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(54) DUAL-SIDED DISPLAY

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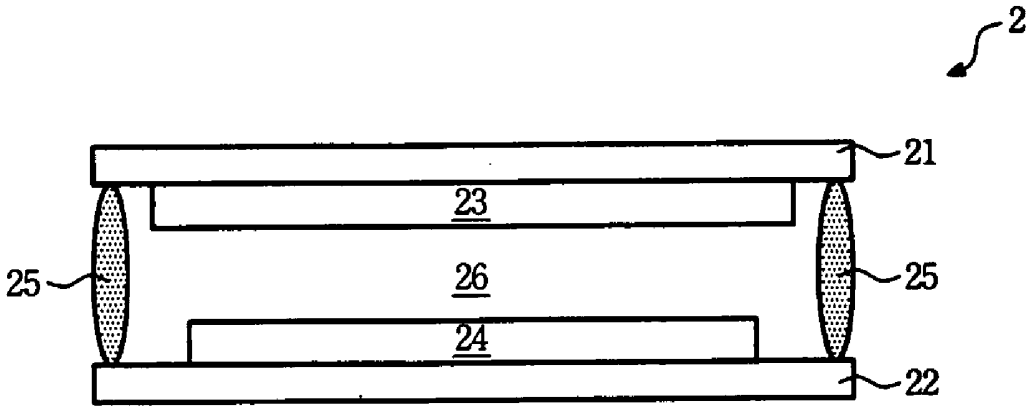
(57) **ABSTRACT**

A dual-sided display panel includes a first transparent substrate, a second transparent substrate located under the first transparent substrate, a first EL (Electroluminescence) substrate layer, and a second EL layer. The first EL layer is positioned on the bottom surface of the first transparent substrate for displaying a first image on the first transparent substrate. The second EL layer is positioned on the upper surface of the second transparent substrate for displaying a second image on the second transparent substrate. Both the first EL and the second EL are sealed in an airtight space formed between the first transparent substrate and the second transparent substrate.



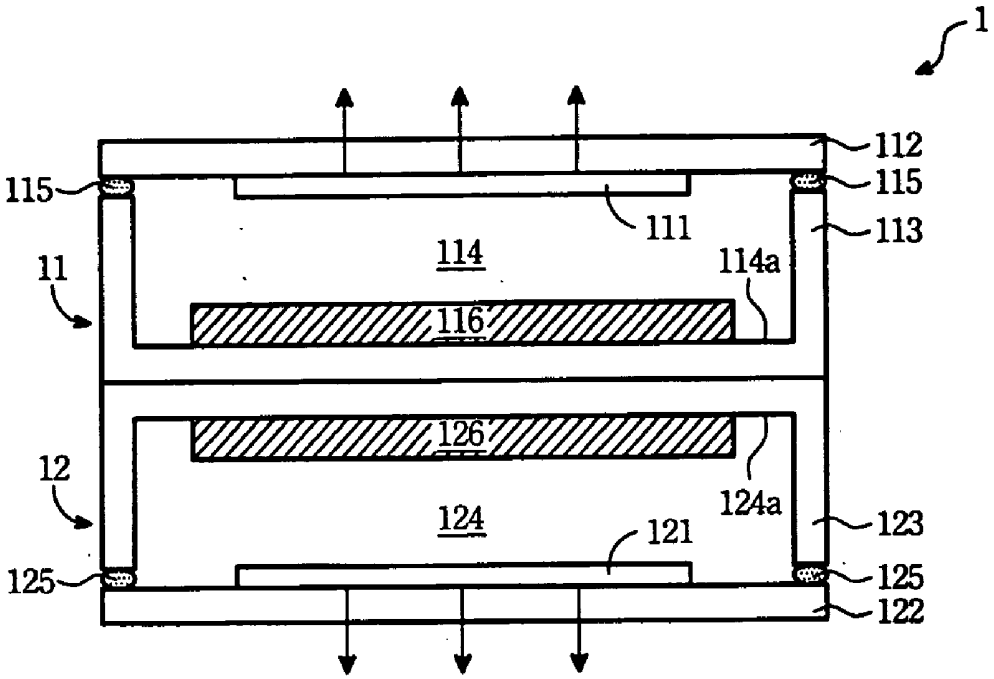


FIG. 1
(Prior Art)

