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(54) ORGANIC ELECTROLUMINESCENT DISPLAY PANEL AND MANUFACTURING METHOD THEREFOR, AND DISPLAY DEVICE

ORGANISCHE ELEKTROLUMINESZENZANZEIGETAFEL, DEREN HERSTELLUNGSVERFAHREN UND ANZEIGEVORRICHTUNG

ÉCRAN D'AFFICHAGE ÉLECTROLUMINESCENT ORGANIQUE, SON PROCÉDÉ DE FABRICATION ET DISPOSITIF D'AFFICHAGE

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(56) References cited:
CN-A- 1 622 706
CN-A- 101 399 283
CN-A- 103 413 819
CN-A- 103 839 964
CN-U- 203 205 422
JP-A- 2008 243 406
JP-A- 2009 176 590
US-A1- 2005 057 151
US-A1- 2010 062 147

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Description

TECHNICAL FIELD

[0001] At least one embodiment of the present invention relates to an organic electroluminescent display panel, its manufacturing method and a display device.

BACKGROUND

[0002] Currently, organic electroluminescent display (OLED) panels are becoming dominant in the display field due to characteristics such as low power consumption, high color saturation, wide angle of view, slim thickness, no requirement for light source, flexible, and so on.

[0003] The basic structure of an OLED includes a base substrate, and an anode, a light emitting layer and a cathode subsequently provided on the base substrate. Its principle for emitting light is that, when a voltage is applied across the anode and the cathode to provide a current, electrons from the cathode are recombined with holes from the anode at the light emitting layer to form excitons, so that the organic material in the light emitting layer is excited to emit light. The light emitting layer can be made by an inkjet printing technology, and generally, before preparing the light emitting layer, a pixel definition layer can be made on the base substrate on which the anode has been formed, to define the position for the pixel area, after that, the light emitting layer is formed in an opening region corresponding to the pixel area in the pixel definition layer, and finally, a film layer for the cathode is made on the light emitting layer. US2005057151A1 discloses: conventionally, there are problems that high resolution is difficult to be achieved since an extreme narrow width bank can not be formed and an aperture ratio as a light-emitting device is low. In addition, there is a threat of electrostatic discharge damage or adhesion of dust during the transportation of a substrate provided with an anode into the equipment for depositing EL material. In view of the foregoing, a first bank formed of an inorganic insulating film is formed, and an insulating film is formed thereon, then, a second bank in contact with a side face of the first bank by carrying out etch back, and then, a side wall bank is formed. For preventing electrostatic discharge damage, an antistatic layer is formed, and the substrate is transported, then, the antistatic layer is removed to form the second bank. US2010062147A1 discloses: a film-formation method is a method for depositing a liquid containing a film material to form a film in a prescribed film formation area enclosed by a partition wall on a substrate. The film-formation method includes forming the partition wall using at least in part a wettability-variable material in which wettability with respect to the liquid is variable, depositing the liquid in the film formation area, varying the wettability of the wettability-variable material in the partition wall in a state in which the liquid is disposed within the film formation area so that liquid affinity of the wettability-variable material becomes higher than liquid affinity of the wettability-variable material before the liquid is deposited in the film formation area, and forming the film by solidifying the film material in the liquid. JP002009176590A discloses: to provide an organic EL device, a method of manufacturing an organic EL device, and electronic equipment in which ink does not hardly overflow and a position of the ink is stabilized after being applied. ;SOLUTION: In the organic EL device, a circuit element layer is formed on a glass substrate, and a pixel electrode is formed on the circuit element layer. An insulated layer is formed on the pixel electrode at a range excluding light-emitting zones. A bank for storing a functional layer material is formed around a range where the light-emitting zones are gathered. An opening surrounded by the banks has a long side and a short side. A first lyophilic membrane is formed on a sidewall at a long-side side. A second lyophilic membrane with a lyophilic property lower than that of the first lyophilic membrane is formed on a sidewall at a short-side side. Thus, when liquid as a functional layer material is discharged to the opening, the liquid existing at the short-side 44 side can be moved to the long-side side.

SUMMARY

[0004] At least one embodiment of the present invention provides an organic electroluminescent display panel, its manufacturing method and a display device, by which the film layer formed after the pixel definition layer has good uniformity, and thus the light emitting performance of the OLED is improved.

