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(54) **DISPLAY DEVICE AND PACKAGING METHOD THEREFOR**

(57) A display device and a method for encapsulating the same are disclosed. A display device includes: a base substrate (1), an insulation layer (2) disposed on the base substrate (1), an organic light emitting component (3) disposed on the insulation layer (2), and an encapsulation layer (4) configured for sealing the organic light emitting component (3). The insulation layer (2) includes an encapsulation region (A), the insulation layer (2) and the

encapsulation layer (4) are in contact with each other in the encapsulation region (A), and at least one cutting groove (5) is formed in a contact region. Since cutting grooves (5) are provided in a contact region between the insulation layer (2) and the encapsulation layer (4), the encapsulating effect of the encapsulation layer (4) is increased, and the probability of moisture entering the encapsulation layer (4) is reduced effectively.

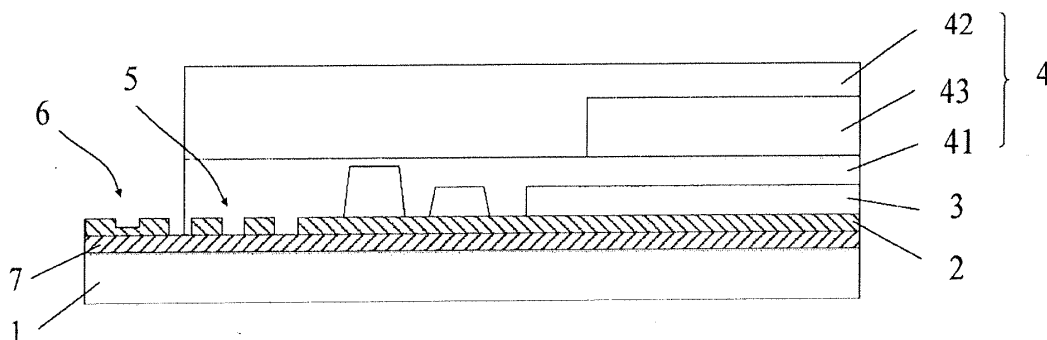


FIG. 3

Description

CROSS-REFERENCE OF RELATED APPLICATION

[0001] The present application claims the priority of Chinese patent application No. 201710624574.X filed on July 27, 2017, the disclosure of which is hereby incorporated by reference herein in its entirety.

TECHNICAL FIELD

[0002] Embodiments of the present disclosure relate to a display device and a method for encapsulating the same.

BACKGROUND

[0003] An organic light emitting component in a display device is less tolerant to the surrounding environment, and in conventional technology, the thin film encapsulating method is used to isolate an organic light emitting component from the external environment with an encapsulation layer.

[0004] While the organic light emitting component is encapsulated, the encapsulation layer is bonded to the organic light emitting component. Since the bonding region between the encapsulation layer and a bulk substrate is unstable, the cutting portion is liable to crack when the bulk substrate is cut, so that the moisture would enter the encapsulation layer, causing the damage to the organic light emitting component, and resulting in encapsulating failures.

SUMMARY

[0005] Embodiments of the present disclosure provide a display device and a method for encapsulating the same. By disposing a cutting groove in a contact region between an insulation layer and an encapsulation layer, the overall encapsulating yield is effectively increased, and the service life of the organic light emitting component is prolonged.

[0006] In the first aspect of the present disclosure, it is provided a display device, which comprises: a base substrate, an insulation layer disposed on the base substrate, an organic light emitting component disposed on the insulation layer, and an encapsulation layer configured for sealing the organic light emitting component, wherein the insulation layer comprises an encapsulation region, the insulation layer and the encapsulation layer are in contact with each other in the encapsulation region, and at least one cutting groove is formed in a contact region.

[0007] In the second aspect of the present disclosure, it is provided a method for encapsulating a display device, comprising: forming an insulation layer and an organic light emitting component sequentially on a base substrate, wherein the organic light emitting component is

disposed on the insulation layer, and the insulation layer comprises an encapsulation region and a cutting region; forming at least one cutting groove in the encapsulation region of the insulation layer; and sealing the organic light emitting component with an encapsulation layer, such that the insulation layer and the encapsulation layer are in contact with each other in the encapsulation region, and the at least one cutting groove is disposed in a contact region.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] In order to clearly illustrate the technical solution of the embodiments of the disclosure, the drawings of the embodiments will be briefly described in the following; it is obvious that the described drawings are only related to some embodiments of the disclosure and thus are not limitative of the disclosure.

