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(54) DISPLAY DEVICE AND MANUFACTURING METHOD OF THE SAME

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(57) **ABSTRACT**

A coating start point is altered to avoid flowing of a sealing resin to an EL element when the sealing resin is pressed and flattened on adhesion of a device substrate and a sealing substrate with the sealing resin interposed therebetween. In a manufacturing method of a display device of the invention which is formed by adhering the device substrate and the sealing substrate with the sealing resin interposed therebetween, when the sealing resin is coated along edges of the device substrate and the sealing substrate, the coating is started on a corner of the substrates as a coating start point and a coating end point is on the same corner as for the coating start point.

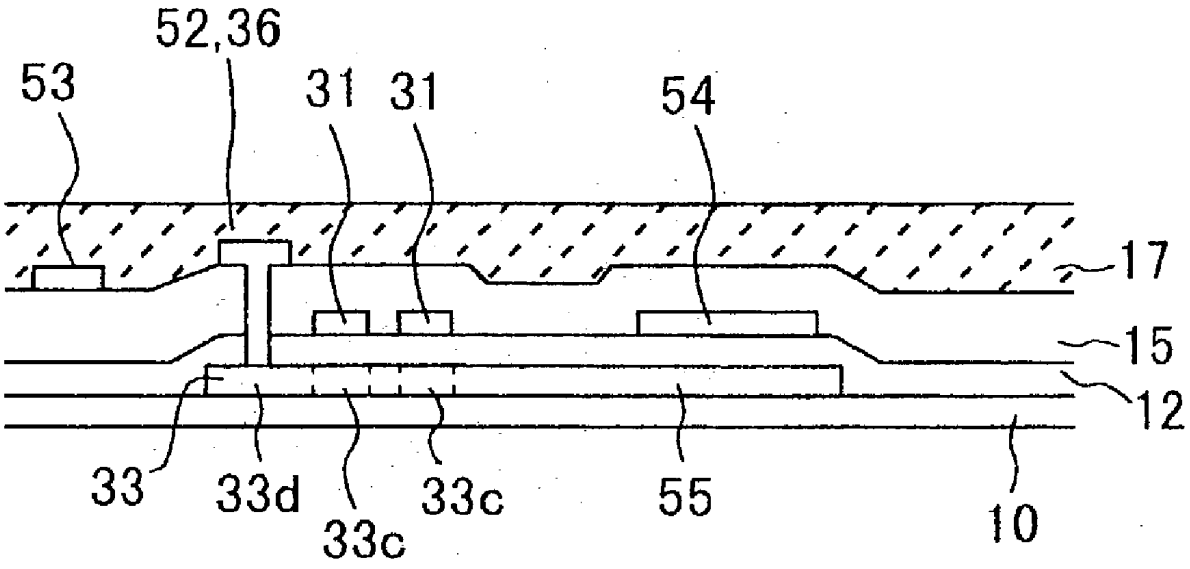


FIG.1A

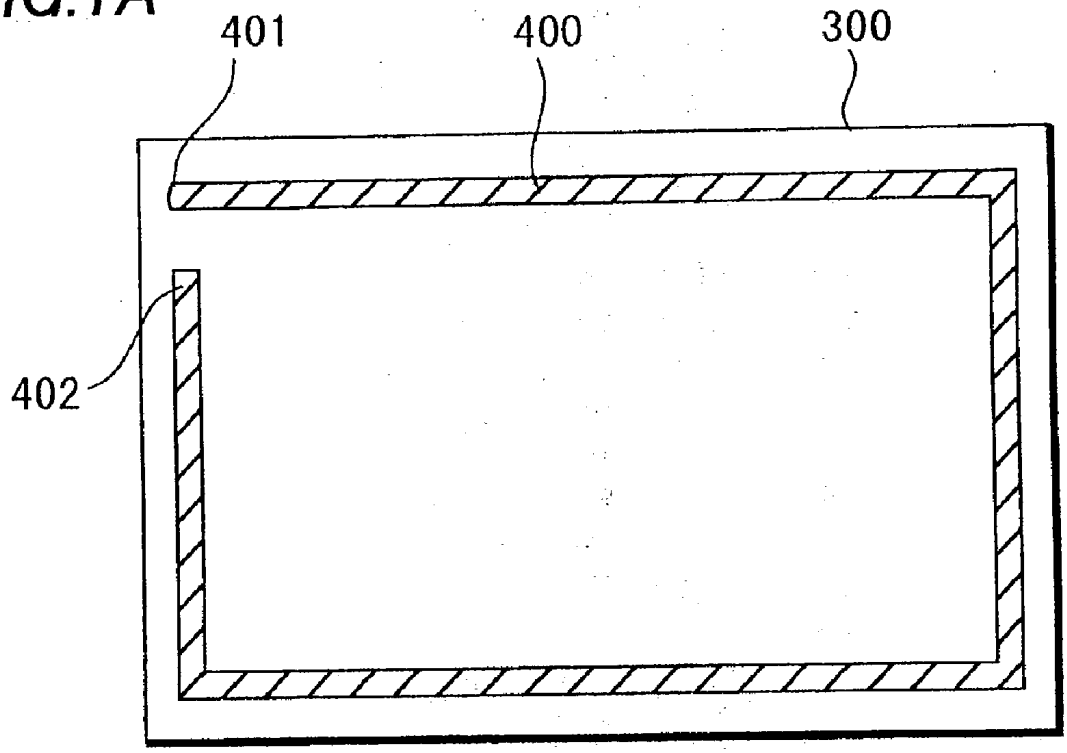


FIG.1B

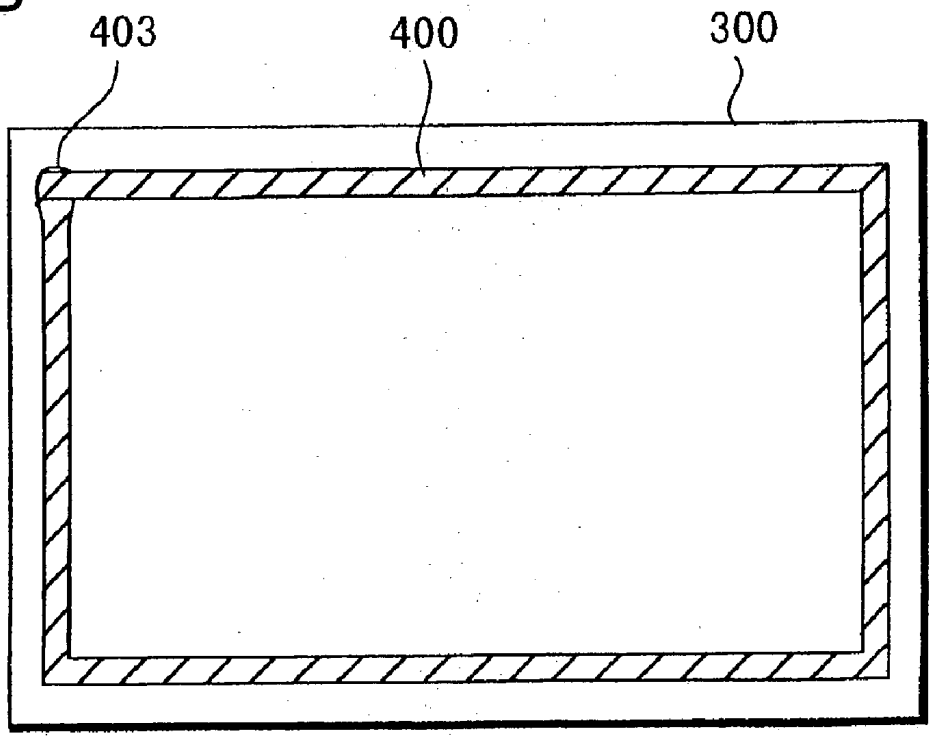


FIG.1C

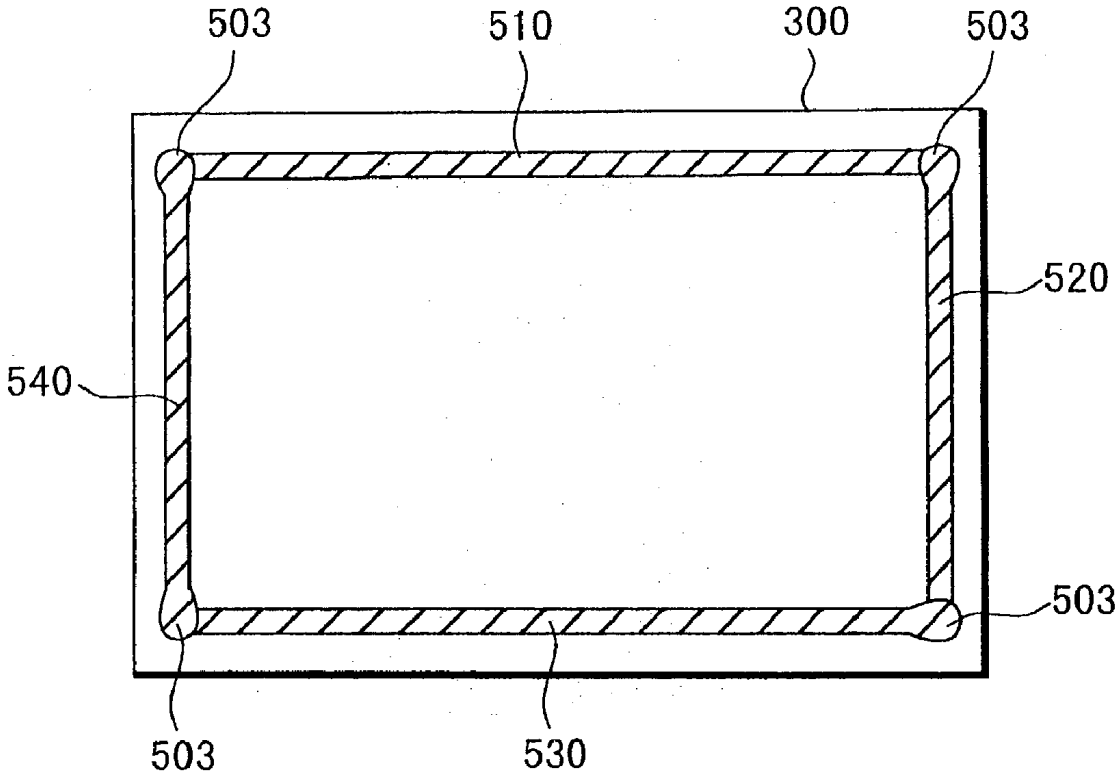
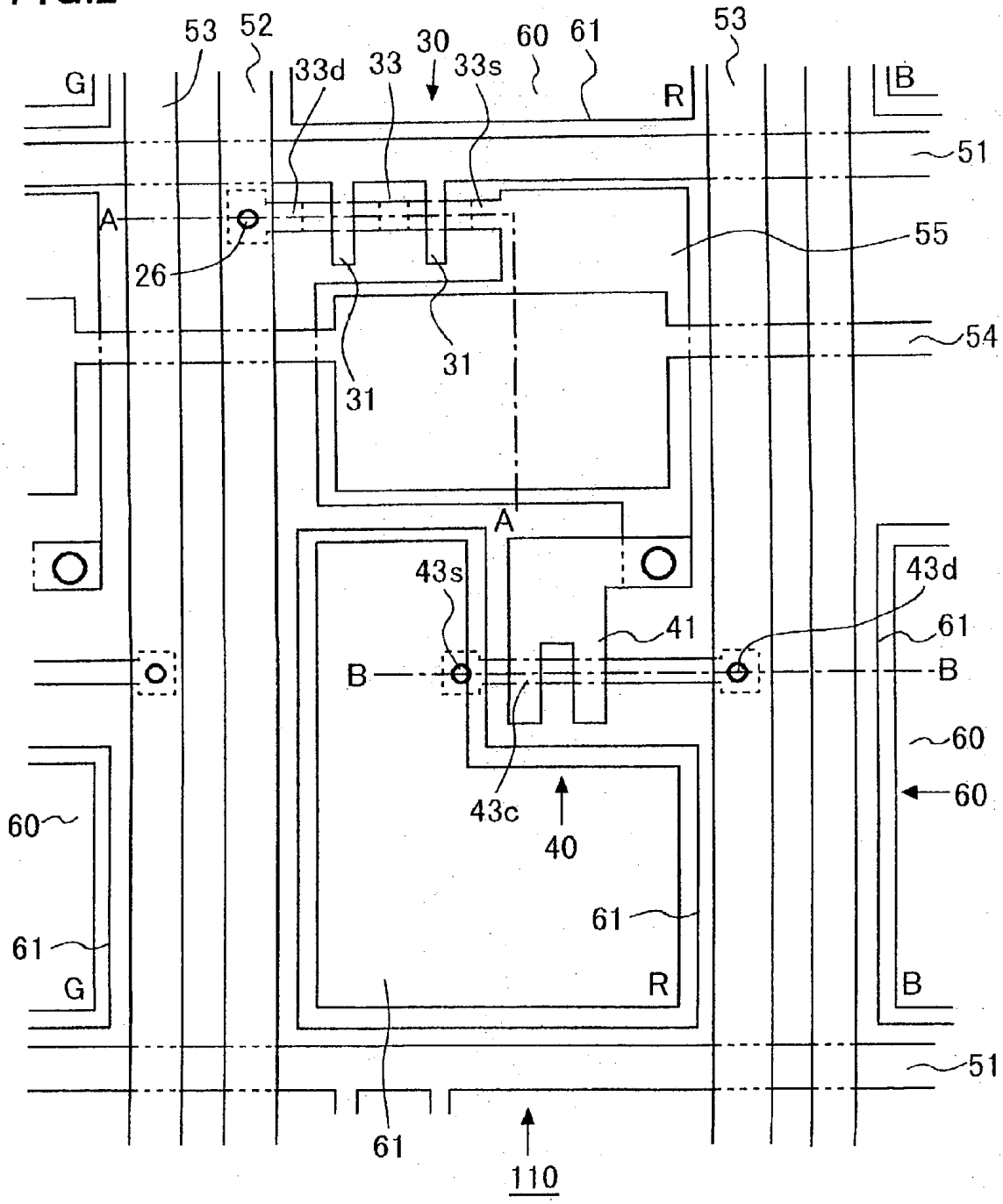