[0005] At least one embodiment of the present invention provides an organic electroluminescent display panel comprising a base substrate and a pixel definition layer located on the base substrate; the pixel definition layer has opening regions corresponding to pixel areas of the organic electroluminescent display panel, and each of the opening regions has an opening larger than a bottom surface of the opening region; the pixel definition layer has a upper surface formed from a hydrophobic material, and an inclination surface of the pixel definition layer corresponding to each of the opening regions is formed from a hydrophilic material, wherein each of the opening regions has a cross section perpendicular to the base substrate with a width firstly increased and then decreased in a continuous manner from the opening to the bottom surface.

[0006] At least one embodiment of the present invention further provides a manufacturing method for the organic electroluminescent display panel provided by the above embodiment of the present invention, the manufacturing method includes forming a pixel definition layer on a base substrate so that the pixel definition layer has opening regions corresponding to pixel areas in the organic electroluminescent display panel, wherein each of the opening regions has an opening larger than a bottom surface of the opening region, the pixel definition layer has an upper surface formed from a hydrophobic mate-

rial, and an inclination surface of the pixel definition layer corresponding to each of the opening regions is formed from a hydrophilic material, wherein each of the opening regions has a cross section perpendicular to the base substrate with a width firstly increased and then decreased in a continuous manner from the opening to the bottom surface.

[0007] At least one embodiment of the present invention further provides a display device including the organic electroluminescent display panel provided by the embodiments of the present invention.

DESCRIPTION OF THE DRAWINGS

[0008] In order to clearly illustrate the technical solution of the embodiments of the invention, 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 invention and thus are not limitative of the invention.

FIG. 1a and FIG. 1b are schematic structure views showing the organic electroluminescent display panel having a pixel definition layer, respectively;

FIG. 2a is a top view showing the organic electroluminescent display panel provided by an embodiment of the present invention;

FIG. 2b is a schematic cross-sectional view of FIG. 2a taken along a direction A-A';

FIG. 3 is a flowchart view showing a manufacturing method for the organic electroluminescent display panel, provided by an embodiment of the present invention;

FIG. 4 is a flowchart view showing a manufacturing method for the organic electroluminescent display panel, provided by a first embodiment of the present invention;

FIG. 5 is a flowchart view showing a manufacturing method for the organic electroluminescent display panel, provided by a second example, not forming part of the present invention;

FIG. 6a to FIG. 6d are schematic views showing the structure of the organic electroluminescent display panel after each of steps of its manufacturing method according to the first embodiment of the present invention is performed, respectively; and

FIG. 7a to FIG. 7b are schematic views showing the structure of the organic electroluminescent display panel after each of steps of its manufacturing method according to the second example, not forming part of the present invention, is performed, respectively.

DETAILED DESCRIPTION

[0009] In order to prepare objects, technical details and advantages of the embodiments of the invention 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 invention. Apparently, the described embodiments are just a part but not all of the embodiments of the invention. 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 invention as defined in the appended claims.

[0010] Currently, the pixel definition layer in an OLED has mainly two kinds of structures. One structure involves a pixel definition layer having a regular trapezoidal cross-section with an upper bottom side being smaller than a lower bottom side, as shown in FIG. 1a (only partly shown in FIG. 1a). Generally, after the pixel definition layer 10 has a regular trapezoidal cross-section is made, in order to avoid color blending between adjacent pixel areas, it is necessary to subject the surface of the pixel definition layer to hydrophobic treatment to have hydrophobic property. In this way, although the color blending problem can be avoided, the inventors of the present application have noted that, there may be unevenly spreading problem when preparing the light emitting layer 20 in the opening regions of the pixel definition layer subsequently, resulting in minute gaps in the light emitting layer 20, thus short circuit at the minute gaps would be easily incurred between the subsequently formed cathode 40 and the anode 50 located below the light emitting layer. Another structure involves a pixel definition layer having an inverted trapezoidal cross-section with an upper bottom side being larger than a lower bottom side, as shown in FIG. 1b (only partly shown in FIG. 1b). Although the pixel definition layer 60 in an inverted trapezoidal shape can avoid short circuit between the cathode 70 and the anode 80, the inventors of the present application have noted that the pixel definition layer 60 in an inverted trapezoidal shape causes the subsequently formed cathode 70 to be broken easily.

