



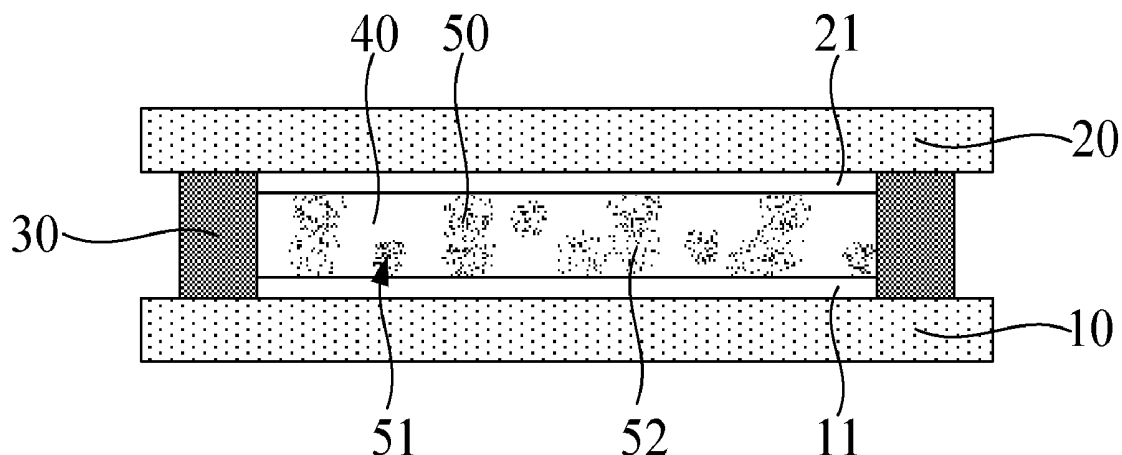
US 20170110682A1

(19) **United States**(12) **Patent Application Publication**
YU et al.(10) **Pub. No.: US 2017/0110682 A1**(43) **Pub. Date: Apr. 20, 2017**(54) **ORGANIC ELECTROLUMINESCENT
DEVICE, METHOD FOR PREPARING THE
SAME AND DISPLAY PANEL**(52) **U.S. Cl.**
CPC *H01L 51/5246* (2013.01); *H01L 51/5203*
(2013.01); *H01L 51/56* (2013.01)(71) Applicant: **Boe Technology Group Co., Ltd.**,
Beijing (CN)(57) **ABSTRACT**(72) Inventors: **Donghui YU**, Beijing (CN); **Chun Jan
WANG**, Beijing (CN); **Huaiting SHIH**,
Beijing (CN)(21) Appl. No.: **15/214,297**(22) Filed: **Jul. 19, 2016**(30) **Foreign Application Priority Data**

Oct. 14, 2015 (CN) 201510662267.1

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

An organic electroluminescent device, a method for preparing an organic electroluminescent device, and a display panel are disclosed. The organic electroluminescent device comprises a conductive layer formed by transparent magnetic conductive particles which are mixed in the sealing layer and stacked on a surface of the first transparent electrode layer. The conductive layer increases the conductive performance while not increasing the thickness of the first transparent electrode layer, thereby avoiding decrease of the light transmittance caused by increase of the thickness of the first transparent electrode layer, and avoiding the problem of voltage drop due to poor conductivity of the first transparent electrode layer, so as to improve the display effect and use stability of the organic electroluminescent device.