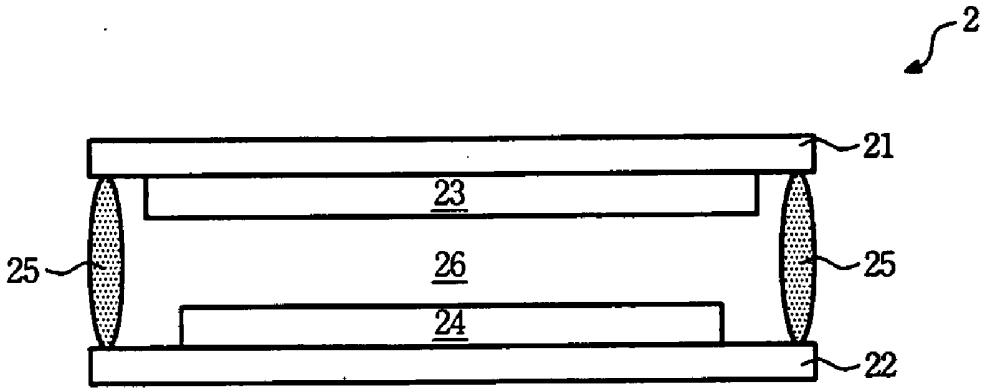


FIG. 2

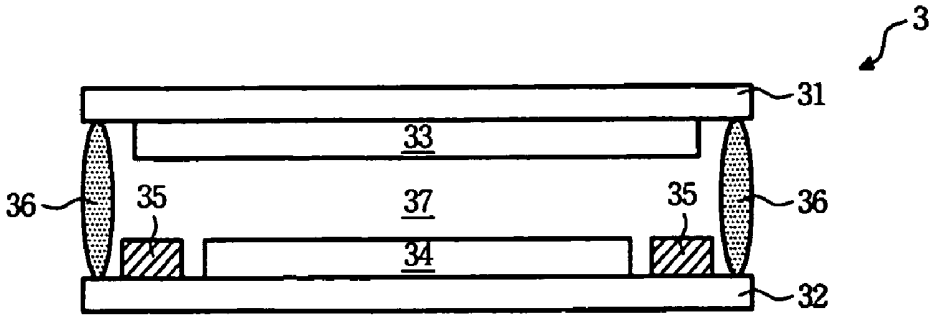


FIG. 3

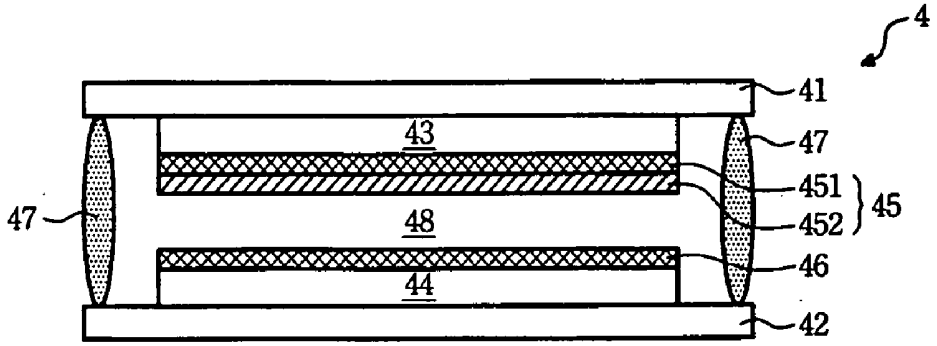


FIG. 4

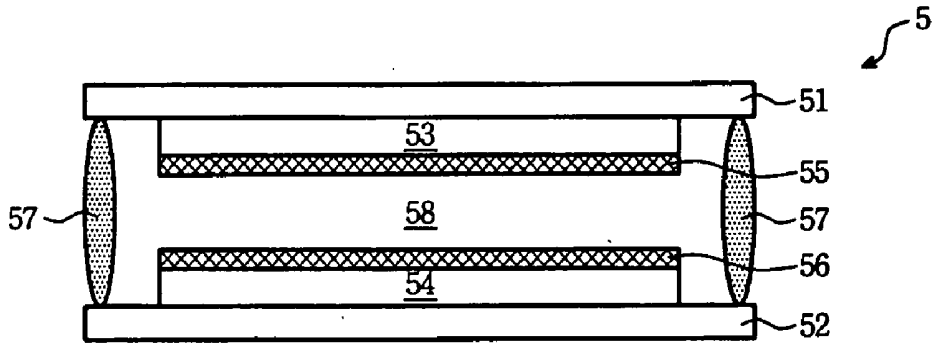


FIG. 5

DUAL-SIDED DISPLAY

BACKGROUND OF THE INVENTION

[0001] (1) Field of the Invention

[0002] The invention relates to an electro luminescence (EL) display, and more particularly to a dual-sided display of an organic light emitting diode (OLED) display.

[0003] (2) Description of the Prior Art

[0004] Since the first appearance of a multilayer OLED contributed by Tang and Van Slyke, potential applications of the OLEDs in flat panel displays have been widely acknowledged. Many approaches now have been devoted to constructing a full-color display of the OLEDs.

[0005] The OLED can also be called as an organic electro luminescence (OEL). A basic structure of the OLED is a multi-layer organic film laminating a hole-injection layer, a hole-transport layer, an emissive layer and an electron-transport layer. When a voltage is applied to the OLED cell, injected positive and negative charges recombine in the emissive layer and create electro luminescent light.

[0006] With advancement of electric appliances, display for the electric appliances is demanding reaction velocity, dots per inch, and pixel quality. Also, light weight and handy size are another trend. For example, the appearance of some dual-sided electric devices explains the urgent need upon a broader viewer to cooperate in the electric devices.

[0007] Presently, the dual-sided display is formed by composing two independent LCD displays. Such kind of dual-sided displays has a 8~10 mm thickness, which is about twice to the thickness of a single display. Definitely, cost for constructing the conventional dual-sided display is also twice to that for constructing the single-sided display. Hence, this kind of the dual-sided displays is hard to be among the master stream of the displays.

[0008] **FIG. 1** shows a cross-section view of a typical conventional dual-sided OLED display. The OLED display **1** is obtained by assembling two OLED sealing structures **11** and **12**. Each of the sealing structures **11**, **12** comprises respectively an EL layer **111** or **121**, an upper substrate **112** or **122**, and an under plate **113** or **123**.

