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(54) **DISPLAY DEVICE AND MANUFACTURING METHOD OF DISPLAY DEVICE**

(71) Applicant: **Japan Display Inc.**, Tokyo (JP)

(72) Inventor: **Hiroki OHARA**, Tokyo (JP)

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(57) **ABSTRACT**

A display device includes a first substrate, a display region with pixels each including a light emitting element above the first substrate, a first inorganic insulating layer covering the display region, a first organic insulating layer on the first inorganic insulating layer, a second inorganic insulating layer on the first organic insulating layer, a second organic insulating layer on the second inorganic insulating layer, a third organic insulating layer a on the second organic insulating layer, acidity of the third organic insulating layer being stronger than acidity of the second organic insulating layer, and a polarizing plate arranged on the third organic insulating layer.

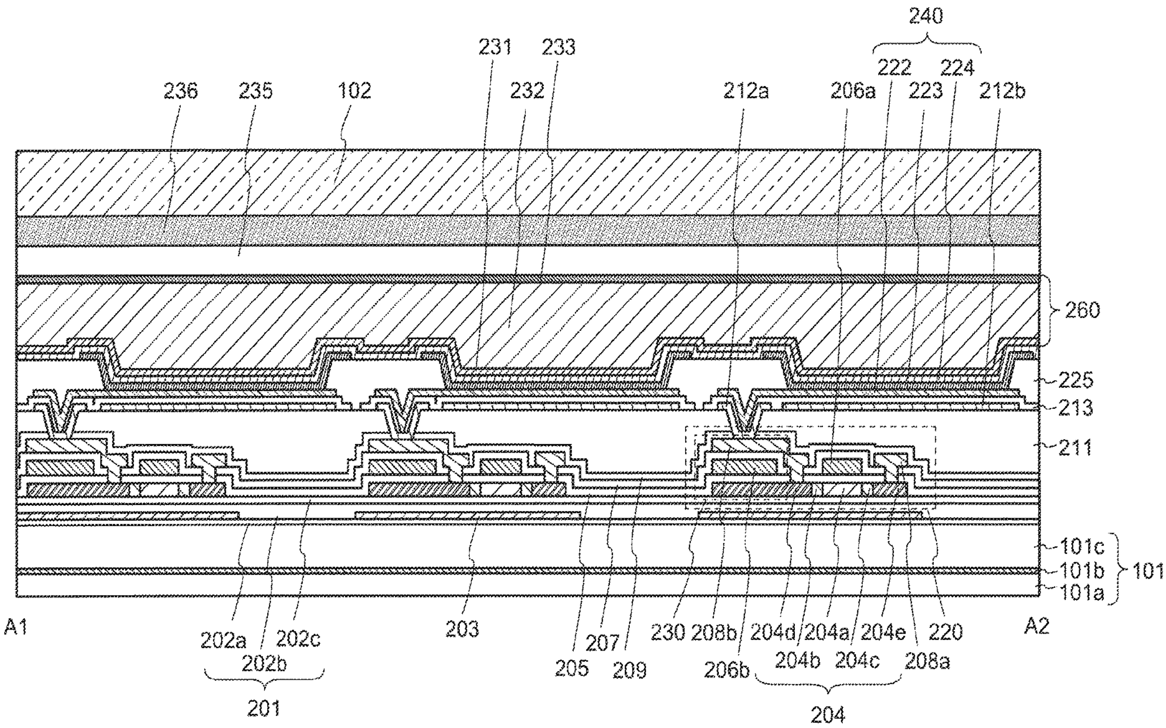
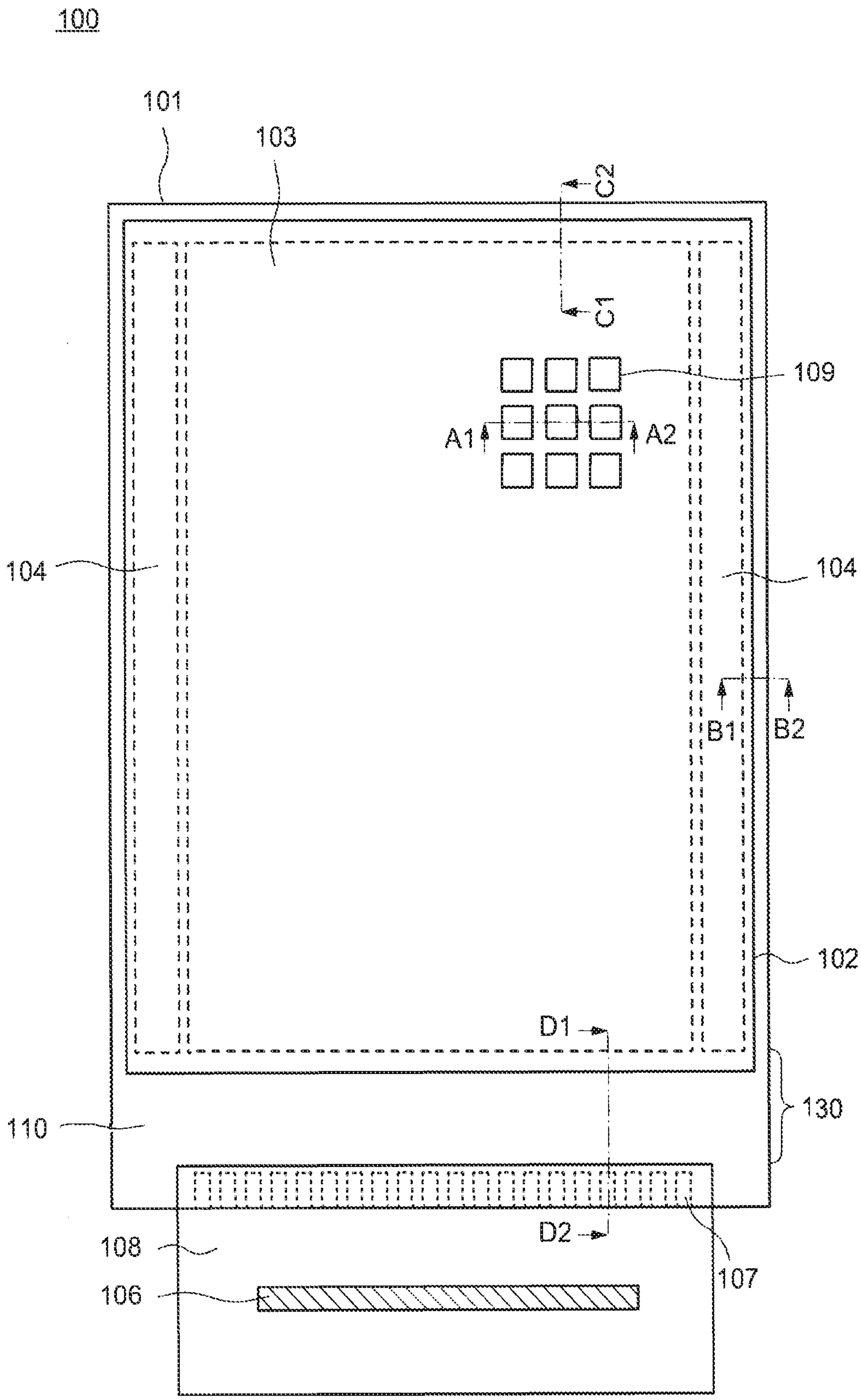


Fig. 1


100
101
103
C2
C1
109
A1
A2
104
104
B1
B2
102
D1
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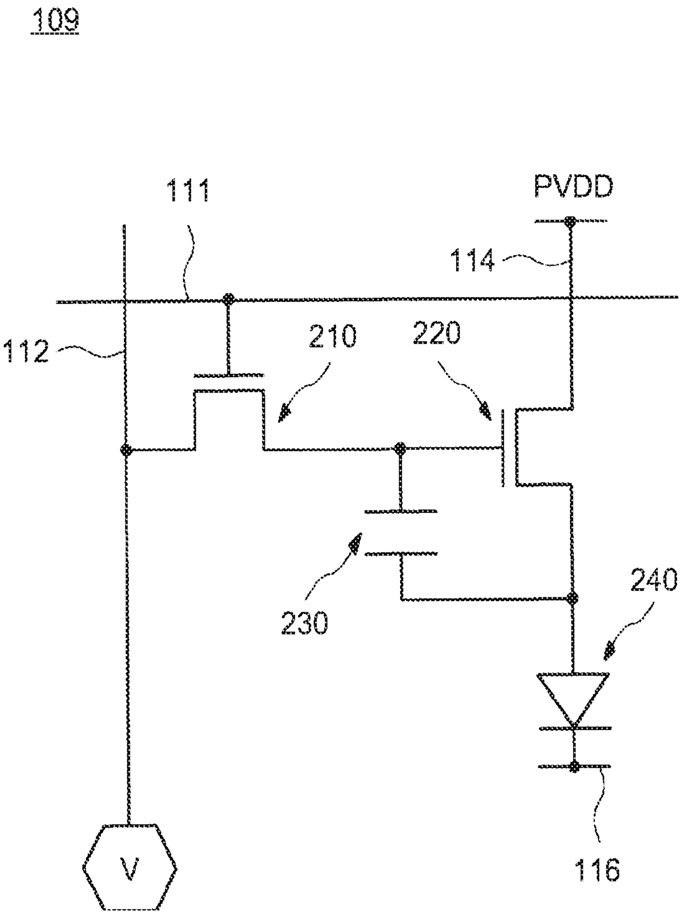
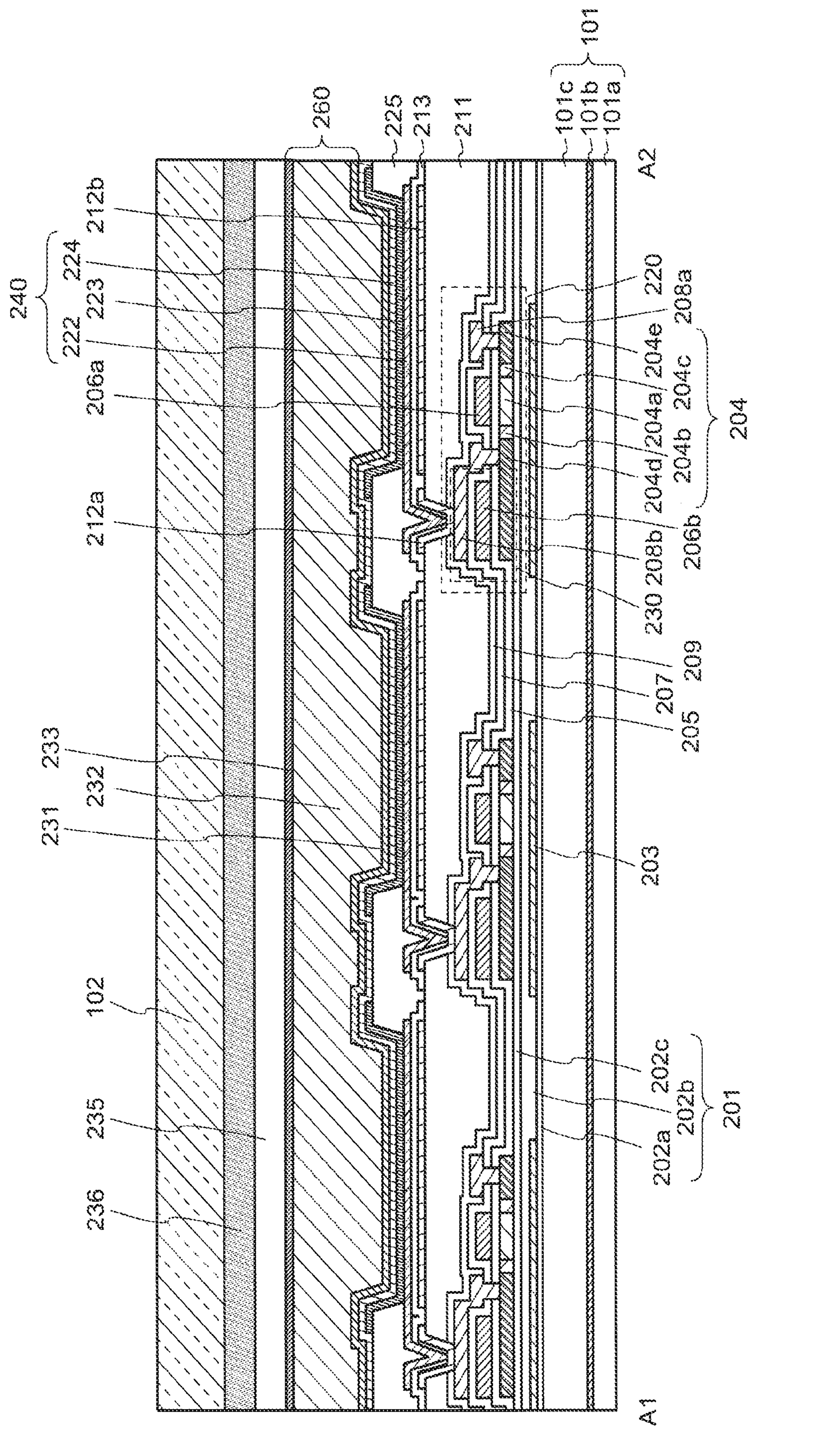
D2
108
107
106

Fig. 2

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235
102
231
232
233
212a
206a
222
223
224
240
212b
260
225
213
211
101c
101b
101a
101
A2
A1
220
208a
204e
204c
204a
204b
204d
204
206b
208b
230
209
207
205
203
202c
202b
202a
201