Fig. 1 schematically illustrates a cross-section view of a display device according to an embodiment of the present disclosure;

Fig. 2 schematically illustrates a top view of a display device according to an embodiment of the present disclosure;

Fig. 3 schematically illustrates a cross-section view of another display device according to an embodiment of the present disclosure;

Fig. 4 schematically illustrates a cross-section view of still another display device according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

[0009] In order to make objects, technical details and advantages of the embodiments of the disclosure apparent, the technical solutions of the embodiments will be described in a clearly and fully understandable way in connection with the drawings related to the embodiments of the disclosure. Apparently, the described embodiments are just a part but not all of the embodiments of the disclosure. Based on the described embodiments herein, those skilled in the art can obtain other embodiment(s), without any inventive work, which should be within the scope of the disclosure.

[0010] Unless otherwise defined, all the technical and scientific terms used herein have the same meanings as commonly understood by one of ordinary skill in the art to which the present disclosure belongs. The terms "first," "second," etc., which are used in the description and the claims of the present disclosure, are not intended to indicate any sequence, amount or importance, but distinguish various components. The terms "comprises," "comprising," "includes," "including," etc., are intended to specify that the elements or the objects stated before these terms encompass the elements or the objects and equivalents thereof listed after these terms, but do not preclude the other elements or objects. The phrases

"connect", "connected", etc., are not intended to define a physical connection or mechanical connection, but may include an electrical connection, directly or indirectly. "On," "under," "right," "left" and the like are only used to indicate relative position relationship, and when the position of the object which is described is changed, the relative position relationship may be changed accordingly.

[0011] As illustrated in Fig. 1 to Fig. 2, an embodiment of the present disclosure provides a display device, which comprises: a base substrate 1, an insulation layer 2 disposed on the base substrate 1, an organic light emitting component 3 disposed on the insulation layer 2, and an encapsulation layer 4 configured for sealing the organic light emitting component 3. Herein, the insulation layer 2 comprises an encapsulation region A, the insulation layer 2 and the encapsulation layer 4 contact with each other in the encapsulation region A, and at least one cutting groove 5 is formed in a contact region. As illustrated in Fig. 2, the insulation layer 2 comprises an encapsulation region A and a cutting region B. Herein, the encapsulation region A surrounds a periphery of the organic light emitting component 3, the cutting region B surrounds a periphery of the encapsulation region A. The cutting region B and the encapsulation region A are adjacent to each other.

[0012] In the above display device, the insulation layer 2 and the encapsulation layer 4 are provided with cutting grooves 5 in the encapsulation region A, which prolongs the path of the moisture entering the organic light emitting component 3 after entering the encapsulation region A, thus, the encapsulating effect of the encapsulation layer 4 is increased, the probability of moisture entering the encapsulation layer 4 is reduced effectively, the overall encapsulating yield is increased, the service life of the organic light emitting component 3 is increased, and the service life of the above display device is further increased.

[0013] In at least some embodiments, at least one cutting groove 5 is a through groove penetrating through the insulation layer 2 and near the organic light emitting component 3. For example, a depth of the through groove is the same as a thickness of the insulation layer 2. A cross-section shape of the through groove 5 may be any shape, such as a rectangle, a trapezoid or the like. As illustrated in Fig. 2, the through groove 5 surrounds the periphery of the organic light emitting component 3, and a closed loop is formed in the encapsulation region A. In other embodiments, the through groove 5 may surround the organic light emitting component 3 in a discontinuous manner.

[0014] While cutting the bulk substrate, the cracks generated by the cutting can be effectively prevented from extending into the encapsulation region by providing the through grooves, because the extension of the cracks can be terminated by the through grooves, and the external moisture can be effectively prevented from entering the organic light emitting component 3, thus the en-

capsulating effect of the encapsulation layer 4 and the service life of the organic light emitting component 3 are increased. A certain amount of moisture may be accommodated in a cavity of the through groove, which can decrease the rate and quantity of moisture flowing into the organic light emitting component 3, and therefore, it acts as a barrier to the external moisture.