[0009] As shown, between the upper substrate **112** and the under plate **113**, an interior space **114** (exaggerated in thickness) is formed to accommodate the EL substrate **111** disposed under the upper substrate **112** and a desiccant layer **116** disposed above the under plate **113** but under the EL substrate **111**. The interior space **114** is mainly contributed by a shallow cavity formed at the under plate **113** by etching or any relevant machining. Also, it is noted that the upper substrate **112** is sealed on the under plate **113** via a sealing material **115**. The desiccant layer **116** positioned on the base **114***a* of the cavity of the under plate **113** is introduced to lower the humidity levels of the airtight space **114**.

[0010] Elements of the sealing structure **12** are basically the same as those of the sealing structure **11**, but presenting a mirror image arrangement with respect to the boarder line in between. The sealing structure **12** comprises an EL layer **121**, an upper substrate **122** and an under plate **123**. The EL substrate **121** is disposed on the upper substrate **122**, and an airtight interior space **124** is formed in the sealing structure **12** by shaping a respective cavity in the under plate **123**. The upper substrate **122** is sealed on the under plate **123** via a sealing material **125** so as to form the airtight space **124** for accommodating the EL layer **121** and the desiccant layer **126**.

[0011] In the art, the thickness of the dual-sided panel **1** is around 3 mm, which is a little too thick to be a so-called film structure. Also, the cost and weight of the dual-sided panel **1** may also make the panel **1** less competitive. Accordingly, an improvement upon the OLED dual-sided display which provides a thinner and larger screen but with a simple production process and a lower cost is definitely welcome to the skill in the art.

SUMMARY OF THE INVENTION

[0012] It is an object of the present invention to provide a dual-sided display of an OLED display.

[0013] It is another object of the present invention to provide a dual-sided display with equal luminescent efficiency.

