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Yuan

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(54) **FLEXIBLE OLED DISPLAY AND MANUFACTURING METHOD THEREOF**

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(Continued)

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CPC ***H01L 51/0097*** (2013.01); ***H01L 27/323*** (2013.01); ***H01L 27/3232*** (2013.01);
(Continued)

(58) **Field of Classification Search**
None
See application file for complete search history.

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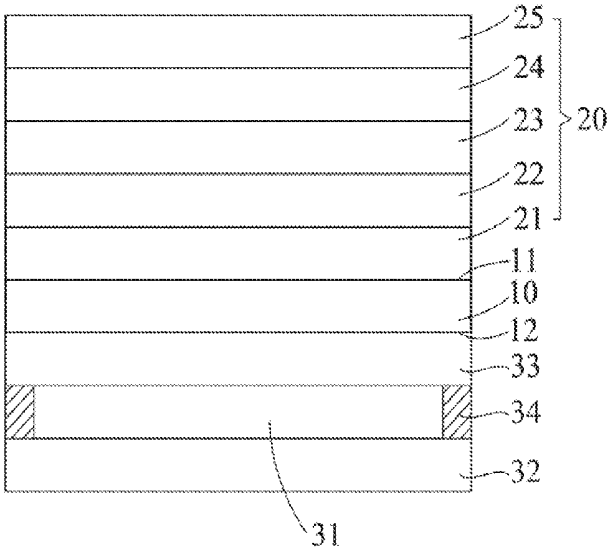
Primary Examiner — J. E. Schoenholtz
(74) *Attorney, Agent, or Firm* — Hemisphere Law, PLLC; Zhigang Ma

(57) **ABSTRACT**

The present disclosure discloses a flexible OLED display including: a flexible substrate, including a first surface and a second surface opposite to each other; an organic electroluminescent component arranged on the first surface; and a photochromic component arranged on the second surface, wherein the photochromic component generates different color changes according to an intensity of an external ambient light so as to completely absorb the external ambient light. The present disclosure further discloses a manufacturing method of a flexible OLED display. The flexible OLED display and the manufacturing method thereof according to the present disclosure can eliminate the influence of the external ambient light on the display and improve the display contrast.

6 Claims, 3 Drawing Sheets



(51) **Int. Cl.**
H01L 51/50 (2006.01)
H01L 27/32 (2006.01)
H01L 51/56 (2006.01)

(52) **U.S. Cl.**
CPC ***H01L 51/5012*** (2013.01); ***H01L 51/5246*** (2013.01); ***H01L 51/5253*** (2013.01); ***H01L 51/56*** (2013.01); *H01L 2251/5338* (2013.01)

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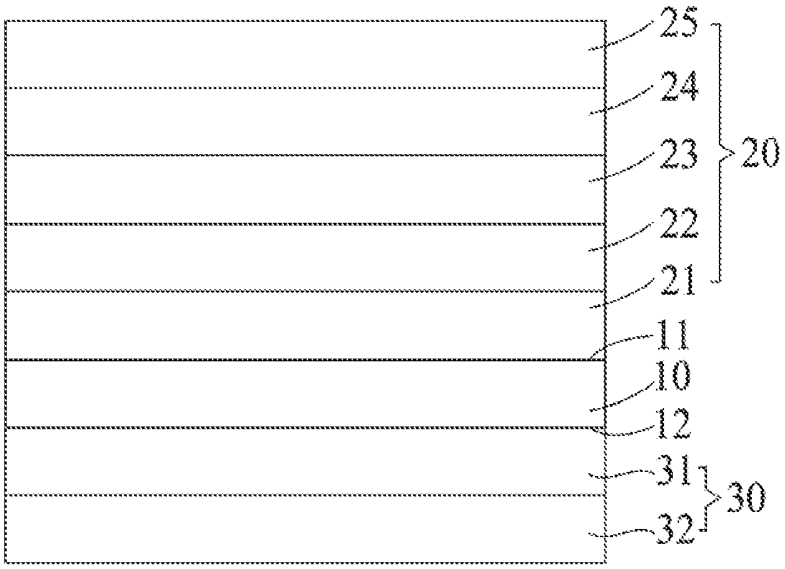