Fig. 3

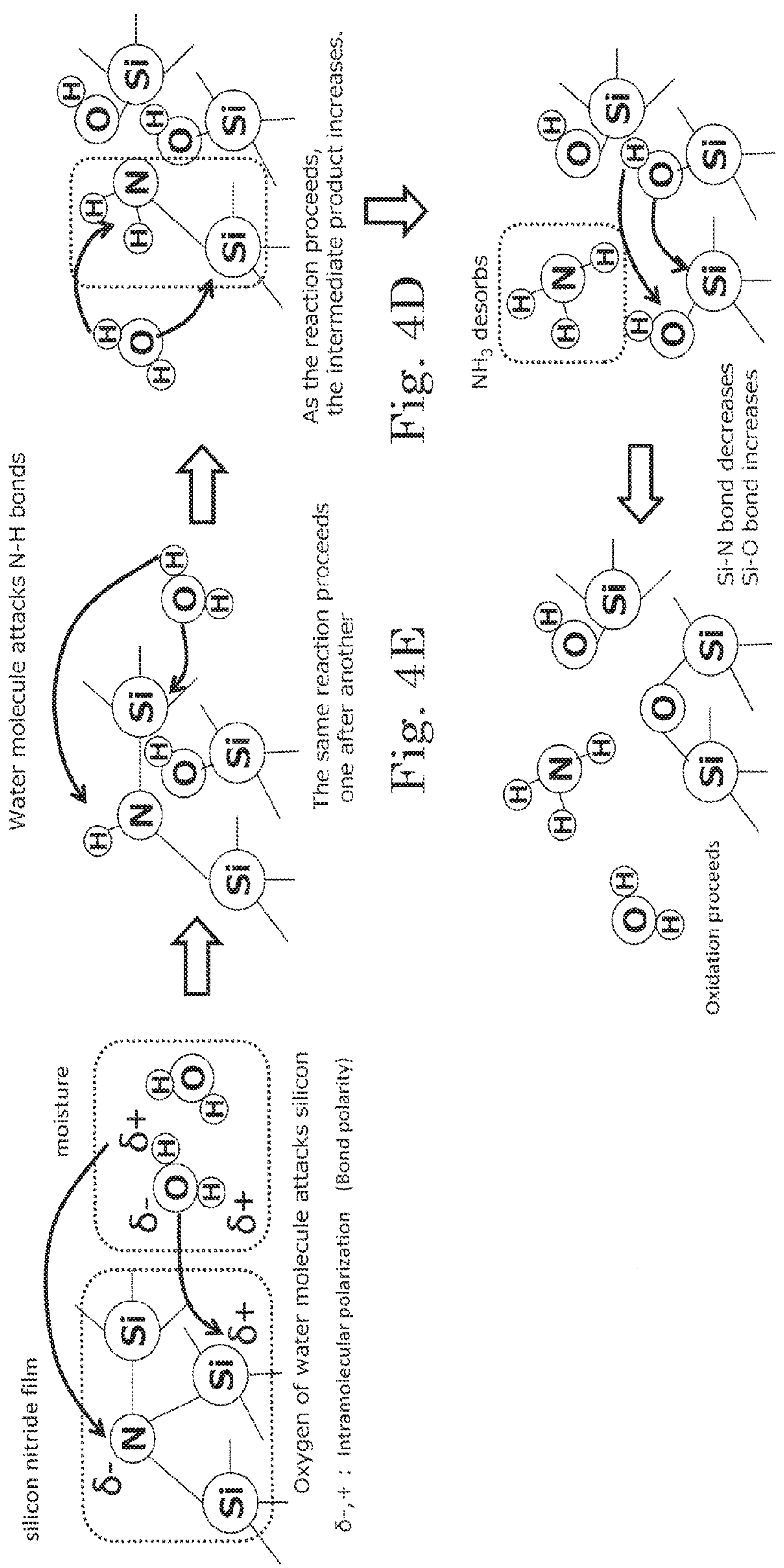


Fig. 4A

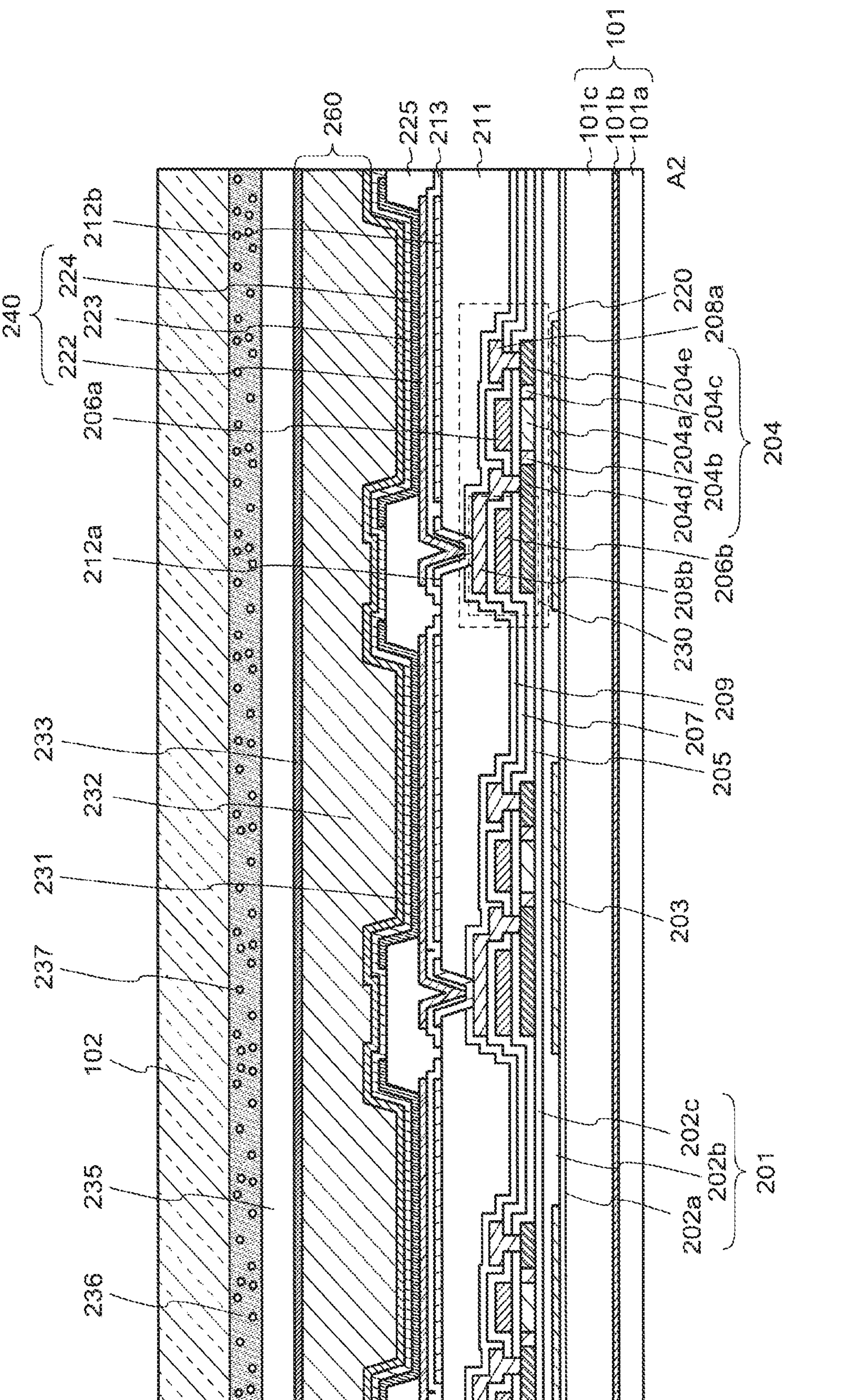
Fig. 4B

Fig. 4C

Fig. 4D

Fig. 4E

Fig. 5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212b
206a
212a
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232
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237
102
235
236
260
225
213
211
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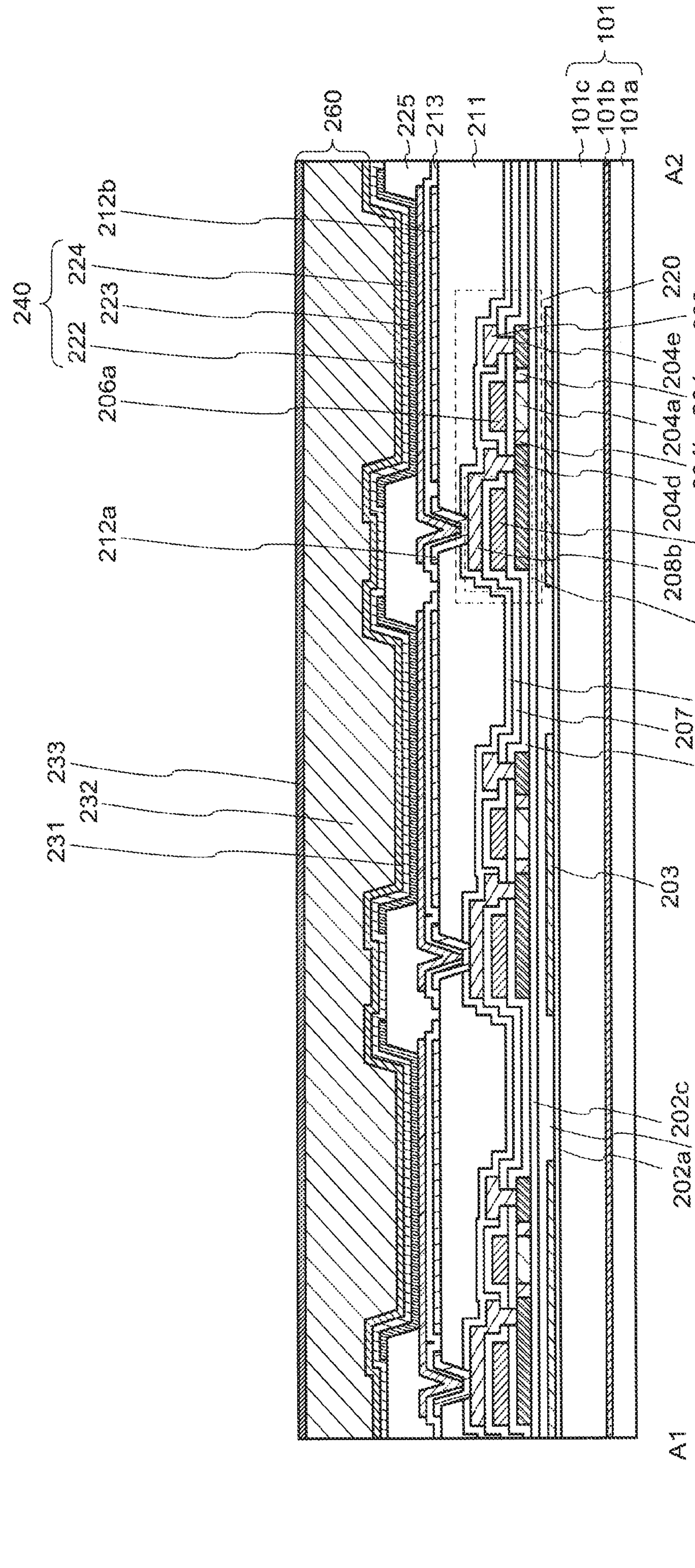
101c
101b
101a
A2
220
208a
204e
204c
204a
204b
204d
204
206b
208b
230
209
207
205
203
202c
202b
202a
201
A1

Fig. 6A


260
225
213
211
101c
101b
101a
101
A2
212b
240
224
223
222
206a
220
208a
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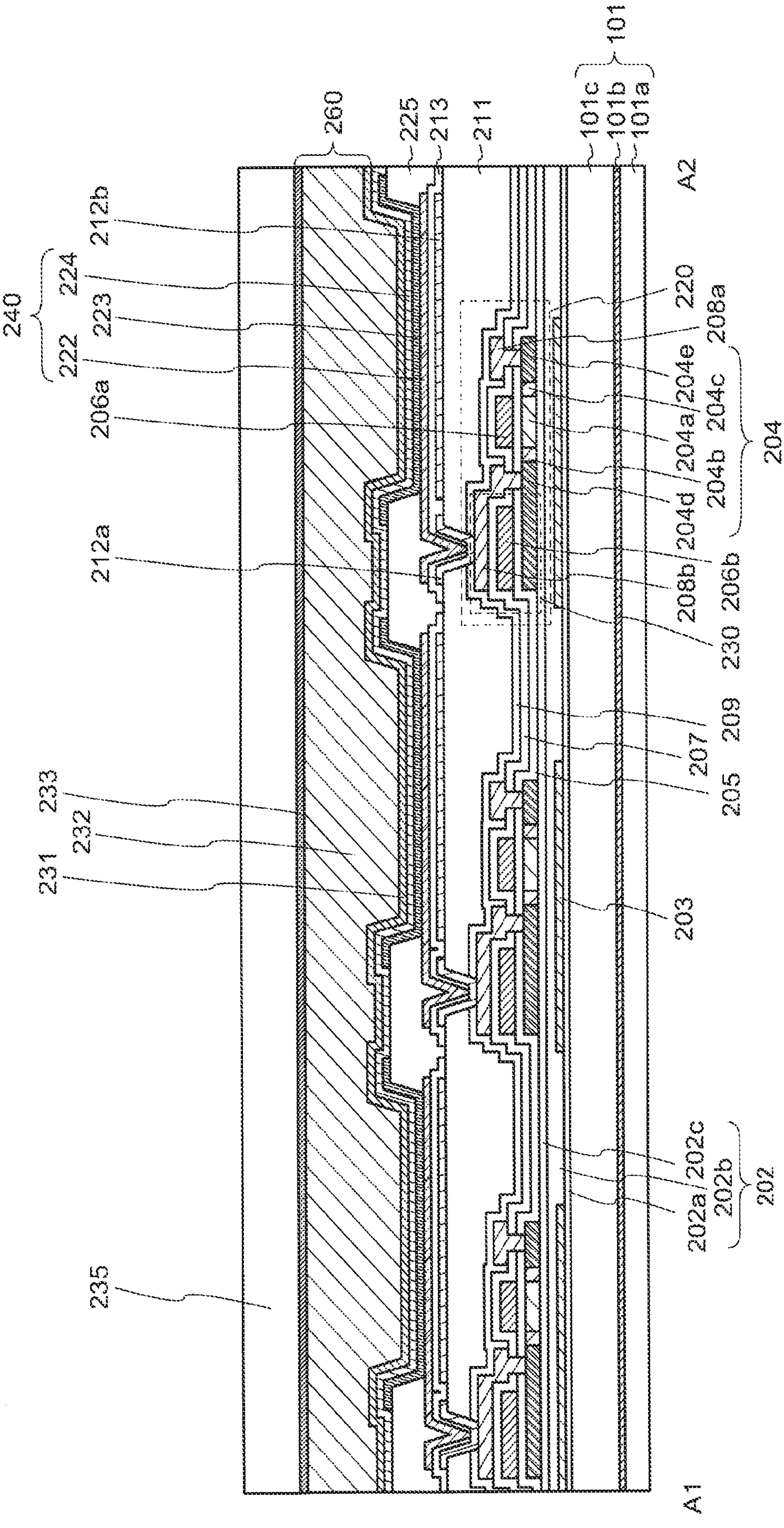
204c
204a
204b
204d
204
212a
208b
206b
230
209
207
205
233
232
231
203
202c
202b
202a
202
A1

