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(54) ELECTROLUMINESCENT DISPLAY DEVICE

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(57) **ABSTRACT**

In a sealing structure of an electroluminescent display device, there are inhibited a temperature rise of a display panel on a light-emission of an EL element and thus deterioration of the EL element. The structure of the invention has a first glass substrate provided with an electroluminescent device on a surface thereof, a second glass substrate attached to the first glass substrate with sealing resin, and a desiccant layer formed on a pocket portion of the second glass substrate, and a high heat conductive layer made of a metal sheet etc covering a surface of the desiccant layer.

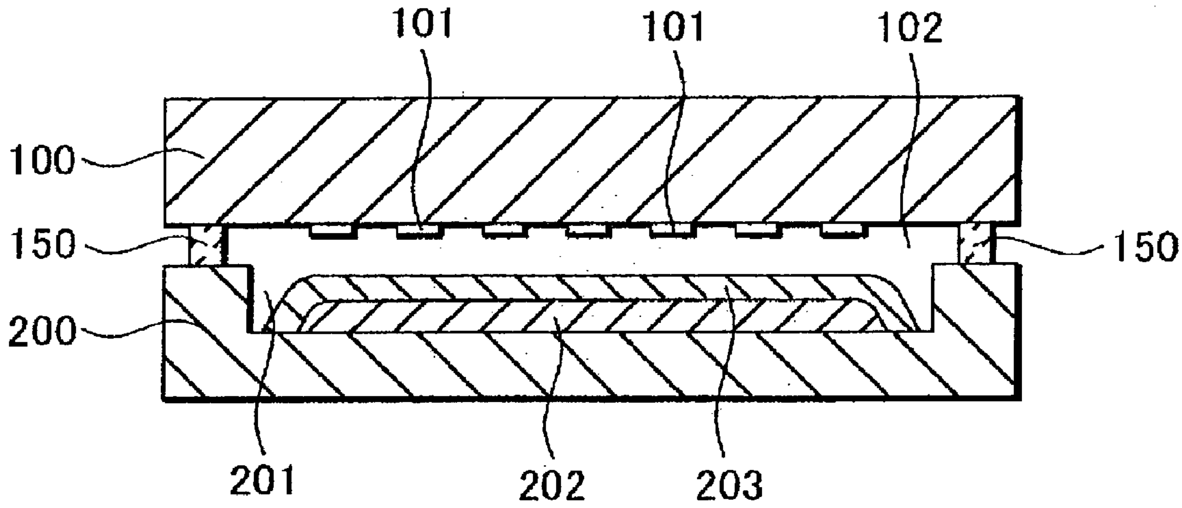


FIG.1

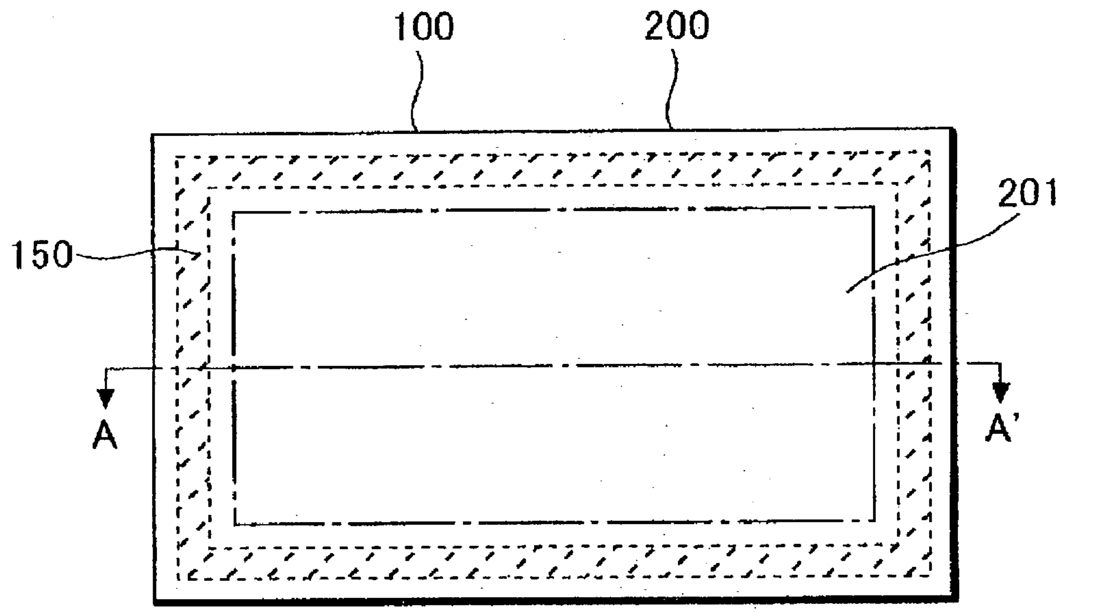


FIG.2

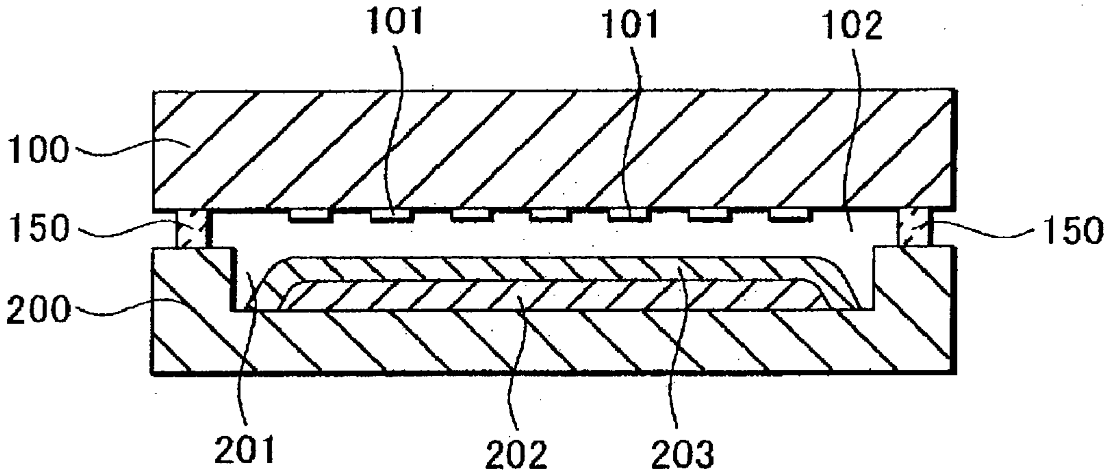


FIG.3

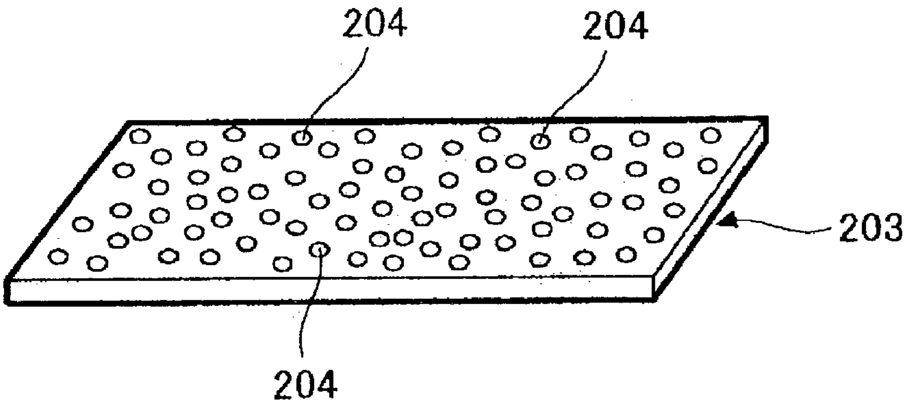


FIG.4

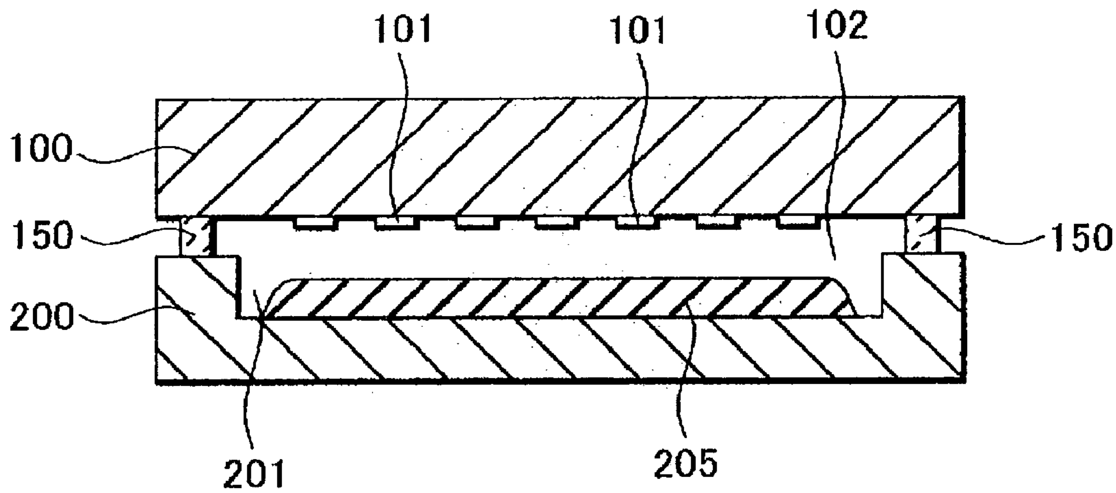


FIG.5

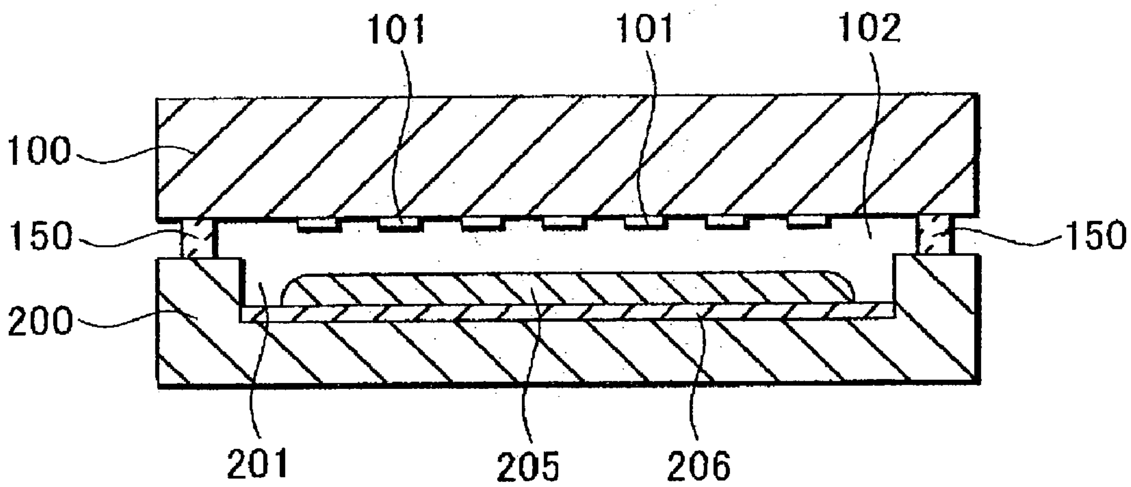
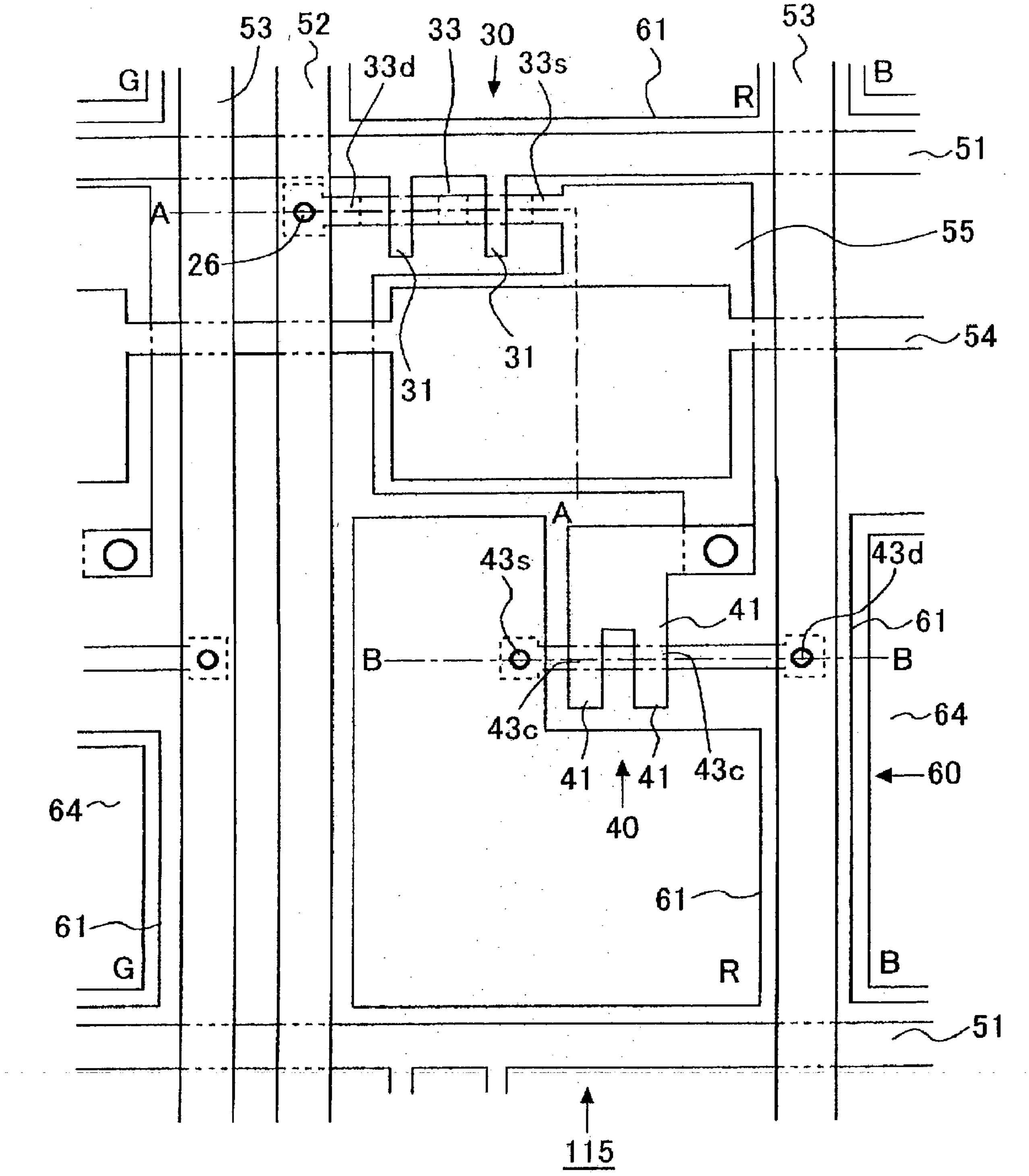