Fig. 1

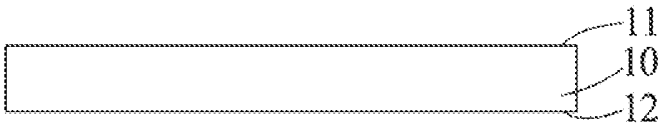

Fig. 2A

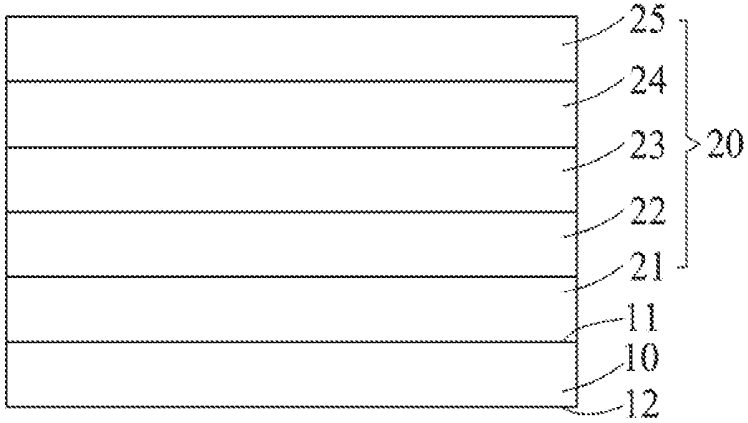

Fig. 2B

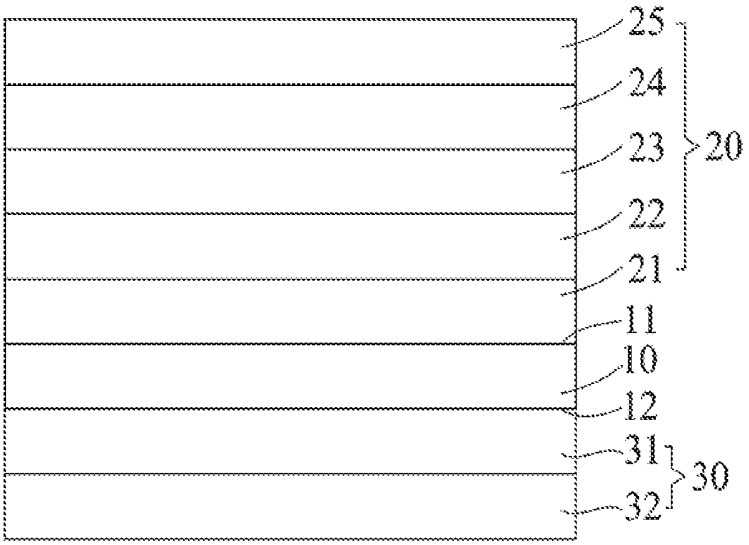
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Fig. 2C

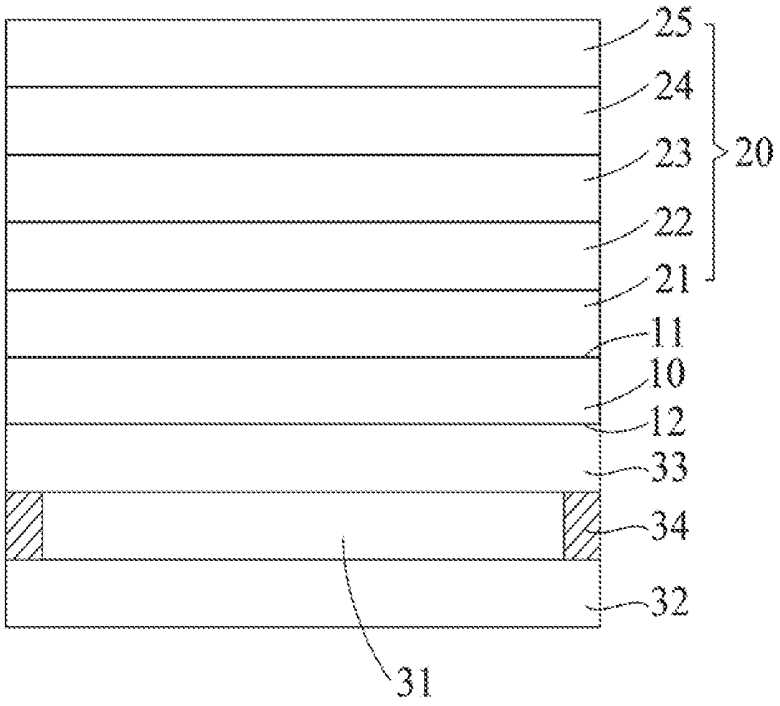
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Fig. 3