[0014] The dual-sided display panel in accordance with the present invention includes a first transparent substrate, a second transparent substrate, a first EL layer, and a second EL layer. Wherein the second transparent substrate is disposed under and sealed to the first transparent substrate, thereby forming an airtight space therebetween. The first EL layer and the second EL layer are both positioned between the first transparent substrate and the second transparent substrate. The first EL layer is disposed in the airtight space and positioned on a bottom surface of the first transparent substrate for displaying a first image through the first transparent substrate. The second EL layer is disposed in the airtight space and positioned on an upper surface of the second transparent substrate and displays a second image through the second transparent substrate. In particular, the area of the first EL layer is larger than the area of the second EL layer.

[0015] In the present invention, all the EL layers mentioned above can be composed of the organic light emitting diodes (OLED) or polymer light emitting diodes (PLED). The thickness of the dual-sided display of the invention can be reduced to range about 0.6-1.4 mm. By comparing to the conventional dual-sided OLED display, the manufacturing process to obtain the dual-sided display according to the present invention can be simplified, and the cost for producing the present dual-sided display can be thus reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The present invention will now be specified with reference to its preferred embodiment illustrated in the drawings, in which

[0017] **FIG. 1** is a cross-section view of a conventional OLED display;

[0018] **FIG. 2** is a cross-section view of a first preferred embodiment of the dual-sided OLED display of the present invention;

[0019] **FIG. 3** is a cross-section view of a second preferred embodiment of the OLED display of the present invention;

[0020] **FIG. 4** is a cross-section view of a third preferred embodiment of the OLED display of the present invention; and

[0021] **FIG. 5** is a cross-section view of a fourth preferred embodiment of the OLED display of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0022] As mentioned in the foregoing section, a need in improving the OLED dual-sided display to achieve a thinner and larger screen with a simple production process and a lower cost is obvious.

[0023] **FIG. 2** shows a cross-section view of a first preferred embodiment of the dual-sided display of the present invention. As shown, the dual-sided display **2** comprises a first transparent substrate **21**, a second transparent substrate **22**, a first EL layer **23**, and a second EL layer **24**.

[0024] The second transparent substrate layer **22** is disposed under and sealed to the first transparent substrate, thereby forming an airtight space **26** therebetween. The first EL layer **23** is disposed on the bottom surface of the first transparent substrate **21**, for displaying a first image through the first transparent substrate **21**. The second EL layer **24** is disposed in the airtight space **26** and positioned on the upper surface of the second transparent substrate **22**, for displaying a second image through the second transparent substrate **22**. The first transparent substrate **21** is sealed in a perimeter wise to the second transparent substrate **22** with a sealing material **25** such that an internal airtight space **26** can be formed between the first transparent substrate **21** and the second transparent substrate **22** for accommodating the EL layers **23**,**24**.

[0025] In the present invention, the area of the first EL layer **23** and the area of the second EL layer **24** are not always the same. Basically, the sizes and the related positioning of these two EL layer **23**,**24** can be varied to comply with different kinds of electric devices. In the first preferred embodiment of the invention, the first EL layer **23** is larger in area than the second EL layer **24**.

[0026] **FIG. 3** shows a cross-section view of a second preferred embodiment of the dual-sided OLED display of the present invention.

[0027] As shown, the dual-sided display **3** comprises a first transparent substrate **31**, a second transparent substrate **32**, a first EL layer **33**, a second EL layer **34**, and a-desiccant layer **35**.

[0028] The second transparent substrate layer **32** is disposed under and sealed to the first transparent substrate, thereby forming an airtight space **37** therebetween. The first EL layer **33** is disposed in the airtight space **37** and positioned on a bottom surface of the first transparent substrate **31** for displaying a first image through the first transparent substrate **31**. The second EL layer **34** is disposed n the airtight space **37** and positioned on an upper surface of the second transparent substrate **32** for displaying a second image on the second transparent substrate **32**. The first transparent substrate **31** is sealed on top of the second transparent substrate **32** with a circling sealing material **36** so as to obtain an airtight space **37** in between first transparent substrate for accommodating thereinside the EL layers **33**,**34**.

[0029] The first EL layer **23** is larger in area than the second EL layer **24**. The area of the substrate **31** or **32** which overlaps with the EL layer **33** or **34** is defined as a display area, and the rest area of the substrate is defined as a non-display area. As shown, the desiccant layer **35** is located in the airtight space and positioned on the non-display area of the upper surface of the second transparent substrate layer **32**.