FIG.6



53
52
33
30
61
53
33d
33s
G
R
B
51
A
26
55
54
31
31
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A
43s
43d
41
61
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43c
64
41
41
43c
60
40
64
61
61
G
R
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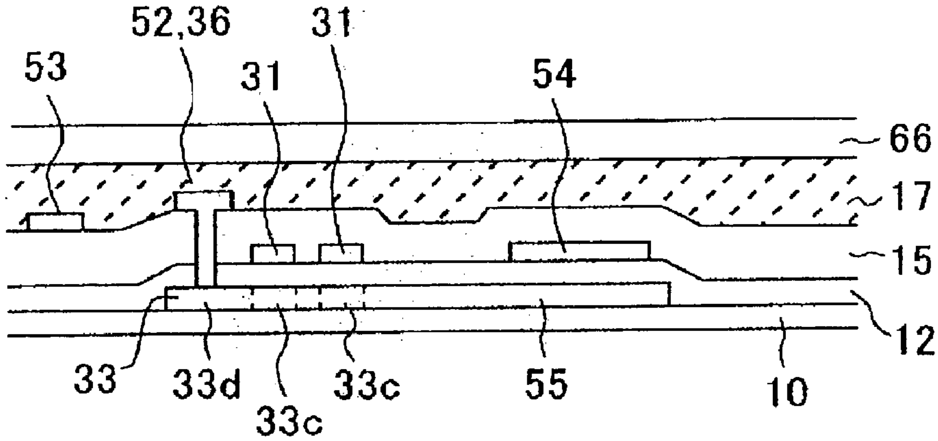
51
115

FIG. 7A


52,36
31
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31
54
66
17
15
12
33
33d
33c
33c
55
10

