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(54) ELECTROLUMINESCENT DISPLAY DEVICE AND MANUFACTURING METHOD OF THE SAME

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(52) **U.S. Cl.** **345/76**

(57) ABSTRACT

An electroluminescent display device has a device glass substrate and a sealing glass substrate that are attached together with a sealing resin. The device glass substrate has a pixel region provided with an organic EL element, and a horizontal driving circuit and a vertical driving circuit, both of which supply driving signals for driving the organic EL element. The sealing glass substrate is provided with a light shield layer for preventing incident light from entering the horizontal driving circuit and the vertical driving circuit. This makes edges of an organic EL panel clear, thereby improving a display contrast.

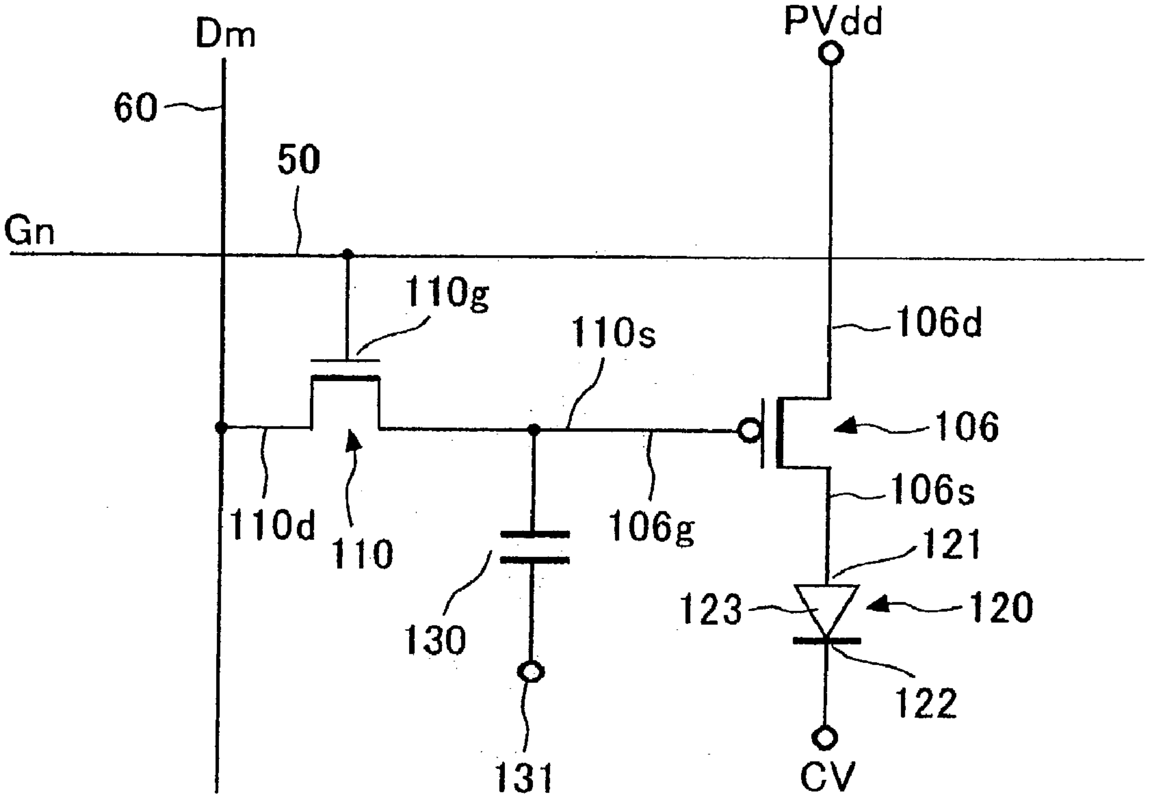


FIG. 1

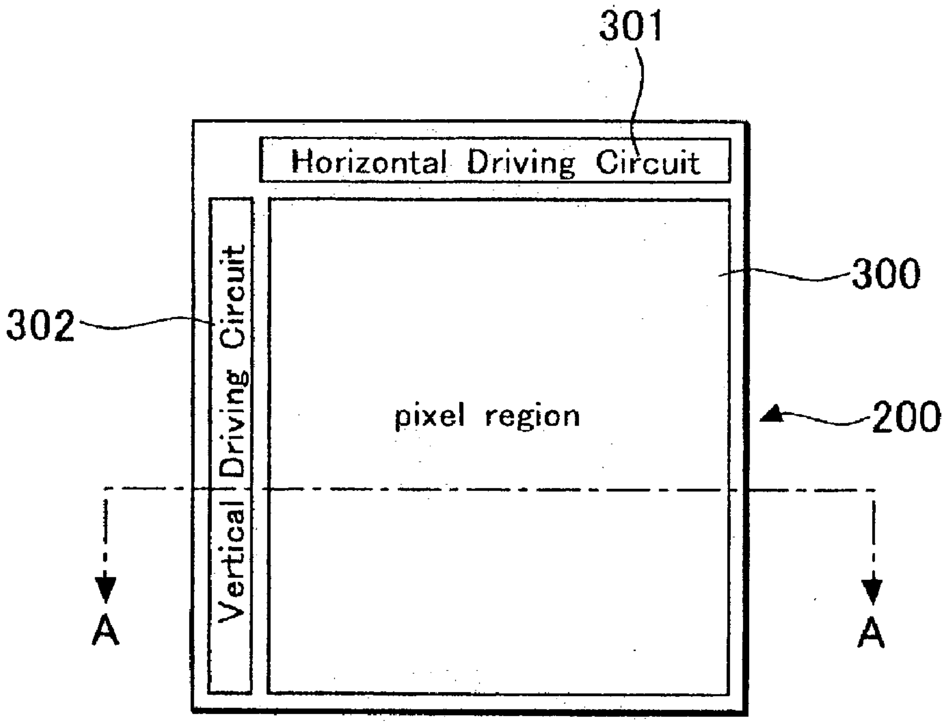

301
Horizontal Driving Circuit
302
Vertical Driving Circuit
300
pixel region
200
A
A

FIG. 2

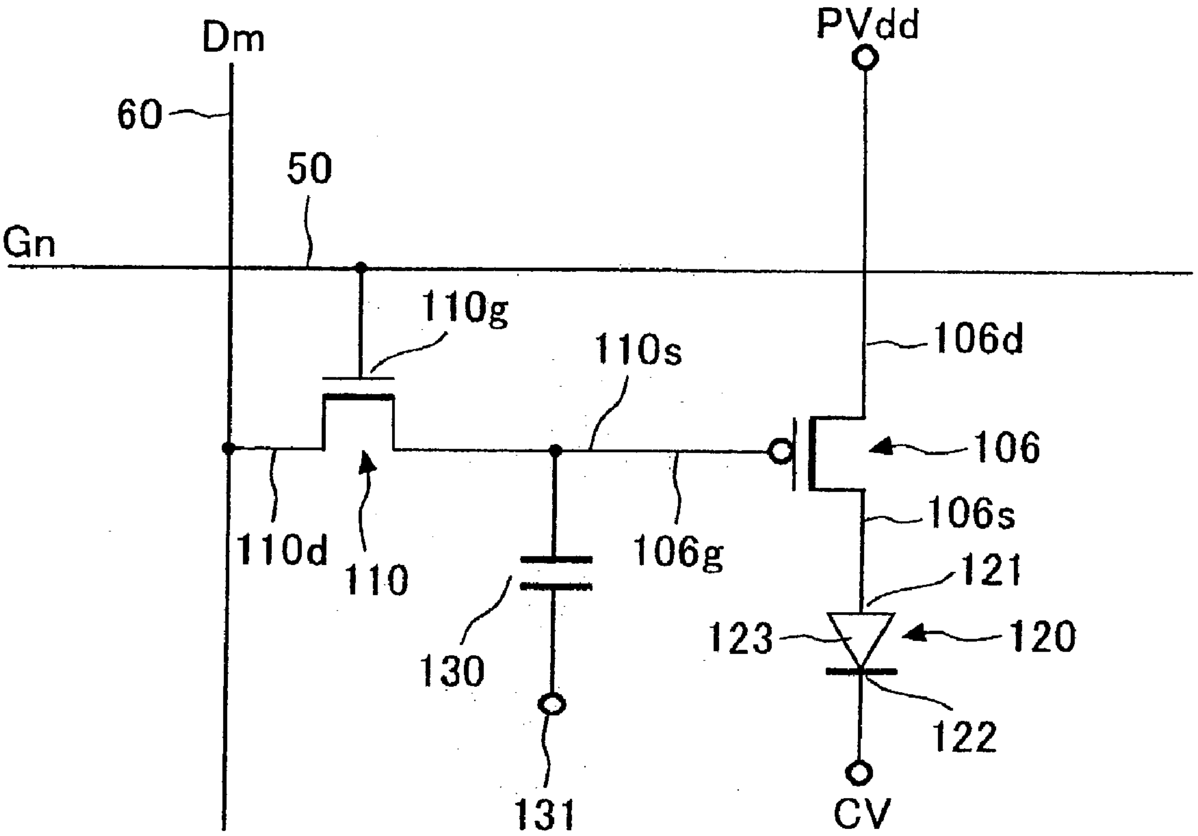

Dm
60
50
Gn
PVdd
110g
110s
106d
106
106s
110d
110
106g
121
123
120
130
122
131
CV

