US 20070054149A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2007/0054149 A1

Cheng et al. (43) Pub. Date: Mar. 8, 2007

(54) SUBSTRATE ASSEMBLY OF A DISPLAY DEVICE AND METHOD OF MANUFACTURING THE SAME

(76) Inventors: **Chi-Ming Cheng**, Chu-Nan (TW); **Chien-Chih Chiang**, Chu-Nan (TW)

Correspondence Address:
ROSENBERG, KLEIN & LEE
3458 ELLICOTT CENTER DRIVE-SUITE 101
ELLICOTT CITY, MD 21043 (US)

(21) Appl. No.: **11/208,709**

(22) Filed: **Aug. 23, 2005**

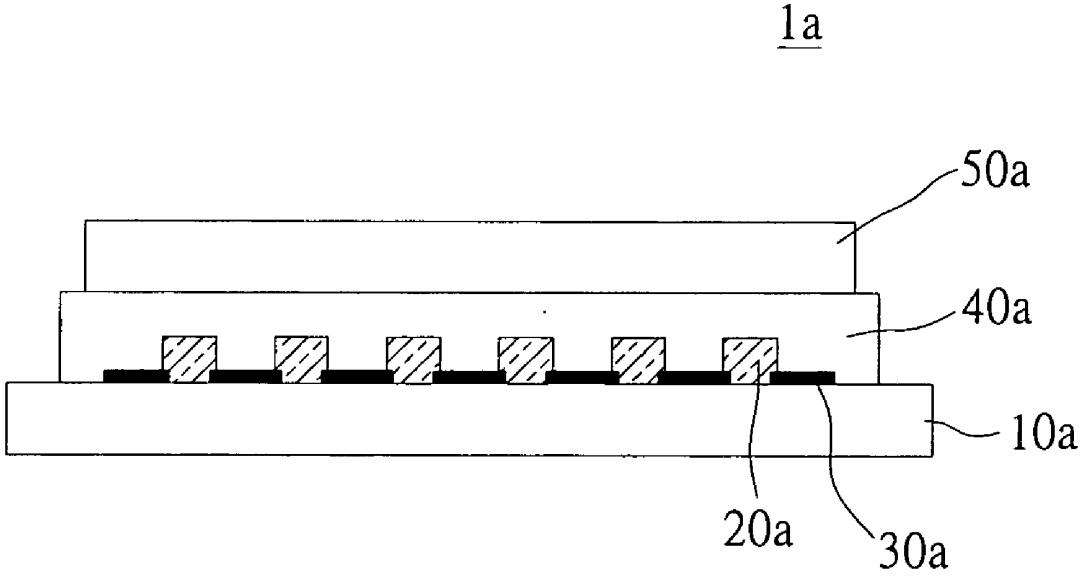
Publication Classification

(51) **Int. Cl.**
H01L 51/52 (2006.01)
H01L 51/56 (2006.01)

(52) **U.S. Cl.** **428/690**; 428/335; 428/698; 428/917; 313/112; 257/98; 427/66

(57) **ABSTRACT**

A substrate assembly of a display device and a method of manufacturing the same are disclosed. The substrate assembly includes a transparent substrate, an optical wavelength conversion layer and an inorganic covering layer. The optical wavelength conversion layer is formed on the transparent substrate. The inorganic covering layer is covered on the optical wavelength conversion layer. Moreover, the substrate assembly is used to support an organic emission element. Whereby the substrate assembly and the organic emission element are assembled together to form a display device. Furthermore, the substrate assembly further includes an inorganic barrier layer formed on the optical wavelength conversion layer and/or on the inorganic covering layer for preventing the organic emission element from being damaged by the moistures or the outgas produced from the optical wavelength conversion layer during heating process.



