process is performed so that the passivation layer 350 and the pixel defining layer 360 are removed together with the protection layer 370.

[0041] According to the above-described embodiments, the multi-layer terminal units, in which the source and drain electrodes are formed together with the terminal units, the source and drain electrodes are formed together with the first terminal units, and the anode electrode are formed together with the second terminal units, are disclosed. However, the terminal units may be formed using the gate electrode. When the terminal units are formed using the gate electrode, it is also possible to form the multi-layer terminal units as well as the single layer terminal units.

[0042] The embodiments of the present invention are not limited to the above-described embodiments. According to the above-described embodiments, an AM driving type organic field emission display is disclosed. However, various modifications such as an inorganic field emission display and a PM driving type organic field emission display may be obtained.

[0043] According to the above-described embodiments, an example in which the protection layer formed of SiO_2 is wet etched was described in detail. However, different etching solutions may be used in accordance with inorganic material and organic material.

[0044] Also, according to the above-described embodiments, the example in which the first electrode layer is used as the anode electrode was disclosed. However, the embodiments of the present invention are not limited to the above and the first electrode layer may be used as a cathode electrode layer.

[0045] As described above, according to the embodiments of the present invention, the protection layer may be formed on the image display part and the pad part so that it is possible to easily protect the second electrode of the electroluminescent device.

[0046] Also, after the panel for sealing the image display part is formed on the image display part where the protection layer is formed, the protection layer formed on the pad part may be removed. Therefore, an additional mask is not required so that it is possible to significantly reduce the number of manufacturing processes. Since the number of masks is reduced, it is also possible to reduce the complex processes used in the respective mask steps (such as cleansing, etching, and strip processes). As a result, it is possible to reduce manufacturing expenses and to improve productivity.

[0047] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit of the invention. Thus, it is intended that the present invention

cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

Claims

1. A method of manufacturing a light emitting display (100) comprising an image display part (120) formed on a substrate (110) and a pad part (130) which comprises at least one terminal (131) electrically connected to the image display part (120), the method comprising:

   forming at least one thin film transistor (210, 230) and at least one electroluminescent device (290) electrically connected to the at least one thin film transistor (210, 230), the at least one electroluminescent device (290) comprising a first electrode layer (291), an emission layer (293), and a second electrode layer (295) arranged on the image display part (120);
   forming a protection layer (370) on the second electrode layer (295) of the electroluminescent device (290) and on the pad part (130);
   sealing the image display part (120) on the protection layer (370); and
   removing at least the part of the protection layer (370) which is formed on the pad part (130) for exposing the at least one terminal (131).

2. The method of claim 1, wherein the step of removing the protection layer (370) comprises removing the protection layer (370) formed in a region excluding a sealed region (150) together with the protection layer (370) formed on the pad part (130).

3. The method according to at least one of claims 1 and 2, wherein the protection layer (370) is formed of an inorganic layer and/or an organic layer.

4. The method according to at least one of claims 1 to 3, wherein the protection layer (370) is formed with a thickness between 600 and 1.300 Å.

5. The method according to at least one of claims 1 to 4, wherein the protection layer (370) is removed deeper than a thickness of the protection layer (370) using an etching process.

6. The method of claim 5, wherein the etching process comprises a wet etching process.

7. The method of claim 6, wherein a buffer oxide etchant (BOE) is used during the wet etching process.

8. The method according to at least one of claims 1 to 7, further comprising: cleansing process after the protection layer (370) is removed.

9. The method of claim 8, wherein a cleansing solution including de-ionized water, an alcoholic cleansing solution, and/or a neutral detergent is used.

10. A light emitting display (100) comprising an image display part (120) formed on a substrate (110) and a pad part (130) comprising at least one terminal (131) electrically connected to the image display part (120), the light emitting display (100) comprising:

    at least one thin film transistor (210, 230) formed on the image display part (120) and at least one electroluminescent device (290) electrically connected to the at least one thin film transistor (210, 230), the at least one electroluminescent device (290) comprising a first electrode layer (291), an emission layer (293), and a second electrode layer (295);
    a protection layer (370) arranged on the electroluminescent device (290) such that the at least one terminal (131) is exposed; and
    a sealing panel (150) formed on the image display part (120) to surround the electroluminescent device (290).

11. The light emitting display of claim 10, wherein the protection layer (370) is formed of an inorganic layer and/or an organic layer.

12. The light emitting display according to at least one of the claims 10 and 11, further comprising a sealing member (160).

13. The light emitting display according to at least one of the claims 10 to 12, wherein the sealing member (160) is disposed between the sealing panel (150) and the protection layer (370).

14. The light emitting display according to at least one of the claims 10 to 13, wherein the protection layer (370) comprises a thickness between 600 and 1.300 Å.