[0030] The desiccant layer **35** can lower the humidity level of the airtight space **37** and thus prevent the EL layers **33**,**34** from possible moisture damage. The desiccant layer **35** on the non-display area of the second transparent substrate layer **32** can be formed by evaporating or sputtering. Upon such an arrangement, the existence of the desiccant layer **35** can show little effect to the thickness of the display **3**.

[0031] Except for positioning the desiccant layer **35** on the non-display area, the desiccant layer **35** can also be positioned on the display area or across the display area and the non-display area, especially to meet a high humidity environment.

[0032] In the present invention, the desiccant layer **35** is made of a material selected from the group consisting of active metals, metallic oxides, and metallic sulfides. The ELs **33**,**34** can be OLEDs or PLEDs.

[0033] Additionally, the drive mode of the present invention can be a mode of passive matrix, a mode of active matrix, or a mixed mode of the passive matrix and the active matrix. The dual-sided display of the invention can be applied to a monochrome display, a polychrome display, or a full-colored display.

[0034] **FIG. 4** shows a cross-section view of a third preferred embodiment of the dual-sided OLED display of the present invention. As shown, the dual-sided display **4** comprises a first transparent substrate **41**, a second transparent substrate **42**, a first EL layer **43**, a second EL layer **44**, a first protection layer **45**, and a second protection layer **46**.

[0035] The second transparent substrate layer **42** is disposed under and sealed to the first transparent substrate **41**, thereby forming an airtight space **48** therebetween. The first EL layer **43** is disposed in the airtight space **48** and positioned on a bottom surface of the first transparent substrate **41** for displaying a first image through the first transparent substrate **41**. The second EL layer **44** is disposed in the airtight space **48** and positioned on an upper surface of the second transparent substrate **42** for displaying a second image through the second transparent substrate **42**.

[0036] The first protection layer **45** is positioned on a bottom surface of the first EL layer **43**, and the second protection layer **46** is positioned on an upper surface of the second EL layer **44**. The first protection layer **45** is comprised of a first barrier layer **451** and a desiccant layer **452**, and the second protection layer **46** is comprised of another barrier layer. As shown, the first barrier layer **451** is laminated between the first EL **43** and the desiccant layer **452**. The desiccant layer **452** positioned on a bottom surface of the first barrier layer **451** can be formed by evaporating or sputtering.

[0037] The first transparent substrate **41** is sealed to the second transparent substrate **42** by a sealing material **47** and thus an airtight space **48** can be formed between the first transparent substrate **41** and the second transparent substrate **42** for accommodating the EL layers **43**,**44**.

[0038] The mentioned desiccant layer **452** can be a hydroscopic agent selected from the group of active metals, metallic oxides, and metallic sulfides.

[0039] The barrier layer, **451** or **46**, is used to provide the EL layer, **43** or **44** respectively, from possible damage of chemical materials which may come from the desiccant layer absorbing ambient mist. The material for the barrier layer **451** or **46** can be selected from the group consisting of nonconductors (such as SiN—SiO—SiC) and low activity metals (for example, Ag—Ti). By adding the desiccant layer **452**, the lifetime of the dual-sided display **4** can be substantially prolonged.

[0040] In this embodiment, the first EL layer **43** has a surface area the same as that of the second EL layer **44**, and the desiccant layer **452** extends to cover all over the barrier layer **451** that has an area about equal to that of the first EL **43**. In the case that the relative sizing of the first and the second ELs **43**,**44** is changed to leave a sufficient room for the desiccant layer **452** to surround either the first EL **43** or the second EL **44**, the desiccant layer **452** can be alternatively positioned on the non-display area as described in the foregoing second preferred embodiment.

[0041] In the present invention, the existence of the barrier layers **451**,**46** for protecting the EL layers **43**,**44** lessens the need of the desiccant layer **452**. Please refer to **FIG. 5**, which shows a cross-section view of a fourth preferred embodiment of the OLED display of the present invention.

[0042] Referring to **FIG. 5**, the dual-sided display **5** comprises a first transparent substrate **51**, a second transparent substrate **52**, a first EL layer **53**, a second EL layer **54**, a first barrier layer **55**, and a second barrier layer **56**. As shown, the arrangement of the dual-sided display **5** in **FIG. 5** is exact the same as that shown in **FIG. 4**, except that the desiccant layer is removed in this fourth embodiment **5**.