FIG.2


53
52
30
60
61
53
G
33d
33
33s
R
B
51
A
55
26
54
31
31
A
43s
43d
41
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60
60
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43c
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61
61
G
R
B
51
61
110

FIG.3A

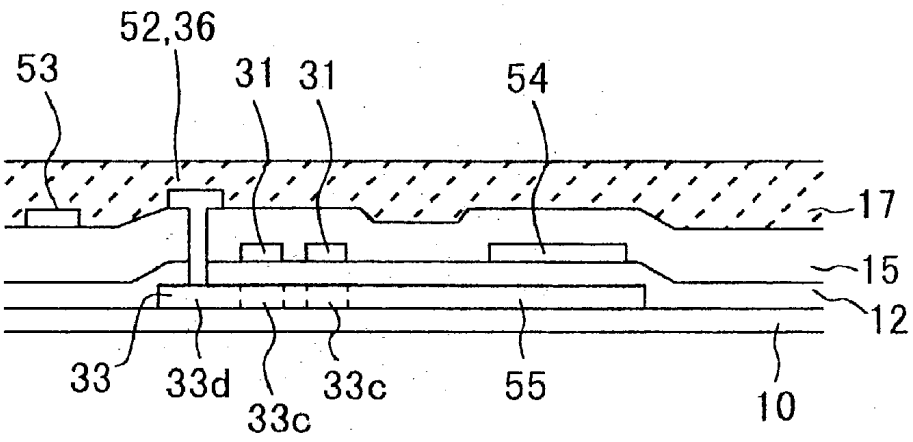

52,36
53
31
31
54
17
15
12
33
33d
33c
33c
55
10

FIG.3B

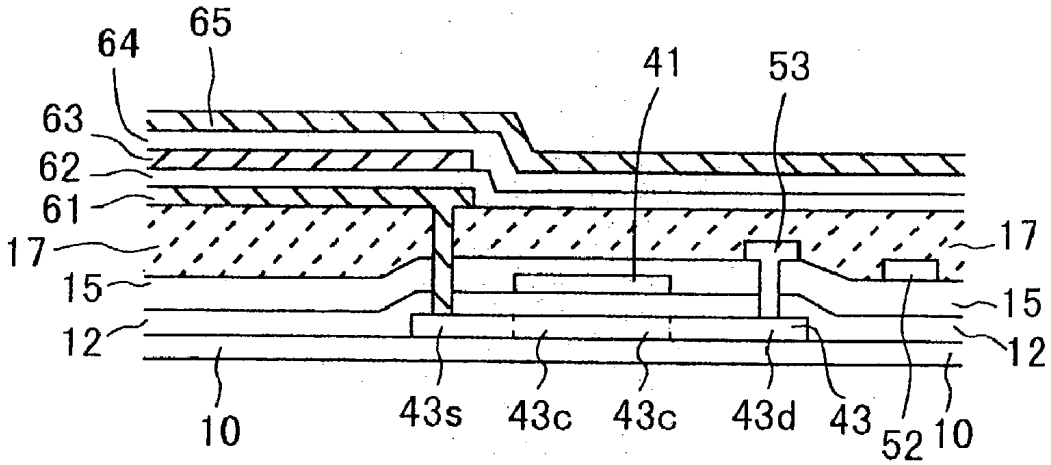

64
65
41
53
63
62
61
17
17
15
15
12
12
10
43s
43c
43c
43d
43
52
10

FIG.4A
PRIOR ART

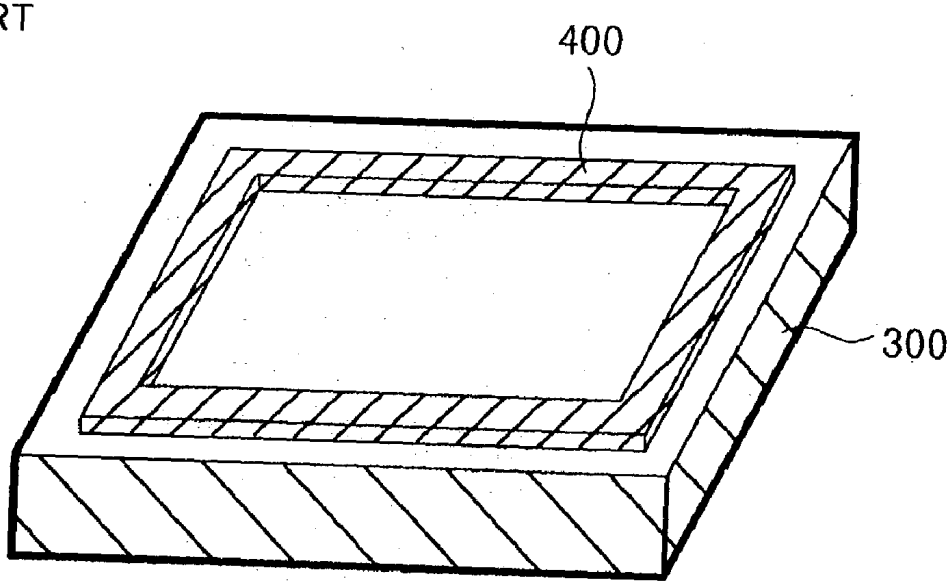


FIG.4B
PRIOR ART

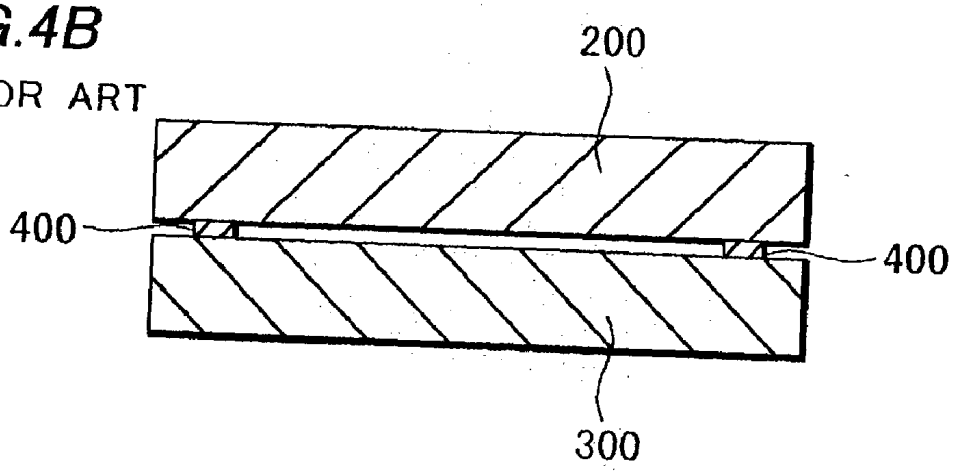


FIG.5A

PRIOR ART

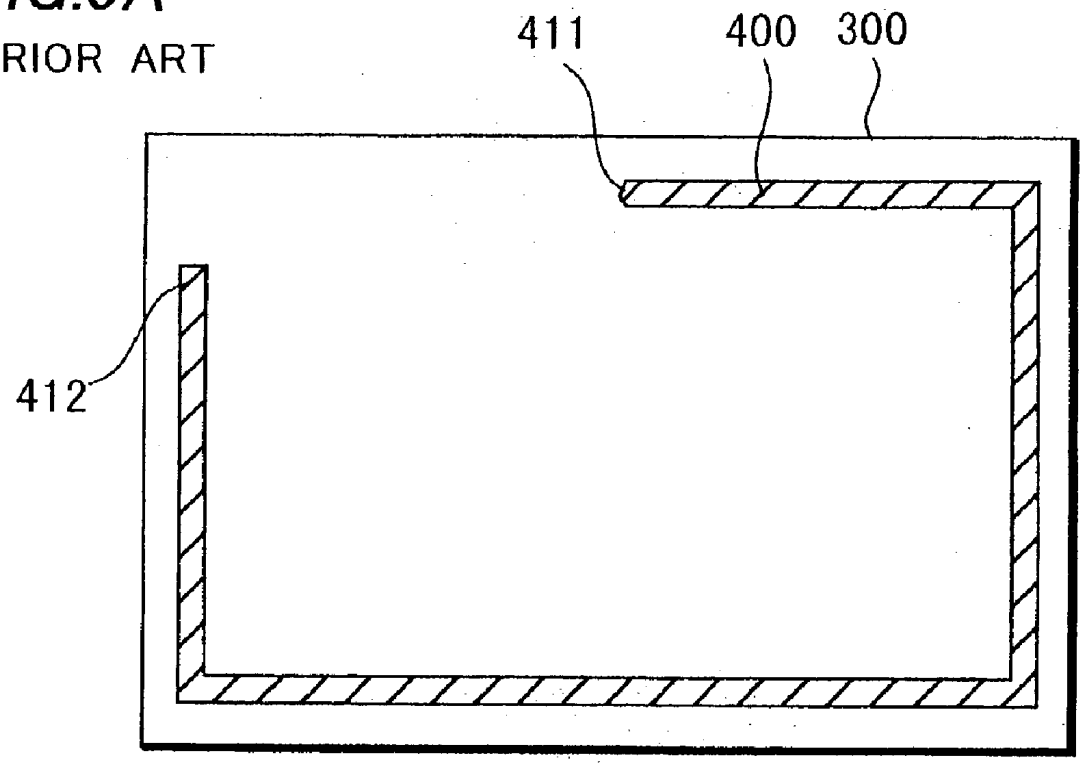
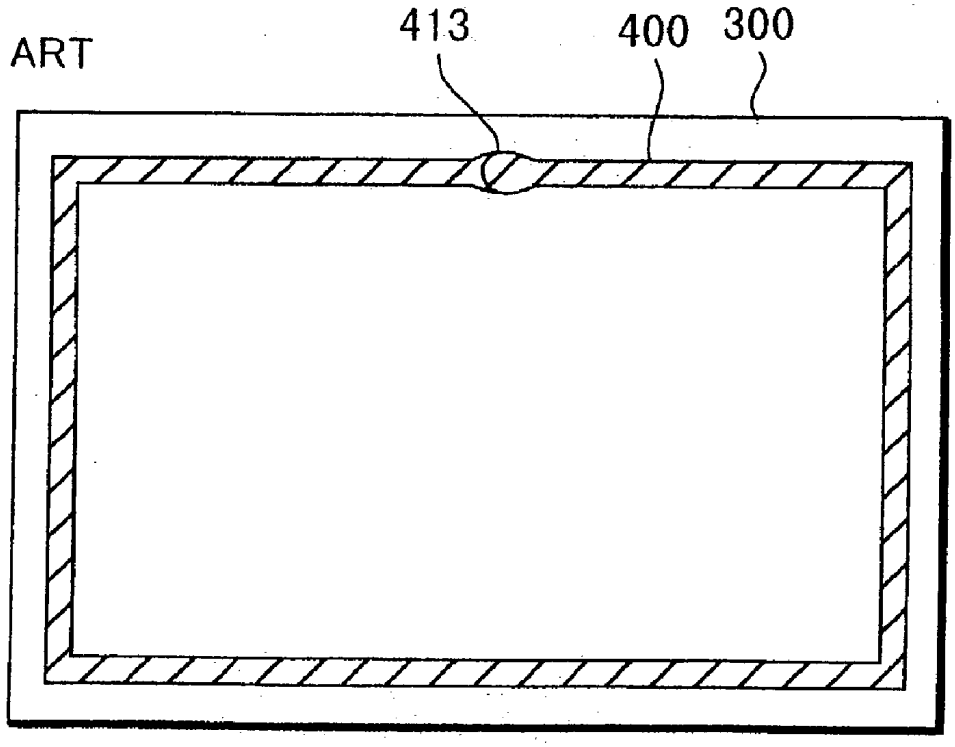


FIG.5B

PRIOR ART



DISPLAY DEVICE AND MANUFACTURING METHOD OF THE SAME

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] This invention relates to a display device provided with a self-emission element, especially to a display device provided with an electroluminescenct element and a thin film transistor.

[0003] 2. Description of the Related Art

[0004] In recent years, an electroluminescenct (hereafter, referred to as an EL) display device with an EL element is receiving an attention as a display device substituting for a CRT and an LCD. For example, research and developments are being pursued for the EL display device provided with a thin film transistor (hereafter, referred to as a TFT) as a switching device for driving the EL element.

[0005] The above-mentioned EL display device is formed, for example, by laminating the TFT and an organic EL element sequentially on a transparent glass substrate (hereafter, referred to as an insulating substrate).

[0006] A gate electrode is formed on the insulating substrate, and a gate insulating film and an active layer made of a p-Si film are laminated sequentially thereon.

[0007] In the active layer, a channel is provided above the gate electrode and source and drain regions are severally provided on both sides of the channel above the gate electrode.

[0008] An interlayer insulating film is formed on whole surfaces of the gate insulating film and the active layer, and a drain electrode is formed by filling metal such as Al in a contact hole provided correspondingly to the drain region.

[0009] Furthermore, on a whole surface of the interlayer insulating film, there are formed a planarization insulation layer for planarizing the surface, which is made of, for example, organic resin, and a contact hole on a position corresponding to the source region in the planarization insulation layer. On the planarization insulation layer, there is formed an anode of the EL device, which serves as a source electrode made of ITO (Indium Tin Oxide) and contacting to the source region through the contact hole.

[0010] A hole transport layer is formed on the anode of ITO and an emissive layer is formed thereon. An electron transport layer is formed to cover the emissive layer and a cathode is laminated thereon.