FIG. 7B

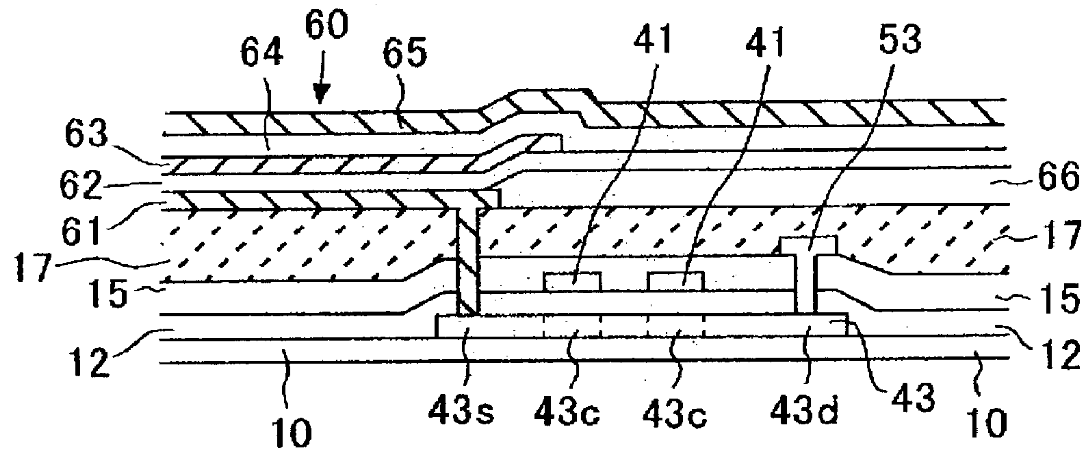
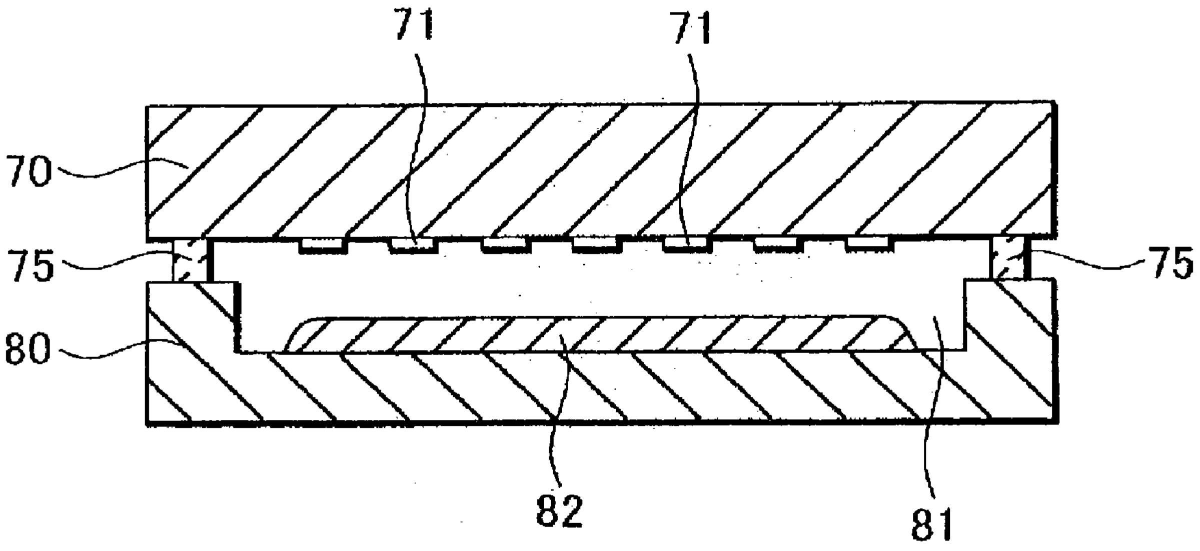

60
64
65
41
41
53
63
62
66
61
17
17
15
15
12
12
10
43s
43c
43c
43d
43
10

FIG.8

PRIOR ART



ELECTROLUMINESCENT DISPLAY DEVICE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] This invention relates to an electroluminescent display device, particularly to a sealing structure of the electroluminescent display device.

[0003] 2. Description of the Related Art

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

[0005] Since the EL element is sensitive to moisture, there has been known an EL display panel structure in which the EL element is covered with a metal cap or a glass cap coated with a desiccant. **FIG. 8** is a cross-sectional view showing such a conventional structure of the EL display panel.

[0006] A first glass substrate **70** has a display region having many EL elements **71** thereon. The first glass substrate **70** is attached to a second glass substrate **80** working as a cap with sealing resin **75** made of an epoxy resin. The second glass substrate **80** includes a concave portion **81** (hereafter, referred to as a pocket portion **81**) in a region corresponding to the display region. The pocket portion **81** is coated with a desiccant layer **82** for absorbing moisture.

[0007] Here, the forming of the pocket portion **81** is for securing a space between the desiccant layer **82** and the EL element **71**, thereby preventing the EL element **71** from being contacted by the desiccant layer **82**, which may cause damage to the EL element **71**.

[0008] Since the EL element **71** is heated upon light-emission, the temperature of the first glass substrate **70** rises. This temperature rise cases an accelerated deterioration of the EL element **71**, and results in a short life use time of the device.

SUMMARY OF THE INVENTION

[0009] The invention provides an electroluminescent display device that includes a first substrate having an electroluminescent element thereon, a second substrate attached to the first substrate, a desiccant layer disposed on the second substrate so that the desiccant layer faces the first substrate, and a heat dissipation layer disposed on the desiccant layer and having a high thermal conductivity.

[0010] The invention also provides an electroluminescent display device that includes a first substrate having an electroluminescent element thereon, a second substrate attached to the first substrate, and a desiccant layer disposed on the second substrate so that the desiccant layer faces the first substrate. The desiccant layer includes a material of a high thermal conductivity.

[0011] The invention further provides an electroluminescent display device that includes a first substrate having an electroluminescent element thereon, a second substrate attached to the first substrate, and a heat dissipation layer disposed on the second substrate so that the heat dissipation layer faces the first substrate. The heat dissipation layer has a high thermal conductivity. The device also includes a desiccant layer disposed on the heat dissipation layer.