[0015] In at least some embodiments, the encapsulation layer 4 comprises a first inorganic layer 41 and a second inorganic layer 42, and an organic buffer layer 43 is disposed between the first inorganic layer 41 and the second inorganic layer 42.

[0016] Most of the external moisture can be blocked by the first inorganic layer 41 and the second inorganic layer 42, thus the encapsulating effect of the encapsulation layer 4 on the organic light emitting component 3 is increased. Further, the organic buffer layer 43 is disposed between the first inorganic layer 41 and the second inorganic layer 42, in order to ensure that the encapsulation layer 4 is leveled while the external moisture is blocked. A structure with the first inorganic layer 41, the organic buffer layer 43 and the second inorganic layer 42 is used in the encapsulation layer 4, thus the encapsulating effect of the encapsulation layer 4 is effectively increased, the moisture is prevented from entering the organic light emitting component 3, and the service life of the organic light emitting component is increased.

[0017] For example, the first inorganic layer 41 is closer to the organic light emitting component 3 than the second inorganic layer 42, and the first inorganic layer 41 is in contact with the insulation layer 2 in the encapsulation region A.

[0018] For example, a material of the first inorganic layer 41 is the same as that of the insulation layer 2, thus the bonding force between the encapsulation layer 4 and the insulation layer 2 is enhanced, the stability of the encapsulation layer 4 is increased, and the encapsulation layer 4 is effectively prevented from crack while being cut or bent.

[0019] In at least some embodiments, a buffer layer 7 is disposed between the base substrate 1 and the insulation layer 2, as illustrated in Figs. 3 and 4.

[0020] The buffer layer 7 is disposed between the base substrate 1 and the insulation layer 2, so that the bonding between the base substrate 1 and the insulation layer 2 is more stable.

[0021] As illustrated in Figs. 1, 3 and 4, the cutting region comprises at least one first cutting groove (e.g., the through groove 5) whose depth is the same as the thickness of the insulation layer 2, and at least one second cutting groove 6 whose depth is smaller than the thickness of the insulation layer 2.

[0022] In case that at least one first cutting groove 5 is disposed at a boundary between the cutting region B and the encapsulation region A, the encapsulation layer 4 is extended laterally and is terminated in the first cutting groove 5, as illustrated in Figs. 1 and 3.

[0023] In case that at least one second cutting groove

6 is disposed at the boundary between the cutting region B and the encapsulation region A, the encapsulation layer 4 is extended laterally and is terminated in the second cutting groove 6, as illustrated in Fig. 4.

[0024] As illustrated in Fig. 3, an edge of the first inorganic layer 41 is bonded with the buffer layer 7, meanwhile, the material of the first inorganic layer 41 is the same as that of the buffer layer 7, then the bonding stability of the encapsulation layer 4 is increased, and the encapsulating effect on the organic light emitting component 3 is increased.

[0025] As illustrated in Fig. 4, the edge of the first inorganic layer 41 is bonded with the insulation layer 2, meanwhile, the material of the first inorganic layer 41 is the same as that of the insulation layer 2, then the bonding stability of the encapsulation layer 4 is increased, and the encapsulating effect on the organic light emitting component 3 is increased. In the second cutting groove 6, the edge of the first inorganic layer 41 is bonded with an inner wall of the second cutting groove 6, then the bonding stability of the encapsulation layer 4 is further increased, and the encapsulating effect on the organic light emitting component 3 is increased.

[0026] In at least some embodiments, the material of the first inorganic layer 41 is silicon nitride or silicon oxynitride.

[0027] Since both silicon nitride and silicon oxynitride have excellent water repellency, the external moisture, oxygen and corrosive substances are effectively blocked, then the organic light emitting component 3 is protected from corrosion, and the service life of the organic light emitting component is increased.