[0011] Therefore, the above structures of the pixel definition layer will influence the uniformity of the film layer formed subsequently, and thus influence the light emitting performance of the OLED.

[0012] Hereinafter, the specific embodiments of the organic electroluminescent display panel, its manufacturing method and the display device provided by the examples of the present invention will be described in detail, in connection with the attached drawings.

[0013] The thickness and shape of the film layers in the attached drawings are not intended to reflect the real scale of the organic electroluminescent display panel, and are used to schematically illustrate the content of the embodiments of the present invention.

[0014] At least one embodiment of the present invention provides an organic electroluminescent display panel, as shown in FIG. 2a and FIG. 2b, the organic electroluminescent dispaly panel includes a base substrate 100 and a pixel definition layer 200 located on the base substrate 100. The pixel definition layer 200 includes opening regions 300 corresponding to pixel areas of the orgainc electroluminescent display panel, and the opening of

each of the opening regions 300 is larger than the bottom surface of the opening region. For example, for each of the opening regions 300, the opening in its cross-section perpendicular to the base substrate is larger than its bottom side, and the width of the cross-section is firstly increased and then decreased from the opening to the bottom side, can be considered as an inverted trapozoidal structure, that is, the cross-section of the pixel definition layer 200 perpendicular to the base substrate 100 has an upper bottom side smaller than a lower bottom side, and the width of the cross-section is firstly decreased and then increased from the upper bottom side to the lower bottom side, and can be considered as a regular trapozoidal structure. Alternatively, for example, the opening of the opening region 300 in the cross-section perpendicular to the base substrate is larger than its bottom side, and the cross-section is gradually decreased from the opening to the bottom side, is in an inverted trapazoidal structure, that is, the cross-section of the pixel definition layer 200 perpendicular to the base substrate 100 has an upper bottom side smaller than a lower bottom side, and the width of the cross-section is gradually increased from the upper bottom side to the lower bottom side, and is in a regualr trapozoidal structure. An upper surface a of the pixel definition layer 200 is formed from a hydrophobic material, and an inclination surface b of the pixel definition layer 200 corresponding to the opening region 300 is formed from a hydrophilic material.

[0015] In the above organic electroluminescent display panel provided by an embodiment of the present invention, the pixel definnition layer provided therein has opening regions corresponding to pixel areas of the organic electroluminescent display panel, and for each of the opening region, the opening is larger than the bottom surface thereof, thus, the breakage problem occurred in the subsequently formed pattern of the cathode can be avoided. By using the hydrophobic material in the upper surface of the pixel definition layer, the subsequently coated light emitting material will not easily residued on the upper surface of the pixel definition layer, and therefore, the color blending problem between the adjacent pixel areas can be avoided. Meantime, by using a hydrophilic material in the inclination surface of the pixel definition layer corresponding to the opening regions, it can be guaranteed that the subsequently coated light emitting material can be uniformly filled into the opening regions, minute gaps occurred due to unevenly spreading of the light emitting material can be avoided, and thus the short circuit problem between the anode and the cathode can be avoided, and therefore the above organic electroluminescent display panel provided by the embodiment of the present invention can guarantee the uniformity of the film layers formed after the pixel definition layer, and the light emitting performance of the organic electroluminescent display panel can be improved.

[0016] In practice, in the organic electroluminescent display panel provided by an embodiment of the present invention, in order enable the pixel definition layer 200 to have the upper surface "a" that is formed from a hydrophobic material and the inclination surface "b" corresponding to the opening regions formed from a hydrophilic material, as shown in FIG. 2b, in one embodiment, the structure of the pixel definition layer 200 may include a first pixel definition layer structure 210 formed by the hydrophobic material, and a second pixel definition layer structure 220 formed by the hydrophilic material, and a side surface of the second pixel definition layer structure is adhered to a side surface of the first pixel definition layer structure. Thus, the pixel definition layer 200 formed by the first pixel definition layer structure 210 and the second pixel definition layer structure 220 can have the hydrophobic characteristic on the upper surface "a," by which the subsequently coated light emitting material cannot be easily left on the upper surface "a," and the color blending problem between the adjacent pixel areas can be avoided. Meantime, the inclination surface "b" of the pixel definition layer 200 has a hydrophilic characteristic, by which it is guaranteed that the subsequently coated light emitting material can be evenly filled in the opening regions 300, and the minute gaps occurred due to unevenly spreading of the light emitting material cannot be caused.