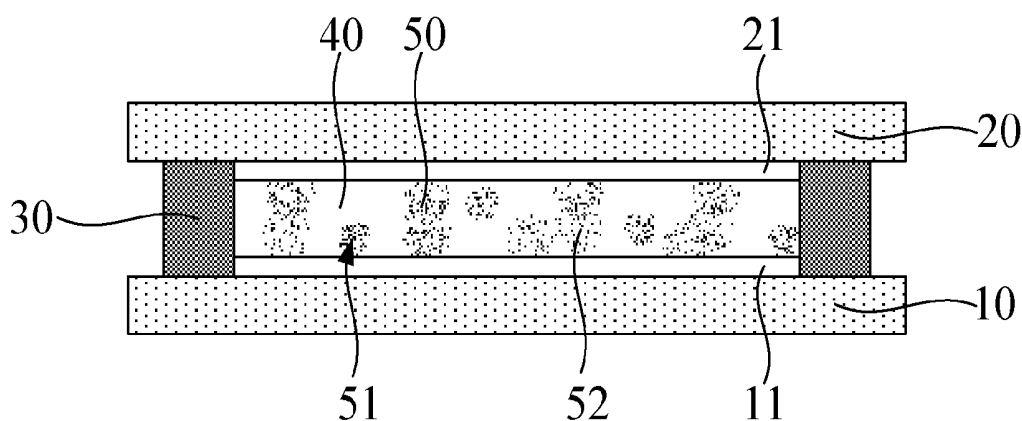


Fig. 1

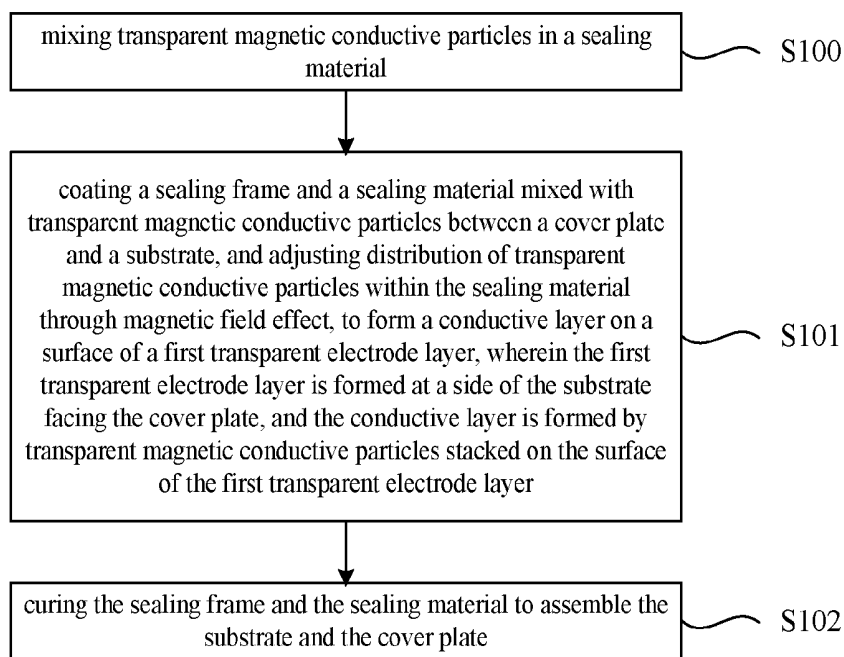


Fig. 2

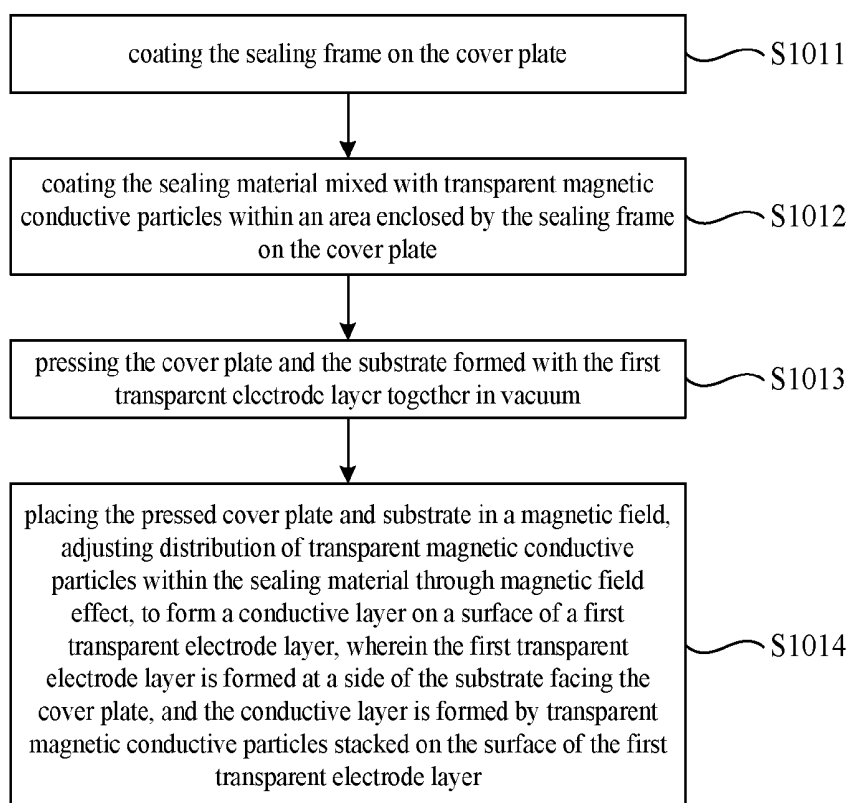


Fig. 3

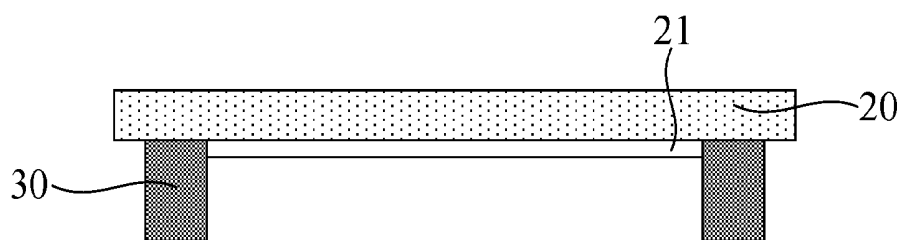


Fig. 4

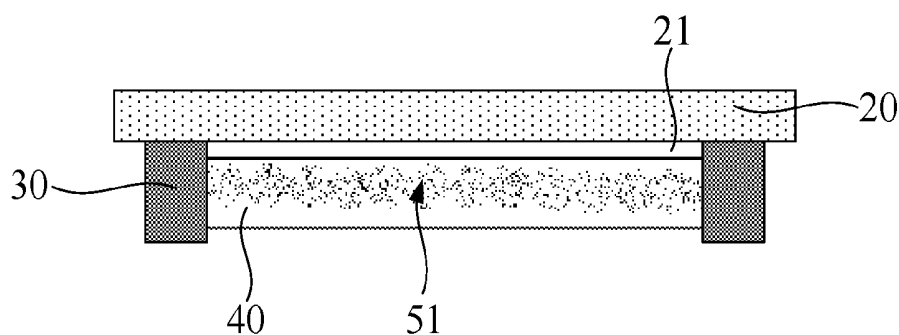


Fig. 5

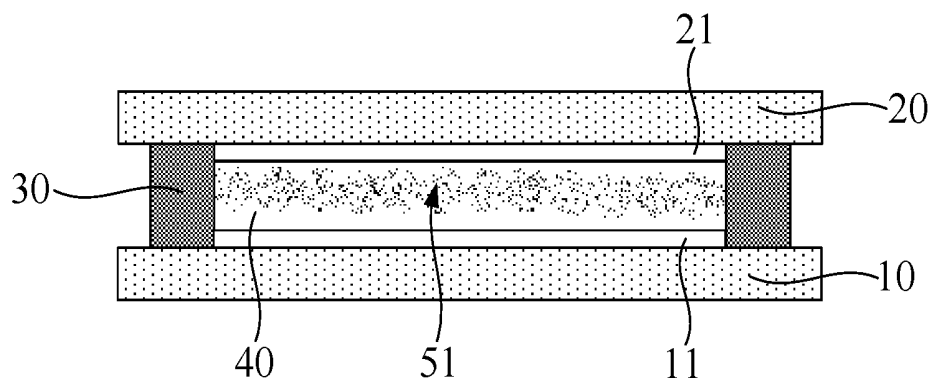


Fig. 6

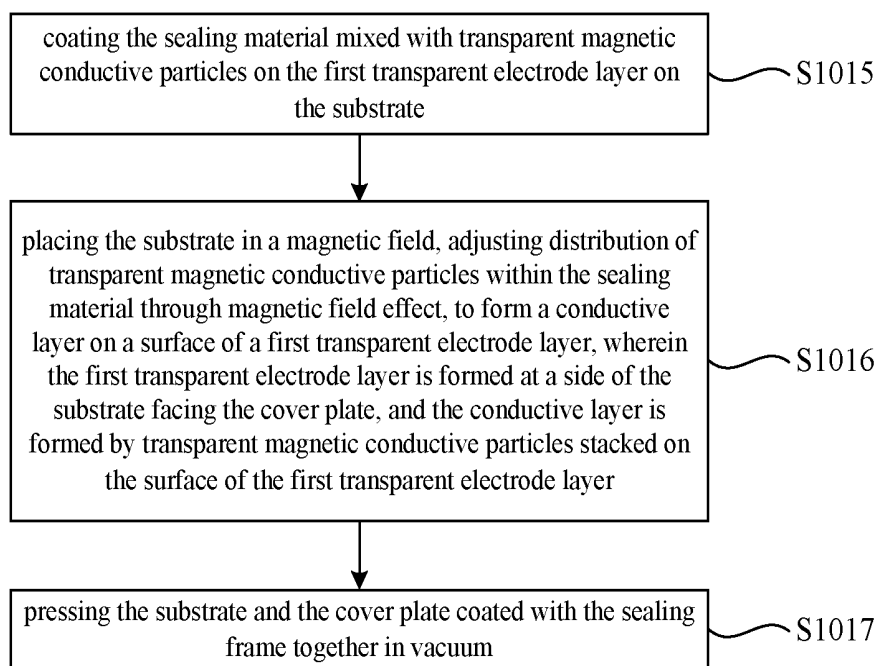


Fig. 7

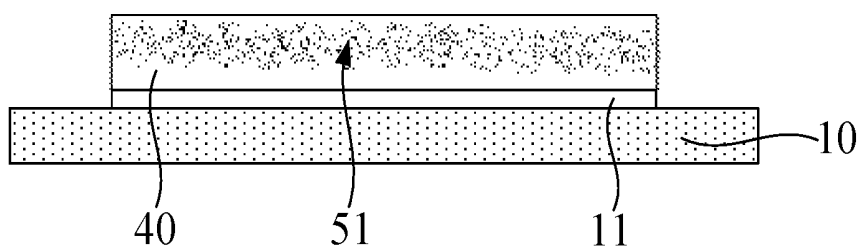


Fig. 8

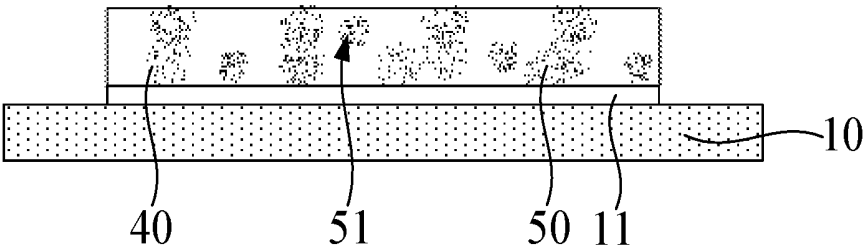


Fig. 9

**ORGANIC ELECTROLUMINESCENT
DEVICE, METHOD FOR PREPARING THE
SAME AND DISPLAY PANEL**

RELATED APPLICATIONS

[0001] The present application claims the benefit of Chinese Patent Application No.

[0002] **201510662267.1**, filed Oct. 14, 2015, the entire disclosure of which is incorporated herein by reference.

TECHNICAL FIELD

[0003] The present invention relates to the field of display technology, particularly to an organic electroluminescent device, a method for preparing an organic electroluminescent device, and a display panel.

BACKGROUND

[0004] The organic electroluminescent device (OLED) itself has the advantages of low power consumption, self-luminous, wide visual angle, low cost, wide temperature range, high response speed, continuous adjustable luminous color, flexible display, and simple process etc., and the organic electroluminescent device display panel has been widely applied in electronic products such as mobile phones.

[0005] The organic electroluminescent device can be classified into a top emitting devices and a bottom emitting device according to the direction of emission of light from the device, in the top emitting device, the light is emitted from the top of the organic electroluminescent device, and does not pass through the driving panel at the bottom, hence, it has a higher aperture ratio, which is benefit for realizing display of high brightness and high resolution.