Fig. 6B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231
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212a
206a
222
223
224
240
212b
260
225
213
211
101c
101b
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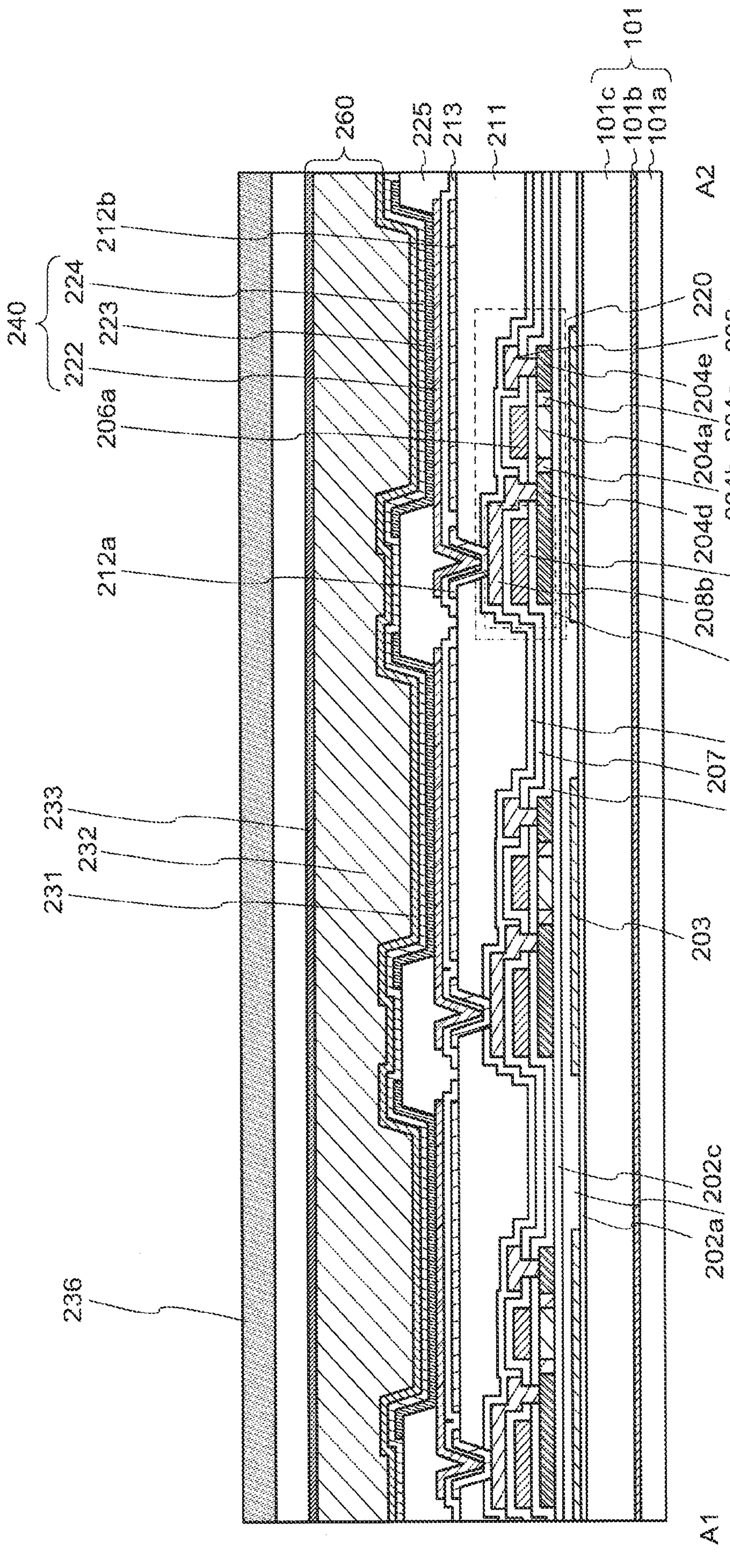
101
A2
A1
220
208a
204e
204c
204a
204b
204d
204
208b
206b
230
209
207
205
203
202c
202b
202a
202

Fig. 6C



101
101c
101b
101a
260
225
213
211
212b
240
224
223
222
206a
212a
220
208a
204e
204c
204a
204b
204d
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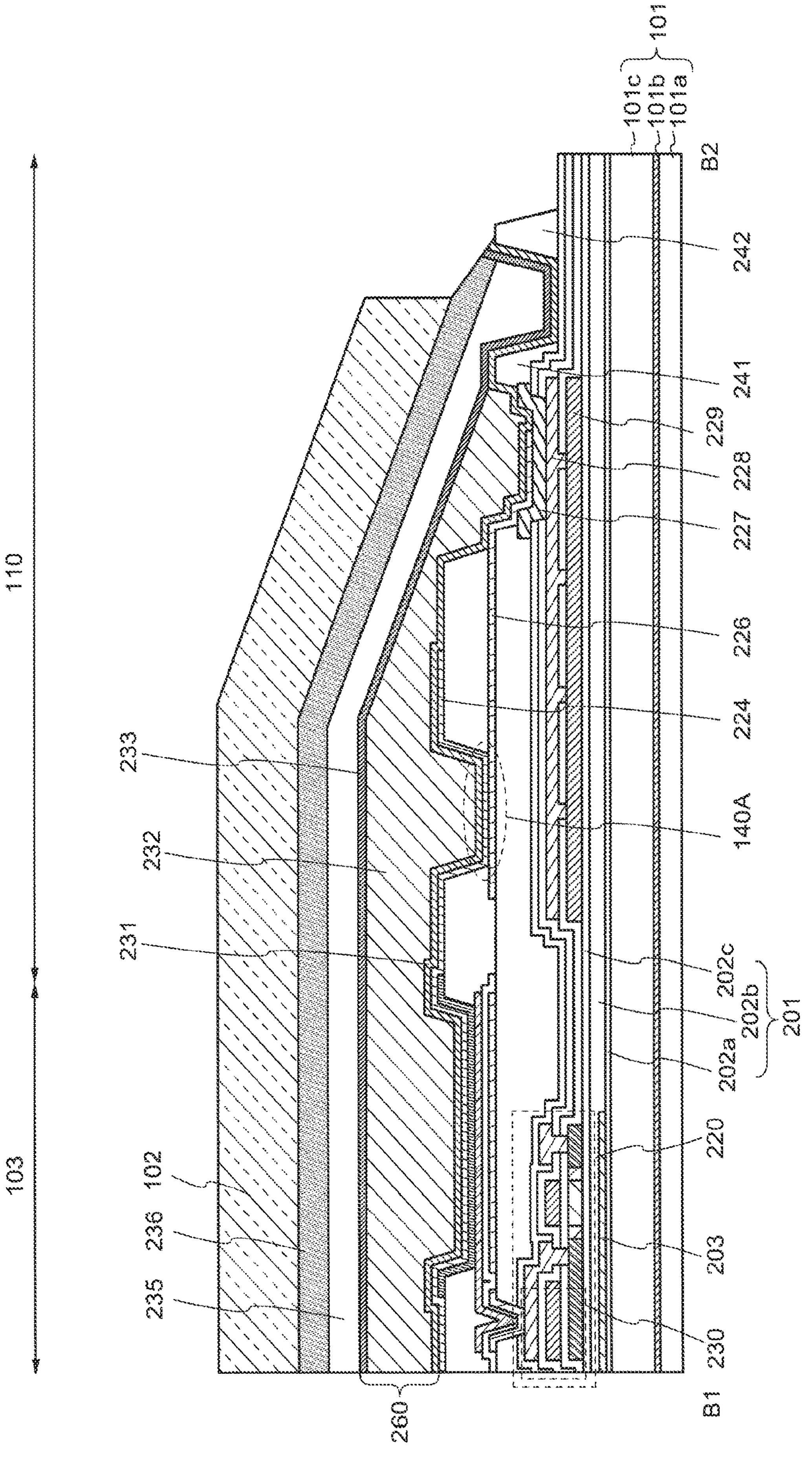
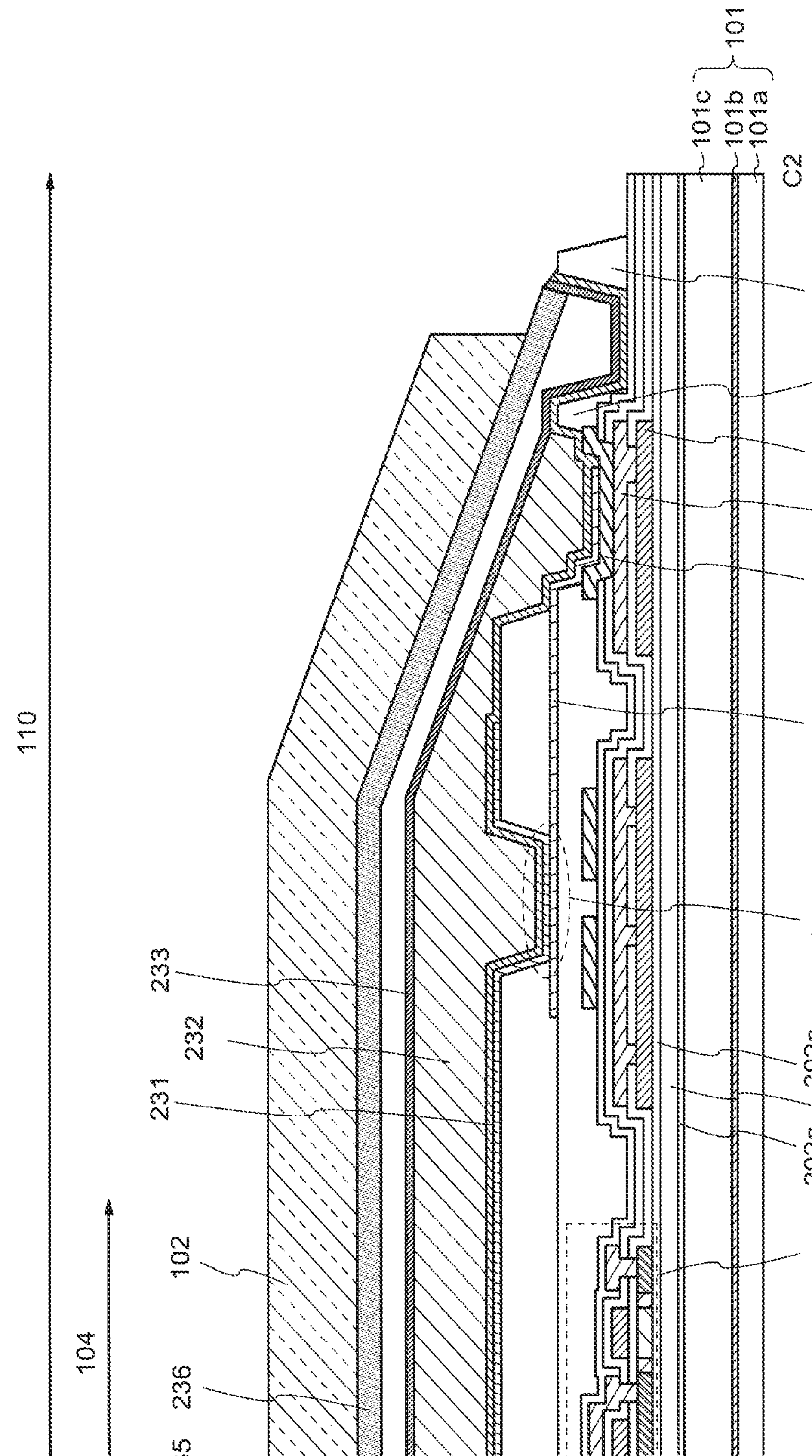
202b
202a
202
236
A1
A2