FIG. 1

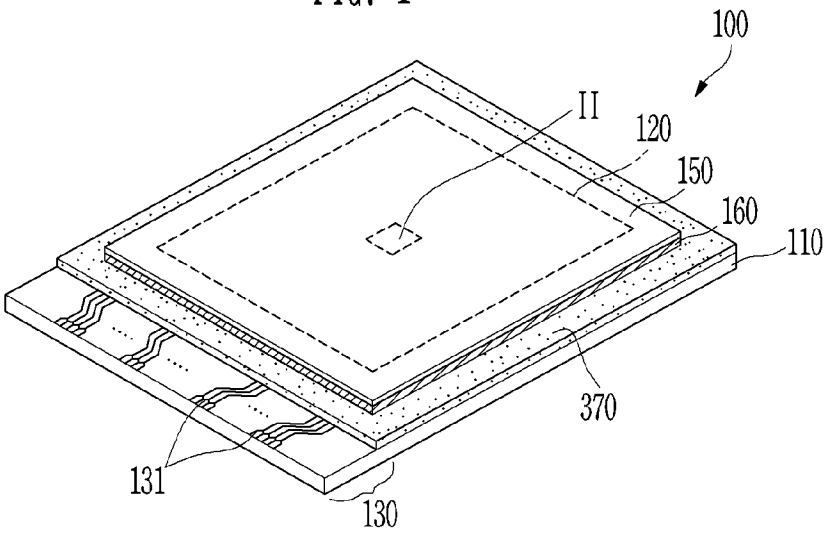

100
II
120
150
160
110
370
131
130

FIG. 2

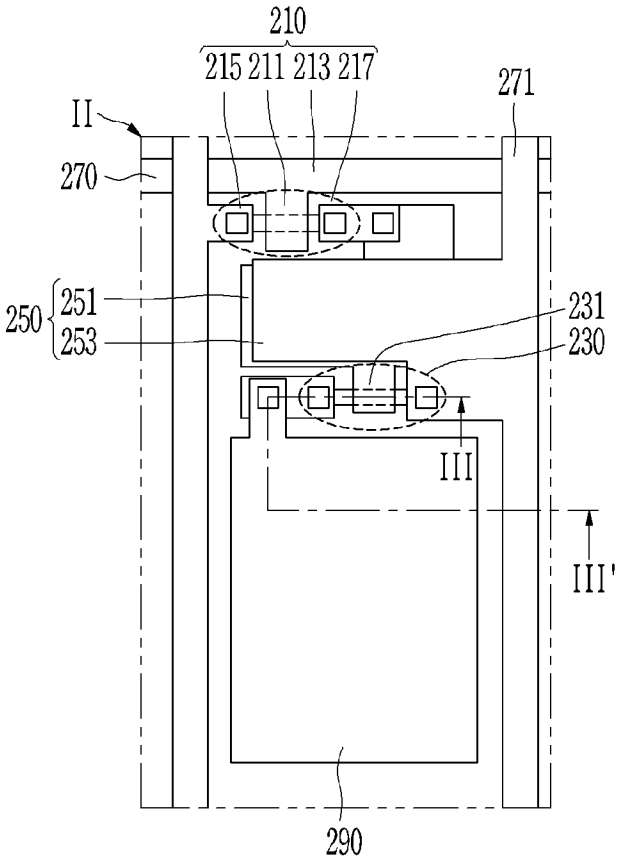

210
215 211 213 217
271
II
270
250
251
253
231
230
III
III'
290

FIG. 3

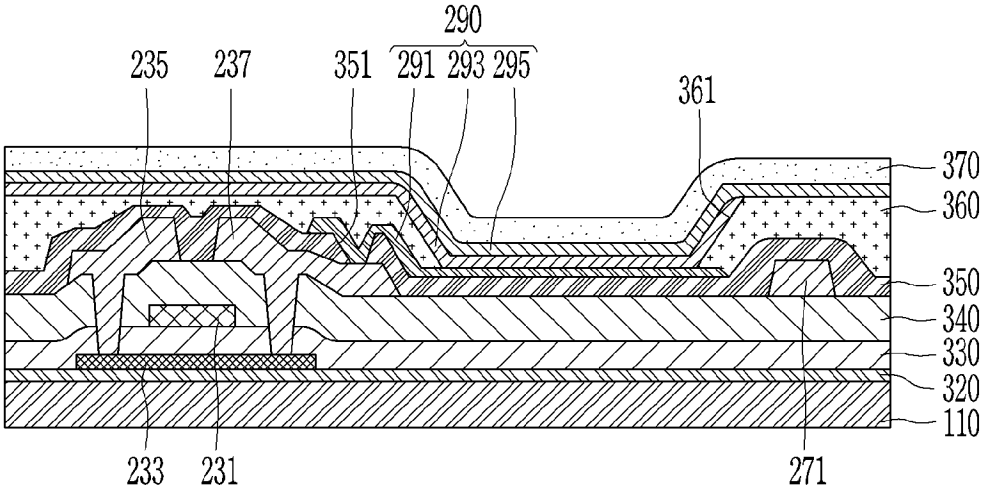

290
235
237
351
291
293
295
361
370
360
350
340
330
320
110
233
231
271

FIG. 4A

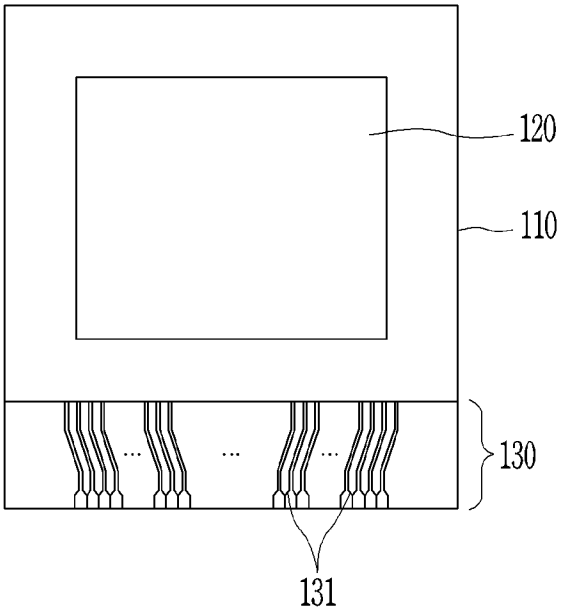

120
110
130
131

FIG. 4B

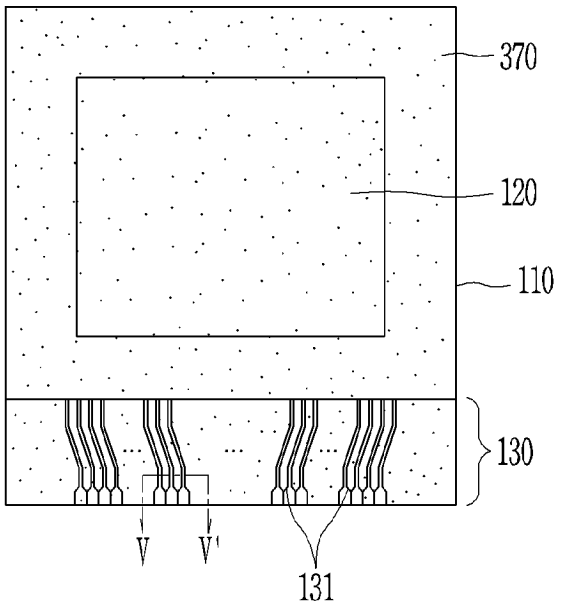


FIG. 4C

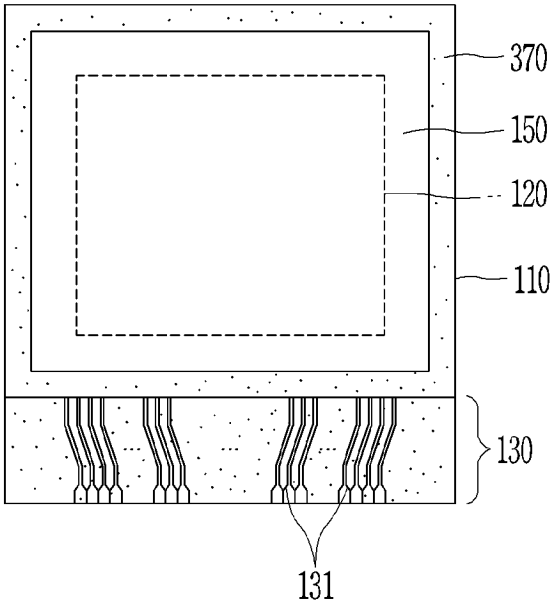


FIG. 4D