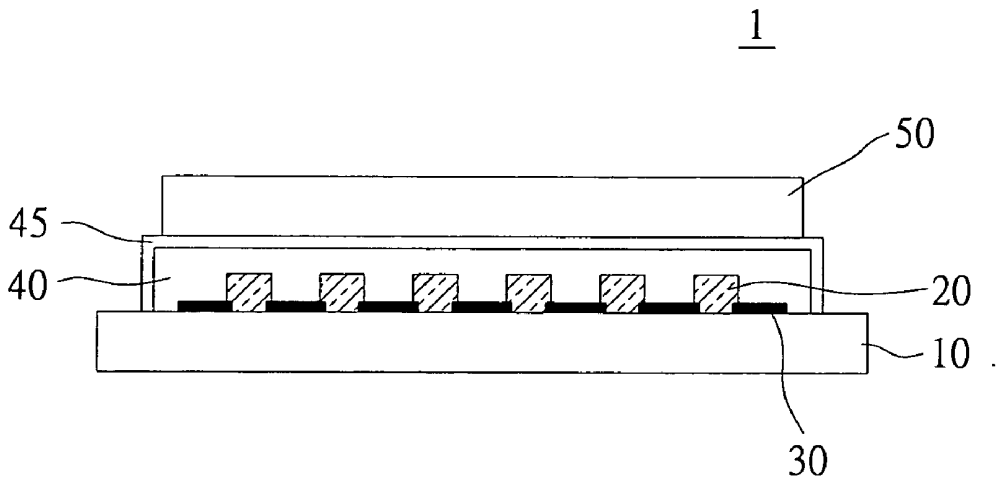


FIG. 1
PRIOR ART

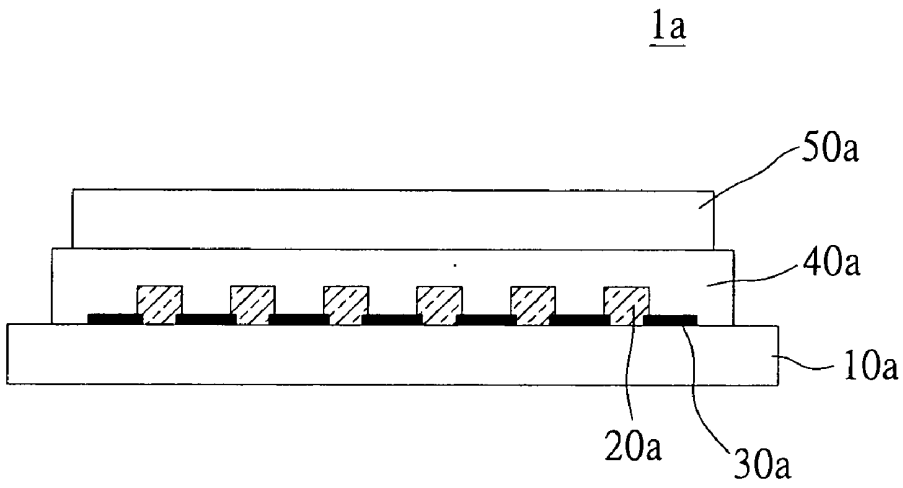


FIG. 2

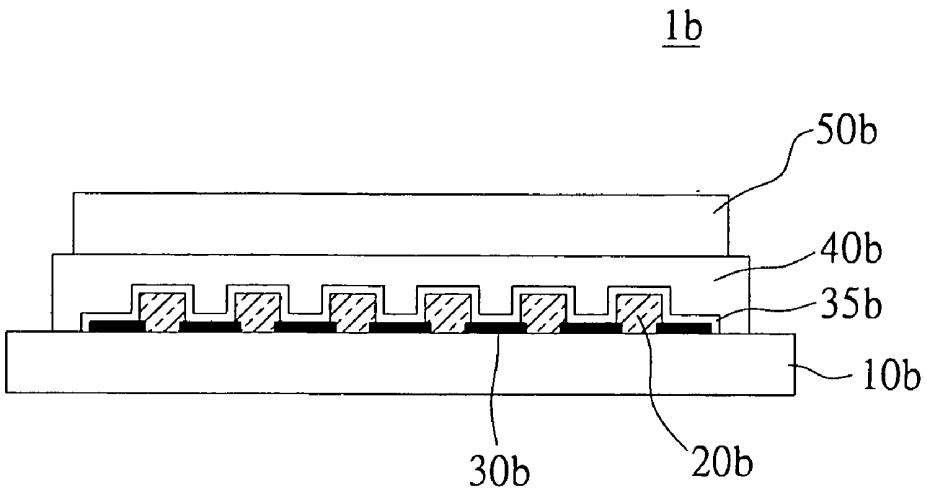


FIG 3

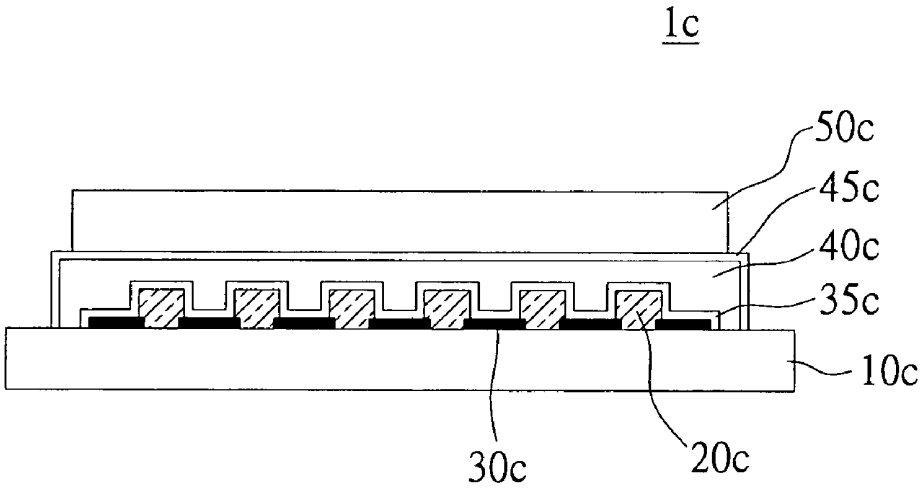


FIG 4

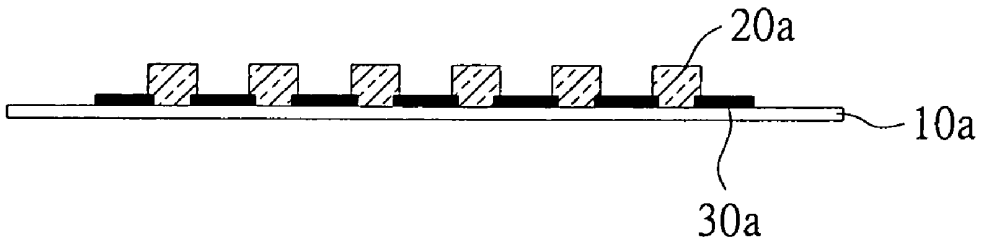


FIG 5A

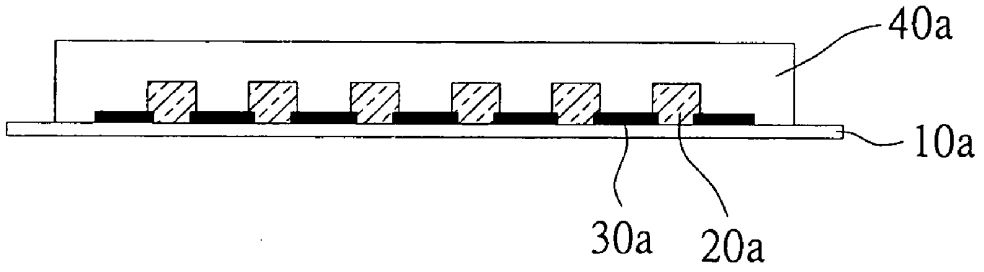


FIG 5B

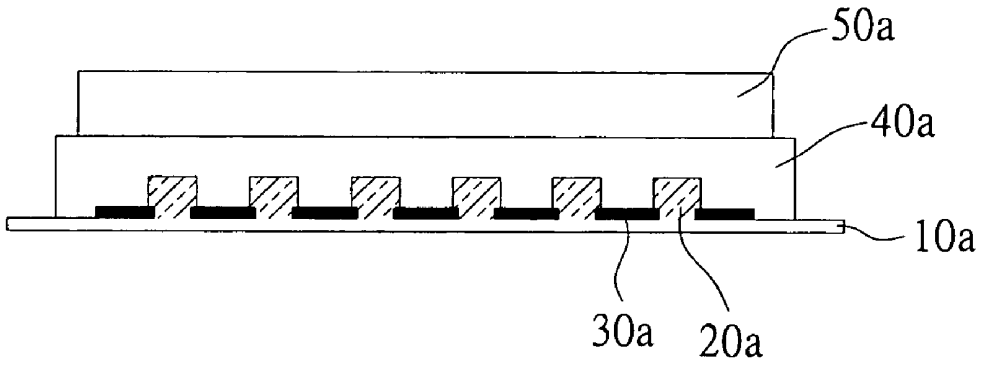


FIG 5C

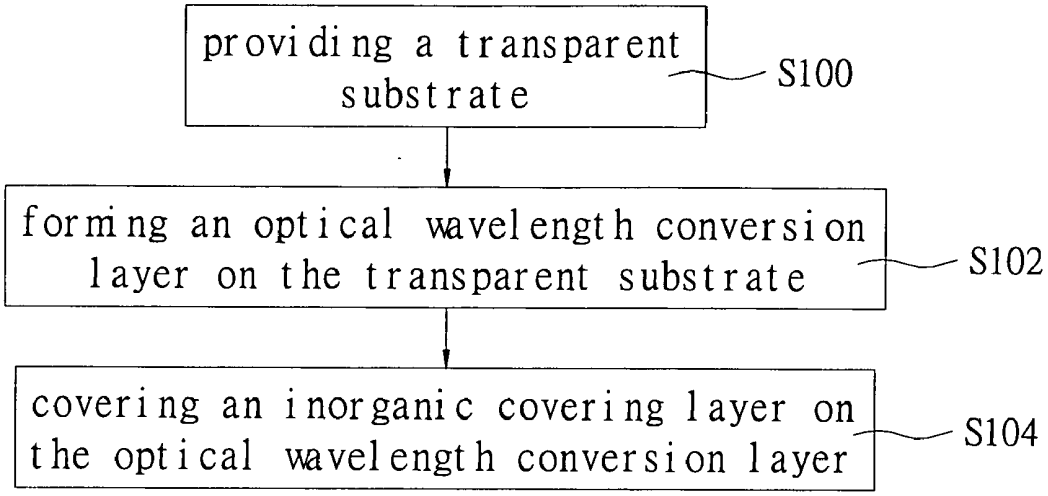

providing a transparent substrate
S100
forming an optical wavelength conversion layer on the transparent substrate
S102
covering an inorganic covering layer on the optical wavelength conversion layer
S104

FIG 6

SUBSTRATE ASSEMBLY OF A DISPLAY DEVICE AND METHOD OF MANUFACTURING THE SAME

BACKGROUND OF THE INVENTION

[0001] 1. Field of The Invention

[0002] The present invention relates to a substrate assembly of a display device and a method of manufacturing the same, and particularly relates to a substrate assembly for prevent an organic emission element from being damaged by moisture or outgas during heating process at 100 to 260° C.

[0003] 2. Description of the Related Art

[0004] FIG. **1** shows a cross-sectional view of an OLED in accordance with the prior art. The OLED of the prior art includes a glass substrate **10**, an optical wavelength conversion layer **20** and a black matrix **30** alternately formed on the glass substrate **10**, an organic covering layer **40** formed on the optical wavelength conversion layer **20**, an inorganic barrier layer **45** formed on the organic covering layer **40**, and an organic emission element **50** assembled on the inorganic barrier layer **45**.