[0006] The top emitting device generally uses indium zinc oxide (IZO) as the electrode layer, and generally uses the method of increasing the thickness of the electrode layer or realizing lapping to enhance the conductivity of the electrode layer. However, with the increase of the thickness of the electrode layer, it may result in decrease of the light transmittance of the organic electroluminescent device, thereby reducing the display effect of the organic electroluminescent device.

SUMMARY

[0007] The present invention provides an organic electroluminescent device, a method for preparing an organic electroluminescent device, and a display panel, which enhances the conductivity thereof on the premise of not increasing the thickness of the electrode layer, avoid the problem of decrease of light transmittance caused by increase of the thickness of the electrode layer, and avoid the problem of voltage drop due to poor conductivity of the first transparent electrode layer, thereby improving display effect and use stability of the organic electroluminescent device.

[0008] In an embodiment, an organic electroluminescent device comprises a substrate and a cover plate arranged opposite to each other, a sealing frame located between the substrate and the cover plate for connecting the substrate and the cover plate, a sealing layer filling an area enclosed by the sealing frame and bonded with the substrate and the cover plate, a first transparent electrode layer being provided at a side of the substrate facing the cover plate. The organic electroluminescent device further comprises a conductive layer formed by transparent magnetic conductive particles

which are mixed in the sealing layer and stacked on a surface of the first transparent electrode layer.