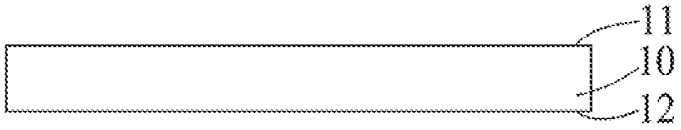

Fig. 4A

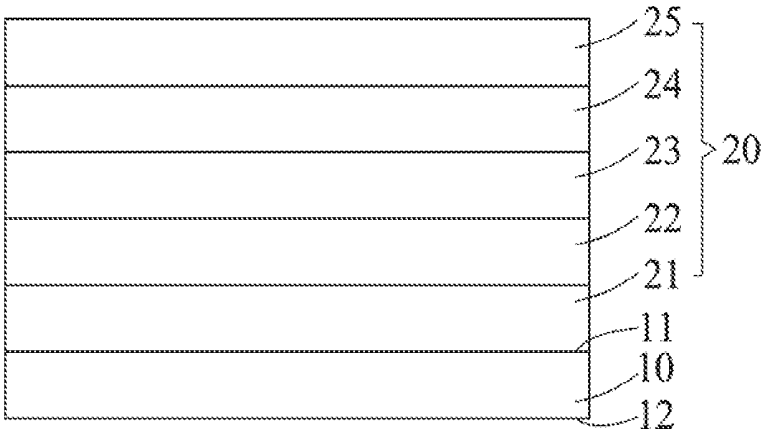

Fig. 4B

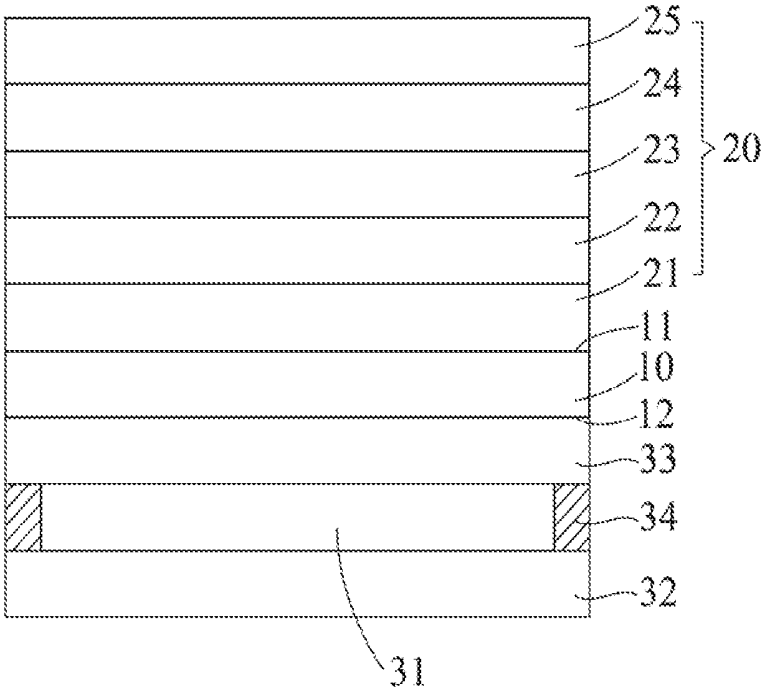

Fig. 4C

FLEXIBLE OLED DISPLAY AND MANUFACTURING METHOD THEREOF

RELATED APPLICATIONS

The present application is a National Phase of International Application Number PCT/CN2017/110825, filed Nov. 14, 2017, and claims the priority of China Application No. 201711059131.7, filed Nov. 1, 2017.

FIELD OF THE DISCLOSURE

The present disclosure relates to an organic electroluminescence technology field, and more particularly to a flexible OLED display and a manufacturing method thereof.

BACKGROUND OF THE DISCLOSURE

In recent years, Organic Light-Emitting Diode (OLED) displays have become very popular emerging flat display devices at home and abroad. Because the OLED display has the advantages of self-luminous, wide viewing angle, short reaction time, high luminous efficiency, wide color gamut, low operating voltage, thin thickness, can produce large size and flexible display and simple manufacturing process. And the OLED display has the potential of low cost.