[0011] **FIGS. 4A and 4B** are explanatory views of a sealing procedure of a conventional EL display device. First, as shown in **FIGS. 4A and 4B**, a device substrate **200** and a sealing substrate **300** made of a glass substrate are adhered with a sealing resin **400** interposed therebetween, which is made of, for example, epoxy resin and coated on the sealing substrate **300** by a dispenser. The device substrate **200** and the sealing substrate **300** are adhered by heating and hardening the sealing resin interposed therebetween.

[0012] For coating the sealing resin **400** along edges of the sealing substrate **300** as shown in **FIG. 5**A, the coating starts at an almost middle point of an edge of the sealing substrate **300**, which is referred to as a coating start point **411**, then terminated at a coating end point, which is identical to the coating start point **411**, and the sealing resin **400** is connected at a connect point **413**. As shown in **FIG. 5**B, however, when pressing and planarization the sealing resin **400** with the sealing substrate **300** and the device substrate **200**, the sealing resin **400** spreads and sometimes flows to the EL device, thereby causing poor operation of the EL device. The reference number **412** is a coating leading point during the coating.

[0013] Conventionally, to avoid the flow of the sealing resin to the EL device by the spread of the sealing resin, a margin is provided in a space between the EL device and the sealing resin. Therefore, there is a need to reduce a size of a display region or increase a size of a display device itself.

[0014] Furthermore, a method to avoid the flow of the sealing resin requires providing a groove on the sealing substrate and coating the sealing resin therein. In this method, however, a groove forming process is needed on the sealing substrate, thereby leading to increased cost.

SUMMARY OF THE INVENTION

[0015] The invention provides a display device including a device substrate, a sealing substrate and a resin layer disposed on peripheral portions of the device and sealing substrates and attaching the sealing substrate to the device substrate. The resin layer includes a connect portion that is formed both as a start point and an end point of a resin layer formation. The connect portion is located at a corner of the sealing substrate and at a corner of the device substrate corresponding to the corner of the sealing substrate.

[0016] The invention also provides a manufacturing method of a display device. The method include providing a device substrate and providing a sealing substrate. The method also includes depositing a line of a sealing resin on peripheral portions of the device substrate. The line depositing of the sealing resin starts from one of the corner portions of the device substrate and ends at the same corner portion of the device substrate. The method further includes attaching the sealing substrate to the device substrate using the sealing resin as an adhesive.

[0017] The invention further includes a manufacturing method of a display device. The method includes providing a device substrate and providing a sealing substrate. The method also includes depositing a line of a sealing resin on peripheral portions of the sealing substrate. The line depositing of the sealing resin starts from one of the corner portions of the sealing substrate and ends at the same corner portion of the sealing substrate. The method further includes attaching the sealing substrate to the device substrate using the sealing resin as an adhesive.

[0018] The invention also provides a display device including a device substrate, a sealing substrate, and a resin layer disposed on peripheral portions of the device and sealing substrates and attaching the sealing substrate to the device substrate. The resin layer includes a connect portion that is formed both as a start point of a resin layer formation and an end point of another resin layer formation. The connect portion is located at a corner of the sealing substrate and at a corner of the device substrate corresponding to the corner of the sealing substrate.

[0019] The invention further provides a display device including a device substrate, a sealing substrate, and a resin

layer disposed on peripheral portions of the device and sealing substrates and attaching the sealing substrate to the device substrate. The resin layer includes a connect portion that is wider than other portions of the resin layer. The connect portion is located at a corner of the sealing substrate and at a corner of the device substrate corresponding to the corner of the sealing substrate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] **FIGS. 1A and 1B** are explanatory views of a coating procedure with a sealing resin on a substrate of an embodiment of this invention, and **FIG. 1C** is an explanatory view of another coating procedure of this embodiment.

[0021] **FIG. 2** is a plan view of an EL display device of the embodiment of this invention.

[0022] **FIGS. 3A and 3B** are cross-sectional views of the EL display device of **FIG. 2**.

[0023] **FIGS. 4A and 4B** are explanatory views of a conventional sealing between a device substrate and a sealing substrate.

[0024] **FIGS. 5A and 5B** are explanatory views of a conventional coating procedure with a sealing resin on a substrate.

DETAILED DESCRIPTION OF THE INVENTION

[0025] An embodiment of this invention will be described as being applicable to an organic EL display device.

[0026] **FIG. 2** shows a plane view of a pixel of the organic EL display device of this embodiment. **FIG. 3A** shows a sectional view along A-A line of **FIG. 2** and **FIG. 3B** shows a sectional view along B-B line of **FIG. 2**.

[0027] As shown in **FIG. 2, a** pixel **110** is formed in a region enclosed with a gate signal line **51** and a drain signal line **52**. The pixels **10** are disposed in a matrix.

[0028] There are disposed in the pixel **110** an organic EL element **60** as a self-emission device, a switching TFT **30** for controlling a timing of supplying an electric current to the organic EL element **60**, a driving TFT **40** for supplying an electric current to the organic EL element **60** and a storage capacitor. The organic EL element **60** is formed of an anode **61**, an emissive layer made of an emission material, and a cathode **65**.

[0029] The switching TFT **30** is provided in a periphery of a point of intersection of the both signal lines **51** and **52**. A source **33***s* of the switching TFT **30** serves as a capacitor electrode **55** for forming a capacitor with a storage capacitor electrode line **54** and is connected to a gate electrode **41** of the driving TFT **40**. A source **43***s* of the driving TFT **40** is connected to the anode **61** of the organic EL element **60**, while a drain **43***d* is connected to a driving source line **53** as a current source to be supplied to the organic EL element **60**.

[0030] The storage capacitor electrode line **54** is disposed in parallel with the gate signal line **51**. The storage capacitor electrode line **54** is made of Cr (chromium) and forms a capacitor by storing an electric charge with the capacitor electrode **55** connected to the source **33***s* of the TFT through a gate insulating film **12**. A storage capacitor **56** is provided for storing voltage applied to the gate electrode **41** of the driving TFT **40**.