[0009] In the organic electroluminescent device, because a conductive layer formed by stack of transparent magnetic conductive particles is formed on the first transparent electrode layer, the conductive layer improves the conductive performance of the first transparent electrode layer. The organic electroluminescent device reduces the thickness of the first transparent electrode layer while ensuring the conductive performance of the first transparent electrode layer, thereby increasing the light transmittance of the organic electroluminescent device, and avoiding the problem of voltage drop due to poor conductivity of the first transparent electrode layer. Therefore, the organic electroluminescent device has higher light transmittance and use stability.

[0010] In an embodiment, the first transparent electrode layer comprises indium zinc oxide.

[0011] In an embodiment, a weight concentration of the transparent magnetic conductive particles in the sealing layer is greater than or equal to 5% and less than or equal to 50%.

[0012] In an embodiment, a diameter of the transparent magnetic conductive particles in the sealing layer is not greater than 200 nm. In an embodiment, the transparent magnetic conductive particles are metal oxide nanoparticles or non-metal oxide nanoparticles.

[0013] In an embodiment, a second transparent electrode layer is formed on a surface of the cover plate facing the substrate, the sealing layer is provided with a conductor structure formed by transparent magnetic conductive particles mixed in the sealing layer, and the conductor structure joins the second transparent electrode layer with the first transparent electrode layer.

[0014] The present invention further provides in an embodiment an organic electroluminescent device display panel, comprising the organic electroluminescent device as stated above.