In recent years, flexible and foldable OLED displays are the new focal points in the display industry. However, the contrast of flexible OLED displays may vary greatly depending on the external environment (mainly the intensity of the external ambient light). For example, in a bright environment, the external ambient light may be emitted in various layers, such as the organic electroluminescent layer and the thin film transistor layer of the flexible OLED display, another part of the external ambient light through the flexible OLED display, the light through the external environment of the flexible OLED display and the organic electroluminescent layer of light mixed to reduce the contrast of the screen, seriously affecting the product's effect.

SUMMARY OF THE DISCLOSURE

In order to solve the problems in the prior art, an object of the present disclosure is to provide a flexible OLED display capable of improving display contrast and a method for fabricating the same.

According to an aspect of the present disclosure, there is provided a flexible OLED display including: a flexible substrate, including a first surface and a second surface opposite to each other; an organic electroluminescent component arranged on the first surface; and a photochromic component arranged on the second surface, wherein the photochromic component generates different color changes according to an intensity of an external ambient light so as to completely absorb the external ambient light.

Wherein, when the intensity of the external ambient light is not less than a predetermined light, the photochromic component discolors deeply, and a light transmittance of the photochromic component is not greater than a first predetermined light transmittance to completely absorb the external ambient light.

Wherein, when the intensity of the external ambient light is less than the predetermined light, the photochromic component discolors slightly, and the light transmittance of the photochromic component is greater than the first predetermined light transmittance and is not greater than a second predetermined light transmittance to completely absorb the external ambient light, the second predetermined light transmittance is greater than the first predetermined light transmittance.

Wherein the photochromic component includes: a photochromic material layer arranged on the second surface, the photochromic material layer varying in color according to the intensity of the external ambient light so as to completely absorb the external ambient light; and a support substrate arranged on a surface of the photochromic material layer facing away from the second surface to support the photochromic material layer.

Wherein the photochromic component includes: a first support substrate arranged on the second surface; a photochromic material layer arranged on a surface of the first support substrate facing away from the second surface, the photochromic material layer varying in color according to the intensity of the external ambient light so as to completely absorb the external ambient light; a second support substrate arranged on a surface of the photochromic material layer away from the first support substrate, the first support substrate and the second substrate are used to support the photochromic material layer; and a sealing component arranged between the first support substrate and the second support substrate and at a side terminal of the photochromic material layer to seal the photochromic material layer.

According to another aspect of the present disclosure, there is also provided a manufacturing method of a flexible OLED display, including: providing a flexible substrate, wherein the flexible substrate includes a first surface and a second surface; forming an organic electroluminescent component on the first surface; and forming a photochromic component and attaching the photochromic component on the second surface, wherein the photochromic component generates different color changes according to an intensity of an external ambient light so as to completely absorb the external ambient light.

Wherein the method of forming a photochromic component and attaching the photochromic component on the second surface includes: providing a support substrate; forming a photochromic material layer on the support substrate, the photochromic material layer varying in color according to the intensity of the external ambient light so as to completely absorb the external ambient light; and attaching a surface of the photochromic material layer facing away from the support substrate to the second surface with optical glue.

Wherein the method of forming a photochromic component and attaching the photochromic component on the second surface includes: providing a first support substrate; forming a photochromic material layer on a surface of the first support substrate facing away from the second surface, the photochromic material layer varying in color according to the intensity of the external ambient light so as to completely absorb the external ambient light; providing a second support substrate, arranging the second support substrate on a surface of the photochromic material layer facing away from the first support substrate, the first support substrate and the second support substrate are used to support the photochromic material layer; forming a sealing component arranged between the first support substrate and the second support substrate and both sides of the photochromic material layer to seal the photochromic material layer; and attaching a surface of the second support substrate facing away from the photochromic material layer on the second surface.