[0043] In the embodiment, either the first barrier layer **55** or the second barrier layer **56** can be a desiccant layer.

[0044] In the present invention, all the EL layers mentioned above can be composed of organic light emitting diodes (OLED) or polymer light emitting diodes (PLED). The thickness of the dual-sided display of the invention can be reduced to range about 0.6-1.4 mm, which is thinner than that mentioned in the prior art. Additionally, one more advantage of the invention is that the production cost can be lowered and the manufacturing process can be much simpler than the conventional process of composing two independent OLED displays.

[0045] While the present invention has been particularly shown and described with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes in form and detail may be without departing from the spirit and scope of the present invention.

We claim:

1. A dual-sided display comprising:

a first transparent substrate;

a second transparent substrate disposed under and sealed to the first transparent substrate, thereby forming an airtight space therebetween;

a first electro luminescence (EL) layer, disposed in the airtight space and positioned on the bottom surface of the first transparent substrate, for displaying a first image through the first transparent substrate; and

a second EL layer, disposed in the airtight space and positioned on the upper surface of the second transparent substrate, for displaying a second image through the second transparent substrate.

2. The dual-sided display according to claim 1, wherein the area of the first EL layer is larger than the area of the second EL layer.

3. The dual-sided display according to claim 1, wherein the thickness of the dual-sided display is about 0.6 mm to 1.4 mm.

4. The dual-sided display according to claim 1, wherein the first EL layer is comprised of organic light emitting diodes (OLEDs) or polymer light emitting diodes (PLEDs).

5. The dual-sided display according to claim 1, further comprising a desiccant layer located in the airtight space.

6. The dual-sided display according to claim 5, wherein the desiccant layer is made of a material selected from the group consisting of active metals, metallic oxides, and metallic sulfides.

7. The dual-sided display according to claim 5, further comprising a barrier layer formed on the bottom surface of the first EL layer so as to isolate the first EL layer from the desiccant layer.

8. The dual-sided display according to claim 7, wherein the barrier layer is made of a material selected from the group consisting of nonconductors and low activity metals.

9. The dual-sided display according to claim 5, further comprising a second barrier layer formed on the upper surface of the second EL layer so as to isolate the second EL layer from the desiccant layer.

10. The dual-sided display according to claim 9, wherein the second barrier layer is made of a material selected from the group consisting of nonconductors and low activity metals.

11. The dual-sided display according to claim 1, further comprising:

a first protection layer formed on the bottom surface of the first EL layer; and

a second protection layer formed on the upper surface of the second EL layer.

12. The dual-sided display according to claim 11, wherein the first protection layer is comprised of a barrier layer.

13. The dual-sided display according to claim 12, wherein the first protection layer is comprised of nonconductors or low activity metals.

14. The dual-sided display according to claim 11, wherein the first protection layer is comprised of a desiccant layer.

15. The dual-sided display according to claim 14, wherein the first protection layer is comprised of active metals, a metallic oxides, or a metallic sulfides.

16. The dual-sided display according claim 11, wherein the first protection layer comprises a barrier layer disposed on the first EL layer, and a desiccant layer disposed on the barrier layer.

17. The dual-sided display according to claim 11, wherein the second protection layer is comprised of a barrier layer.

18. The dual-sided display according to claim 17, wherein the second protection layer is made of a material selected from the group consisting of nonconductors and low activity metals.

19. The dual-sided display according to claim 11, wherein the second protection layer is comprised of a desiccant layer.

20. The dual-sided display according to claim 19, wherein the second protection layer is comprised of active metals, metallic oxides, or metallic sulfides.

* * * * *

专利名称(译)	双面显示		
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当前申请(专利权)人(译)	友达光电.		
[标]发明人	SU CHIH HUNG HU MIN CHIEH		
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摘要(译)

双面显示面板包括第一透明基板，位于第一透明基板下方的第二透明基板，第一EL（电致发光）基板层和第二EL层。第一EL层位于第一透明基板的底表面上，用于在第一透明基板上显示第一图像。第二EL层位于第二透明基板的上表面上，用于在第二透明基板上显示第二图像。第一EL和第二EL都密封在第一透明基板和第二透明基板之间形成的气密空间中。