[0028] In at least some embodiments, a distance from the cutting region B to the organic light emitting component 3 is greater than zero and less than or equal to 80 μm . Or, the distance from the boundary between the cutting region B and the encapsulation region A to the organic light emitting component 3 is greater than zero and less than or equal to 80 μm .

[0029] In the above embodiment, since the cutting groove is disposed in the contact region between the encapsulation layer 4 and the insulation layer 2, the path of the external moisture entering the organic light emitting component 3 is effectively prolonged. When the encapsulation layer 4 is extended into the cutting region B, the crack of the encapsulation layer 4 can be avoided while cutting the insulation layer 2, furthermore, a coverage area of the encapsulation layer 4 is increased, and the distance from the edge of the encapsulation layer 4 to the organic light emitting component 3 is increased. The probability of the crack extending to the encapsulation region is reduced by providing the cutting groove 5, and a certain amount of moisture can be accommodated in the cutting groove 5, thus the difficulty and distance of moisture entering the organic light emitting component 3 is increased, and then the service life of the organic light emitting component 3 is increased.

[0030] As illustrated in Figs. 1 and 2, another embod-

iment of the present disclosure provides a method for encapsulating a display device, which comprises:

forming an insulation layer 2 and an organic light emitting component 3 sequentially on a base substrate 1, the organic light emitting component 3 is disposed on the insulation layer 2, and the insulation layer 2 comprises an encapsulation region A and a cutting region B;

forming at least one cutting groove 5 in the encapsulation region A of the insulation layer 2; and sealing the organic light emitting component 3 with the encapsulation layer 4, such that the insulation layer 2 and the encapsulation layer 4 are in contact with each other in the encapsulation region A, and at least one cutting groove 5 is disposed in a contact region.

[0031] In at least some embodiments, at least one cutting groove comprises at least one first cutting groove, the at least one first cutting groove is a through groove penetrating through the insulation layer and near the organic light emitting component.

[0032] In at least some embodiments, a depth of the through groove is the same as a thickness of the insulation layer.

[0033] In at least some embodiments, the encapsulation layer comprises a first inorganic layer and a second inorganic layer, and an organic buffer layer is disposed between the first inorganic layer and the second inorganic layer.

[0034] In at least some embodiments, the first inorganic layer is closer to the organic light emitting component than the second inorganic layer, and is in contact with the insulation layer in the encapsulation region.

[0035] In at least some embodiments, at least one first cutting groove is disposed at a boundary between the encapsulation region and the cutting region of the insulation layer, the encapsulation layer is extended laterally and is terminated in the first cutting groove.

[0036] In at least some embodiments, at least one cutting groove further comprises at least one second cutting groove, and a depth of the second cutting groove is smaller than a thickness of the insulation layer.

[0037] In at least some embodiments, the at least one second cutting groove is disposed at a boundary between the encapsulation region and the cutting region of the insulation layer, the encapsulation layer is extended laterally and is terminated in the second cutting groove.

[0038] The layers, materials and arrangement manners thereof mentioned in the present embodiment, may be referred to the above embodiments, and details are not elaborated herein.

[0039] The display device mentioned in the above embodiments is, for example, a flexible display device, that is, the base substrate is made of a flexible material. The organic light emitting component comprises, for example, a plurality of organic light emitting units, and each

organic light emitting unit comprises an anode, a cathode, and a light emitting layer disposed between the anode and the cathode.

[0040] In the present embodiment, since the cutting groove is disposed in the contact region between the encapsulation layer 4 and the insulation layer 2, the path of the external moisture entering the organic light emitting component 3 is effectively prolonged. When the encapsulation layer 4 is extended into the cutting region B, the crack of the encapsulation layer 4 can be avoided while cutting the insulation layer 2, furthermore, a coverage area of the encapsulation layer 4 is increased, and the distance from the edge of the encapsulation layer 4 to the organic light emitting component 3 is increased. The probability of the crack extending to the encapsulation region is reduced by providing the cutting groove 5, and a certain amount of moisture can be accommodated in the cutting groove 5, thereby the difficulty and distance of moisture entering the organic light emitting component 3 is increased, and then the service life of the organic light emitting component 3 is increased.