[0017] In practice, in at least one example of the above organic electroluminescent display panel provided by the embodiment of the present invention, the first pixel definition layer structure 210 may adopt an inverted trapezoidal structure in cross-section perpendicular to the base substrate 100; in at least one example, the second pixel definition layer structure 220 may adopt a triangular structure in cross-section perpendicular to the base substrate 100. When preparing the pixel definition layer 200, in at least one embodiment, the material for the first pixel definition layer structure 210 may employ a hydrophobic material with negative photoresist characteristics, so as to prepare the first pixel definition layer structure 210 having the cross-section in an inverted trapezoidal structure. Because the material with negative photoresist characteristics will form a material insoluble in developing liquid after exposure while the unexposed material will be soluble in the developing liquid, a pattern of the first pixel definition layer structure can be formed. Also because as the thickness of the negative photoresist is increased, the closer the photoresist material approaches the base substrate, the less the light intensity received by the photoresist material. In at least one embodiment, the material for the second pixel definition structure 220 can employ a hydrophilic material with positive photoresist characteristics, to prepare the second pixel definition layer structure 220 having the cross-section in a triangular structure. The positive photoresist material is insoluble in the developing liquid by itself, after being irradiated, forms a material soluble in the developing liquid, and thus the structure having the cross-section in a triangular structure can be easily formed.

[0018] In practice, in the above organic electroluminescent display panel provided by the embodiment of the

present invention, in order to prevent the second pixel definition layer structure made from the hydrophilic material from influencing the hydrophobic characteristics of the upper surface of the pixel definition layer, in at least one example, the height of the second pixel definition layer structure in the cross-section perpendicular to the base substrate is set to be lower than the height of the first pixel definition layer structure in the cross-section perpendicular to the base substrate. In at least one example, the height of the first pixel definition layer structure in the cross-section perpendicular to the base substrate can be controlled to be from 0.1 μm to 100 μm, for example, the height of the first pixel definition layer structure in its cross-section perpendicular to the base substrate is controlled to be from 0.5 μm to 5 μm, if the height of the second pixel definition layer structure in the cross-section perpendicualr to the base substrate is lower than the height of the first pixel definition layer structure in the cross-section perpendicular to the base substrate, the cross-section of the pixel definition layer perpendicular to the base substrate is in a structure like a regular trapezoidnal. If the height of the second pixel definition layer structure in the cross-section perpendicualr to the base substrate is equal to the height of the first pixel definition layer structure in the cross-section perpendicular to the base substrate, the cross-section of the pixel definition layer perpendicular to the base substrate is in a regular trapezoidnal structure. Accordingly, if the cross-section of the pixel definition layer perpendicular to the base substrate is in a structure like a regular trapezoidnal, the opening regions have a structure like an inverted trapezoidnal in the cross-section perpendicular to the base substrate; and if the cross-section of the pixel definition layer perpendicular to the base substrate is in a regular trapezoidnal structure, the opening regions have an inverted trapezoidnal structure in the cross-section perpendicular to the base substrate.

[0019] In practice, the organic electroluminescent display panel provided by the embodiment of the present invention will usually include film layer structures, such as a light emitting layer, a cathode, an anode, and so on, and other structures such as thin film transistors, gate lines, data lines, or the like will generally also be formed on the base substrate, and these structures can be embodied by many methods, and will not be limited.

[0020] Base on the same invention concept, at least one embodiment of the present invention further provides a manufacturing method for the above organic electroluminescent display panel provided by any embodiment of the present invention, the manufacturing method includes forming a pixel definition layer on a base substrate so that the pixel definition layer has opening regions corresponding to pixel areas in the organic electroluminescent display panel, each of the opening regions has an opening larger than the bottom surface of the opening region, the upper surface of the pixel definition layer is formed from a hydrophobic material, and the inclination surface of the pixel definition layer corresponding to the opening region is formed from a hydrophilic material. Because the principle of the present method for solving the problem in the known technology is similar to that in the organic electroluminescent display panel as described above, the implementation of the method can refer to the implementation of the above organic electroluminescent display panel, and repetitions will be omitted here.