FIG.3A

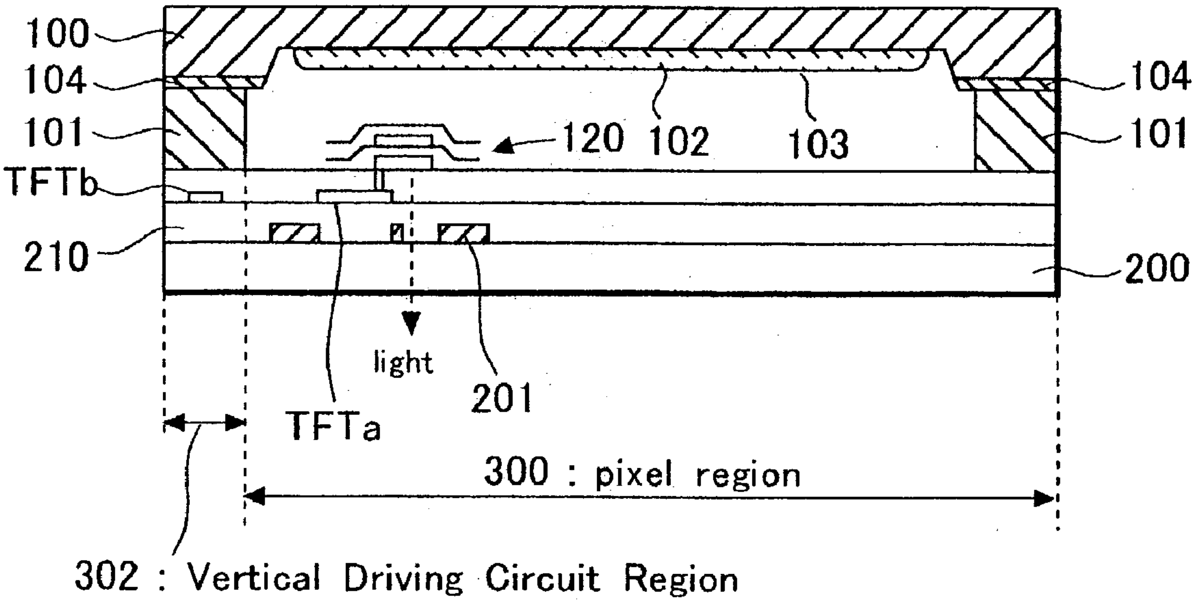

100
104
101
TFTb
210
120
102
103
104
101
200
light
201
TFTa
300 : pixel region
302 : Vertical Driving Circuit Region

FIG.3B

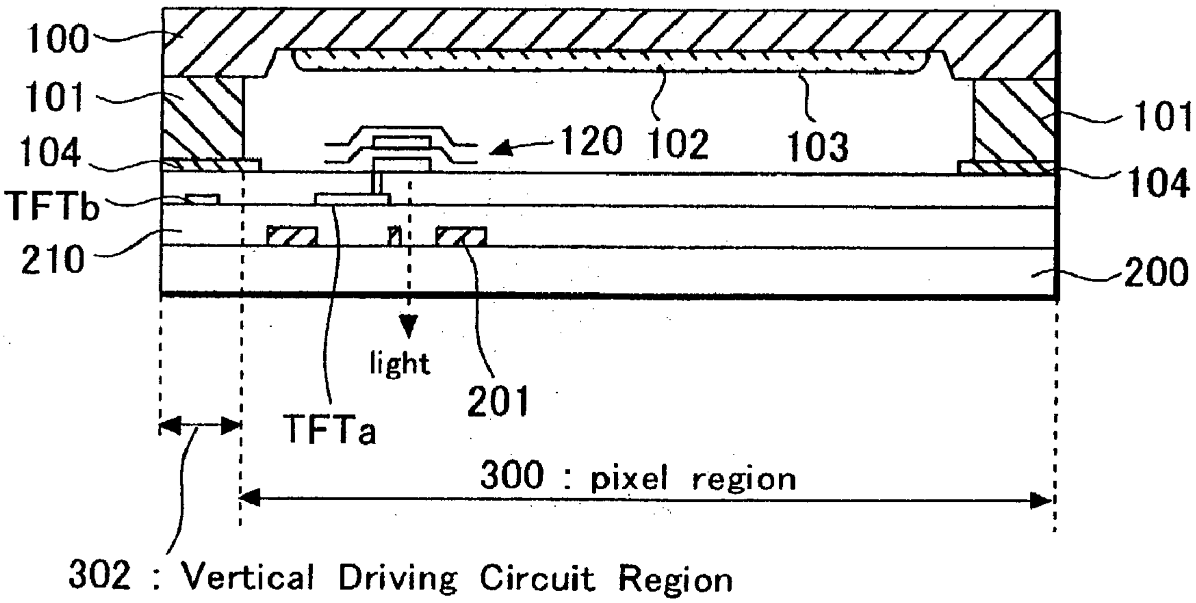

100
101
104
TFTb
210
120
102
103
101
104
200
light
201
TFTa
300 : pixel region
302 : Vertical Driving Circuit Region