[0015] The present invention further provides in an embodiment a method for preparing the organic electroluminescent device as stated above, comprising:

[0016] step S101, coating a sealing frame and a sealing material mixed with transparent magnetic conductive particles between a cover plate and a substrate, and adjusting distribution of transparent magnetic conductive particles within the sealing material through magnetic field effect, to form a conductive layer on a surface of a first transparent electrode layer, wherein the first transparent electrode layer is formed at a side of the substrate facing the cover plate, and the conductive layer is formed by transparent magnetic conductive particles stacked on the surface of the first transparent electrode layer; and

[0017] step S102, curing the sealing frame and the sealing material to assemble the substrate and the cover plate.

[0018] In the method, because the transparent magnetic conductive particles within the sealing material, under the effect of magnetic field, are stacked on the first transparent electrode layer and form a conductive layer, the conductive layer improves the conductive performance of the first transparent electrode layer. The method reduces the thickness of the first transparent electrode layer while ensuring the conductive performance of the first transparent electrode layer, thereby increasing the light transmittance of the organic electroluminescent device, and avoiding the problem of voltage drop due to poor conductivity of the first

transparent electrode layer. Therefore, the method increases the display effect and use stability of the organic electroluminescent device.

[0019] In an embodiment, the step S101 comprises:

[0020] coating the sealing frame on the cover plate;

[0021] coating the sealing material mixed with transparent magnetic conductive particles within an area enclosed by the sealing frame on the cover plate;

[0022] pressing the cover plate and the substrate formed with the first transparent electrode layer together in vacuum; and

[0023] placing the pressed cover plate and substrate in a magnetic field, adjusting distribution of transparent magnetic conductive particles within the sealing material through magnetic field effect, to form the conductive layer on the surface of the first transparent electrode layer, wherein the first transparent electrode layer is formed at a side of the substrate facing the cover plate, and the conductive layer is formed by transparent magnetic conductive particles stacked on the surface of the first transparent electrode layer.

[0024] In an embodiment, the sealing material is coated on the cover plate using gluing process, slot coating or ink jet coating.

[0025] In an embodiment, the step S101 comprises:

[0026] coating the sealing material mixed with transparent magnetic conductive particles on the first transparent electrode layer on the substrate;

[0027] placing the substrate in a magnetic field, adjusting distribution of transparent magnetic conductive particles within the sealing material through magnetic field effect, to form a conductive layer on a surface of a first transparent electrode layer, wherein the first transparent electrode layer is formed at a side of the substrate facing the cover plate, and the conductive layer is formed by transparent magnetic conductive particles stacked on the surface of the first transparent electrode layer; and

[0028] pressing the substrate and the cover plate coated with the sealing frame together in vacuum.

[0029] In an embodiment, the sealing material is coated on the substrate using ink jet coating or slot coating.

[0030] In an embodiment, the step S102 comprises:

[0031] curing the sealing frame and the sealing material by UV radiation or heating to assemble the substrate and the cover plate.

[0032] In an embodiment, prior to the step S101, the method further comprises:

[0033] mixing transparent magnetic conductive particles in the sealing material.

BRIEF DESCRIPTION OF DRAWINGS

[0034] FIG. 1 is a structural schematic view of an organic electroluminescent device provided by an embodiment of the present invention;

[0035] FIG. 2 is a flow chart of a method for preparing an organic electroluminescent device provided by an embodiment of the present invention;

[0036] FIG. 3 is a flow chart of an implementation of step S101 in the method as shown in FIG. 2;

[0037] FIG. 4 is a structural schematic view of an organic electroluminescent device formed after coating a sealing frame on a cover plate;

[0038] FIG. 5 is a structural schematic view of an organic electroluminescent device after a sealing layer is formed;

[0039] FIG. 6 is a structural schematic view of an organic electroluminescent device after pressing the cover plate and the substrate together;

[0040] FIG. 7 is a flow chart of another implementation of step S101 in the method as shown in FIG. 2;

[0041] FIG. 8 is a structural schematic view of an organic electroluminescent device after forming a sealing layer on the substrate; and

[0042] FIG. 9 is a structural schematic view of an organic electroluminescent device after a conductive layer is formed by placing the substrate in a magnetic field.

DETAILED DESCRIPTION OF EMBODIMENTS

[0043] Next, the technical solutions in embodiments of the present invention will be described clearly and completely with reference to the drawings in the embodiments of the present invention. Apparently, the embodiments described are only a part of rather than all of the embodiments of the present invention. Based on the embodiments in the present invention, all other embodiments obtained by the ordinary skilled person in the art on the premise of not paying any creative work belong to the protection scope of the present invention.

[0044] Reference signs: 10-substrate; 11-first transparent electrode layer; 20-cover plate; 21-second transparent electrode layer; 30-sealing frame; 40-sealing layer; 50-conductive layer; 51-transparent magnetic conductive particle; 52-conductor structure.