The beneficial effects of the present disclosure are as follows: the flexible OLED display and the manufacturing

method thereof according to the present disclosure can eliminate the influence of the external ambient light on the display and improve the display contrast.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other aspects, features, and advantages of the embodiments of the present disclosure will become more apparent from the following description taken in conjunction with the accompanying drawings. In the figures:

FIG. **1** is a schematic structural diagram of a flexible OLED display according to Embodiment 1 of the present disclosure;

FIG. **2**A to **2**C are process diagrams of a flexible OLED display according to Embodiment 1 of the present disclosure;

FIG. **3** is a schematic structural diagram of a flexible OLED display according to Embodiment 2 of the present disclosure;

FIG. **4**A to **4**C are process diagrams of a flexible OLED display according to Embodiment 2 of the present disclosure.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Hereinafter, embodiments of the present disclosure will be described in detail with reference to the accompanying drawings. However, the disclosure may be embodied in many different forms and should not be construed as limited to the specific embodiments set forth herein. Rather, these embodiments are provided to explain the principles of the disclosure and its practical application to thereby enable those of ordinary skill in the art to understand various embodiments of the disclosure and various modifications as are suited to the particular use contemplated.

In the drawings, the thickness of layers and regions are exaggerated for clarity of the device. The same reference numbers indicate the same components throughout the specification and the drawings.

FIG. **1** is a schematic structural diagram of a flexible OLED display according to a first embodiment of the present disclosure.

Referring to FIG. **1**, a flexible OLED display according to Embodiment 1 of the present disclosure includes a flexible substrate **10**, an organic electroluminescent component **20** and a photochromic component **30**.

The flexible substrate **10** includes a first surface **11** and a second surface **12** opposite to each other. In the present embodiment, the flexible substrate **10** may formed by polyimide (PI). However, the present disclosure is not limited thereto.

The organic electroluminescent component **20** arranged on the first surface **11**. In the present embodiment, the organic electroluminescent component **20** is for emitting light autonomously to display an image.

Specifically, in the present embodiment, the organic electroluminescent component **20** includes a switch layer **21**, an organic light-emitting layer **22**, an encapsulation layer **23**, a touch layer **24** and a polarizer **25** sequentially in a direction away from the first surface **11**.

The switch layer **21** is arranged on the first surface **11**. The switch layer **21** typically includes a plurality of thin film transistors, which are typically arranged in an array. Switches in the switch layer **21** are typically used to control the OLED devices in the organic light-emitting layer **22**.

The organic light-emitting layer **22** is arranged on the switch layer **21**, the organic light-emitting layer **22** is for emitting light autonomously. The organic light-emitting layer **22** generally includes several OLED devices, which are arranged in an array. As an embodiment of the present disclosure, the thin film transistor and the OLED device are in a one-to-one correspondence, and the corresponding thin film transistor controls the corresponding OLED device, but the present disclosure is not limited thereto.

The encapsulation layer **23** arranged on the organic light-emitting layer **22** is for encapsulating the organic light-emitting layer **22** so as to prevent the organic light-emitting layer **22** from being attacked by moisture and oxygen.

The touch layer **24** is arranged on the encapsulation layer **23**. The touch layer **24** is generally used for touch control operation.

The polarizer **25** is arranged on the touch layer **24**.

The photochromic component **30** arranged on the second surface **12**, wherein the photochromic component **30** generates different color changes according to an intensity of an external ambient light so as to completely absorb the external ambient light.

Specifically, the photochromic component **30** includes a photochromic material layer **31** and a support substrate **32**.

The photochromic material layer **31** is arranged on the second surface **12**. The photochromic material layer **31** varying in color according to the intensity of the external ambient light so as to completely absorb the external ambient light. Wherein the photochromic material layer **31** may be composed of one or more of photochromic materials such as AgCl, $ZnCl_2$, $CuCl_2$, $MgCl_2$ and the like. In addition, the number of the photochromic material layers of the present disclosure is not limited to one layer, and may be a multi-layer composite structure.

When the intensity of the external ambient light is not less than a predetermined light, the photochromic material layer **31** discolors deeply, and a light transmittance of the photochromic material layer **31** is not greater than a first predetermined light transmittance to completely absorb the external ambient light. In other words, when the external ambient light is applied to the photochromic material layer **31** through the first support substrate **32**, the photochromic material in the photochromic material layer **31** discolors deeply in a bright environment. The deeply discolored photochromic material layer **31** can effectively absorb external ambient light so as to prevent the light of the external environment from entering the organic electroluminescent element **20** and mixing with the light emitted by the organic light-emitting layer **22** to improve the contrast of the flexible OLED display.