[0005] Moreover, the inorganic barrier layer **45** is formed on the organic covering layer **40** for preventing the organic emission element **50** from being damaged by the moisture or the outgas from the optical wavelength conversion layer **20** and/or the organic covering layer **40** during heating process. Furthermore, after forming the organic covering layer **40** on the optical wavelength conversion layer **20**, the top surface of the organic covering layer **40** needs to be cleaned. However, moistures or outgas are easily absorbed by the opening of the organic covering layer **40** during the cleaning process, and the moistures or the outgas in the opening are vapored to affect the organic emission element **50** in other processes. Moreover, because the organic covering layer **40** is organic material, moistures or outgas are easily produced from the organic covering layer **40** to affect or damage the organic emission element **50**.

SUMMARY OF THE INVENTION

[0006] The present invention provides a substrate assembly of a display device and a method of manufacturing the same. The substrate assembly has an inorganic barrier layer formed on an optical wavelength conversion layer and/or on an inorganic covering layer for preventing the organic emission element from being damaged by the moistures or the outgas produced from the optical wavelength conversion layer during heating process, and prevent the optical wavelength conversion layer from being damaged by cleaning process before making the inorganic covering layer.

[0007] Furthermore, the present invention provides the inorganic covering layer that is made of inorganic material. Hence the structure of the inorganic covering layer is very compact, and the inorganic covering is hard to absorb moistures or outgas. Whereby, the inorganic covering layer can prevent the organic emission element from being damaged by moistures or the outgas produced from a transparent substrate.

[0008] One aspect of the invention is a substrate assembly. The substrate assembly includes a transparent substrate, an optical wavelength conversion layer and an inorganic covering layer. The optical wavelength conversion layer is formed on the transparent substrate. The inorganic covering layer is covered on the optical wavelength conversion layer. Moreover, the substrate assembly is used to support an organic emission element. Whereby the substrate assembly and the organic emission element are assembled together to form a display device.

[0009] Furthermore, the substrate assembly further includes an inorganic barrier layer formed on the optical wavelength conversion layer and/or on the inorganic covering layer for preventing the organic emission element from being damaged by the moistures or the outgas produced from the optical wavelength conversion layer during heating process.

[0010] One aspect of the invention is a method of manufacturing a substrate assembly. The method includes providing a transparent substrate; forming an optical wavelength conversion layer on the transparent substrate; and covering an inorganic covering layer on the optical wavelength conversion layer.

[0011] Moreover, the method further includes forming an inorganic barrier layer on the optical wavelength conversion layer and/or on the inorganic covering layer. Furthermore, an organic emission element can be assembled on the inorganic barrier layer to form a display device after forming the inorganic barrier layer on the optical wavelength conversion layer. In addition, the method further includes a planarization process after covering the inorganic covering layer on the optical wavelength conversion layer or on the inorganic barrier layer.

[0012] It is to be understood that both the foregoing general description and the following detailed description are exemplary, and are intended to provide further explanation of the invention as claimed. Other advantages and features of the invention will be apparent from the following description, drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The various objectives and advantages of the present invention will be more readily understood from the following detailed description when read in conjunction with the appended drawing, in which:

[0014] FIG. **1** is a cross-sectional view of an OLED in accordance with the prior art;

[0015] FIG. **2** is a cross-sectional view of an OLED in accordance with the first embodiment of the present invention;

[0016] FIG. **3** is a cross-sectional view of an OLED in accordance with the second embodiment of the present invention;

[0017] FIG. **4** is a cross-sectional view of an OLED in accordance with the third embodiment of the present invention;

[0018] FIGS. **5**A to **5**C respectively are three cross-sectional views of manufacturing an OLED in accordance with the first embodiment of the present invention; and

[0019] FIG. **6** is a flow chart of a method of manufacturing a substrate assembly in accordance with the first embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0020] FIG. **2** shows a cross-sectional view of an OLED (Organic Electro-Luminescence Display) in accordance with the first embodiment of the present invention. The OLED **1***a* includes a transparent substrate **10***a*, an optical wavelength conversion layer **20***a*, an inorganic covering layer **40***a* and an organic emission element **50***a*. The optical wavelength conversion layer **20***a* is formed on the transparent substrate **10***a*. The inorganic covering layer **40***a* is covered on the optical wavelength conversion layer **20***a*. The organic emission element **50***a* is disposed on the inorganic covering layer **40***a*. Moreover, the transparent substrate **10***a* can be made of glass, quartz or plastic materials. The transparent substrate **10***a* has an active matrix or a passive matrix such as TFT (Thin Film Transistor). Furthermore, the organic emission element **50***a* can be an OLED (Organic Light Emitting Diode) or a PLED (Polymer Light Emitting Diode).