103
110
102
236
235
233
232
231
260
101
101c
101b
101a
B2
242
241
229
228
227
226
224
140A
202c
202b
202a
201
220
203
230
B1

Fig. 7

Fig. 8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235
233
232
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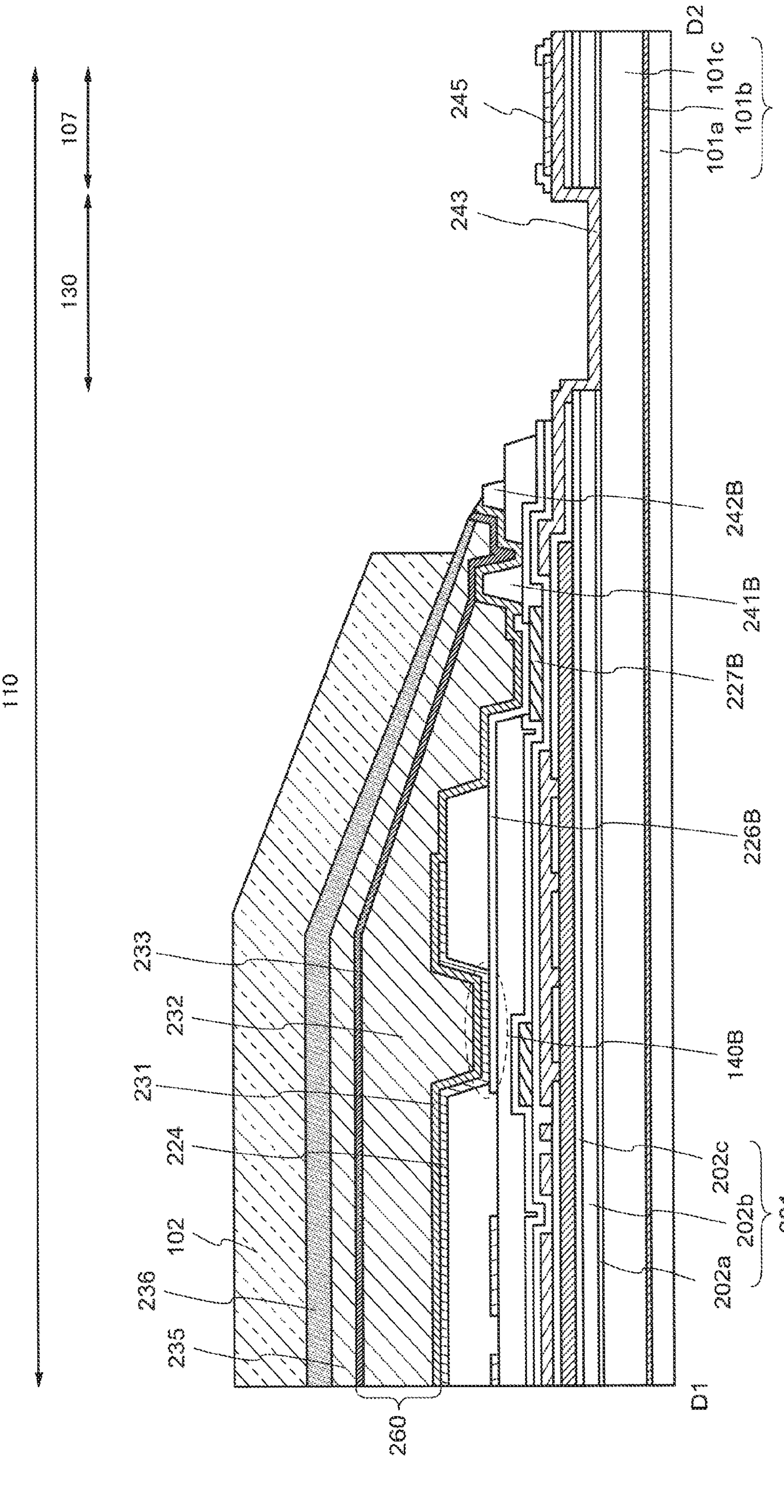
260
140
226A
227A
228A
229A
241A
242A
101c
101b
101a
101
C1
C2
250
202a
202b
202c
201

Fig. 9



110
130
107
245
243
242B
241B
227B
226B
140B
233
232
231
224
102
236
235
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202a
202b
202c
201
101a
101b
101c
101
D1
D2