FIG.4

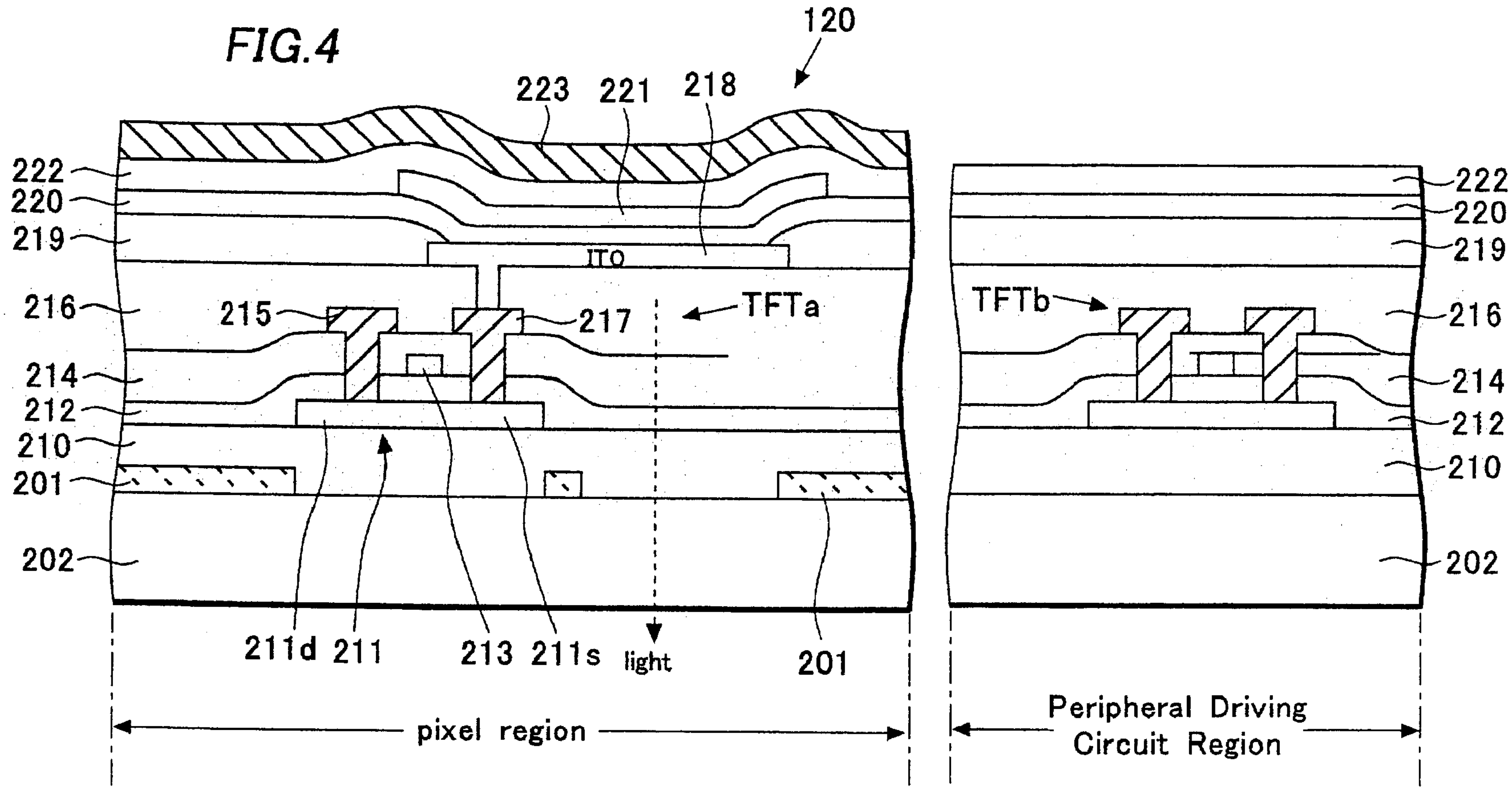

120
223
221
218
222
220
219
216
214
212
210
201
202
215
217
TFTa
ITO
211d
211
213
211s
light
201
pixel region
TFTb
222
220
219
216
214
212
210
202
Peripheral Driving
Circuit Region