[0021] In addition, the inorganic covering layer **40***a* is made of a material selected from the group consisting of silicon oxide, silicon nitride, silicon nitride oxide, silicon carbide, titanium oxide, titanium nitride, zirconium oxide, zirconium nitride, aluminum oxide, aluminum nitride, tin oxide, indium oxide, lead oxide, boric oxide, calcium oxide, $SiO_xC_iH_j$, $SiN_yC_iH_j$ and $SiO_xN_yC_iH_j$. The inorganic covering layer **40***a* has a perfect thickness of from 1 to 50 μm for preventing the moisture or the outgas of the optical wavelength conversion layer **20***a* from spreading to the organic emission element **50***a* in a heating process. The inorganic covering layer **40***a* is a multi-layers structure. Moreover, the organic emission element **50***a* is easily formed on a plane top surface of the inorganic covering layer **40***a*. The optical wavelength conversion layer **20***a* can be a color filter (CF) layer, a color conversion medium (CCM) layer or a combination of the color filter layer and the color conversion medium layer. The organic emission element **50***a* can be white or blue. Furthermore, in order to ensure the display effect of the OLED, the inorganic covering layer **40***a* has a transmittance larger than 80%.

[0022] FIG. **3** shows a cross-sectional view of an OLED **1***b* in accordance with the second embodiment of the present invention. In order to prevent the organic emission element **50***b* from being damaged by the moisture or the outgas of the optical wavelength conversion layer **20***b*, and prevent the optical wavelength conversion layer **20***b* from being damaged by cleaning process before making the inorganic covering layer **40***b*, an inorganic barrier layer **35***b* can be formed on the optical wavelength conversion layer **20***b* by a CVD (Chemical Vapor Deposition) or PVD (Physical Vapor Deposition) method.

[0023] FIG. **4** shows a cross-sectional view of an OLED I c in accordance with the third embodiment of the present invention. In addition to form the inorganic barrier layer **35***c* on the optical wavelength conversion layer **20***c*, an inorganic barrier layer **45***c* can be formed on the inorganic covering layer **40***c* by the CVD or PVD method. The inorganic barrier layers **35***c*, **40***c* not only can prevent the organic emission element **50***c* from being damaged by the moisture or the outgas of the optical wavelength conversion layer **20***c*, but also can prevent a transparent electrode from being damaged by etching liquids during making element patterns. However, the inorganic barrier layer (**35***b*, **35***c* or **45***c*) has a thickness smaller than that of the barrier layer **45** of the prior art. In other words, the thickness of the inorganic barrier layer (**35***b*, **35***c* or **45***c*) is from 500×10^{-10} to 5000×10^{-10} m that has same effect as prior art. Moreover, the inorganic barrier layer (**35***b*, **35***c* or **45***c*) can be a multi-layers structure.

[0024] FIGS. **5**A to **5**C respectively show three cross-sectional views of manufacturing an OLED in accordance with the first embodiment of the present invention, and FIG. **6** shows a flow chart of a method of manufacturing a substrate assembly in accordance with the first embodiment of the present invention. The present invention provides a method of manufacturing a substrate assembly for display. The method includes: providing a glass substrate or a transparent substrate **10***a* with TFT array (S**100**); forming an optical wavelength conversion layer **20***a* on the transparent substrate **10***a* (S**102**), moreover the patterns of the optical wavelength conversion layer **20***a* are separated by a black matrix **30***a*; covering an inorganic covering layer **40***a* on the optical wavelength conversion layer **20***a* (S**104**). Furthermore, the inorganic covering layer **40***a* is made of a material selected from the group consisting of silicon oxide, silicon nitride, silicon nitride oxide, silicon carbide, titanium oxide, titanium nitride, zirconium oxide, zirconium nitride, aluminum oxide, aluminum nitride, tin oxide, indium oxide, lead oxide, boric oxide, calcium oxide, $SiO_xC_iH_j$, $SiN_yC_iH_j$ and $SiO_xN_yC_iH_j$. The inorganic covering layer **40***a* can be formed by a CVD, PVD or SOG (Spin On Glass) method. The inorganic covering layer **40***a* is a multi-layers structure. In addition, the method includes assembling an organic emission element **50***a* on the inorganic covering layer **40***a*.