Fig. 10

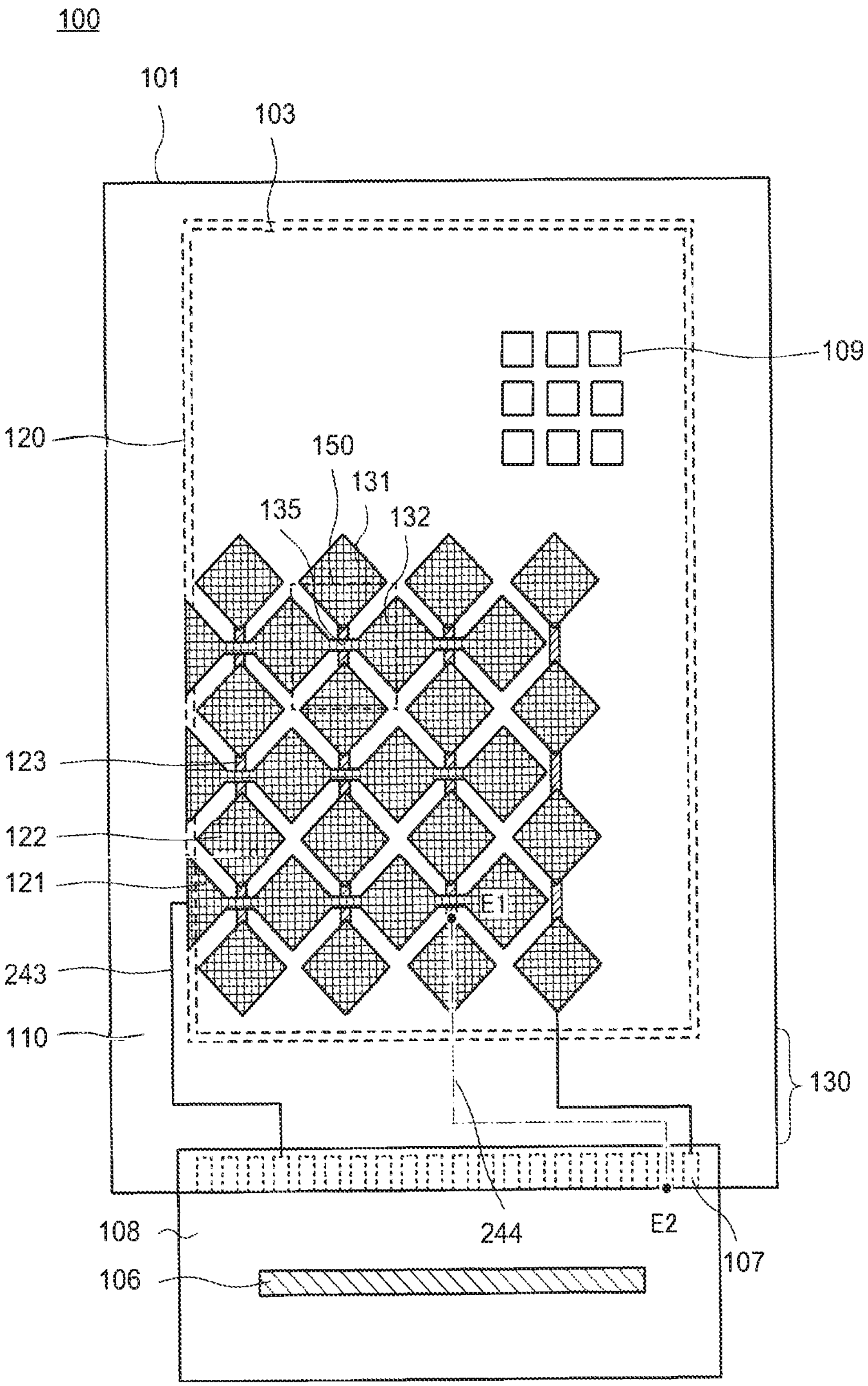

100
101
103
109
120
150
131
135
132
123
122
121
E1
243
110
130
244
E2
107
108
106

Fig. 11

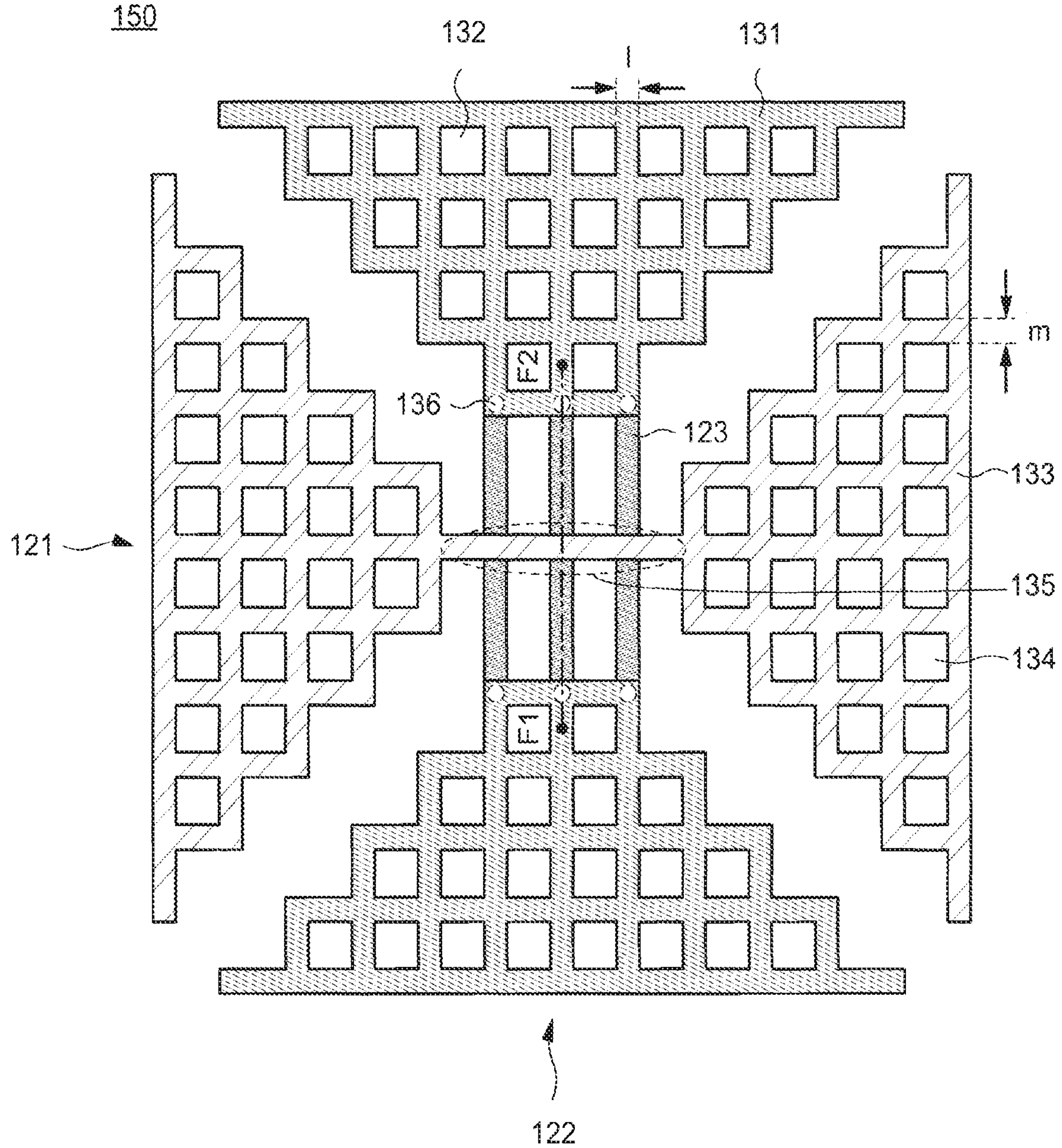


Fig. 12

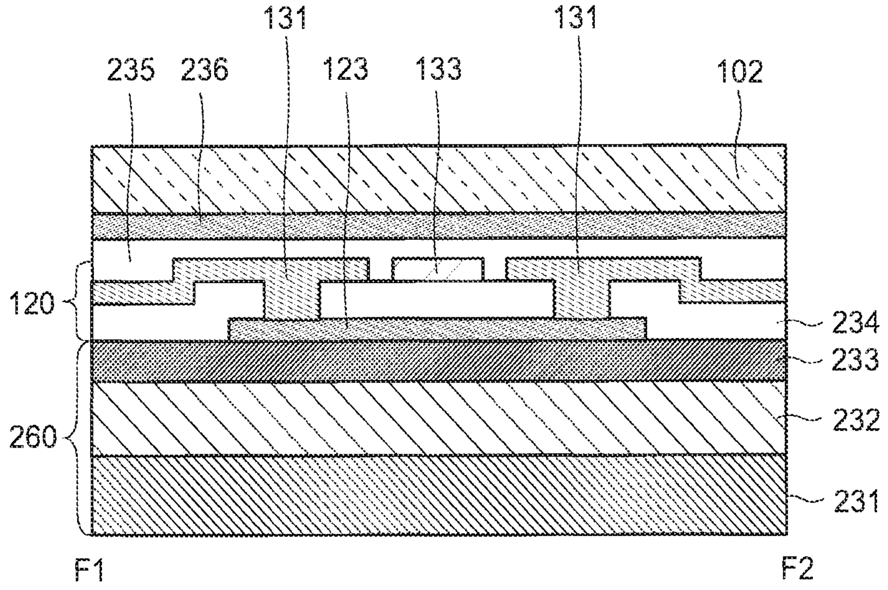
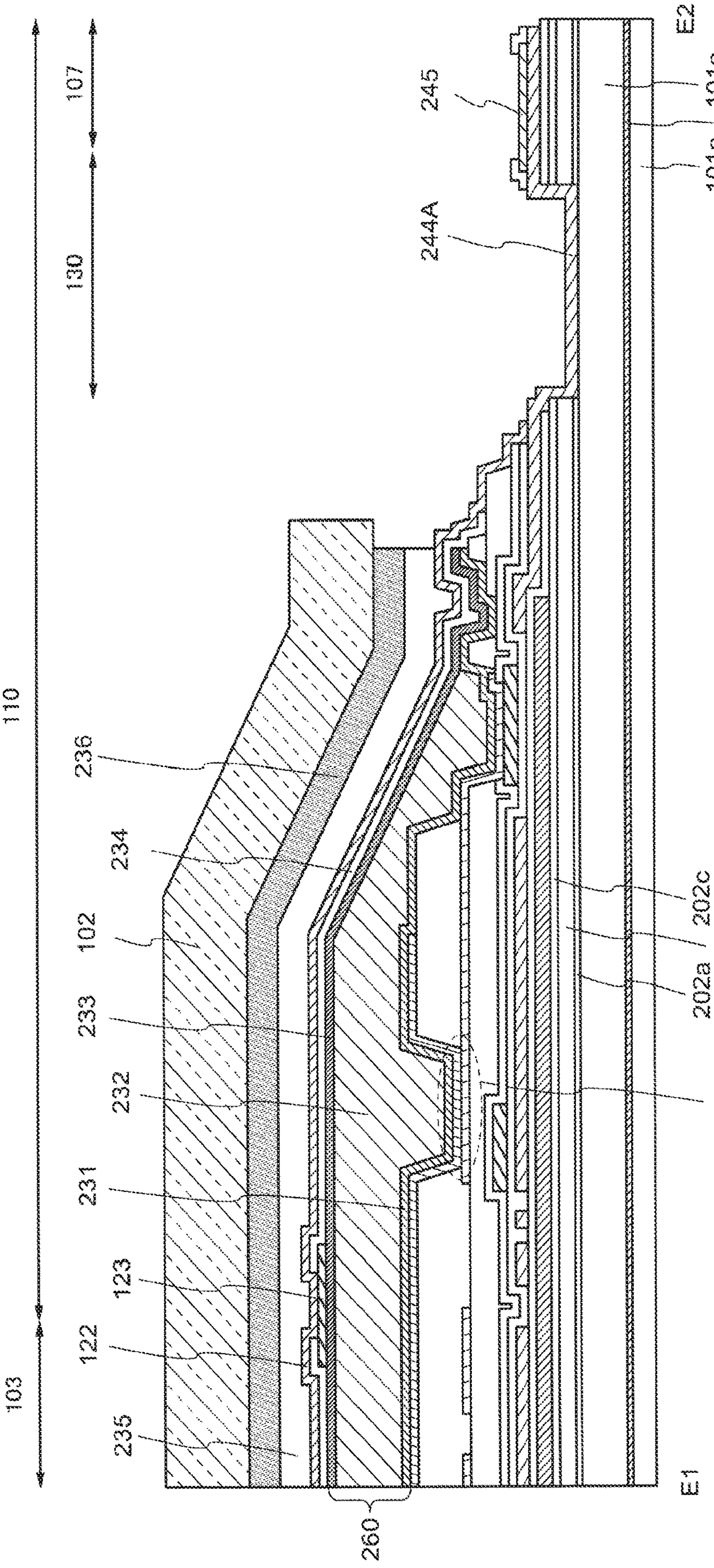


Fig. 13


103
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123
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232
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102
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236
244A
245
E1
E2
260
140
202a
202b
202c
201
101a
101b
101c
101

DISPLAY DEVICE AND MANUFACTURING METHOD OF DISPLAY DEVICE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is based upon and claims the benefit of priority from the prior Japanese Patent Application No. 2019-003067, filed on Jan. 11, 2019, the entire contents of which are incorporated herein by reference.

FIELD

[0002] One embodiment of the present invention is related to a display region in a display device.

BACKGROUND

[0003] Conventionally, an organic EL display device (Organic Electroluminescence Display) using an organic electroluminescence material (organic EL material) in a light emitting element (organic EL element) of a display region has been known as a display device. An organic EL display device is a so-called self-light emitting type display device which realizes a display by causing an organic EL material to emit light.

[0004] A light emitting element included in a display region deteriorates due to moisture. The deterioration of a light emitting element is suppressed by arranging a sealing film above the light emitting element in order to prevent the entrance of moisture to the light emitting element. For example, a display device is disclosed in patent document 1 (Japanese Laid Open Patent Publication No: 2013-243094) in which a first sealing film and a second sealing film comprised form an inorganic material such as a silicon nitride film or silicon oxide film are arranged above a light emitting element.

SUMMARY

[0005] A display device in an embodiment according to the present invention includes a first substrate, a display region with pixels each including a light emitting element above the first substrate, a first inorganic insulating layer covering the display region, a first organic insulating layer on the first inorganic insulating layer, second inorganic insulating layer on the first organic insulating layer, a second organic insulating layer on the second inorganic insulating layer, a third organic insulating layer on the second organic insulating layer, acidity of the third organic insulating layer being stronger than acidity of the second organic insulating layer, and a polarizing plate arranged on the third organic insulating layer.

[0006] A display device in an embodiment according to the present invention includes a first substrate, a display region with pixels each including a light emitting element above the first substrate, a first inorganic insulating layer covering the display region, a first organic insulating layer on the first inorganic insulating layer, a second inorganic insulating layer on the first organic insulating layer, a first electrode on the second inorganic insulating layer, a third inorganic insulating layer on the first electrode, a second electrode on the third inorganic insulating layer and electrically connected to the first electrode, a second organic insulating layer on the second electrode, a third organic insulating layer on the second organic insulating layer, acidity of the third organic insulating layer being stronger than acidity of the second organic insulating layer, and a polarizing plate arranged on the third organic insulating layer.

[0007] A manufacturing method of a display device in an embodiment according to the present invention includes forming pixels each including a light emitting element above a first substrate, forming a first inorganic insulating layer covering the pixels, forming a first organic insulating layer on the first inorganic insulating layer, forming a second inorganic insulating layer on the first organic insulating layer, forming a second organic insulating layer on the second inorganic insulating layer, forming a third organic insulating layer on the second organic insulating layer, acidity of the third organic insulating layer being stronger than acidity of the second organic insulating layer, and bonding a polarizing plate on the third organic insulating layer.

BRIEF DESCRIPTION OF DRAWINGS

[0008] FIG. **1** is a schematic view showing a structure of a display device related to one embodiment of the present invention;

[0009] FIG. **2** is a circuit diagram of a pixel in a display device related to one embodiment of the present invention;

[0010] FIG. **3** is a cross-sectional view of a pixel in a display device related to one embodiment of the present invention;

[0011] FIG. **4**A is a diagram for explaining a mechanism for desorbing NH_3 from a film including nitrogen;

[0012] FIG. **4**B is a diagram for explaining a mechanism for desorbing NH_3 from a film including nitrogen;

[0013] FIG. **4**C is a diagram for explaining a mechanism for desorbing NH_3 from a film including nitrogen;

[0014] FIG. **4**D is a diagram for explaining a mechanism for desorbing NH_3 from a film including nitrogen;

[0015] FIG. **4**E is a diagram for explaining a mechanism for desorbing NH_3 from a film including nitrogen;

[0016] FIG. **5** is a cross-sectional view of a pixel in a display device related to one embodiment of the present invention;

[0017] FIG. **6**A is a cross-sectional view for explaining a manufacturing method of a display device related to one embodiment of the present invention;

[0018] FIG. **6**B is a cross-sectional view for explaining a manufacturing method of a display device related to one embodiment of the present invention;

[0019] FIG. **6**C is a cross-sectional view for explaining a manufacturing method of a display device related to one embodiment of the present invention;

[0020] FIG. **7** is cross-sectional view along a line B**1**-B**2** of a display region shown in FIG. **1**;

[0021] FIG. **8** is cross-sectional view along a line C**1**-C**2** of a display region shown in FIG. **1**;

[0022] FIG. **9** is cross-sectional view along a line D**1**-D**2** of a display region shown in FIG. **1**;

[0023] FIG. **10** is a schematic view showing a structure of a display device related to one embodiment of the present invention;

[0024] FIG. **11** is an expanded diagram of a part of a display device shown in FIG. **10**;

[0025] FIG. **12** is cross-sectional view along a line F**1**-F**2** of a display device shown in FIG. **11**; and

[0026] FIG. **13** is cross-sectional view along a line E**1**-E**2** of a display region shown in FIG. **10**.

DESCRIPTION OF EMBODIMENTS

[0027] Each embodiment of the present invention is explained below while referring to the drawings. However, the present invention can be implemented in various modes without departing from the gist of the invention and should not to be interpreted as being limited to the description of the embodiments exemplified below.

[0028] Although the drawings may be schematically represented in terms of width, thickness, shape, and the like of each part as compared with their actual mode in order to make explanation clearer, it is only an example and an interpretation of the present invention is not limited. In addition, in the drawings, the same reference numerals are provided to the same elements as those described above with reference to preceding figures and repeated explanations may be omitted accordingly.

[0029] In the case when a single film is processed to form a plurality of structural bodies, each structural body may have different functions and roles, and the bases formed beneath each structural body may also be different. However, the plurality of structural bodies are derived from films formed in the same layer by the same process and have the same material. Therefore, the plurality of these films are defined as existing in the same layer.

[0030] When expressing a mode in which another structure is arranged above a certain structure, in the case where it is simply described as [above], unless otherwise noted, a case where another structure is arranged directly above a certain structure as if in contact with that structure, and a case where another structure is arranged via another structure above a certain structure, are both included.

[0031] The expression [a certain structure is exposed from another structure] means a region where a part of a certain structure is not covered by another structure. However, the part which is not covered by another structure also includes the case where it is covered by yet another structure.

First Embodiment

[0032] An example of the structure of a display device **100** related to one embodiment of the present invention is explained while referring to FIG. **1** to FIG. **9**.

<Display Device Structure>

[0033] FIG. **1** is a planar view of a display device **100** related to one embodiment of the present invention. A substrate **101** includes a display region **103**, a periphery region **110** which surrounds the display region **103**, a scanning line drive circuit **104** arranged in the periphery region **110**, a plurality of terminals **107** arranged at an end part of the substrate **101**, and a bent region **130** arranged between the display region **103** and the plurality of terminals **107**. In addition, a polarizing plate **102** is arranged overlapping the display region **103** and the scanning line drive circuit **104**.

[0034] The display region **103** includes a plurality of pixels **109** and the plurality of pixels **109** are arranged in a matrix.

[0035] The periphery region **110** is a region from the display region **103** to the end part of the substrate **101**. In other words, the periphery region **110** is a region where the display region **103** is arranged above the substrate **101** (that is, a region outside of the display region). The scanning line drive circuit **104** and the plurality of terminals **107** are arranged provided in the periphery region **110**. The scanning line drive circuits **104** are arranged to oppose the display region **103**. The plurality of terminals **107** are connected to a flexible printed circuit substrate **108**. A driver IC **106** is arranged above the flexible printed circuit substrate **108**.

[0036] The bent region **130** is a region where the substrate **101** is bent. In the bent region **130**, the frame of the display device **100** can be narrowed by bending the substrate **101** so that the plurality of terminals **107** of the substrate **101** overlap with the rear surface of the display region **103**.

[0037] An image signal and various control signals are supplied from a controller (not shown in the diagram) external to the display device **100** via the flexible printed circuit substrate **108**. The image signal is processed by the driver IC **106** and input to the plurality of pixels **109**. Each circuit signal is input to the scanning line drive circuit **104** via the driver IC **106**.

[0038] In addition to the image signal and each drive circuit, power for driving the scanning line drive circuit **104**, the driver IC **106** and the plurality of pixels **109** is supplied to the display device **100**. Each of the plurality of pixels **109** includes a light emitting element **240** which is described later. A part of the power which is supplied to the display device **100** is supplied to the light emitting element **240** included in each of the plurality of pixels **109** and causes the light emitting element **240** to emit light.

<Pixel Circuit>

[0039] FIG. **2** is a pixel circuit included in each of the plurality of pixels **109** arranged in the display device **100** related to the present invention. The pixel circuit includes at least a transistor **210**, a transistor **220**, a capacitor **230** and a light emitting element **240**.

[0040] The transistor **210** functions as a selection transistor. That is, in the transistor **210**, the conduction state of the gate of the transistor **210** is controlled by a scanning line **111**. The gate of the transistor **210** is connected to the scanning line **111**, a source is connected to the signal line **112**, and a drain is connected to a gate of the transistor **220**.

[0041] The transistor **220** functions as a drive transistor. That is, the transistor is connected to the light emitting element **240** and controls the light emitting luminosity of the light emitting element **240**. A gate of the transistor **220** is connected to a source of the transistor **210**, the source is connected to a drive power supply line **114**, and a drain connected to an anode of the light emitting element **240**.