FIG.5A

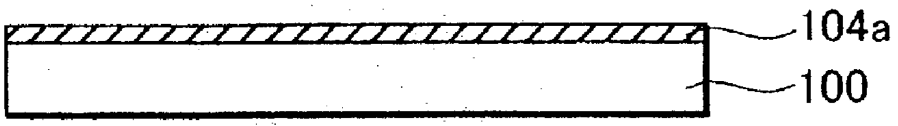


FIG.5B

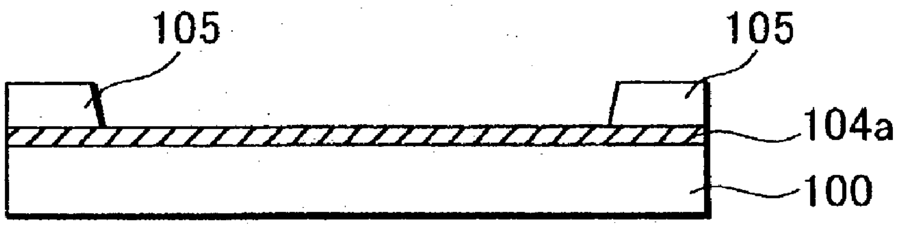


FIG.5C

FIG.5D

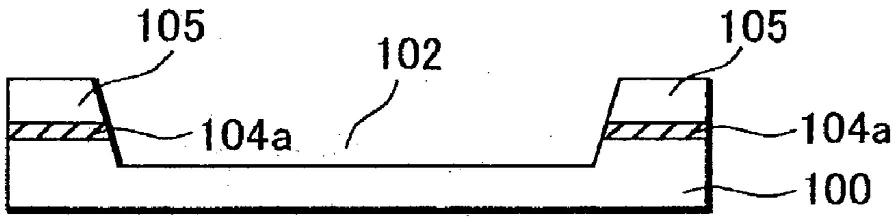


FIG.5E

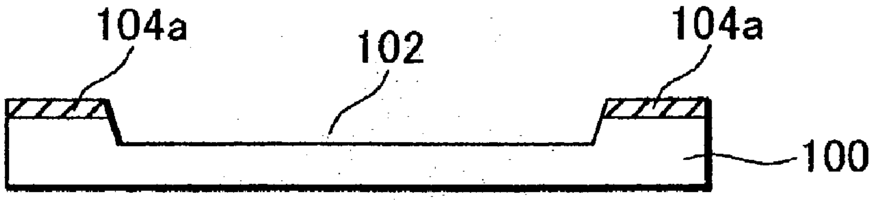


FIG.5F

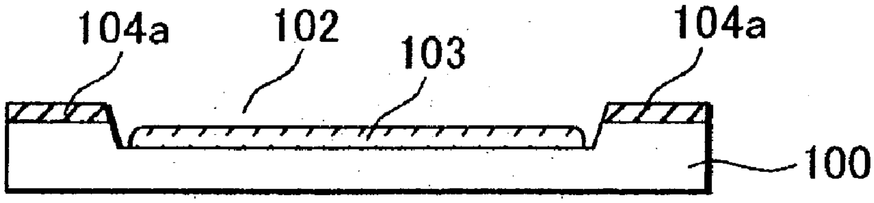
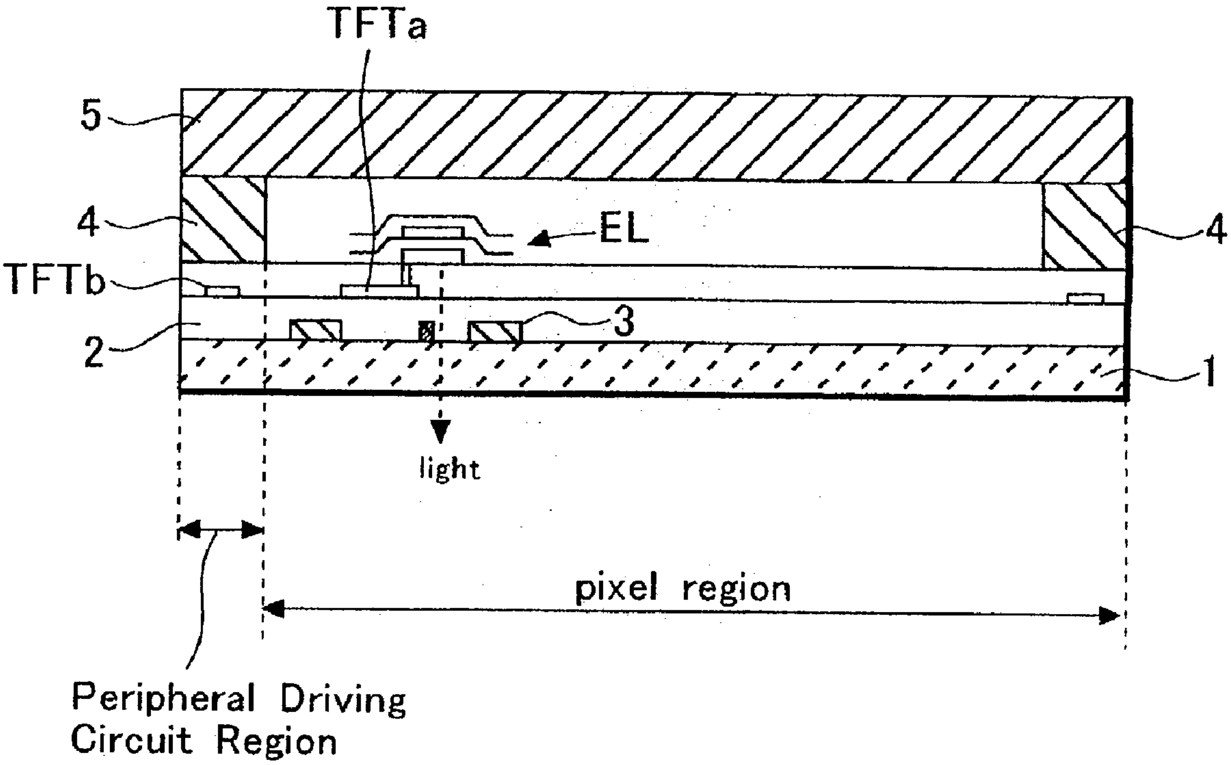


FIG.6


TFTa
5
4
EL
4
TFTb
3
2
1
light
pixel region
Peripheral Driving Circuit Region

ELECTROLUMINESCENT DISPLAY DEVICE AND MANUFACTURING METHOD OF THE SAME

BACKGROUND OF THE INVENTION

[0001] 1 Field of the Invention

[0002] This invention relates to an electroluminescent display device and a manufacturing method thereof, particularly to an electroluminescent display device with an improved display qualities.

[0003] 2. Description of the Related Art

[0004] In recent years, electroluminescent (hereafter, referred to as EL) display devices with an EL element have been receiving an attention as a display device replacing a CRT and an LCD.

[0005] **FIG. 6** is a schematic view showing a structure of a conventional organic EL panel. A pixel region and a peripheral driving circuit region are formed on a device glass substrate **1**. The pixel region includes a plurality of pixels and each of the pixels has an organic EL element, an organic EL element driving TFT (thin film transistor), TFTa, and a pixel selecting TFT (not shown). For example, the organic EL element driving TFT, TFTa, has an active layer made of a polysilicon layer. A light shield layer **3** made of Cr (chromium) is disposed below TFTa with an insulating film **2** interposed therebetween.

[0006] This light shield layer **3** is placed off the position exactly below the active layer of TFTa. The reason is as follows. In the manufacturing process of this display device, the active layer of TFTa is initially made of an amorphous silicon. This amorphous silicon is then crystallized by excimer laser irradiation. At this process step, if the light shield layer **3** made of Cr is located exactly below the active layer of TFTa, thermal conductivity becomes high. This makes it difficult to control grain sizes of the active layer, thereby degrading characteristics of TFTa.

[0007] A peripheral driving circuit disposed in a periphery of the pixel region includes many TFTs, TFTb, as well as related wiring (not shown). The light shield layer **3** made of Cr is not formed exactly below TFTb with the same reason as described above.