[0031] As shown in **FIGS. 3A and 3B**, the organic EL display device is formed by laminating the TFTs and the organic EL element sequentially on a substrate **10** such as a substrate made of glass or synthetic resin, a conductive substrate, or a semiconductor substrate. When using a conductive substrate or a semiconductor substrate as the substrate **10**, however, an insulating film such as SiO_2 or SiN is formed on the substrate **10**, and then the switching TFT **30**, the driving TFT **40** and the organic EL element **60** are formed thereon. Each of the both TFTs has a so-called top gate structure in which a gate electrode is disposed above an active layer with a gate insulating film being interposed therebetween.

[0032] There will be described the switching TFT **30** first.

[0033] As shown in **FIG. 3**A, an amorphous silicon film (hereafter, referred to as an a-Si film) is formed on the insulating substrate **10** made of a silica glass or a non-alkali glass by a CVD method. The a-Si film is irradiated by laser beams for melting and recrystalizing to form a poly-silicon film (hereafter, referred to as a p-Si film) as an active layer **33**. On the active layer **33**, a single-layer or a multi-layer of an SiO_2 film and an SiN film is formed as the gate insulating film **12**. There are disposed on the gate insulating film **12** the gate signal line **51** made of metal having a high melting point such as Cr(chromium) or Mo(molybdenum) and also serving as a gate electrode **31**, the drain signal line **52** made of Al(aluminum), and the driving source line **53** made of Al and serving as a driving source of the organic EL element.

[0034] An interlayer insulating film **15** laminated with an SiO_2 film, an SiN film and an SiO_2 film sequentially is formed on whole surfaces of the gate insulating film **12** and the active layer **33**. There is provided a drain electrode **36** by filling metal such as Al in a contact hole provided correspondingly to a drain **33***d*. Furthermore, a planarization insulation film **17** for planarization a surface which is made of organic resin is formed on a whole surface.

[0035] Next, there will be described the driving TFT **40** of the organic EL element. As shown in **FIG. 3**B, an active layer **43** formed by poly-crystalizing an a-Si film by irradiating laser beams thereto, the gate insulating film **12**, and the gate electrode **41** made of metal having a high melting point such as Cr or Mo are formed sequentially on the insulating substrate **10** made of a silica glass or a non-alkali glass. There are provided in the active layer **43** a channel **43***c*, and a source **43***s* and a drain **43***d* on both sides of the channel **43***c*. The interlayer insulating film **15** laminated with an SiO_2 film, an SiN film and an SiO_2 film sequentially is formed on whole surfaces of the gate insulating film **12** and the active layer **43**. There is disposed the driving source line **53** connected to a driving source by filling metal such as Al in a contact hole provided correspondingly to a drain **43***d*. Furthermore, a planarization insulation film **17** for planarization a surface, which is made of, for example, organic resin etc is formed on a whole surface. A contact hole is formed in a position corresponding to a source **43***s* in the planarization insulation film **17**. There is formed on the planarization insulation film **17** a transparent electrode made of ITO and contacting to the source **43***s* through the contact hole, i.e., the anode **61** of the organic EL element. The anode **61** is formed in each of the pixels, being isolated as an island.

[0036] The organic EL element **60** has a structure of laminating sequentially the anode **61** made of a transparent electrode such as ITO, a first hole transport layer made of MTDATA (4,4-bis (3-methylphenylphenylamino) biphenyl), a hole transport layer **62** made of a second hole transport layer made of TPD (4,4,4-tris (3-methylphenylphenylamino)triphenylanine), an emissive layer **63** made of $Bebq_2$ (bis (10-hydroxybenzo[h]quinolinato)beryllium) containing a quinacridone derivative, an electron transport layer **64** made of $Bebq_2$ and a cathode **65** made of a magnesium-indium alloy, aluminum or an aluminum alloy.

[0037] In the organic El element **60**, a hole injected from the anode **61** and an electron injected from the cathode **65** are recombined in the emissive layer and an exciton is formed by exciting an organic module forming the emissive layer **63**. Light is emitted from the emissive layer **63** in a process of relaxation of the exciton and then released outside after going through the transparent anode **61** to the transparent insulating substrate **10**, thereby completing light-emission.

[0038] The substrate integrated with the above-mentioned EL element **60** is referred to as a device substrate **200** hereafter and there will be described a resin-sealing structure of the EL element **60** of the device substrate **200** with a sealing substrate **300** and a sealing resin **400**.

[0039] In this embodiment, as shown in **FIGS. 1A and 1B**, when the sealing resin is coated along edges of the device substrate **200** and the sealing substrate **300**, a coating start point **401** for starting the coating of the sealing resin **400** on the sealing substrate **300** is on a corner of the sealing substrate **300**. The sealing resin **400** is coated from the coating start point **401**, and the sealing resin **400** is connected at a coating end point, which is identical to the coating start point **401**. The reference number **402** is a coating leading point during the coating and **403** is a connect point formed at the end of the coating.

[0040] In the coating procedure of **FIGS. 1A and 1B**, one resin coating line **400** surrounds the central portion of the sealing substrate **300**, in which the EL elements are sealed when the display device is completed. However, in other coating procedure, which is applicable to this embodiment, one resin coating line **510**, **520**, **530**, **540** is formed for each edge of the sealing substrate **300**, as shown in **FIG. 1C**. Accordingly, four connect points **503** are formed at four corners of the sealing substrate **300**, respectively. For example, a connect point **503** is formed at the upper left corner where the horizontal resin coating line **510** and the vertical resin coating line **540** meet. Because of the overlapping of the two resin coating lines, the connect point **503** becomes wider than the rest of the resin coating line when the sealing substrate is pressed onto the device substrate **200** for the adhesion.