[0045] As shown in FIG. 1, an embodiment of the present invention provides an organic electroluminescent device, comprising a substrate 10 and a cover plate 20 arranged opposite to each other, a sealing frame 30 located between the substrate 10 and the cover plate 20 for connecting the substrate 10 and the cover plate 20, a sealing layer 40 filling an area enclosed by the sealing frame 30 and bonded with the substrate 10 and the cover plate 20, a side of the substrate 10 facing the cover plate 20 being provided with a first transparent electrode layer 11, further comprising a conductive layer 50 formed by stack of transparent magnetic conductive particles 51 mixed in the sealing layer 40 on a surface of the first transparent electrode layer 11.

[0046] In the organic electroluminescent device, because a conductive layer 50 formed by stack of transparent magnetic conductive particles 51 is formed on the first transparent electrode layer 11, the conductive layer 50 improves the conductive performance of the first transparent electrode layer 11. The organic electroluminescent device reduces the thickness of the first transparent electrode layer 11 while ensuring the conductive performance of the first transparent electrode layer 11, thereby increasing the light transmittance of the organic electroluminescent device, and avoiding the problem of voltage drop due to poor conductivity of the first transparent electrode layer 11. Therefore, the organic electroluminescent device has higher light transmittance and use stability.

[0047] In an example, the first transparent electrode layer comprises indium zinc oxide.

[0048] In an example, in order to ensure the conductive performance of the sealing layer, a weight concentration of the transparent magnetic conductive particles in the sealing layer is greater than or equal to 5% and less than or equal to 50%.

[0049] In an embodiment, a diameter of the transparent magnetic conductive particles in the sealing layer is not greater than 200 nm.

[0050] In an example, the transparent magnetic conductive particles are metal oxide nanoparticles or non-metal oxide nanoparticles.

[0051] In the example as shown in FIG. 1, a second transparent electrode layer 21 is formed on a surface of the cover plate 20 facing the substrate 10, the sealing layer 40 is provided with a conductor structure 52 formed by transparent magnetic conductive particles 51 mixed in the sealing layer, so as to lap the second transparent electrode layer 21 formed on the cover plate 20 with the first transparent electrode layer 11.

[0052] Because the first transparent electrode layer 11 and the second transparent electrode layer 21 are lapped through the conductor structure 52 formed by transparent magnetic conductive particles 51, and the conductor structure 52 is a transparent structure, compared with the manner of realizing lapping using a metal conductive layer formed on a spacer in the prior art, the manner increases the light transmittance of the organic electroluminescent device.

[0053] An embodiment of the present invention further provides an organic electroluminescent device display panel, comprising the above organic electroluminescent device.

[0054] As shown in FIG. 2, the present invention further provides a method for preparing the above organic electroluminescent device, comprising:

[0055] step S101, coating a sealing frame and a sealing material mixed with transparent magnetic conductive particles between a cover plate and a substrate, and adjusting distribution of transparent magnetic conductive particles within the sealing material through magnetic field effect, to form a conductive layer on a surface of a first transparent electrode layer, wherein the first transparent electrode layer is formed at a side of the substrate facing the cover plate, and the conductive layer is formed by transparent magnetic conductive particles stacked on the surface of the first transparent electrode layer; and

[0056] step S102, curing the sealing frame and the sealing material to assemble the substrate and the cover plate.

[0057] In the method, because the transparent magnetic conductive particles within the sealing material, under the effect of magnetic field, are stacked on the first transparent electrode layer and form a conductive layer, the conductive layer improves the conductive performance of the first transparent electrode layer. The method reduces the thickness of the first transparent electrode layer while ensuring the conductive performance of the first transparent electrode layer, thereby increasing the light transmittance of the organic electroluminescent device, and avoiding the problem of voltage drop due to poor conductivity of the first transparent electrode layer. Therefore, the method increases the display effect and use stability of the organic electroluminescent device.

[0058] The step S101 can be carried out using the following two manners.

[0059] In the first manner, as shown in FIG. 3, the step S101 comprises:

[0060] step S1011, as shown in FIG. 4, coating a sealing frame 30 on a cover plate 20;

[0061] step S1012, as shown in FIG. 5, coating the sealing material mixed with transparent magnetic conductive par-

ticles 51 within an area enclosed by the sealing frame 30 on the cover plate 20, to form a sealing layer 40;

[0062] step S1013, as shown in FIG. 6, pressing the cover plate 20 and the substrate 10 formed with the first transparent electrode layer 11 together in vacuum; and

[0063] step S1014, placing the pressed cover plate 20 and substrate 10 as shown in FIG. 6 in a magnetic field, adjusting distribution of transparent magnetic conductive particles 51 within the sealing layer 40 through magnetic field effect, to form a conductive layer 50 formed by stack of transparent magnetic conductive particles 51 on a surface of the first transparent electrode layer 11 formed at a side of the substrate 10 facing the cover plate 20, so as to form an organic electroluminescent device as shown in FIG. 1.