[0008] The device glass substrate **1** is attached to a sealing glass substrate **5** with a sealing resin **4** made of an epoxy resin interposed therebetween.

[0009] As described above, since the light shield layer **3** is not formed exactly below TFTbs in the peripheral driving circuit, light incident from the sealing glass substrate **5** penetrates to the device glass substrate **1**. Therefore, edges of the organic EL panel become blurred to an observer and a display contrast is degraded.

SUMMARY OF THE INVENTION

[0010] The invention provides an electroluminescent display device that includes a first substrate, an electroluminescent element disposed on the first substrate, a peripheral driving circuit disposed on a peripheral portion of the first substrate and supplying a driving signal for the electroluminescent element, a second substrate attached to the first substrate, and a light shield layer covering the peripheral driving circuit.

[0011] The invention also provides an electroluminescent display device that includes a first substrate, an electroluminescent element disposed on the first substrate, a peripheral driving circuit disposed on a peripheral portion of the first substrate and supplying a driving signal for the electroluminescent element, a second substrate attached to the first substrate, and means for preventing light coming from the second substrate and entering the peripheral driving circuit from passing through the first substrate.

[0012] The invention further provides a manufacturing method of an electroluminescent display device. The method includes providing a first substrate having thereon an electroluminescent element and a peripheral driving circuit for supplying a driving signal for driving the electroluminescent element. The peripheral driving circuit is disposed on a peripheral portion of the first substrate. The method also includes forming a light shield layer on a second substrate, forming a photoresist layer on the light shield layer at a peripheral region of the second substrate, and removing a portion of the light shield layer by etching using the photoresist layer as a mask. The method further includes forming a pocket region on the second substrate by etching the second substrate using the photoresist layer and the remaining light shield layer as a mask, removing the photoresist layer, forming a desiccant layer in the pocket region, and attaching the second substrate to the first substrate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] **FIG. 1** is a plan view of a device glass substrate according to an embodiment of the invention.

[0014] **FIG. 2** is an equivalent circuit diagram of a pixel formed on a pixel region shown in **FIG. 1**

[0015] **FIGS. 3A and 3B** are cross-sectional views of an organic EL panel according to the embodiment.

[0016] **FIG. 4** is a partial cross-sectional view of the pixel region and a peripheral driving circuit region shown in **FIG. 1**.

[0017] FIGS. **5A-5F** show manufacturing steps of a sealing glass substrate of the embodiment.

[0018] **FIG. 6** is a cross-sectional view of a conventional organic EL panel.

DETAILED DESCRIPTION OF THE INVENTION

[0019] Next, there will be described an embodiment of the invention with reference to FIGS. **1-5**F. First, a structure of a device glass substrate **200** of this embodiment will be described with reference to **FIGS. 1 and 2**.

[0020] As shown in **FIG. 1**, there are disposed on the device glass substrate **200** a pixel region **300**, and a horizontal driving circuit **301** and a vertical driving circuit **302** as a peripheral driving circuit of the pixel region. The vertical driving circuit **302** supplies a gate signal Gn (a horizontal scanning signal) to each pixel of the pixel region **300**. The horizontal driving circuit **301** supplies a drain signal (a video signal Dm) to each pixel of the pixel region **300** in accordance with the horizontal scanning signal.

[0021] **FIG. 2** is an equivalent circuit diagram of one of the pixels placed in the pixel region **300**. A gate signal line

50 for supplying the gate signal Gn and a drain signal line **60** for supplying the drain signal, i.e. the video signal Dm intersect each other.

[0022] There are disposed in the vicinity of the intersection of both signal lines an organic EL element **120**, a TFT **106** for driving the organic EL element **120** and a TFT **110** for selecting a pixel.

[0023] A positive source voltage PVdd is supplied to a drain **106***d* of the organic EL element driving TFT **106**. A source **106***s* is connected to an anode **121** of the organic EL element **120**.

[0024] A gate **110***g* of the pixel selecting TFT **110** is connected to the gate signal line **50**, receiving the gate signal Gn, and a drain **110***d* of the pixel selecting TFT **110** is connected to the drain signal line **60**, receiving the video signal Dm. A source **110***s* of the TFT **110** is connected to a gate **106***g* of the organic EL element driving TFT **106**. The gate signal Gn is outputted from a vertical driving circuit **302**. The video signal Dm is outputted from a horizontal driving circuit **301**.

[0025] The organic EL element **120** includes the anode **121**, a cathode **122** and an emissive layer **123** disposed between the anode **121** and the cathode **122**. The cathode **122** is supplied with a negative source voltage CV.

[0026] A storage capacitor **130** is connected to the gate **106***g* of the TFT **106**. That is, one of the electrodes of the storage capacitor **130** is connected to the gate **106***g*, and the other electrode is connected to a storage capacitor electrode **131**. The storage capacitor **130** is provided to hold the video signal of the display pixel for one field period by keeping the charge corresponding to the video signal Dm.

[0027] The operation of the EL display device having the above structure is described as follows. The pixel selecting TFT **110** turns on when the gate signal Gn becomes a high level for one horizontal period. Then, the video signal Dm is applied from the drain signal line **60** to the gate **106***g* of the organic EL element driving TFT **106** through the TFT **110**. The conductance of the TFT **106** changes in response to the video signal Dm supplied to the gate **106***g*, and a driving current corresponding to the changed conductance is supplied to the organic EL element **120** through the TFT **106**. Then, the organic EL element **120** emits light.