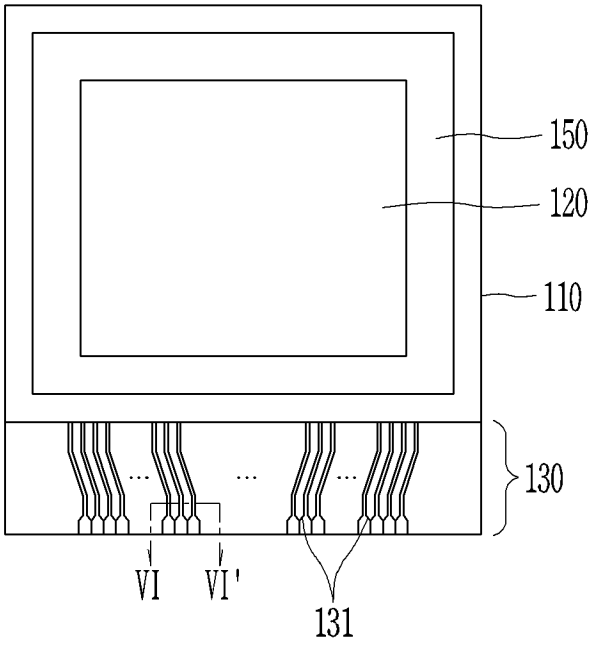


FIG. 5A

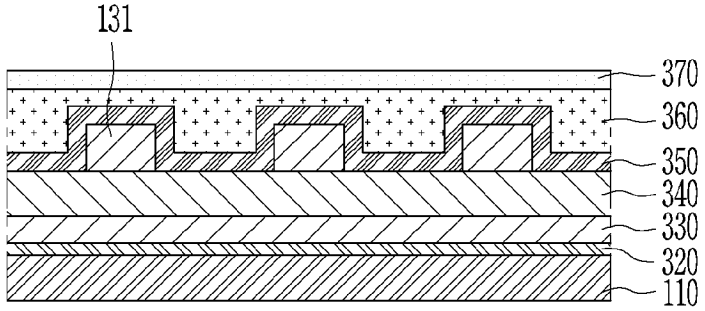


FIG. 5B

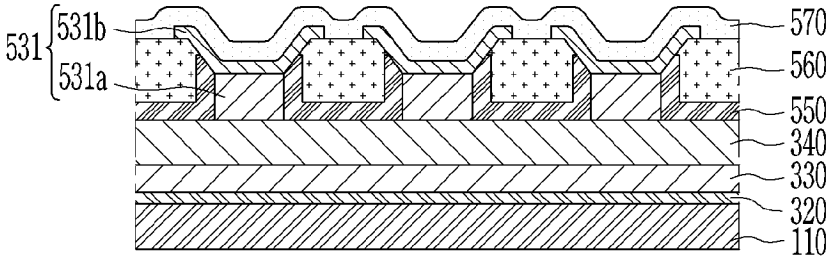


FIG. 6A

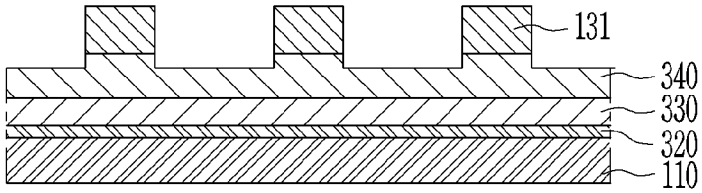
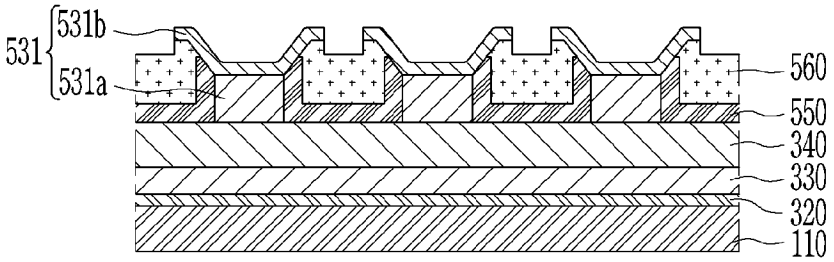


FIG. 6B



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 11 1735

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y	* paragraphs [0067], [0134] - [0143]; figures 9a,9b *	1,3	ADD. H01L27/32

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28 June 2006	De Laere, A

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

专利名称(译)	发光显示器及其制造方法		
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申请(专利权)人(译)	三星SDI CO.，LTD.		
当前申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
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摘要(译)

一种制造发光显示器的方法，包括形成在基板（110）上的图像显示部分（120）和焊盘部分（130），焊盘部分（130）包括电连接到图像显示部分的至少一个端子（131）。该方法包括形成薄膜晶体管和至少一个电连接到薄膜晶体管并且在图像显示部分上包括第一电极层，发光层和第二电极层的电致发光器件，形成保护层（370）。电致发光器件的第二电极层和焊盘部分，将图像显示部分密封在保护层（150,160）上，并去除至少在焊盘部分上形成的保护层，以暴露端子。因此，可以容易地去除由在焊盘部分上形成的有机材料或无机材料形成的保护层而无需额外的掩模。