[0041] In the present disclosure, the following points should be noted:

(1) The accompanying drawings involve only the structure(s) in connection with the embodiment(s) of the present disclosure, and other structure(s) can be referred to common design(s).

(2) For the purpose of clarity only, in accompanying drawings for illustrating the embodiment(s) of the present disclosure, the thickness of a layer or area may be enlarged or narrowed, that is, the drawings are not drawn in a real scale.

(3) In case of no conflict, features in one embodiment or in different embodiments can be combined as a new embodiment.

[0042] What is described above is related to the illustrative embodiments of the disclosure only and not limitative to the scope of the disclosure; the scopes of the disclosure are defined by the accompanying claims.

Claims

1. A display device, comprising: a base substrate, an insulation layer disposed on the base substrate, an organic light emitting component disposed on the insulation layer, and an encapsulation layer configured for sealing the organic light emitting component, wherein the insulation layer comprises an encapsulation region, the insulation layer and the encapsulation layer are in contact with each other in the encapsulation region, and at least one cutting groove is formed in a contact region.
2. The display device according to claim 1, wherein the at least one cutting groove comprises at least one

first cutting groove, and the at least one first cutting groove is a through groove penetrating through the insulation layer and near the organic light emitting component.

3. The display device according to claim 2, wherein a depth of the through groove is same as a thickness of the insulation layer.
4. The display device according to any one of claims 1-3, wherein the encapsulation layer comprises a first inorganic layer and a second inorganic layer, and an organic buffer layer is disposed between the first inorganic layer and the second inorganic layer.
5. The display device according to claim 4, wherein the first inorganic layer is closer to the organic light emitting component than the second inorganic layer, and the first inorganic layer is in contact with the insulation layer in the encapsulation region.
6. The display device according to claim 2 or 3, wherein at least one first cutting groove is disposed at a boundary between the encapsulation region and a cutting region of the insulation layer, the encapsulation layer is extended laterally and is terminated in the at least one first cutting groove.
7. The display device according to claim 2 or 3, wherein the at least one cutting groove further comprises at least one second cutting groove, and a depth of the at least one second cutting groove is smaller than a thickness of the insulation layer.
8. The display device according to claim 7, wherein the at least one second cutting groove is disposed at a boundary between the encapsulation region and a cutting region of the insulation layer, the encapsulation layer is extended laterally and is terminated in the at least one second cutting groove.
9. The display device according to any one of claims 1-8, wherein a buffer layer is disposed between the base substrate and the insulation layer.
10. The display device according to any one of claims 1-9, wherein the insulation layer further comprises a cutting region, wherein the encapsulation region surrounds a periphery of the organic light emitting component, the cutting region surrounds a periphery of the encapsulation region, and the cutting region and the encapsulation layer are adjacent to each other.
11. The display device according to claim 4 or 5, wherein a material of the first inorganic layer is silicon nitride or silicon oxynitride.
12. The display device according to any one of claims

- 1-11, wherein a distance from the at least one cutting groove to the organic light emitting component is greater than zero and less than or equal to 80 μm .
- 13.** A method for encapsulating a display device, comprising:
- forming an insulation layer and an organic light emitting component sequentially on a base substrate, wherein the organic light emitting component is disposed on the insulation layer, and the insulation layer comprises an encapsulation region and a cutting region;
 - forming at least one cutting groove in the encapsulation region of the insulation layer; and
 - sealing the organic light emitting component with an encapsulation layer, such that the insulation layer and the encapsulation layer are in contact with each other in the encapsulation region, and the at least one cutting groove is disposed in a contact region.
- 14.** The method according to claim 13, wherein the at least one cutting groove comprises at least one first cutting groove, the at least one first cutting groove is a through groove penetrating through the insulation layer and near the organic light emitting component.
- 15.** The method according to claim 14, wherein a depth of the through groove is same as a thickness of the insulation layer.
- 16.** The method according to any one of claims 13-15, wherein the encapsulation layer comprises a first inorganic layer and a second inorganic layer, and an organic buffer layer is disposed between the first inorganic layer and the second inorganic layer.
- 17.** The method according to claim 16, wherein the first inorganic layer is closer to the organic light emitting component than the second inorganic layer, and the first inorganic layer is in contact with the insulation layer in the encapsulation region.
- 18.** The method according to claim 14 or 15, wherein the at least one first cutting groove is disposed at a boundary between the encapsulation region and the cutting region of the insulation layer, the encapsulation layer is extended laterally and is terminated in the at least one first cutting groove.
- 19.** The method according to claim 14 or 15, wherein the at least one cutting groove further comprises at least one second cutting groove, and a depth of the at least one second cutting groove is smaller than a thickness of the insulation layer.
- 20.** The method according to claim 19, wherein the at least one second cutting groove is disposed at a boundary between the encapsulation region and the cutting region of the insulation layer, the encapsulation layer is extended laterally and is terminated in the at least one second cutting groove.