[0012] The invention also provides an electroluminescent display device that includes a first substrate having an electroluminescent element thereon, a second substrate attached to the first substrate, and means for dissipating heat generated by the electroluminescent element.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] **FIG. 1** is a plan view of an electroluminescent display device according to a first embodiment of the invention.

[0014] **FIG. 2** is a cross-sectional view along line A-A' of **FIG. 1**.

[0015] **FIG. 3** is a perspective view of a high heat conductive layer of the first embodiment of the invention.

[0016] **FIG. 4** is a cross-sectional view of an electroluminescent display device according to a second embodiment of the invention.

[0017] **FIG. 5** is a cross-sectional view of an electroluminescent display device according to a third embodiment of the invention.

[0018] **FIG. 6** is a plan view of a pixel of the organic EL display devices of the first, second and third embodiments.

[0019] **FIGS. 7A and 7B** are cross-sectional views of the pixel of **FIG. 6**.

[0020] **FIG. 8** is a cross-sectional view of a conventional electroluminescent display device.

DETAILED DESCRIPTION OF THE INVENTION

[0021] **FIG. 1** is a plan view of an electroluminescent display device according to a first embodiment of the invention. **FIG. 2** is a cross-sectional view along line A-A' of **FIG. 1**.

[0022] A first glass substrate **100** (a display panel) has a display region having many EL elements **101** on a surface thereof. The thickness of the first glass substrate **100** is approximately 0.7 mm. In this display region, a plurality of pixels is disposed in a matrix and the EL element **101** is disposed in each of those pixels.

[0023] A second glass substrate **200** is a glass substrate for sealing the above mentioned first glass substrate **100** and its thickness is approximately 0.7 mm. This second glass substrate **200** includes a concave portion **201** (hereafter, referred to as a pocket portion **201**) in a region corresponding to the display region, which is formed by etching. The depth of the pocket portion **201** is approximately 0.3 mm. There is coated on the pocket portion **201** a desiccant layer **202** for absorbing moisture. The desiccant layer **202** is formed, for example, by coating a solvent dissolved with powdered calcium oxide or barium oxide and a resin as an adhesive on a bottom of the pocket portion **201** and then hardening the solvent by UV irradiation or heating.

[0024] The desiccant layer **202** is covered with a high heat conductive layer **203**. The high heat conductive layer **203** is formed of, for example, a metal sheet having a thickness of 10 to 100 micrometers. The metal sheet can be made of any metal, for example, Al (aluminum) and Cr (chromium).

Furthermore, as shown in **FIG. 3**, the high heat conductive layer **203** preferably includes many air vents **204**. This is for keeping air permeability of the desiccant layer **202** high to prevent its losing the function as a desiccant.

[0025] The first glass substrate **100** and the second glass substrate **200** are attached with sealing resin **150** made of an epoxy resin in a chamber of N_2 gas atmosphere. Thus, N_2 gas fills a space surrounded by the high heat conductive layer **203**, the first glass substrate **100** and the sealing resin **105** to form an N_2 gas layer **102**.

[0026] The electroluminescent display device of the invention has a structure in which the high heat conductive layer **203** is disposed between the desiccant layer **202** and the EL element **101**. Therefore, heat generated upon light-emission of the EL element **101** is dissipated rapidly toward the second glass substrate **200** through the high heat conductive layer **203**. Thus, the first glass substrate **100** is not subject to the raised temperature environment despite the heat generated by the EL element **101**. Accordingly, the accelerated deterioration of the EL element **101** is prevented.

[0027] Here, the total thickness of the desiccant layer **202** and the high heat conductive layer **203** is preferably as large as possible provided that the high heat conductive layer **203** does not contact the EL element **101** to the extent that the EL element **101** is damaged. Typically, the thickness is half the depth of the pocket portion **201**, i.e., 0.1 to 0.2 mm. This is for thinning the N_2 gas layer **102** that has a low heat conductivity.

[0028] **FIG. 4** is a cross-sectional view of an electroluminescent display device according to a second embodiment of the invention. **FIG. 4** corresponds to a cross-sectional view along line A-A' of **FIG. 1**.

[0029] Note that the same numerals are given to the same portions as those of **FIG. 2**.

[0030] In this embodiment, a high heat conductive material is mixed in the desiccant layer **205** formed on the pocket portion **201**. The desiccant layer **205** is formed, for example, by mixing the high heat conductive material as well as powdered calcium oxide or barium oxide and a resin in a solvent. Conductive particles such as conductive fibers and carbon nanotubes are appropriate as the high heat conductive material.