[0028] Next, there will be described a structure of an organic EL panel that includes the device glass substrate **200** and the related structures described above as well as a sealing glass substrate **100** that covers the device glass substrate **200**, with reference to **FIGS. 3A and 3B**. **FIG. 3A** is a cross-sectional view corresponding to line A-A of **FIG. 1**.

[0029] The device glass substrate **200** and the sealing glass substrate **100** are attached together at corresponding edges with a sealing resin **101** made of a resin material that works as an adhesive, such as an epoxy resin. This prevents moisture infiltration from the outside. The device glass substrate **200** and the sealing glass substrate **100** may have the same thickness of about 0.7 mm.

[0030] A plurality of pixels is disposed in a matrix in the pixel region **300** of the device glass substrate **200**. Each of the pixels includes the organic EL element **120**, the organic EL element driving TFT, TFTa, and the pixel selecting TFT, as described above. For example, TFTa has the active layer made of a polysilicon layer. A light shield layer **201** made of Cr (chromium) is disposed below TFTa with an insulating film **210** interposed therebetween. The light shield layer **201** is placed off the position exactly below the active layer of TFTa, as is the case with the display panel of **FIG. 6**.

[0031] A concave portion (hereafter, referred to as a pocket region **102**) is formed on an inside surface of the sealing glass substrate **100** facing the device glass substrate **200** by etching. A depth of the pocket region **102** is preferably 0.1 to 0.3 mm, and a desiccant layer **103** is formed on a bottom of the pocket region **102**. The desiccant layer **103** is formed, for example, by coating resin dissolved with powdered calcium oxide or barium oxide and an adhesive on the bottom of the pocket region **102** and hardening the resin by UV irradiation or heating. Forming of the pocket region **102** is for securing a gap between the desiccant layer **103** and the organic EL element **120** to prevent the breaking of the EL element due to contacting with the desiccant layer **103**.

[0032] Furthermore, a light shield layer **104** having a laminated structure of a chromium oxide layer and a chromium layer is formed on a convex portion in the periphery of the pocket region **102**. The light shield layer **104** is disposed to cover the vertical driving circuit **302**. Although not shown in **FIG. 3**, the light shield layer **104** is extended to cover the horizontal driving circuit **301**.

[0033] In the above-described structure, since the light shield layer **104** is disposed in the region over the vertical driving circuit **302** and the horizontal driving circuit **301**, light incident from the sealing glass substrate **100** can be shielded. Thus, edges of the organic EL panel are clear to improve a display contrast.

[0034] In this embodiment, the forming of the light shield layer **104** is not restricted to the top surface of the convex portion in the periphery of the pocket region **102**, but can be in any position as long as the position is over the vertical driving circuit **302** and the horizontal driving circuit **301**. For example, the light shield layer **104** may be formed on an outside surface of the device glass substrate **200** instead of on the surface of the sealing glass substrate **100**. Specifically, the light shield layer **104** may be placed on the surface of an insulating layer that covers the TFTs, TFTa, TFTb, formed on the device glass substrate **200**, as shown in **FIG. 3B**. In addition, the pocket region **102** may not be formed in the sealing glass substrate **100**.

[0035] **FIG. 4** is a partial cross-sectional view of the pixel region **300** and the peripheral driving circuit region, for example, the region of the vertical driving circuit **302**. The organic EL element **120** and TFTa are shown in the pixel region **300**, and TFTb is shown in the peripheral driving circuit region. In the pixel region, TFTa is formed over an insulating substrate **202** made of a silica glass or a non-alkali glass with an insulating film **210** interposed therebetween. TFTa includes an active layer **211** formed by poly-crystallizing an amorphous silicon film by laser irradiation, a gate insulating film **212**, and a gate electrode **213** made of a metal having a high melting point such as Cr or Mo (molybdenum). The active layer **211** is provided with a channel, and a source **21** Is and a drain **211***d* on each side of the channel.

[0036] The light shield layer **201** is formed on an insulating substrate **202** below TFTa.

[0037] The light shield layer **201** is formed in a region except the region exactly below the active layer **211**.

[0038] An interlayer insulating film **214** laminated with an SiO_2 film, an SiNx film and an SiO_2 film sequentially is formed on the whole surfaces of the gate insulating film **212** and the active layer **211**. There is disposed a driving source line **215** (a drain electrode) connected to a driving source PVdd by filling a contact hole provided correspondingly to a drain **211***d* with a metal such as Al. Furthermore, a first planarization insulating film **216** for planarizing the surface, which is made of, for example, an organic resin is formed on the whole surface. A contact hole is formed in a position corresponding to a source **211***s* in the planarization insulating film **216**. There is formed on the first planarization insulating film **216** a transparent electrode made of ITO (Indium Tin Oxide) and contacting to a source electrode **217** through the contact hole, i.e., an anode layer **218** of the organic EL element **120**. The anode layer **218** is formed in each of the pixels, being isolated as an island.

[0039] A second planarization insulating film **219** is formed in a periphery of the anode layer **218**. The second planarization insulating film **219** on the anode layer **218** is removed. The organic EL element is formed by laminating the anode layer **218**, a hole transport layer **220**, an emissive layer **221**, an electron transport layer **222** and a cathode layer **223** in this order.