[0021] In practice, as shown in FIG. 3, the manufacturing method for the organic electroluminescent display panel provided by the embodiment of the present invention, for example, may include the steps of:

S101, forming a pattern of the first pixel definition layer structure on the base substrate; and

S102, forming a pattern of the second pixel definition layer structure on the base substrate on which the first pixel definition layer structure has been formed.

[0022] In practice, in the manufacturing method for the above organic electroluminescent display panel provided by the embodiment of the present invention, the step S101 of forming a pattern of the first pixel definition layer structure on the base substrate, for example, may be achieved by firstly depositing a layer of a hydrophobic material with negative photoresist characteristics on the base substrate, and then subjecting the hydrophobic material with the negative photoresist characteristics to a patterning process by using a first mask plate to form the pattern of the first pixel definition layer structure.

[0023] In practice, because the first pixel definition structure is formed from the a hydrophobic material with negative photoresist characteristics, the first pixel definition layer structure can have its cross-section perpendicular to the base substrate to be of an inverted trapezoidal structure.

[0024] In practice, in the manufacturing method for the above organic electroluminescent display panel provided by the embodiment of the present invention, the step S102 of forming the pattern of the second pixel definition layer structure on the base substrate on which the first pixel definition layer structure has been formed, for example, can be achieved by firstly depositing a layer of a hydrophilic material with positive photoresist characteristics on the base substrate on which the first pixel definition layer structure has been formed, and then subjecting the hydrophilic material with positive photoresist characteristics to a patterning process by using the pattern of the first pixel definition layer structure as a mask plate, to form the pattern of the second pixel definition layer structure.

[0025] In practice, because the material of the second pixel definition layer structure employs the hydrophilic material with positive photoresist characteristics, the second pixel definition layer structure can have its cross-section perpendicular to the base substrate to be a triangular structure.

[0026] In practice, only one mask plate can be used during the manufacturing process of the first pixel defi-

nition layer structure and the second pixel definition layer structure (that is, the same mask plate is used when preparing the first pixel definition layer structure and the second pixel definition layer structure), and thus the number of the mask plate will not be increased compared with the manufacturing process for a pixel definition layer in single layer structure. Furthermore, because the materials respectively for forming the second pixel definition layer structure and the first pixel definition layer structure have opposite photosensitive characteristics, the pattern of the first pixel definition layer structure which is formerly formed can also be used as a mask plate during the manufacturing process of the second pixel definition layer structure, whereby the error occurred in alignment of the mask plate with the base substrate can be avoided, which otherwise would influence the accuracy for forming the patterns.

[0027] Hereinafter, with reference to two specific embodiments, the manufacturing method for the organic electroluminescent display panel provided by the embodiment of the presnet invention will be described in detail.

First Example, according to the present invention

[0028] As shown in FIG. 4, the steps for manufacturing the organic electroluminescent display panel will be described as follows, as illustrated by step S201 to step S204:

S201, coating a layer of a hydrophobic material with negative photoresist characteristics on the base substrate 100, as shown in FIG. 6a;

S202, patterning the hydrophobic material with negative photoresist characteristics by means of exposure, development, and etching by using a first mask plate, to form the pattern of the first pixel definition layer structure 210. In this process, because the hydrophobic material has negative photoresist characteristics, it is insoluble in a development liquid after being exposed, while the unexposed material is soluble in the development liquid, thus the pattern of the first pixel definition layer structure can be formed. Also because as the thickness of the negative photoresist is increased, the closer the photoresist material approaches the base substrate, the less the light intensity the photoresist material can receive, the thus-formed pattern of the first pixel definition layer structure 210 can have its cross-section perpendicular to the base substrate to be an inverted trapezoidal structure, as shown in FIG. 6b.

S203, coating a layer of a hydrophilic material with positive photoresist characteristics on the base substrate 100, on which the first pixel definition layer structure 210 has been formed, by a thickness less than the height of the first pixel definition layer structure 210, that is, the hydrophilic material with positive photoresist characteristics is only coated in the opening regions of the pixel definition layer, as shown in FIG. 6c.