[0031] A high content of the high heat conductive material in the desiccant layer **205** increases the heat conductivity of the desiccant layer **205**. However, when the content is too high, the desiccant capacity is poor. When the content is too low, the heat conductivity is poor. Therefore, the content of the high heat conductive material is preferably 10 to 60 weight %.

[0032] According to the invention, heat generated upon light-emission of the EL element **101** is dissipated rapidly toward the second glass substrate **200** through the desiccant layer **205** having high heat conductivity. Thus, the temperature rise of the EL element **101** is prevented.

[0033] The thickness of the desiccant layer **202** is preferably as large as possible provided that the desiccant layer **202** does not contact the EL element **101** to the extent that the EL element **101** is damaged. Typically, the thickness is half the depth of the pocket portion **201**, i.e., 0.1 to 0.2 mm. This is for thinning the N_2 gas layer **102** that has a low heat conductivity.

[0034] **FIG. 5** is a cross-sectional view showing an electroluminescent display device according to a third embodiment of the invention. **FIG. 5** corresponds to a cross-sectional view along line A-A' of **FIG. 1**. Note that the same numerals are given to the same portions as those of **FIG. 2**.

[0035] The electroluminescent display device of this embodiment has a structure in which a high heat conductive layer **206** is formed on bottom of the pocket **201** of the second glass substrate **200** and the desiccant layer **202** is coated on the high heat conductive layer **206**. The high heat conductive layer **206** is formed, for example, of a metal, such as Al and Cr, by sputtering, thermal spraying or vapor deposition. Its thickness is appropriately 20 to 30 micrometers.

[0036] In this structure, heat generated upon light-emission of the EL element **101** is dissipated rapidly toward the second glass substrate **200** through the high heat conductive layer **206**. Thus, a temperature rise of the first glass substrate **100** is prevented.

[0037] The total thickness of the desiccant layer **202** and the high heat conductive layer **206** is preferably as large as possible provided that the desiccant layer **202** does not contact the EL element **101** to the extent that the EL element **101** is damaged. Typically, the thickness is half the depth of the pocket portion **201**, i.e., 0.1 to 0.2 mm. This is for thinning the N_2 gas layer **102** that has a low heat conductivity.

[0038] Next, there will be described an example of structures of the pixel of the EL display device to be commonly applied to the first to third embodiments described above.

[0039] **FIG. 6** is a plan view of a pixel of the organic EL display devices of the first, second and third embodiments. **FIG. 7A** is a cross-sectional view along line A-A of **FIG. 6**, and **FIG. 7B** is a cross-sectional view along line B-B of **FIG. 6**.

[0040] As shown in **FIG. 6, a** pixel **115** is formed in a region enclosed with a gate signal line **51** and a drain signal line **52**. A plurality of the pixels **115** is disposed in a matrix.

[0041] There are disposed in the pixel **115** an organic EL element **60** as a self-emission element, a switching TFT (thin film transistor) **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** includes an anode **61**, an emissive layer made of an emission material and a cathode **65**.

[0042] The switching TFT **30** is provided in a periphery of a point of intersection of 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**.

[0043] 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 and forms a capacitor by storing electric charges with the capacitor electrode **55** connected to the source **33***s* of the TFT through a gate insulating film **12**. The storage capacitor is provided for storing voltage applied to the gate electrode **41** of the driving TFT **40**.

[0044] As shown in **FIGS. 7A and 7B**, the organic EL display device is formed by laminating the TFTs and the organic EL element sequentially on a substrate **10** made of a glass a synthetic resin, a conductive material, or a semiconductor. When using a conductive substrate or a semiconductor substrate as the substrate **10**, however, an insulating film such as SiO_2 or SiN_x 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 two 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.

[0045] There will be described the switching TFT **30** first. As shown in **FIG. 7**A, an amorphous silicon film (hereafter, referred to as an a-Si film) is formed on the insulating substrate **10** made of silica glass, non-alkali glass, etc by a CVD method etc. 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_x 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 and Mo (molybdenum) and also serving as a gate electrode **31**, the drain signal line **52** made of Al, and the driving source line **53** made of Al and serving as a driving source of the organic EL element.

[0046] An interlayer insulating film **15** laminated with an SiO_2 film, an SiN_x film and an SiO_2 film sequentially is formed on the whole surfaces of the gate insulating film **12** and the active layer **33**. There is provided a drain electrode **36** by filling a contact hole provided correspondingly to a drain **33***d* with a metal such as Al. Furthermore, a planarization insulation film **17** for planarizing the surface which is made of an organic resin is formed on the whole surface.