[0042] One capacitor electrode of the capacitor **230** is connected to the gate of the transistor **220** and connected to the drain of the transistor **210**. In addition, the other capacitor electrode is connected to the anode of the light emitting element **240** and the drain of the transistor **220**.

[0043] The anode of the light emitting element **240** is connected to the drain of the transistor **220** and a cathode is connected to the reference power line **116**.

<Display Region Structure>

[0044] FIG. **3** is a cross-sectional view in the case where the display device **100** shown in FIG. **1** is cut along the line **A1-A2**. FIG. **3** is a cross-sectional view of the pixel **109** of the display device **100** related to one embodiment of the present invention.

[0045] The substrate **101** has a stacked layer structure including a first resin layer **101***a*, an inorganic layer **101***b* and a second resin layer **101***c*. The first resin layer **101***a* and the second resin layer **101***c* are formed as layers including a material selected from, for example, acrylic, polyimide, polyethylene terephthalate, and polyethylene naphthalate and the like. In addition, silicon nitride, silicon oxide or amorphous silicon is used as the inorganic layer **101***b*. It is preferred that the inorganic layer **101***b* is arranged between the first resin layer **101***a* and the second resin layer **101***c* in order to improve adhesion between the first resin layer **101***a* and the second resin layer **101***c*.

[0046] An undercoat layer **202** is arranged on the substrate **101**. The undercoat layer **202** is arranged by, for example, a single layer or a stacked layer of a silicon oxide film and a silicon nitride film. In the present embodiment, the undercoat layer **202** is arranged by stacking three layers of a silicon oxide layer **202***a*, a silicon nitride layer **202***b* and a silicon oxide layer **202***c*. Since the silicon oxide layer **202***a* is used to improve adhesion to the substrate, the silicon nitride layer **202***b* is used as a blocking film for moisture and impurities from the exterior, the silicon oxide layer **202***c* functions as a blocking film to ensure that hydrogen included in the silicon nitride layer **202***b* described later is prevented from diffusing to the semiconductor layer side.

[0047] In addition, the undercoat layer **202** may be arranged with a light shielding layer **203** to match the location where the transistor **220** is arranged. Since the light shielding layer **203** suppresses changes in transistor characteristics due to entrance of light from the back surface of a channel of the transistor **220**, or forms the light shielding layer **203** as a conductive layer, it is possible to impart the transistor **220** with back-gate effects by providing a predetermined potential to the transistor **220**. That is, the undercoat layer **202** is arranged with the silicon oxide layer **202***a*, the light shielding layer **203**, the silicon nitride layer **202***b* and the silicon oxide layer **202**c.

[0048] The transistor **220** is arranged above the undercoat layer **202**. The transistor **220** includes a semiconductor layer **204**, a gate insulating film **205** and a gate electrode **206***a*. Although an example is shown in which an n-channel transistor is used as the transistor **220**, a p-channel transistor may also be used. In the present embodiment, a n-channel TFT has a structure in which low concentration impurity regions **204***b* and **204***c* are arranged between a channel region **204***a* and source or drain regions **204***d* and **204***e* (high concentration impurity regions). Amorphous silicon, polysilicon, or an oxide semiconductor is used as the semiconductor layer **204**. For example, silicon oxide or silicon nitride is arranged as a single layer or a stacked layer as the gate insulating film **205**. For example, MoW is used as the gate electrode **206***a*. Furthermore, although the structure of the transistor **220** is shown in FIG. **3**, the structure of the transistor **210** is similar to the structure of the transistor **220**.

[0049] An interlayer insulating layer **207** is arranged to cover the gate electrode **206***a*. The interlayer insulating layer **207** is arranged with a single layer or a stacked layer of a silicon oxide layer or a silicon nitride layer. Source or drain electrodes **208***a* and **208***b* are arranged above the interlayer insulating layer **207**.

[0050] Each of the source or drain electrodes **208***a* and **208***b* is connected to the source or drain regions **204***d* and **204***e* of the semiconductor layer **204** via opening parts in the interlayer insulating layer **207** and the gate insulating film **205**.

[0051] Here, a conductive layer **206***b* is arranged above the gate insulating film **205**. The conductive layer **206***b* is formed in the same process as the gate electrode **206***a*. The conductive layer **206***b* forms a capacitor by the source or drain regions **204***d* and **204***e* of the semiconductor layer **204** interposed by the gate insulating film **205**. In addition, the conductive layer **206***b* forms a capacitor by the source or drain electrode **208***b* interposed by the interlayer insulating layer **207**.

[0052] A planarization film **211** is arranged above the source or drain electrodes **208***a* and **208***b*.

[0053] An insulating layer **213** is arranged above the planarization film **211**. An organic material such as photosensitive acrylic or polyimide is used as the planarization film **211**. By arranging the planarization film **211**, it is possible to planarize a step caused by the transistor **220**.

[0054] Transparent conductive films **212***a* and **212***b* are arranged above the planarizing film **211**. The transparent conductive film **212***a* is connected to the source or drain electrode **208***b* through the opening part of the planarization film **211** and the insulating layer **209**.

[0055] An insulating layer **213** is arranged above the transparent conductive films **212***a* and **212***b*. The insulating layer **213** is arranged with openings parts in a region which overlaps the transparent conductive film **212***a* and the source or drain electrode **208***b*, and a region between the transparent conductive film **212***a* and the transparent conductive film **212***b* of an adjacent pixel.

[0056] A pixel electrode **222** is arranged above the insulating layer **213**. The pixel electrode **222** is connected to the transparent conductive film **212***a* through the opening part of the insulating layer **213**. The pixel electrode **222** is formed as a reflective electrode and has a three layer structure of IZO, Ag, and IZO.

[0057] An insulating layer **225** which becomes a partition wall is arranged at the boundary between a pixel electrode **222** and the pixel electrode **222** of the adjacent pixel. The insulating layer **225** is also called a bank or a rib. An organic material similar to the material of the planarization film **211** is used for the insulating layer **225**. The insulating layer **225** is opened so that a part of the pixel electrode **222** is exposed. In addition, it is preferred that the end part of an opening part takes on a gentle taper shape. When the end part of the opening has a steep shape, coverage failure occurs in the organic layer **223** which is formed later.

[0058] Here, the planarization film **211** and the insulating layer **225** contact with each other at an opening part arranged in the insulating layer **225**. By including such a structure, it is possible to remove moisture and gas which are released from the planarization film **211** when carrying out heat treatment when the insulating layer **225** is formed. In this way, it is possible to suppress peeling at the interface between the planarization film **211** and the insulating layer **225**.

[0059] After forming the insulating layer **225**, an organic layer **223** for forming an organic EL layer is stacked. Although the organic layer **223** is shown as a single layer in FIG. **3**, a hole transport layer, a light emitting layer and an electron transport layer are stacked in that order from the pixel electrode **222** side. In addition, although the light emitting layer in the organic layer **223** is described as being selectively arranged for each pixel **109** in FIG. **3**, a hole transport layer and an electron transport layer may also be arranged in all over the display region **103**. These layers may be formed by vapor deposition, or may be formed by coating on a solvent dispersion. Not only the hole transport layer and the electron transport layer, but a light emitting layer may also be arranged in all over the display region **103**. In the case where the light emitting layer is arranged in all over the display region **103**, white light can be obtained in all the pixels and it is possible to adopt a structure in which a desired color wavelength part can be extracted by a color filter (not shown in the diagram).

[0060] After formation of the organic layer **223**, the counter electrode **224** is formed. Here, since a top emission structure is adopted, the counter electrode **224** is required have light translucency. Furthermore, a top emission structure means a structure in which light is emitted from the counter electrode **224** which is arranged above the pixel electrode **222** interposed by the organic layer **223**. Here, an MgAg film is formed as a thin film which allows light emitted from the organic EL layer to pass therethrough as the counter electrode **224**. According to the order of formation of the organic layer **223** described above, the pixel electrode **222** side becomes an anode, and the counter electrode **224** side becomes a cathode.

[0061] A sealing film **260** is arrange above the counter electrode **224** of the light emitting element **240**. The sealing film **260** has a function for preventing moisture from entering the organic layer **223** from the exterior, and the sealing film **260** is required to have high gas barrier properties. A film containing nitrogen can be given as an example of a film having such a function. Here, a structure is shown in which a first inorganic insulating layer **231**, an organic insulating layer **232** and a second inorganic insulating layer **233** are stacked as the sealing film **260** including a film containing nitrogen.

[0062] A resin mask **235** (also called a second organic insulating layer) is arranged to cover the display region **103**. The resin mask **235** has a mask function for etching the first inorganic insulating layer **231** and the second inorganic insulating layer **233**. For example, an acrylic resin, rubber resin, silicone resin or urethane resin adhesive can be used as the resin mask **235**.

[0063] A polarizing plate **102** is arranged above the resin mask **235**. The polarizing plate **102** has a laminated structure including a quarter wavelength plate and a linear polarizing plate. By adopting this structure, it is possible to emit light from the light emitting region to the exterior from the display side surface of the polarizing plate **102**. Here, the thickness of the polarizing plate **102** is 100 μm to 200 μm.

[0064] As explained above, by arranging the sealing film **260** above the light emitting element **240**, it is possible to suppress moisture the entrance of moisture from the exterior from entering the light emitting element **240**. However, there is a problem whereby moisture entering from the outside or moisture included in an organic resin reacts with a film including nitrogen which may generate ammonium ions.

<Mechanism of Ammonia Ion Generation>

[0065] Next, in the case when a silicon nitride film is used as a film including nitrogen, moisture which enters from the exterior or moisture included the organic resin reacts with the silicon nitride film which generates ammonium ions. This mechanism is explained using FIG. **4**A to FIG. **4**E.

[0066] As shown in FIG. **4**A, moisture which is included in the resin mask **235** and oxygen of the moisture which enters from the exterior attack the silicon of the silicon nitride film. Next, as shown in FIG. **4**B, moisture attacks not only the silicon of the silicon nitride film but also the N—H bond. As the reaction proceeds, the intermediate product ≡Si—N—H2 increases as shown in FIG. **4**C. As the reaction proceeds further, NH_3 is desorbed from the silicon nitride film as shown in FIG. **4**D. Finally, Si—N bonds decrease and Si—O bonds increase. That is, as shown in FIG. **4**E, the silicon nitride film becomes oxidized by moisture.

[0067] As was explained above, a film including nitrogen contained in the sealing film which is arranged above the light emitting element generates ammonia due to hydrolysis. If moisture is not sufficiently removed from within the light emitting element, ammonia is generated from the film including nitrogen due to the movement of moisture to the sealing film. In this way, when alkaline ammonium ions are generated due to moisture, the ammonium ions reach the polarizing plate and attack the iodine complex of the polarizing plate. In this way, there is a problem whereby color loss occurs in the polarizing plate and a defect occurs in the display screen.

[0068] When NH_3 which is desorbed from a silicon nitride film reaches a polarizing plate through a resin mask, the iodine complex of the polarizing plate **102** is attacked. In this way, there is a problem whereby the polarizing plate is changed to white and a defect occurs on the display screen.

[0069] One object of the present invention is to suppress any change in color of a polarizing plate due to the generation of ammonia in contact between a film including nitrogen and an organic resin.

[0070] In the display device **100** related to one embodiment of the present invention, an organic prevention film **236** (also called a third organic insulating layer) is arranged between the resin mask **235** and the polarizing plate **102**. The organic prevention film **236** is arranged to cover at least the display region **103**. In this way, it is possible to suppress the ammonia which is generated by contact between the second inorganic insulating layer **233** and the resin mask **235** from reaching the polarizing plate **102** by the organic prevention film **236**.

[0071] The organic prevention film **236** has a function for neutralizing or adsorbing ammonia. For example, in the case when the organic prevention film **236** neutralizes ammonia, it is preferred that the organic prevention film **236** show stronger acidity than the resin mask **235** (large amount of acidic components HX). Furthermore, showing a strong acidity means that the pH becomes small when it becomes a liquid.

[0072] For example, a photo-curing resin such as an epoxy resin or an acrylic resin is used as the organic prevention film **236**. For example, in the case when a photo-curable resin is formed by UV curing, an additive is necessary for adjusting a monomer, a polymerization initiator, viscosity or surface tension and the like. The polymerization initiator has a cationic system and a radical system. In addition, in the case when an epoxy resin is used as the organic prevention film **236**, a cationic polymerization initiator is used, and in the case when an acrylic resin is used, a radical polymerization initiator is used. In the case when a photoacid generator is used as a polymerization initiator, polymerization begins by light irradiation, and an acid is generated. An onium salt composed of a cation moiety which absorbs light and an anion moiety which serves as an acid generation source is used as the polymerization initiator. A sulfonium ion or an iodonium ion is used for the cation portion of such an onium salt. Therefore, by controlling the amount of the polymerization initiator for forming the resin mask **235** and controlling the amount of the polymerization initiator for forming the organic prevention film **236**, it is possible to the make the pH of the organic prevention film **236** more acidic than the pH of the resin mask **235**.

[0073] The thickness of the organic prevention film **236** is preferred to be larger than the thickness of the resin mask **235**. For example, it is preferred that the total thickness of the organic prevention film **236** and the resin mask **235** is 10 μm or more and 20 μm or less. It is preferred that the thickness of the organic prevention film **236** is 1 μm or more and 15 μm or less, and the resin mask **235** is preferred to be 5 μm or more and 19 μm or less.