S204, because the cross-section of the first pixel definition layer perpendicular to the base substrate is in an inverted trapezoidal structure with its opening larger than its bottom side, by using the pattern of the first pixel definition layer structure 210 as a mask plate, patterning the hydrophilic material with positive photoresist characteristics by means of exposure, development and etching, to form the pattern of the second pixel definition layer structure 220. Since the second pixel definition layer structure 220 is formed from the hydrophilic material with positive photoresist characteristics, at this time, the second pixel definition layer structure 220 has its cross-section perpendicular to the base substrate to be a triangular structure, as shown in FIG. 6d.

[0029] Up to now, by the above steps S201 to S204 provided in the first embodiment, the pixel definition layer of the above organic electroluminescent display panel provided by the embodiment of the present invention can be made.

Second Example, not forming part of the present invention

[0030] As shown in FIG. 5, the steps for manufacturing the pixel definition layer of the organic electroluminescent display panel will be described in detail below, as illustrated by steps S301 to S304.

[0031] The steps S301 and S302 are totally identical with the steps S201 and S202 in the first embodiment, thus will not be further described here.

[0032] S303, coating a layer of a hydrophilic material with positive photoresist characteristics on the base substrate 100 on which the first pixel definition layer structure 210 has been formed. In this process, the hydrophilic material fully covers the first pixel definition layer structure 210, that is, the upper surface of the first pixel definition layer structure 210 is also covered by the hydrophilic material, as shown in FIG. 7a.

[0033] S304, patterning the hydrophilic material with positive photoresist characteristics by means of exposure, development, and etching, to form the pattern of the second pixel definition layer structure 220. Upon etching, the hydrophilic material covering the upper surface of the first pixel definition layer structure 210 is etched off to expose the upper surface of the first pixel definition layer structure, and a portion of the hydrophilic material between the first pixel definition layer structures 210 is also etched off, as shown in FIG. 7b.

[0034] Up to now, by the above steps S301 to S304 provided in the second example, the pixel definition layer of the above organic electroluminescent display panel can be made.

[0035] In practice, the manufacturing method for the organic electroluminescent display panel provided by the embodiments of the present invention may further in-

clude forming film layer structures, such as a light emitting layer, a cathode, an anode, and so on, on the base substrate, and other structures such as thin film transistors, gate lines, data lines, or the like can also be formed on the base substrate, and these specific structures can be embodied in many ways, and will not be limited here.

[0036] Based on the same invention concept, at least one embodiment of the present invention further provides a display device including any one of the above organic electroluminescent display panels as provided by the embodiments of the present invention. The display device can be a mobile phone, a tablet computer, a television, a display, a laptop computer, a digital photo frame, a navigator, and any other product or component having display function. Other component essential to the display device can be conceived by the person skilled in the art, will not be further described and also will not be regarded as limitation on the present invention. The implementation of the display device can be made with reference to the embodiments of the above organic electroluminescent display panel, and the repetition will be omitted here.

[0037] With the organic electroluminescent display panel, its manufacturing method and the display device provided by the embodiments of the present invention, the pixel definition layer provided in the organic electroluminescent display panel has opening regions corresponding to the pixel areas of the organic electroluminescent display panel, and each of the opening regions has an opening larger than a bottom surface of the opening region, that is, the cross-section of the pixel definition layer perpendicular to the base substrate is of a regular trapezoidal structure or a structure like a regular trapezoidal, thus the breakage problem occurred in the subsequently formed pattern of the cathode can be avoided. By forming the upper surface of the pixel definition layer from a hydrophobic material, the subsequently coated light emitting material is not easily left on the upper surface of the pixel definition layer, and thus the color blending problem between the adjacent pixel areas can be avoided. At the same time, the inclination surface of the pixel definition layer corresponding to the opening regions is formed from a hydrophilic material, whereby it can be guaranteed that the subsequently coated light emitting material can be evenly filled in the opening regions, and the minute gaps occurred due to unevenly spreading of the light emitting material would not be caused. Therefore, with the above organic electroluminescent display panel provided by the embodiments of the present invention, the uniformity of the film layers formed after the pixel definition layer can be guaranteed, and the light emitting performance of the organic electroluminescent display panel can be improved.

[0038] The present disclosure has been described above by way of the exemplary embodiment, and the protection scope of the present disclosure would not be limited therein, and is only defined by the following claims.