When the intensity of the external ambient light is less than the predetermined light, the photochromic material layer **31** discolors slightly, and the light transmittance of the photochromic material layer **31** is greater than the first predetermined light transmittance and is not greater than a second predetermined light transmittance to completely absorb the external ambient light, the second predetermined light transmittance is greater than the first predetermined light transmittance. In other words, when the external ambient light is applied to the photochromic material layer **31** through the first support substrate **32**, the photochromic material in the photochromic material layer **31** will be slightly discolored in a low light environment. The slightly discolored photochromic material layer **31** can effectively absorb the external weak light so as to prevent the light of the external environment from entering the organic elec-

troluminescent element **20** to mix with the light emitted by the organic light-emitting layer **22** to improve the contrast of the flexible OLED display.

FIG. **2**A to **2**C are process diagrams of a flexible OLED display according to Embodiment 1 of the present disclosure.

The flexible OLED display according to Embodiment 1 of the present disclosure includes step 1 to step 3.

Step 1: referring to FIG. **1** and FIG. **2**A, providing a flexible substrate **10**.

Step 2: referring to FIG. **1** and FIG. **2**B, forming the organic electroluminescent element **20** on the first surface **11**. Wherein the method of forming the organic electroluminescent element **20** specifically includes: sequentially forming the switch layer **21**, the organic light-emitting layer **22**, the encapsulation layer **23**, the touch layer **24** and the polarizer **25** on the first surface **11**.

Step 3: referring to FIG. **1** and FIG. **2**C, forming the photochromic component **30** and attaching the photochromic component **30** on the second surface **12**.

Specifically, the method of forming the photochromic component **30** and attaching the photochromic component **30** on the second surface **12** includes:

providing a first support substrate **32**. In the present embodiment, the first support substrate **32** may be made of polyimide (PI), but the disclosure is not limited thereto;

forming a photochromic material layer **31** on the first support substrate **32**; and

attaching a surface of the photochromic material layer **31** facing away from the first support substrate **32** to the second surface **12** with optical glue.

FIG. **3** is a schematic structural diagram of a flexible OLED display according to Embodiment 2 of the present disclosure.

Referring to FIG. **3**, The difference from the structure of the flexible OLED display of Embodiment 1 shown in FIG. **1** is: the photochromic component **30** further includes a second support substrate **33** and a sealing component **34**.

The second support substrate **33** is arranged between the second surface **12** and the photochromic material layer **31** to support the photochromic material layer **31**. The sealing component **34** is arranged between the first support substrate **32** and the second support substrate **33** and at a side terminal of the photochromic material layer **31** to seal the photochromic material layer **31**. In the present embodiment, the sealing component **34** may be a sealant, but the disclosure is not limited thereto.

In the present embodiment, by sealing the photochromic material layer **31**, the photochromic material layer **31** can be prevented from being damaged by moisture or oxygen, so as to improve the service life of the photochromic material layer **31**.

FIG. **4**A to **4**C are process diagrams of a flexible OLED display according to Embodiment 2 of the present disclosure.

The flexible OLED display according to Embodiment 2 of the present disclosure includes step 1 to step 3.

Step 1: referring to FIG. **3** and FIG. **4**A, providing a flexible substrate **10**.

Step 2: referring to FIG. **3** and FIG. **4**B, forming the organic electroluminescent element **20** on the first surface **11**. Wherein the method of forming the organic electroluminescent element **20** specifically includes: sequentially forming the switch layer **21**, the organic light-emitting layer **22**, the encapsulation layer **23**, the touch layer **24** and the polarizer **25** on the first surface **11**.

Step 3: referring to FIG. **3** an FIG. **4**C, forming the photochromic component **30** and attaching the photochromic component **30** on the second surface **12**.

Specifically, the method of forming the photochromic component **30** and attaching the photochromic component **30** on the second surface **12** includes:

providing a first support substrate **32**. In the present embodiment, the first support substrate **32** may be made of polyimide (PI), but the disclosure is not limited thereto;

forming a photochromic material layer **31** on the first support substrate **32**;

providing a second support substrate **33** arranged on a surface of the photochromic material layer **31** facing away from the first support substrate **32**.

forming a sealing component **34** arranged between the first support substrate **32** and the second support substrate **33** and both sides of the photochromic material layer **31** to seal the photochromic material layer **31**; and

attaching a surface of the second support substrate **33** facing away from the photochromic material layer **31** on the second surface **12**.