[0041] When the sealing substrate **300** is attached to the device substrate **200** using the resin coating lines, the device substrate itself may receive the similar resin coating layer for easy adhesion. Alternatively, the coating layer may be formed only on the device substrate **200** and the sealing substrate **300** without coating layer may be attached to the device substrate **200**.

[0042] The corners of the device substrate **200** and the sealing substrate **300** have larger area available for coating manipulation than other portions of the edge regions (for example, a center of the edge of the substrate where the coating conventionally starts). In other words, on the corners, spacing between the sealing resin **400** and the EL element **60** is larger. Therefore, even if the sealing resin **400** is pressed and flattened to spread as shown in **FIG. 1**B, on adhesion of the device substrate **200** and the sealing substrate **300**, flowing of the sealing resin **400** to the EL element **60** can be avoided.

[0043] Accordingly, in this embodiment, the method above prevents the flowing of the sealing resin **400** to the EL element **60** and poor operation of the EL element **60**.

[0044] Furthermore, the embodiment of this invention is not limited to the EL display, and is also applicable to a variety of display devices such as a liquid crystal display.

[0045] According to this embodiment, when a sealing resin is coated on edges of a device substrate and a sealing substrate, a corner of the substrates is set as a coating start point, a coating end point is on the same corner as the coating start point, and the sealing resin is connected on the corner of the substrates. Even if the sealing resin at this point spreads wider than the sealing resin at other parts, the contact of the sealing resin to the EL element can be avoided since the corner is large enough to accommodate the spread of the sealing resin. Consequently, the sealing resin does not flow to the EL device, thereby preventing poor operation of the EL device.

What is claimed is:

1. A display device comprising:

a device substrate;

a sealing substrate; and

a resin layer disposed on peripheral portions of the device and sealing substrates and attaching the sealing substrate to the device substrate, the resin layer comprising a connect portion that is formed both as a start point and an end point of a resin layer formation,

wherein the connect portion is located at a corner of the sealing substrate and at a corner of the device substrate corresponding to said corner of the sealing substrate.

2. The display device of claim 1, wherein the connect portion of the resin layer is wider than the rest of the resin layer that is not the connect portion.

3. The display device of claim 1, wherein the device substrate includes an electroluminescent element.

4. The display device of claim 2, wherein the device substrate includes an electroluminescent element.

5. A manufacturing method of a display device, comprising:

providing a device substrate;

providing a sealing substrate;

depositing a line of a sealing resin on peripheral portions of the device substrate, the line depositing of the sealing resin starting from one of the corner portions of the device substrate and ending at said one of the corner portion of the device substrate; and

attaching the sealing substrate to the device substrate using the sealing resin as an adhesive.

6. The manufacturing method of a display device of claim 5, wherein the device substrate includes an electroluminescent element and the electroluminescent element is encircled by the line of the sealing resin.

7. A manufacturing method of a display device, comprising:

providing a device substrate;

providing a sealing substrate;

depositing a line of a sealing resin on peripheral portions of the sealing substrate, the line depositing of the sealing resin starting from one of the corner portions of the sealing substrate and ending at said one of the corner portion of the sealing substrate; and

attaching the sealing substrate to the device substrate using the sealing resin as an adhesive.

8. The manufacturing method of a display device of claim 7, wherein the device substrate includes an electroluminescent element and the electroluminescent element is encircled by the line of the sealing resin.

9. A display device comprising:

a device substrate;

a sealing substrate; and

a resin layer disposed on peripheral portions of the device and sealing substrates and attaching the sealing substrate to the device substrate, the resin layer comprising a connect portion that is formed both as a start point of a resin layer formation and an end point of another resin layer formation,

wherein the connect portion is located at a corner of the sealing substrate and at a corner of the device substrate corresponding to said corner of the sealing substrate.

10. A display device comprising:

a device substrate;

a sealing substrate; and

a resin layer disposed on peripheral portions of the device and sealing substrates and attaching the sealing substrate to the device substrate, the resin layer comprising a connect portion that is wider than other portions of the resin layer,

wherein the connect portion is located at a corner of the sealing substrate and at a corner of the device substrate corresponding to said corner of the sealing substrate.

* * * * *

专利名称(译)	显示装置及其制造方法		
公开(公告)号	US20030178923A1	公开(公告)日	2003-09-25
申请号	US10/377116	申请日	2003-03-03
[标]申请(专利权)人(译)	三洋电机株式会社		
申请(专利权)人(译)	SANYO ELECTRIC CO.，LTD.		
当前申请(专利权)人(译)	SANYO ELECTRIC CO.，LTD.		
[标]发明人	OMURA TETSUJI SASATANI TORU		
发明人	OMURA, TETSUJI SASATANI, TORU		
IPC分类号	H01L27/32 H01L51/50 H01L51/52 H05B33/04 H05B33/10 H01J5/02		
CPC分类号	H01L27/3244 H05B33/04 H01L51/5237 H01L51/5246		
优先权	2002057009 2002-03-04 JP		
外部链接	Espacenet USPTO		

摘要(译)

改变涂覆起始点以避免密封树脂在密封树脂被压制时流动到EL元件，并且在密封基板和密封基板之间插入密封树脂时使其平坦化。在本发明的显示装置的制造方法中，通过将器件基板和密封基板之间插入密封树脂而形成，当沿着器件基板和密封基板的边缘涂覆密封树脂时，涂层是在基板的一角开始作为涂层起点，涂层终点与涂层起点位于同一角落。