[0047] Next, there will be described the driving TFT **40** of the organic EL element. As shown in **FIG. 7B**, 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 and Mo are formed sequentially on the insulating substrate **10**. 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_x film and an SiO_2 film sequentially is formed on the 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 a contact hole provided correspondingly to a drain **43***d* with a metal such as Al. Furthermore, a planarization insulation film **17** for planarizing a 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 **43***s* in the planarization insulation film **17**. There is formed on the planarization insulation film **17** a transparent electrode made of ITO (Indium Tin Oxide) 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.

[0048] The organic EL element **60** has a structure of laminating sequentially the anode **61** made of a transparent electrode such as ITO, a hole transport layer **62** including a first hole transport layer made of MTDATA (4,4-bis(3-methylphenylphenylamino)biphenyl), and 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 magnesium-indium alloy, aluminum or aluminum alloy.

[0049] A second planarization insulation film **66** is formed on the planarization insulation film **17**. The second planarization insulation film **66** is removed on the anode **61**.

[0050] 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 radiation of the exciton and then released outside after going through the transparent anode **61** and the transparent insulating substrate **10**, thereby to complete a light-emission.

What is claimed is:

1. An electroluminescent display device comprising:

a first substrate having an electroluminescent element thereon;

a second substrate attached to the first substrate;

a desiccant layer disposed on the second substrate so that the desiccant layer faces the first substrate; and

a heat dissipation layer disposed on the desiccant layer and having a high thermal conductivity.

2. The electroluminescent display device of claim 1, wherein the heat dissipation layer comprises a metal sheet.

3. The electroluminescent display device of claim 1, wherein the heat dissipation layer includes a plurality of air vents.

4. The electroluminescent display device of claim 2, wherein the heat dissipation layer includes a plurality of air vents.

5. The electroluminescent display device of claim 1, wherein the second substrate includes a concave portion and the desiccant layer is disposed in the concave portion.

6. The electroluminescent display device of claim 1, wherein an inert gas fills a space between the first substrate and the heat dissipation layer.

7. An electroluminescent display device comprising:

a first substrate having an electroluminescent element thereon;

a second substrate attached to the first substrate; and

a desiccant layer disposed on the second substrate so that the desiccant layer faces the first substrate, the desiccant layer including a material of a high thermal conductivity.

8. The electroluminescent display device of claim 7, wherein the material of a high thermal conductivity is a material with electronic conductivity, and the material with electronic conductivity is disposed in the desiccant layer as particles.

9. The electroluminescent display device of claim 8, wherein the particles are electrically conductive particles.

10. The electroluminescent display device of claim 8, wherein the particles are carbon nanotubes.

11. The electroluminescent display device of claim 7, wherein an inert gas fills a space between the first substrate and the desiccant layer.

12. An electroluminescent display device comprising:

a first substrate having an electroluminescent element thereon;

a second substrate attached to the first substrate;

a heat dissipation layer disposed on the second substrate so that the heat dissipation layer faces the first substrate, the heat dissipation layer having a high thermal conductivity; and

a desiccant layer disposed on the heat dissipation layer.

13. The electroluminescent display device of claim 12, wherein the second substrate includes a concave portion and the heat dissipation layer is disposed in the concave portion.

14. The electroluminescent display device of claim 12, wherein the heat dissipation layer comprises a metal sheet.

15. The electroluminescent display device of claim 13, wherein the heat dissipation layer comprises a metal sheet.

16. The electroluminescent display device of claim 12, wherein an inert gas fills a space between the first substrate and the desiccant layer.

17. An electroluminescent display device comprising:

a first substrate having an electroluminescent element thereon;

a second substrate attached to the first substrate; and

means for dissipating heat generated by the electroluminescent element.

* * * * *

专利名称(译)	电致发光显示装置		
公开(公告)号	US20040032207A1	公开(公告)日	2004-02-19
申请号	US10/423059	申请日	2003-04-25
[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	SASATANI TORU OMURA TETSUJI MATSUOKA HIDEKI		
发明人	SASATANI, TORU OMURA, TETSUJI MATSUOKA, HIDEKI		
IPC分类号	H01L51/50 H01L51/52 H05B33/04 H05B33/00		
CPC分类号	H01L51/5237 H05B33/04 H01L51/529 H01L51/5243 H01L51/5259		
优先权	2002127422 2002-04-26 JP		
外部链接	Espacenet USPTO		

摘要(译)

在电致发光显示装置的密封结构中，抑制了EL元件发光时显示板的温度升高，从而抑制了EL元件的劣化。本发明的结构具有：第一玻璃基板，在其表面上设置有电致发光器件;第二玻璃基板，其通过密封树脂附接到第一玻璃基板;以及干燥剂层，形成在第二玻璃基板的袋部分上，以及由金属片等制成的高导热层，覆盖干燥剂层的表面。