In summary, according to the embodiments of the present disclosure, it is possible to eliminate the influence of the external ambient light on the display and improve the display contrast.

Although the disclosure has been shown and described with reference to specific embodiments, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the disclosure as defined by the appended claims and their equivalents.

What is claimed is:

1. A flexible OLED display, comprising:

a flexible substrate, comprising a first surface and a second surface opposite to each other;

an organic electroluminescent component arranged on the first surface; and

a photochromic component arranged on the second surface, wherein the photochromic component generates different color changes according to an intensity of an external ambient light so as to completely absorb the external ambient light;

wherein the photochromic component comprises:

a photochromic material layer arranged on the second surface, the photochromic material layer varying in color according to the intensity of the external ambient light so as to completely absorb the external ambient light; and

a support substrate arranged on a surface of the photochromic material layer facing away from the second surface to support the photochromic material layer.

2. The flexible OLED display according to claim **1**, wherein, when the intensity of the external ambient light is not less than a predetermined light, the photochromic component discolors, and a light transmittance of the photochromic component is not greater than a first predetermined light transmittance to completely absorb the external ambient light.

3. The flexible OLED display according to claim **2**, wherein, when the intensity of the external ambient light is less than the predetermined light, the photochromic component discolors slightly, and the light transmittance of the photochromic component is greater than the first predetermined light transmittance and is not greater than a second predetermined light transmittance to completely absorb the

external ambient light, the second predetermined light transmittance is greater than the first predetermined light transmittance.

4. A manufacturing method of a flexible OLED display, comprising:

providing a flexible substrate, wherein the flexible substrate comprises a first surface and a second surface;

forming an organic electroluminescent component on the first surface; and

forming a photochromic component and attaching the photochromic component on the second surface, wherein the photochromic component generates different color changes according to an intensity of an external ambient light so as to completely absorb the external ambient light;

wherein the method of forming a photochromic component and attaching the photochromic component on the second surface comprises:

providing a first support substrate;

forming a photochromic material layer on a surface of the first support substrate facing away from the second surface, the photochromic material layer varying in color according to the intensity of the external ambient light so as to completely absorb the external ambient light;

providing a second support substrate, arranging the second support substrate on a surface of the photochromic material layer facing away from the first support substrate, the first support substrate and the second support substrate are used to support the photochromic material layer;

forming a sealing component arranged between the first support substrate and the second support substrate and both sides of the photochromic material layer to seal the photochromic material layer; and

attaching a surface of the second support substrate facing away from the photochromic material layer on the second surface.

5. The manufacturing method of a flexible OLED display according to claim **4**, wherein, when the intensity of the external ambient light is not less than a predetermined light, the photochromic component discolors deeply, and a light transmittance of the photochromic component is not greater than a first predetermined light transmittance to completely absorb the external ambient light.

6. The manufacturing method of a flexible OLED display according to claim **5**, wherein, when the intensity of the external ambient light is less than the predetermined light, the photochromic component discolors slightly, and the light transmittance of the photochromic component is greater than the first predetermined light transmittance and is not greater than a second predetermined light transmittance to completely absorb the external ambient light, the second predetermined light transmittance is greater than the first predetermined light transmittance.

* * * * *

专利名称(译)	柔性OLED显示器及其制造方法		
公开(公告)号	US10516120	公开(公告)日	2019-12-24
申请号	US15/579401	申请日	2017-11-14
发明人	YUAN, CHAOYU		
IPC分类号	H01L51/00 H01L51/56 H01L27/32 H01L51/50 H01L51/52		
CPC分类号	H01L51/0097 H01L27/3232 H01L51/56 H01L51/5253 H01L27/323 H01L51/5246 H01L51/5012 H01L2251/5338 H01L51/5284 H01L51/5281		
代理人(译)	MA，志刚		
其他公开文献	US20190229280A1		
外部链接	Espacenet		

摘要(译)

本发明公开了一种柔性OLED显示器，包括：柔性基板，包括彼此相对的第一表面和第二表面；以及柔性基板。 布置在第一表面上的有机电致发光组分； 设置在第二表面上的光致变色组件，其中，光致变色组件根据外部环境光的强度产生不同的颜色变化，以完全吸收外部环境光。 本发明还公开了一种柔性OLED显示器的制造方法。 根据本公开的柔性OLED显示器及其制造方法，可以消除外部环境光对显示器的影响，提高显示器的对比度。