[0040] A TFT, TFTb, is formed in the peripheral driving circuit region. A structure of TFTb is the same as that of TFTa in the pixel region except that the light shield layer **201** is not provided in its lower layer. The light shield layer **104** is provided on the sealing glass substrate **100** as described above.

[0041] Next, a manufacturing method of the sealing glass substrate **100** provided with the light shield layer **104** will be described with reference to FIGS. **5**A-**5**F.

[0042] First, as shown in **FIG. 5**A, chromium oxide and chromium layers **104***a* is formed on the sealing glass substrate **100** by sputtering. Then, as shown in **FIG. 5B, a** photoresist layer **105** is formed on the chromium oxide and chromium layers **104***a*. The photoresist layer **105** is formed in a region corresponding to the peripheral driving circuit.

[0043] Next, as shown in **FIG. 5**C, the chromium oxide and chromium layers **104***a* is removed by etching using the photoresist layer **105** as a mask. The light shield layer **104** remains under the photoresist layer **105**.

[0044] As shown in **FIG. 5**D, the surface of the sealing glass substrate **100** is removed by etching with hydrofluoric acid (HF) by using the photoresist layer **105** and the light shield layer **104** as a mask. The etching continues, for example, for two hours and the sealing glass substrate **100** is etched by approximately 0.3 mm. Here, the light shield layer **104** functions as a mask for etching with the photoresist layer **105**. Thus, the pocket region **102** is formed.

[0045] Then, as shown in **FIG. 5**E, the photoresist layer **105** is removed. The light shield layer **104** is not removed and remains as it is. As shown in **FIG. 5**F, the desiccant layer **103** is formed on the bottom of the pocket region **102**. The sealing glass substrate **100** thus produced is attached to the device glass substrate **200** with the sealing resin **101**. Thus, the organic EL panel shown in **FIGS. 3A and 3B** is completed.

[0046] In this manufacturing method, the chromium oxide and chromium layers are used for forming the pocket region **102** and as the light shield layer **104** in the completed display device. Therefore, an additional step for forming the light shield layer is not required when the display panel has the pocket region.

What is claimed is:

1. An electroluminescent display device comprising:

a first substrate;

an electroluminescent element disposed on the first substrate;

a peripheral driving circuit disposed on a peripheral portion of the first substrate and supplying a driving signal for the electroluminescent element;

a second substrate attached to the first substrate; and

a light shield layer covering the peripheral driving circuit.

2. The electroluminescent display device of claim 1, wherein the light shield layer is disposed on a peripheral portion of the second substrate.

3. The electroluminescent display device of claim 2, wherein the second substrate includes a pocket portion having a desiccant therein, and the light shield layer is disposed around the pocket portion.

4. The electroluminescent display device of claim 1, wherein the light shield layer is disposed on a peripheral portion of the first substrate.

5. The electroluminescent display device of claim 1, wherein the light shield layer comprises a chromium layer and a chromium oxide layer.

6. The electroluminescent display device of claim 1, wherein each of the first and second substrates is made of a glass.

7. An electroluminescent display device comprising:

a first substrate;

an electroluminescent element disposed on the first substrate;

a peripheral driving circuit disposed on a peripheral portion of the first substrate and supplying a driving signal for the electroluminescent element;

a second substrate attached to the first substrate; and

means for preventing light coming from the second substrate and entering the peripheral driving circuit from passing through the first substrate.

8. A manufacturing method of an electroluminescent display device, comprising:

providing a first substrate having thereon an electroluminescent element and a peripheral driving circuit for supplying a driving signal for driving the electroluminescent element, the peripheral driving circuit being disposed on a peripheral portion of the first substrate;

forming a light shield layer on a second substrate;

forming a photoresist layer on the light shield layer at a peripheral region of the second substrate;

removing a portion of the light shield layer by etching using the photoresist layer as a mask;

forming a pocket region on the second substrate by etching the second substrate using the photoresist layer and the remaining light shield layer as a mask;

removing the photoresist layer;

forming a desiccant layer in the pocket region; and

attaching the second substrate to the first substrate.

9. The manufacturing method of the electroluminescent display device of claim 8, wherein the forming of the light shield layer comprises laminating a chromium layer and a chromium oxide layer on the second substrate.

* * * * *

专利名称(译)	电致发光显示装置及其制造方法		
公开(公告)号	US20040012549A1	公开(公告)日	2004-01-22
申请号	US10/430383	申请日	2003-05-07
[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	NISHIKAWA RYUJI		
发明人	NISHIKAWA, RYUJI		
IPC分类号	H05B33/04 G09G3/30 H01L27/32 H01L51/50 H01L51/52 H01L51/56 H05B33/02 H05B33/10 H05B33/14		
CPC分类号	H01L27/3272 H01L51/5281 H01L51/5237 H01L51/5259		
优先权	2002134354 2002-05-09 JP		
外部链接	Espacenet USPTO		

摘要(译)

电致发光显示装置具有装置玻璃基板和密封玻璃基板，它们用密封树脂连接在一起。器件玻璃基板具有设置有有机EL元件的像素区域，以及水平驱动电路和垂直驱动电路，两者都提供用于驱动有机EL元件的驱动信号。密封玻璃基板设置有遮光层，用于防止入射光进入水平驱动电路和垂直驱动电路。这使得有机EL面板的边缘清晰，从而改善了显示对比度。