[0074] FIG. **5** is a cross-sectional view of a pixel **109** of the display device **100** related to one embodiment of the present invention. Furthermore, FIG. **5** is partially different in the structure of the organic prevention film **236** shown in FIG. **3**. The organic prevention film **236** shown in FIG. **5** may have a function for adsorbing ammonia. For example, an organic resin containing particles such as silicon oxide, alumina, calcium oxide and aluminum silicate is used as the organic prevention film **236**. The particles in the organic resin may be porous transparent fine particles. By including porous transparent fine particles in the organic resin, it is possible to adsorb ammonium ions without affecting light extraction efficiency. The particle diameter of the transparent fine particles is preferred to be, for example, 1 μm or more and 100 μm or less. In addition, the addition amount of a transparent fine particle can suppress the occurrence of scattered light when it is 10% or more and 30% or less per unit volume.

[0075] Generally, since an organic resin contains moisture, ammonia ions are generated in a structure arranged with the organic resin above a film which includes nitrogen. Therefore, even if the organic prevention film **236** is arranged in contact with the film which includes nitrogen, the generation of ammonia ions cannot be avoided. According to the display device related to one embodiment of the present invention, a stacked layer structure is adopted in which a resin mask **235** and an organic prevention film **236** having a function for neutralizing or adsorbing ammonia are arranged above a film containing nitrogen. In this way, even if ammonia is generated by contact between the film containing nitrogen and the resin mask **235**, it is possible to suppress the movement of ammonia ions by the organic prevention film **236**. Therefore, since ammonia ions can be prevented from reaching the polarizing plate **102**, the polarizing plate **102** can be prevented from turning white.

[0076] A cover glass may be arranged above the polarizing plate **102** in the display device **100** according to necessity. A touch sensor or the like may also be formed on the cover glass. In this case, a filler using a resin or the like may be used in order to fill a gap between the polarizing plate **102** and the cover glass.

<Method for Manufacturing Display Device>

[0077] Next, a method for manufacturing the display device **100** related to one embodiment of the present invention is explained while referring to FIG. **6**A to FIG. **6**C.

[0078] FIG. **6**A is a cross-sectional view showing a method for manufacturing the display device **100** related to one embodiment of the present invention. A detailed description of a method for forming the substrate **101** to the counter electrode **224** included in the light emitting element **240** is omitted.

[0079] A sealing film **260** is formed above the counter electrode **224** of the light emitting element **240**. First, the first inorganic insulating layer **231** is formed as the sealing film **260**. The first inorganic insulating layer **231** is preferred to be formed by a film containing nitrogen in order to suppress moisture from entering the light emitting element **240**, and for example, a silicon nitride film and an aluminum nitride film or the like is used as the film containing nitrogen. In the present embodiment, the case where a silicon nitride film is used as the first inorganic insulating layer **231** is explained.

[0080] Next, an organic insulating layer **232** is formed above the first inorganic insulating layer **231**. For example, an acrylic resin, an epoxy resin, a polyimide resin, a silicone resin, a fluorine resin or a siloxane resin or the like can be used as the organic insulating layer **232**. The film thickness of the organic insulating layer **232** is preferred to be 5 μm or more and 15 μm or less for example.

[0081] Next, a second inorganic insulating layer **233** is formed above the organic insulating layer **232**. Similar to the first inorganic insulating layer **231**, the second inorganic insulating layer **233** is formed from a film containing nitrogen in order to suppress moisture from entering the light emitting element **240**. For example, a silicon nitride film, a silicon nitride oxide film or an aluminum nitride film or the like is used as the film containing nitrogen. In the present embodiment, a case where a silicon nitride film is used as the second inorganic insulating layer **233** is explained.

[0082] FIG. **6**B is a diagram for explaining a process for forming a resin mask **235** above the second inorganic insulating layer **233**. For example, an acrylic resin, a rubber resin, a silicone resin or a urethane resin can be used as the resin mask **235**.

[0083] FIG. **6**C is a diagram for explaining a process for forming the organic prevention film **236** above the resin mask **235**. For example, an organic resin such as an epoxy resin or an acrylic resin is used as the organic prevention film **236**.

[0084] When the film containing nitrogen is in contact with an organic resin having strong acidity, the generation of ammonia as explained in FIG. **4**A to FIG. **4**E is promoted, and the generation of ammonia increases. Therefore, in the case when the pH of the resin mask **235** is more acidic than the pH of the organic prevention film **236**, there is a possibility that the generation of ammonia from the film containing nitrogen is promoted. In addition, the H+of the organic resin in contact with the film containing nitrogen increases in an environment where not only water but also an acid exists. In this way, as shown in FIG. **4**A to FIG. **4**E, the attack frequency on Si—N by H+ becomes active, the N—H bonds increase and thereby the generation of NH_3 increases. Therefore, it is possible to suppress the generation of ammonia by weakening the acidity of the resin mask **235** in contact with the film containing nitrogen. In this way, it is preferred that the pH of the resin mask **235** is less acidic than the pH of the organic prevention film **236**.

[0085] It is possible to control the pH of the resin mask **235** and the organic prevention film **236** by, for example, the amount of an initiator for curing the resin.

[0086] For example, the amount of the initiator for the organic prevention film **236** is less than the amount of the initiator for the resin mask **235**. The amount of initiator in the organic prevention film **236** can be reduced by 20% to 50% compared with the amount of initiator of the resin mask **235**. In this way, the pH of the organic prevention film **236** can be made more acidic than the pH of the resin mask **235**.

[0087] In addition, the thickness of the organic prevention film **236** is preferred to be larger than the thickness of the resin mask **235**. For example, the total thickness of the organic prevention film **236** and the resin mask **235** is preferred to be 10 μm or more and 20 μm or less. The thickness of the organic prevention film **236** is preferred to be 1 μm or more and 15 μm or less, and the thickness of the resin mask **235** is preferred to be 5 μm or more and 19 μm or less. In this way, it is possible to suppress the amount of ammonia generated by contact between the film containing nitrogen and the resin mask **235**, and it is possible to neutralize the ammonia by the organic prevention film **236**. In addition, in the case when the thickness of the resin mask **235** and the thickness of the organic prevention film **236** are less than 10 μm, there is a possibility that scratches cannot be prevented as a result of handling in a subsequent process. In addition, if the thickness exceeds 20 μm, there is a possibility that the organic insulating film **236** which is applied by inkjet may not be able to stop the flow due to a convex shaped insulating layer called a dam which is formed at the end part of the substrate **101**. In addition, since there is a limit to the height at which the convex insulating layer can be formed, when the thickness of the organic prevention layer **236** exceeds 20 μm, it becomes difficult to form convex shaped insulating layer having a height which can prevent the organic prevention film **236** from flowing. In addition, since the amount of resin applied increases if the organic prevention film **236** is thick, there is a possibility that display defects (such as streaks) are produced due to poor curing. Furthermore, the resin overflows from the convex shaped insulting layer which may cause bending defects on the terminal side or there is a possibility that cutting defects are produced when dividing the substrate **101** in order to separate the display device.

[0088] Next, although not shown in the diagram, the first inorganic insulating layer **231** and the second inorganic insulating layer **233** are etched using the organic prevention film **236** and the resin mask **235** as a mask. In this way, in the periphery region **110** of the substrate **101**, it is possible to remove the first inorganic insulating layer **231** and the second inorganic insulating layer **233** and expose the terminal **107**.

[0089] Finally, it is possible to manufacture the display device **100** shown in FIG. **1** and FIG. **3** by attaching the polarizing plate **102** above the organic prevention film **236**.

[0090] As explained above, the pH of the resin mask **235** which is arranged above the second inorganic insulating layer **233** is made more acidic than the pH of the organic prevention film **236**. In this way, the reaction between the second inorganic insulating layer **233** and the resin mask **235** which is formed later can be suppressed, the generation of ammonia can be reduced, and the generated ammonia can be neutralized by the organic prevention film **236**. In this way, since it is possible to suppress the generated ammonia from reaching the polarizing plate **102**, it is possible to suppress the polarizing plate **102** from being turning white.

<Structure of Periphery Region>

[0091] Next, a structure of a cross section in the periphery region **110** of the display device **100** explained while referring to FIG. **7** to FIG. **9**.

[0092] FIG. **7** is a cross-sectional view of the display device **100** shown in FIG. **1** along a line B**1**-B**2**. The upper part of the periphery region **110** of the substrate **101** shown in FIG. **7** is a region where various wirings are routed. As shown in FIG. **7**, in the periphery region **110**, the counter electrode **224** of the light emitting element **240** is arranged with a cathode contact **140** connected to the transparent conductive film **226**. The transparent conductive film **226** is electrically connected to a conductive layer **227**, a conductive layer **228** and a wiring layer **229**. That is, the counter electrode **224** is electrically connected to any of the plurality of terminals **107** by the wiring layer **229**.

[0093] Convex shaped insulating layers **241** and **242** called dams are arranged at the end of the substrate **101**. The organic insulating layer **232** is stopped by the insulating layer **241**. In addition, the first inorganic insulating layer **231**, the second inorganic insulating layer **233**, the resin mask **235**, and insulating layer **242** are also arranged. In addition, the first inorganic insulating layer **231** and the second inorganic insulating layer **233** have a region which overlaps from the insulating layer **241** to the insulating layer **242**. By sealing the organic insulating layer **232** using the first inorganic insulating layer **231** and the second inorganic insulating layer **233**, it is possible to prevent moisture entering from the exterior from reaching the light emitting element **240** through the organic insulating layer **232**.

[0094] The first inorganic insulating layer **231** and the second inorganic insulating layer **233** are arranged above the convex shaped insulating layer **242**. The first inorganic insulating layer **231** and the second inorganic insulating layer **233** are removed by etching using the organic prevention film **236** as a mask. Therefore, the side surface of the organic prevention film **236** overlaps the side surface of the convex shaped insulating layer **242** via the first inorganic insulating layer **231** and the second inorganic insulating layer **233**.

[0095] FIG. **8** is a cross-sectional view of the display device **100** shown in FIG. **1** along the line C**1**-C**2**. A periphery region **110** of the substrate **101** shown in FIG. **8** is a region where a scanning line drive circuit **104** is arranged. As shown in FIG. **8**, the scanning line drive circuit **104** is arranged with a transistor **250**. The transistor **250** may have the same structure or a different structure from the transistors **210** and **220** which are in the pixel **109**. The light shielding layer **203** is not necessarily arranged in the scanning line driver circuit **104**.

[0096] In addition, the counter electrode **224** is arranged with a cathode contact **140**A connected to the transparent conductive film **226**A in a region between the scanning line drive circuit **104** and the end part of the substrate **101**. The transparent conductive film **226**A is electrically connected to the conductive layer **227**A, the conductive layer **228**A and the wiring layer **229**A. That is, the counter electrode **224** is electrically connected to any of the plurality of terminals **107** by the wiring layer **229**A.

[0097] The first inorganic insulating layer **231** and the second inorganic insulating layer **233** are arranged above the convex shaped insulating layer **242**A. The first inorganic insulating layer **231** and the second inorganic insulating layer **233** are removed by etching using the organic prevention film **236** as a mask.

[0098] Therefore, the side surface of the organic prevention film **236** overlaps a side surface of the convex shaped insulating layer **242**A interposed by the first inorganic insulating layer **231** and the second inorganic insulating layer **233**.

[0099] FIG. **9** is a cross-sectional view of the display device **100** shown in FIG. **1** along the line D**1**-D**2**. A periphery region **110** of the substrate **101** shown in FIG. **9** includes a bent region **130** and a plurality of terminals **107**.

[0100] The counter electrode **224** of the light emitting element **240** is arranged with a cathode contact **140**B which is connected to the transparent conductive film **226**. The wiring layer **243** is a lead wiring. The wiring layer **243** extends in the periphery region **110** and is exposed in the vicinity of the end part of the periphery region **110**. A region which contacts the wiring layer **243** and the transparent conductive film **245** becomes the terminal **107**.

[0101] Since the inorganic insulating layer has particularly poor toughness, and thus easily cracks as the substrate **101** bends, cracks easily occur and the inorganic insulating layer is removed in the bent region **130**. In order to secure the strength of this region, a resin layer or the like may be further arranged above the wiring layer **244** so as to cover the bent region **130**.

[0102] The first inorganic insulating layer **231** and the second inorganic insulating layer **233** are arranged above the convex shaped insulating layer **242**B.

[0103] The first inorganic insulating layer **231** and the second inorganic insulating layer **233** are removed by etching using the organic prevention film **236** as a mask. In this way, the first inorganic insulating layer **231** and the second inorganic insulating layer **233** in the bent region **130** and the terminal **107** are removed. Therefore, the side surface of the organic prevention film **236** overlaps the side surface of the convex shaped insulating layer **242**A interposed by the first inorganic insulating layer **231** and the second inorganic insulating layer **233**.

[0104] As explained while referring to FIG. **7** to FIG. **9**, the organic prevention film **236** is stopped by the convex shaped insulating layers **242**, **242**A and **242**B which function as dams. That is, the display region **103** and the scanning line drive circuit **104** are covered by the organic prevention film **236**. In addition, the resin mask **235** is not exposed since it is covered by the organic prevention film **236**. In this way, it is preferred to cover the display region **103** and the scanning line drive circuit **104** with the organic prevention film **236** which suppresses ammonia ions from moving and reaching the polarizing plate **102**. On the other hand, the organic prevention film **236** does not have to completely cover the resin mask **235** and may be provided at least in a region which overlaps the display region **103**.