[0025] Furthermore, the inorganic covering layer **40***a* has a thickness of from 1 to 50 μm, and the inorganic covering layer **40***a* is covered on the optical wavelength conversion layer at the temperature of between 20 and 300° C. and the pressure of between 0.0005 torr and 1 atm.

[0026] Moreover, the method further includes forming an inorganic barrier layer on the optical wavelength conversion layer and/or on the inorganic covering layer. Furthermore, an organic emission element can be assembled on the inorganic barrier layer to form a display device after forming the inorganic barrier layer on the optical wavelength conversion layer. In addition, the method further includes a planarization process after covering the inorganic covering layer on the optical wavelength conversion layer or on the inorganic barrier layer.

[0027] In conclusion, the inorganic barrier layer (**35***b*, **35***c* or **45***c*) is provided to prevent the organic emission element (**50***a*, **50***b* or **50***c*) from being damaged by the moistures or the outgas produced from the optical wavelength conversion layer (**20***a*, **20***b* or **20***c*) during heating process, and prevent the optical wavelength conversion layer (**20***a*, **20***b* or **20***c*) from being damaged by cleaning process before making the inorganic covering layer (**40***a*, **40***b* or **40***c*).

[0028] Furthermore, the inorganic covering layer (**40***a*, **40***b* or **40***c*) is made of inorganic material. Hence the structure of the inorganic covering layer (**40***a*, **40***b* or **40***c*) is very compact, and the inorganic covering (**40***a*, **40***b* or **40***c*) is hard to absorb moistures or outgas. Whereby, the inorganic covering layer (**40***a*, **40***b* or **40***c*) can prevent the organic emission element (**50***a*, **50***b* or **50***c*) from being

damaged by the moistures or the outgas produced from a transparent substrate (**10***a*, **10***b* or **10***c*).

[**0029**] Although the present invention has been described with reference to the preferred embodiments thereof, it will be understood that the invention is not limited to the details thereof. Various substitutions and modifications have been suggested in the foregoing description, and others will occur to those of ordinary skill in the art. Therefore, all such substitutions and modifications are intended to be embraced within the scope of the invention as defined in the appended claims.

What is claimed is:

1. A substrate assembly comprising:

a transparent substrate;

an optical wavelength conversion layer formed on the transparent substrate; and

an inorganic covering layer covering on the optical wavelength conversion layer;

wherein the substrate assembly is used to support an organic emission element, the substrate assembly and the organic emission element are assembled together to form a display device.

2. The substrate assembly as claimed in claim 1, wherein the inorganic covering layer has a thickness of from 1 to 50 μm.

3. The substrate assembly as claimed in claim 1, further comprising an inorganic barrier layer formed on the optical wavelength conversion layer.

4. The substrate assembly as claimed in claim 1, further comprising an inorganic barrier layer formed on the inorganic covering layer.

5. The substrate assembly as claimed in claim 4, wherein the inorganic barrier layer has a thickness of from 500×10^{-10} to 5000×10^{-10} m.

6. The substrate assembly as claimed in claim 4, wherein the inorganic barrier layer is a multi-layers structure.

7. The substrate assembly as claimed in claim 1, wherein the inorganic covering layer is made of a material selected from the group consisting of silicon oxide, silicon nitride, silicon nitride oxide, silicon carbide, titanium oxide, titanium nitride, zirconium oxide, zirconium nitride, aluminum oxide, aluminum nitride, tin oxide, indium oxide, lead oxide, boric oxide, calcium oxide, $SiO_xC_iH_j$, $SiN_yC_iH_j$ and $SiO_xN_yC_iH_j$.