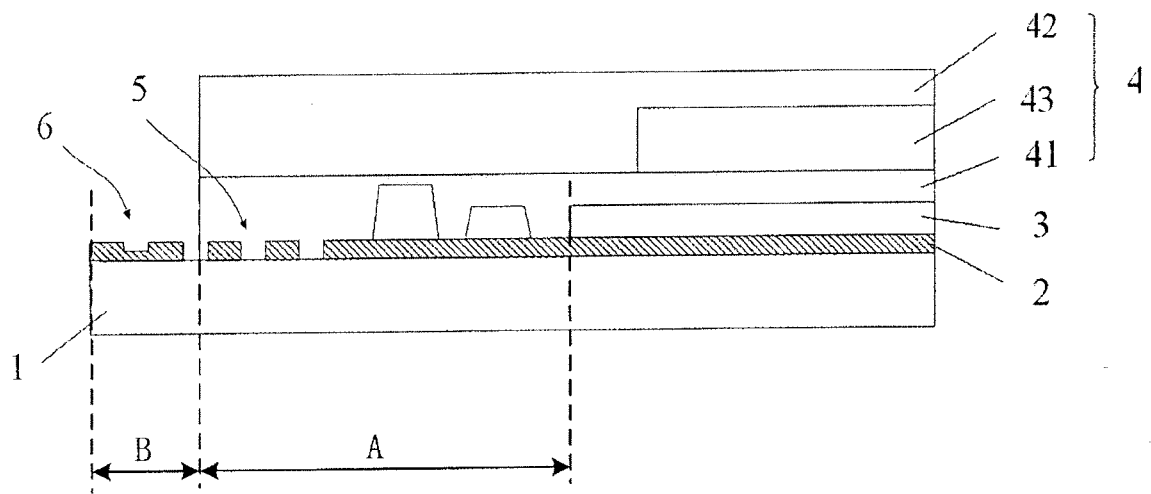


FIG. 1

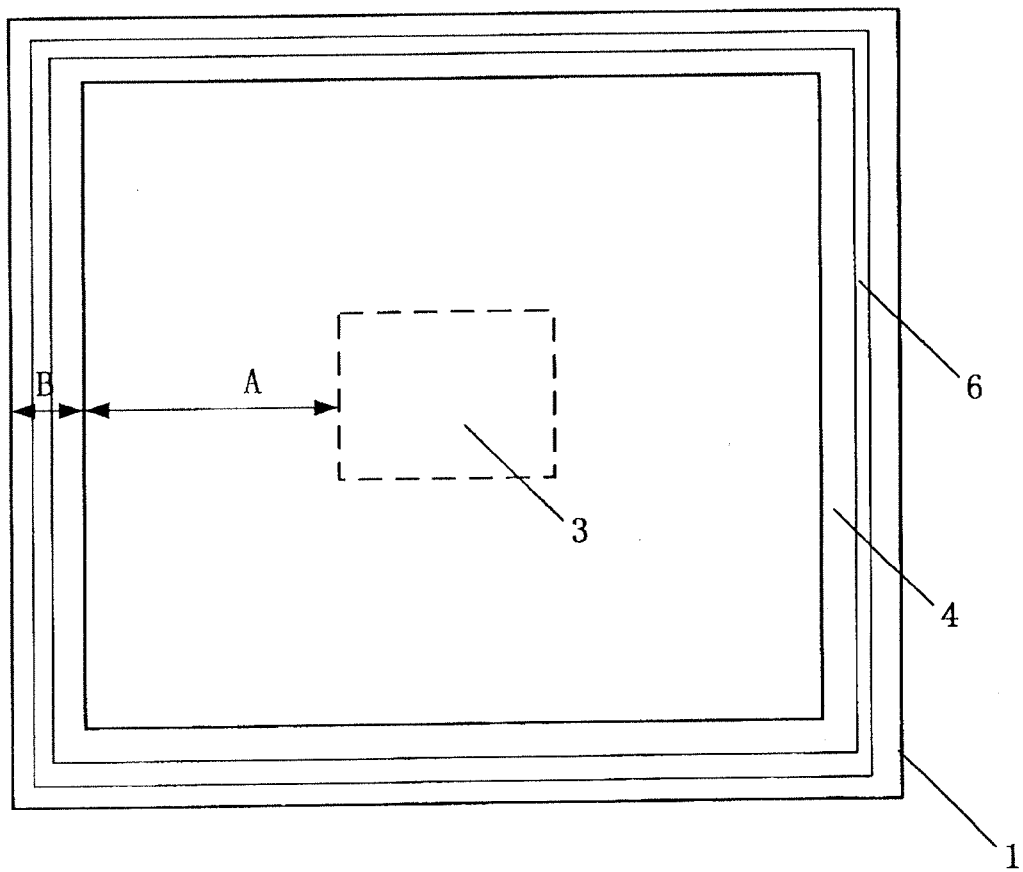


FIG. 2

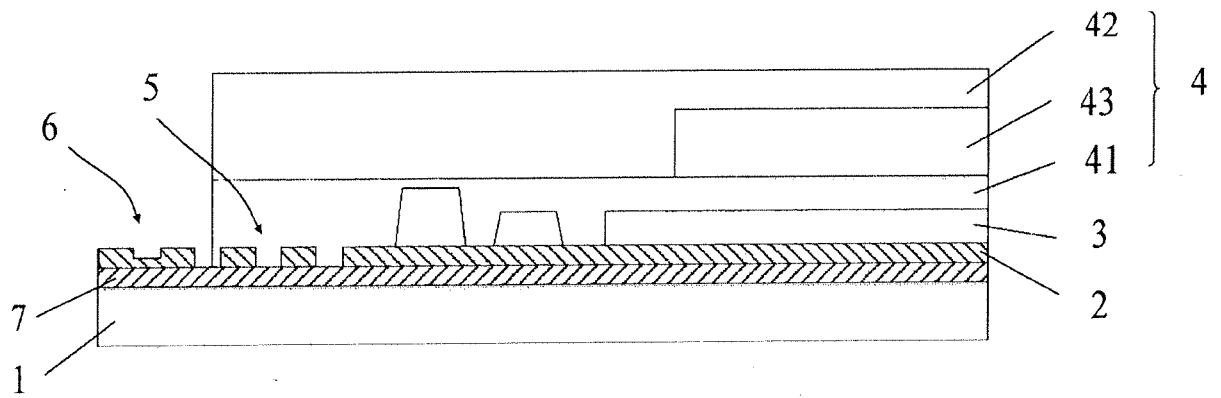


FIG. 3

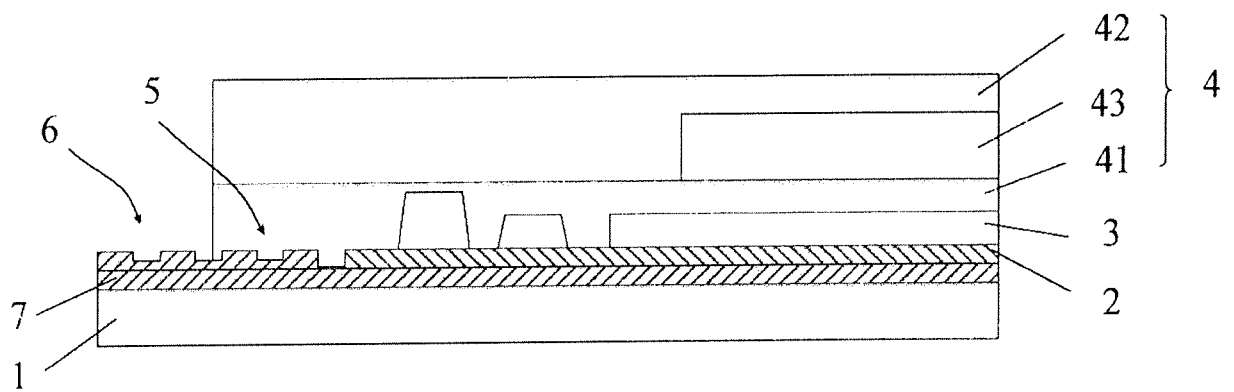


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2018/075240

A. CLASSIFICATION OF SUBJECT MATTER

H01L 51/52 (2006.01) i; H01L 27/32 (2006.01) i; H01L 51/56 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01L 51; H01L 27; H05B 33

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS, CNTXT, CNKI, SIPOABS, DWPI: 有机, 显示, 电致发光, 场致发光, 沟槽, 凹, 槽, 封装, 密封, OLED, organic, display, electroluminescence, groove, recess, trench, encapsulate, seal, package

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 203883009 U (BOE TECHNOLOGY GROUP CO., LTD.) 15 October 2014 (15.10.2014), description, paragraphs [0030]-[0037], and figures 2-6	1-20