[0064] In an embodiment, the sealing material is coated on the cover plate using gluing process, slot coating or ink jet coating. In the second manner, as shown in FIG. 7, the step S101 comprises:

[0065] step S1011, as shown in FIG. 8, coating the sealing material mixed with transparent magnetic conductive particles 51 on the first transparent electrode layer 11 on the substrate 10, so as to form a sealing layer 40;

[0066] step S1012, as shown in FIG. 9, placing the substrate 10 in a magnetic field, adjusting distribution of transparent magnetic conductive particles 51 within the sealing layer 40 through magnetic field effect, to form a conductive layer 50 formed by stack of transparent magnetic conductive particles 51 on a surface of the first transparent electrode layer 11 formed at a side of the substrate 10 facing the cover plate 20; and

[0067] step S1013, pressing the substrate 10 and the cover plate 20 coated with the sealing frame 30 together in vacuum, to form an organic electroluminescent device as shown in FIG. 1.

[0068] In an embodiment, the sealing material is coated on the substrate using ink jet coating or slot coating.

[0069] In an example, the step S102 comprises:

[0070] curing the sealing frame and the sealing material by UV radiation or heating to assemble the substrate and the cover plate.

[0071] In an example, prior to the step S101, the method further comprises:

[0072] step S100, mixing transparent magnetic conductive particles in the sealing material.

[0073] In the method shown in FIGS. 3 and 7, the sealing material is coated in a single step to form the sealing layer. In other embodiments, the sealing layer is formed by coating the sealing material in two or more steps. In an example, a sealing material which comprises transparent magnetic conductive particles is coated between the cover plate and the substrate, and a sealing material which does not comprises transparent magnetic conductive particles is coated on the sealing material. In another example, a sealing material comprising transparent magnetic conductive particles in a first weight concentration is coated between the cover plate and the substrate, and a sealing material comprising transparent magnetic conductive particles in a second weight concentration larger than the first weight concentration is coated on the sealing material.

[0074] Apparently, the skilled person in the art can make various modifications and variations to the present invention without departing from the spirit and the scope of the present invention. In this way, provided that these modifications and variations of the present invention belong to the scopes of

the claims of the present invention and the equivalent technologies thereof, the present invention also intends to encompass these modifications and variations.

What is claimed is:

1. An organic electroluminescent device, comprising a substrate and a cover plate arranged opposite to each other, a sealing frame located between the substrate and the cover plate for connecting the substrate and the cover plate, a sealing layer filling an area enclosed by the sealing frame and bonded with the substrate and the cover plate, a first transparent electrode layer being provided at a side of the substrate facing the cover plate, wherein the organic electroluminescent device further comprises a conductive layer formed by transparent magnetic conductive particles which are mixed in the sealing layer and stacked on a surface of the first transparent electrode layer.

2. The organic electroluminescent device of claim 1, wherein the first transparent electrode layer comprises indium zinc oxide.

3. The organic electroluminescent device of claim 1, wherein a weight concentration of the transparent magnetic conductive particles in the sealing layer is greater than or equal to 5% and less than or equal to 50%.

4. The organic electroluminescent device of claim 3, wherein a diameter of the transparent magnetic conductive particles in the sealing layer is not greater than 200 nm.

5. The organic electroluminescent device of claim 1, wherein the transparent magnetic conductive particles are metal oxide nanoparticles or non-metal oxide nanoparticles.

6. The organic electroluminescent device of claim 1, wherein a second transparent electrode layer is formed on a surface of the cover plate facing the substrate, the sealing layer is provided with a conductor structure formed by transparent magnetic conductive particles mixed in the sealing layer, and the conductor structure joins the second transparent electrode layer with the first transparent electrode layer.

7. The organic electroluminescent device of claim 2, wherein a second transparent electrode layer is formed on a surface of the cover plate facing the substrate, the sealing layer is provided with a conductor structure formed by transparent magnetic conductive particles mixed in the sealing layer, and the conductor structure joins the second transparent electrode layer with the first transparent electrode layer.

8. The organic electroluminescent device of claim 3, wherein a second transparent electrode layer is formed on a surface of the cover plate facing the substrate, the sealing layer is provided with a conductor structure formed by transparent magnetic conductive particles mixed in the sealing layer, and the conductor structure joins the second transparent electrode layer with the first transparent electrode layer.

9. The organic electroluminescent device of claim 4, wherein a second transparent electrode layer is formed on a surface of the cover plate facing the substrate, the sealing layer is provided with a conductor structure formed by transparent magnetic conductive particles mixed in the sealing layer, and the conductor structure joins the second transparent electrode layer with the first transparent electrode layer.