Second Embodiment

[0105] Another example of the structure of the display device **100** related to one embodiment of the present invention is explained while referring to FIG. **10** to FIG. **13**. In the present embodiment, a display device **100**A is explained in which a touch sensor **120** is provided above a sealing film **260**.

[0106] FIG. **10** is a planar diagram of a display device **100**A related to one embodiment of the present invention. Apart from a touch sensor **120** being provided so as to overlap the display region **103** which is provided over the substrate **101**, and the scanning line drive circuit **104** and the polarizing plate **102** not being shown in the diagram, the structure of the display device **100**A shown in FIG. **10** is the same as that of the display device **100** shown in FIG. **1**.

[0107] The touch sensor **120** includes a plurality of sensor electrodes **121** arranged in a stripe shape in a row direction and a plurality of sensor electrodes **122** arranged in a stripe shape in a column direction. One of the sensor electrode **121** and the sensor electrode **122** is also called a transmission electrode (Tx), and the other is also called a reception electrode (Rx). Each sensor electrode **121** and each sensor electrode **122** are separated from each other, and a capacitance is formed between them. For example, the capacitance changes when a human finger or the like touches the display region **103** via the sensor electrode **121** and the sensor electrode **122** (referred to as a touch herein), and the position of the touch is determined by reading this change. In this way, the sensor electrode **121** and the sensor electrode **122** form a so-called projection capacitive touch sensor **120**.

[0108] The sensor electrode **122** is electrically connected to a wiring layer **243** which is arranged in the periphery region **110** of the display region **103**. The terminal **107** is connected to the flexible printed circuit substrate **108**, and a touch sensor signal is applied from the driver IC **106** to the sensor electrode **122** via the terminal **107**. Furthermore, the wiring layer **243** may also be provided in a region which overlaps the scanning line driver circuit **104**.

[0109] Similarly, the sensor electrode **121** is electrically connected to the wiring layer **244** which is arranged in the periphery region **110** of the display region **103**. The terminal **107** is connected to the flexible printed circuit substrate **108**, and a touch sensor signal is applied from the driver IC **106** to the sensor electrode **122** via the terminal **107**.

[0110] In the touch sensor **120**, the sensor electrode **121** includes a plurality of conductive layers **131** which have a substantially square shape, and a connection electrode **123**, and the sensor electrode **122** includes a plurality of conductive layers which have a substantially square shape, and a connection region **135**. In addition, the sensor electrode **121** and the sensor electrode **122** are electrically independent and separated from each other.

[0111] FIG. **11** is an expanded diagram of a region **150** in the display device **100**A shown in FIG. **10**. Although different hatchings are shown in FIG. **11** in order to distinguish the sensor electrode **121** and the sensor electrode **122**, the sensor electrode **121** and the sensor electrode **122** are formed from the same conductive layer. In the sensor electrode **121**, conductive layers **133** which are adjacent left and right are connected via a connection region **135**. In the sensor electrode **122**, conductive layers **131** which are adjacent up and down are connected via the connection electrode **123**. The sensor electrode **121** includes a plurality of conductive layers **133** and a plurality of openings **134**, and the sensor electrode **122** includes a plurality of conductive layers **131** and a plurality of openings **132**. In each of the conductive layers **131** and the conductive layers **133**, the plurality of openings **132** and the plurality of openings **134** are arranged in a matrix. In this way, the conductive layer **131** and the conductive layer **133** have a mesh shape. Here, a width I of wiring which forms the conductive layer **131** is 1 μm or more and 10 μm or less, or 2 μm or more and 8 μm or less and typically 5 μm. Similarly, a width m of wiring which forms the conductive layer **133** is 1 μm or more and 10 μm or less, or 2 μm or more and 8 μm or less and typically 5 μm.

[0112] As shown in FIG. **11**, the connection region **135** which connects left and right conductive layers **133** is arranged along a first direction, and the connection electrode **123** which connects up and down conductive layers **131** is arranged in a second direction which intersects the first direction. In other words, the connection electrode **123** has a region which intersects a part of the sensor electrode **121**. Furthermore, although the width of the connection electrode **123** is shown as the same width as the width I of the conductive layer **131** in FIG. **11**, it may also be larger than the width I of the conductive layer **131**. The connection electrode **123** is preferred not to overlap the light emitting region of the light emitting element **240** of the pixel **109**.

[0113] FIG. **12** is a cross-sectional view along the line F**1**-F**2** of the touch sensor **120** shown in FIG. **11**. Furthermore, an illustration of the structure below the first inorganic insulating layer **231** is omitted in FIG. **12**. As shown in FIG. **12**, a third inorganic insulating layer **234** is arranged under the sensor electrode **121** and the sensor electrode **122** in order to prevent the sensor electrode **121** and the sensor electrode **122** from contacting each other. Next, the connection electrode **123** for connecting conductive layers **131** adjacent up and down above and below the sensor electrode **122** is arranged via the third inorganic insulating layer **234**. In this way, it is possible to prevent the sensor electrode **121** and the sensor electrode **122** from contacting each other in the region where the sensor electrode **121** and the sensor electrode **122** intersect.

[0114] For example, a silicon nitride film, a silicon nitride oxide film or an aluminum nitride film or the like is used for the third inorganic insulating layer **234** similar to the first inorganic insulating layer **231** and the second inorganic insulating layer **233**. In addition, the third inorganic insulating layer **234** is in contact with the resin mask **235**.

[0115] In the display device **100**A related to one embodiment of the present invention, the organic prevention film **236** is arranged between the resin mask **235** and the polarizing plate **102**. The organic prevention film **236** is arranged so as to cover at least the display region **103**. In this way, it is possible to suppress the ammonia which is generated by contact between the third inorganic insulating layer **234** and the resin mask **235** from reaching the polarizing plate **102** by the organic prevention film **236**.

[0116] The organic prevention film **236** has a function for neutralizing or adsorbing ammonia. For example, in the case when the organic prevention film **236** neutralizes ammonia, the pH of the organic prevention film **236** is preferred to exhibit a stronger acidity than the pH of the resin mask **235**.

[0117] The thickness of the organic prevention film **236** is preferred to be larger than the thickness of the resin mask **235**. For example, the total thickness of the organic prevention film **236** and the resin mask **235** is preferred to be 10 μm or more and 20 μm or less. The thickness of the organic prevention film **236** is preferred to be 1 μm or more and 15 μm or less, and the thickness of the resin mask **235** is preferred to be 5 μm or more and 19 μm or less.

[0118] The organic prevention film **236** may have a function for adsorbing ammonia. For example, an organic resin containing transparent fine particles such as silicon oxide, alumina, calcium oxide and aluminum silicate is used as the organic prevention film **236**. By including porous fine particles in the organic resin, it is possible to adsorb ammonium ions without affecting the light extraction efficiency. The particle size of the transparent fine particles is preferred to be, for example, 1 μm or more and 100 μm or less. In addition, it is possible to n suppress the occurrence of light scattering by adding transparent fine particles at 10% or more and 30% or less per unit volume.

[0119] According to the display device **100**A related to one embodiment of the present invention, it is possible to suppress the amount of ammonia which is generated by contact between the third inorganic insulating layer **234** and the resin mask **235**. In addition, it is possible to adsorb ammonia which is generated by contact between the third inorganic insulating layer **234** and the resin mask **235** using the organic prevention film **236**. In this way, since it is possible to suppress ammonia reaching the polarizing plate **102**, it is possible to suppress the polarizing plate **102** turning white. Therefore, the reliability of the display device **100**A can be improved.

[0120] FIG. **13** is a cross-sectional view along line E**1**-E**2** of the display device **100**A shown in FIG. **10**. The structure from the substrate **101** to the sealing film **260** is the same as in FIG. **1**. In the present embodiment, the touch sensor **120** is arranged above the second inorganic insulating layer **233** of the sealing film **260**. FIG. **13** shows a connection region between the sensor electrode **122** and the connection electrode **123**. The connection electrode **123** is arranged above the second inorganic insulating layer **233**, the third inorganic insulating layer **234** is arranged above the connection electrode **123**, and the sensor electrode **122** is arranged above the third inorganic insulating layer **234**. The wiring layer **244**A extends in the periphery region **110** and is exposed near the end part of the periphery region **110**. A region in contact with the wiring layer **244**A and the transparent conductive film **245** becomes the terminal **107**.

[0121] Although the organic prevention film **236** is shown as covering the resin mask **235** in the periphery region **110** which surrounds the display region **103** shown in FIG. **13**, one embodiment of the present invention is not limited to this. The organic prevention film **236** only needs to overlap at least the display region **103**. When the organic prevention film **236** overlaps at least the display region **103**, the generated ammonia can be neutralized or adsorbed by the organic prevention film **236**. In this way it is possible to suppress the polarizing plate **102** becoming white due to ammonia reaching the polarizing plate **102**.

[0122] In the display devices **100** and **100**A related to one embodiment of the present invention, the organic prevention film **236** is arranged above the resin mask **235** which is in contact with a film including nitrogen, and thereby it is possible to suppress the ammonia generated by contact between the film including nitrogen and the resin mask **235** from reaching the polarizing plate **102**. In this way, since it is possible to suppress a polarizing plate turning white due to ammonia, the reliability of the display devices **100** and **100**A can be improved.

What is claimed is:

1. A display device comprising:

a first substrate;

a display region with pixels each including a light emitting element above the first substrate;

a first inorganic insulating layer covering the display region;

a first organic insulating layer on the first inorganic insulating layer;

a second inorganic insulating layer on the first organic insulating layer;

a second organic insulating layer on the second inorganic insulating layer;

a third organic insulating layer on the second organic insulating layer, acidity of the third organic insulating layer being stronger than acidity of the second organic insulating layer, and

a polarizing plate arranged on the third organic insulating layer.

2. The display device according to claim **1**, wherein a thickness of the third organic insulating layer is larger than a thickness of the second organic insulating layer.

3. The display device according to claim **1**, wherein the total thickness of the third organic insulating layer and the second organic insulating layer is 10 μm or more and 20 μm or less.

4. The display device according to claim **1**, wherein the third organic insulating layer is an organic resin including particles of silicon oxide, alumina, calcium oxide or aluminum silicate.

5. The display device according to claim **1**, further comprising a convex shaped insulating layer in a periphery region surrounding the display region,

wherein the first inorganic insulating layer and the second inorganic insulating layer are stacked above the convex shaped insulating layer,

a first side surface of the third organic insulating layer overlaps a second side surface of the convex shaped insulating layer, and

the first inorganic insulating layer and the second inorganic insulating layer is located between the first side surface and the second side surface.

6. A display device comprising:

a first substrate;

a display region with pixels each including a light emitting element above the first substrate;

a first inorganic insulating layer covering the display region;

a first organic insulating layer on the first inorganic insulating layer;

a second inorganic insulating layer on the first organic insulating layer;

a first electrode on the second inorganic insulating layer;

a third inorganic insulating layer on the first electrode;

a second electrode on the third inorganic insulating layer and electrically connected to the first electrode;

a second organic insulating layer on the second electrode;

a third organic insulating layer on the second organic insulating layer, acidity of the third organic insulating layer being stronger than acidity of the second organic insulating layer, and

a polarizing plate arranged on the third organic insulating layer.

7. The display device according to claim **6**, wherein a thickness of the third organic insulating layer is larger than a thickness of the second organic insulating layer.

8. The display device according to claim **6**, wherein the total thickness of the third organic insulating layer and the second organic insulating layer is 10 μm or more and 20 μm or less.

9. The display device according to claim **6**, wherein the third organic insulating layer is an organic resin including particles of silicon oxide, alumina, calcium oxide or aluminum silicate.

10. A manufacturing method of a display device comprising:

forming pixels each including a light emitting element above a first substrate;

forming a first inorganic insulating layer covering the pixels;

forming a first organic insulating layer on the first inorganic insulating layer;

forming a second inorganic insulating layer on the first organic insulating layer;

forming a second organic insulating layer on the second inorganic insulating layer;

forming a third organic insulating layer on the second organic insulating layer, acidity of the third organic insulating layer being stronger than acidity of the second organic insulating layer, and

bonding a polarizing plate on the third organic insulating layer.

11. The manufacturing method of a display device according to claim **10**, further comprising:

curing the third organic insulating layer; and

curing the second organic insulating layer,

wherein an amount of a polymerization initiator for curing the third organic insulating layer is larger than an amount of a polymerization initiator for curing the second organic insulating layer.

* * * * *

专利名称(译)	显示装置及其制造方法		
公开(公告)号	US20200227682A1	公开(公告)日	2020-07-16
申请号	US16/734532	申请日	2020-01-06
[标]申请(专利权)人(译)	株式会社日本显示器		
申请(专利权)人(译)	日本展示INC.		
当前申请(专利权)人(译)	日本展示INC.		
[标]发明人	OHARA HIROKI		
发明人	OHARA, HIROKI		
IPC分类号	H01L51/52 H01L51/50		
CPC分类号	H01L51/5256 H01L51/5221 H01L51/5206 H01L51/5012		
优先权	2019003067 2019-01-11 JP		
外部链接	Espacenet USPTO		

摘要(译)

显示装置包括:第一基板;具有像素的显示区域,每个像素均包括位于第一基板上方的发光元件;覆盖显示区域的第一无机绝缘层;在第一无机绝缘层上的第一有机绝缘层;第二无机绝缘层 第一有机绝缘层上的有机层,第二无机绝缘层上的第二有机绝缘层,第二有机绝缘层上的第三有机绝缘层a,第三有机绝缘层的酸度强于第二有机绝缘层的酸度 以及设置在第三有机绝缘层上的偏振片。