PX	CN 107359275 A (BOE TECHNOLOGY GROUP CO., LTD.) 17 November 2017 (17.11.2017), description, paragraphs [0024]-[0045], and figures 1 and 2	1-20
A	CN 105810710 A (KUNSHAN GOVISIONOX OPTOELECTRONICS CO., LTD.) 27 July 2016 (27.07.2016), entire document	1-20
A	CN 1710999 A (SAMSUNG SDI CO., LTD.) 21 December 2005 (21.12.2005), entire document	1-20

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	"&" document member of the same patent family

Date of the actual completion of the international search

26 April 2018

Date of mailing of the international search report

09 May 2018

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INTERNATIONAL SEARCH REPORT
 Information on patent family members

 International application No.
 PCT/CN2018/075240

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 203883009 U	15 October 2014	WO 2015180366 A1	03 December 2015
CN 107359275 A	17 November 2017	None	
CN 105810710 A	27 July 2016	None	
CN 1710999 A	21 December 2005	JP 2006004909 A	05 January 2006
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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 201710624574 X [0001]

专利名称(译)	显示装置及其封装方法		
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IPC分类号	H01L51/52 H01L27/32 H01L51/56		
CPC分类号	H01L27/32 H01L51/5237 H01L51/524 H01L51/5246 H01L51/5253 H01L27/3244 H01L27/3258		
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外部链接	Espacenet		

摘要(译)

公开了一种显示装置及其封装方法。显示装置包括：基底基板（1），设置在基底基板（1）上的绝缘层（2），设置在绝缘层（2）上的有机发光组件（3）和封装层（4）用于密封有机发光组件（3）。绝缘层（2）包括封装区域（A），绝缘层（2）和封装层（4）在封装区域（A）中彼此接触，并且至少一个切割槽（5）。在接触区域中形成。由于在绝缘层（2）和封装层（4）之间的接触区域中设置了切割槽（5），因此提高了封装层（4）的封装效果，并且水分进入封装层（4）有效减少。

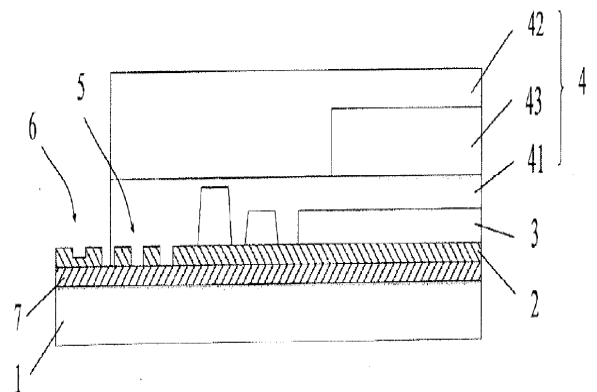


FIG. 3