10. The organic electroluminescent device of claim 5, wherein a second transparent electrode layer is formed on a surface of the cover plate facing the substrate, the sealing

layer is provided with a conductor structure formed by transparent magnetic conductive particles mixed in the sealing layer, and the conductor structure joins the second transparent electrode layer with the first transparent electrode layer.

11. An organic electroluminescent device display panel, comprising an organic electroluminescent device of claim 1.

12. A method for preparing an organic electroluminescent device of claim 1, comprising:

step S101, coating a sealing frame and a sealing material mixed with transparent magnetic conductive particles between a cover plate and a substrate, and adjusting distribution of transparent magnetic conductive particles within the sealing material through magnetic field effect, to form a conductive layer on a surface of a first transparent electrode layer, wherein the first transparent electrode layer is formed at a side of the substrate facing the cover plate, and the conductive layer is formed by transparent magnetic conductive particles stacked on the surface of the first transparent electrode layer;

step S102, curing the sealing frame and the sealing material to assemble the substrate and the cover plate.

13. The method of claim 12, wherein the step S101 comprises:

coating the sealing frame on the cover plate;

coating the sealing material mixed with transparent magnetic conductive particles within an area enclosed by the sealing frame on the cover plate;

pressing the cover plate and the substrate formed with the first transparent electrode layer together in vacuum; and

placing the pressed cover plate and substrate in a magnetic field, adjusting distribution of transparent magnetic conductive particles within the sealing material through magnetic field effect, to form the conductive layer on the surface of a first transparent electrode layer, wherein the first transparent electrode layer is formed at a side of the substrate facing the cover plate, and the conductive layer is formed by transparent magnetic conductive particles stacked on the surface of the first transparent electrode layer.

14. The method of claim 12, wherein the sealing material is coated on the cover plate using gluing process, slot coating or ink jet coating.

15. The method of claim 12, wherein the step S101 comprises:

coating the sealing material mixed with transparent magnetic conductive particles on the first transparent electrode layer on the substrate;

placing the substrate in a magnetic field, adjusting distribution of transparent magnetic conductive particles within the sealing material through magnetic field effect, to form a conductive layer on a surface of a first transparent electrode layer, wherein the first transparent electrode layer is formed at a side of the substrate facing the cover plate, and the conductive layer is formed by transparent magnetic conductive particles stacked on the surface of the first transparent electrode layer; and

pressing the substrate and the cover plate coated with the sealing frame together in vacuum.

16. The method of claim 14, wherein the sealing material is coated on the substrate using ink jet coating or slot coating.

17. The method of claim 12, wherein the step S102 comprises:

curing the sealing frame and the sealing material by UV radiation or heating to assemble the substrate and the cover plate.

18. The method of claim 12, wherein prior to the step S101, the method further comprises: mixing transparent magnetic conductive particles in the sealing material.

19. The method of claim 12, wherein coating the sealing material between the cover plate and the substrate comprises:

coating a sealing material which comprises transparent magnetic conductive particles between the cover plate and the substrate; and

coating on the sealing material a sealing material which does not comprises transparent magnetic conductive particles.

20. The method of claim 12, wherein coating the sealing material between the cover plate and the substrate comprises:

coating a sealing material comprising transparent magnetic conductive particles in a first weight concentration between the cover plate and the substrate; and

coating on the sealing material a sealing material comprising transparent magnetic conductive particles in a second weight concentration larger than the first weight concentration.

* * * * *

专利名称(译)	有机电致发光器件，其制备方法和显示板		
公开(公告)号	US20170110682A1	公开(公告)日	2017-04-20
申请号	US15/214297	申请日	2016-07-19
[标]申请(专利权)人(译)	京东方科技集团股份有限公司		
申请(专利权)人(译)	京东方科技集团股份有限公司.		
当前申请(专利权)人(译)	京东方科技集团股份有限公司.		
[标]发明人	YU DONGHUI WANG CHUN JAN SHIH HUAITING		
发明人	YU, DONGHUI WANG, CHUN JAN SHIH, HUAITING		
IPC分类号	H01L51/52 H01L51/56		
CPC分类号	H01L51/5246 H01L51/56 H01L51/5203		
优先权	201510662267.1 2015-10-14 CN		
其他公开文献	US9761829		
外部链接	Espacenet USPTO		

摘要(译)

公开了一种有机电致发光器件，制备有机电致发光器件的方法和显示面板。有机电致发光器件包括由透明导电颗粒形成的导电层，所述透明导电颗粒混合在密封层中并堆叠在第一透明电极层的表面上。导电层在不增加第一透明电极层的厚度的同时提高了导电性能，从而避免了由第一透明电极层的厚度增加引起的透光率的降低，并且避免了由于导电性差导致的电压降的问题。第一透明电极层的第一透明电极层，以提高有机电致发光器件的显示效果和使用稳定性。