8. The substrate assembly as claimed in claim 1, wherein the optical wavelength conversion layer is a color filter layer, a color conversion medium layer or a combination of the color filter layer and the color conversion medium layer.

9. The substrate assembly as claimed in claim 1, wherein the inorganic covering layer is a multi-layers structure.

10. The substrate assembly as claimed in claim 1, wherein the organic emission element is an OLED (Organic Light Emitting Diode) or a PLED (Polymer Light Emitting Diode), and the transparent substrate is made of glass, quartz or plastic materials.

11. A method of manufacturing a substrate assembly, comprising:

providing a transparent substrate;

forming an optical wavelength conversion layer on the transparent substrate; and

covering an inorganic covering layer on the optical wavelength conversion layer.

12. The method as claimed in claim 11, wherein the inorganic covering layer has a thickness of from 1 to 50 μm made by a CVD (Chemical Vapor Deposition), PVD (Physical Vapor Deposition), or SOG (Spin On Glass) method.

13. The method as claimed in claim 11, wherein the inorganic covering layer is covered on the optical wavelength conversion layer at the temperature of between 20 and 300° C. and the pressure of between 0.0005 torr and 1 atm.

14. The method as claimed in claim 11, further comprising forming an inorganic barrier layer on the optical wavelength conversion layer.

15. The method as claimed in claim 14, further comprising assembling an organic emission element on the inorganic barrier layer after forming the inorganic barrier layer on the optical wavelength conversion layer.

16. The method as claimed in claim 11, further comprising forming an inorganic barrier layer on the inorganic covering layer.

17. The method as claimed in claim 16, wherein the inorganic barrier layer has a thickness of from 500×10^{-10} to 5000×10^{-10} m.

18. The method as claimed in claim 16, wherein the inorganic barrier layer or the inorganic covering layer is a multi-layers structure.

19. The method as claimed in claim 11, wherein the inorganic covering layer is made of a material selected from the group consisting of silicon oxide, silicon nitride, silicon nitride oxide, silicon carbide, titanium oxide, titanium nitride, zirconium oxide, zirconium nitride, aluminum oxide, aluminum nitride, tin oxide, indium oxide, lead oxide, boric oxide, calcium oxide, $SiO_xC_iH_j$, $SiN_yC_iH_j$ and $SiO_xN_yC_iH_j$.

20. The method as claimed in claim 11, further comprising a planarization process after covering the inorganic covering layer on the optical wavelength conversion layer.

* * * * *

专利名称(译)	显示装置的基板组件及其制造方法		
公开(公告)号	US20070054149A1	公开(公告)日	2007-03-08
申请号	US11/208709	申请日	2005-08-23
[标]申请(专利权)人(译)	程智明 CHIANG简志		
申请(专利权)人(译)	成志明 CHIANG CHIEN-CHIH		
当前申请(专利权)人(译)	UNIVISION TECHNOLOGY INC.		
[标]发明人	CHENG CHI MING CHIANG CHIEN CHIH		
发明人	CHENG, CHI-MING CHIANG, CHIEN-CHIH		
IPC分类号	H01L51/52 H01L51/56		
CPC分类号	H01L27/322 Y10T428/264 H01L51/5237 H01L51/5253		
外部链接	Espacenet USPTO		

摘要(译)

公开了一种显示装置的基板组件及其制造方法。基板组件包括透明基板，光学波长转换层和无机覆盖层。光学波长转换层形成在透明基板上。无机覆盖层覆盖在光学波长转换层上。此外，基板组件用于支撑有机发光元件。由此将基板组件和有机发射元件组装在一起以形成显示装置。此外，基板组件还包括形成在光波长转换层上和/或无机覆盖层上的无机阻挡层，用于防止有机发光元件在加热期间被光波长转换层产生的湿气或排气损坏处理。