Claims

1. An organic electroluminescent display panel, comprising a base substrate (100) and a pixel definition layer (200) located on the base substrate (100), wherein:

   the pixel definition layer (200) has opening regions (300) corresponding to pixel areas of the organic electroluminescent display panel, and each of the opening regions (300) has an opening larger than a bottom surface of the opening region (300);
   an upper surface (a) of the pixel definition layer (200) is formed from a hydrophobic material, and an inclination surface (b) of the pixel definition layer (200) corresponding to each of the opening regions (300) is formed from a hydrophilic material,
   characterized in that each of the opening regions (300) has a cross-section perpendicular to the base substrate (100) with a width firstly increased and then decreased in a continuous manner from the opening to the bottom surface.

2. The organic electroluminescent display panel according to claim 1, wherein the pixel definition layer (200) includes a first pixel definition layer structure (210) formed from the hydrophobic material and a second pixel definition layer structure (220) formed from the hydrophilic material, and a side surface of the second pixel definition layer structure (220) is adhered with a side surface of the first pixel definition layer structure (210).

3. The organic electroluminescent display panel according to claim 2, wherein the first pixel definition layer structure (210) has an inverted trapezoidal structure in a cross-section perpendicular to the base substrate (100).

4. The organic electroluminescent display panel according to claim 2 or 3, wherein the second pixel definition layer structure (220) has a triangular structure in a cross-section perpendicular to the base substrate (100).

5. The organic electroluminescent display panel according to any one of claims 2-4, wherein a height of the second pixel definition layer structure (220) in its cross-section perpendicular to the base substrate (100) is lower than a height of the first pixel definition layer structure (210) in its cross-section perpendicular to the base substrate (100).

6. The organic electroluminescent display panel according to any one of claims 2-5, wherein a material for the first definition layer structure is a hydrophobic

material with negative photoresist characteristics.

7. The organic electroluminescent display panel according to claim 6, wherein a material for the second pixel definition layer structure (220) is a hydrophilic material with positive photoresist characteristics.

8. A manufacturing method for the organic electroluminescent display panel according to any one of claims 1-7, including steps of:
forming the pixel definition layer (200) on the base substrate (100), wherein the pixel definition layer (200) has opening regions (300) corresponding to pixel areas of the organic electroluminescent display panel, and each of the opening regions (300) has an opening larger than a bottom surface of the opening region (300); and an upper surface (a) of the pixel definition layer (200) is formed from a hydrophobic material, and an inclination surface of the pixel definition layer (200) corresponding to each of the opening regions (300) is formed from a hydrophilic material, **characterized in that** each of the opening regions (300) has a cross-section perpendicular to the base substrate (100) with a width firstly increased and then decreased in a continuous manner from the opening to the bottom surface.

9. The manufacturing method according to claim 8, wherein forming of the pixel definition layer (200) on the base substrate (100) includes:

forming a pattern of the first pixel definition layer structure (210) on the base substrate (100); and forming a pattern of the second pixel definition layer structure (220) on the base substrate (100) on which the first pixel definition layer structure (210) has been formed.

10. The manufacturing method according to claim 9, wherein:

a layer of the hydrophobic material with negative photoresist characteristics is deposited on the base substrate (100);
the hydrophobic material with negative photoresist characteristics is subjected to a patterning process by a first mask plate to form the pattern of the first pixel definition layer structure (210).

11. The manufacturing method according to claim 9 or 10, wherein:

a layer of the hydrophilic material with positive photoresist characteristics is deposited on the base substrate (100) on which the first pixel definition layer structure (210) has been formed;
the hydrophilic material with positive photoresist characteristics is subjected to a patterning process by using the pattern of the first pixel definition layer structure (210) as a mask plate or by using the mask plate used in forming the first pixel definition layer structure (210), to form the pattern of the second pixel definition layer structure (220).

12. The manufacturing method according to claim 11, wherein upon depositing the hydrophilic material, a thickness by which the hydrophilic material is coated is less than a height of the first pixel definition layer structure (210).

13. The manufacturing method according to claim 11, wherein, in depositing the hydrophilic material, the hydrophilic material is caused to fully cover the first pixel definition layer structure (210), and in forming the pattern of the second pixel definition layer structure (220), the hydrophilic material covering the top of the first pixel definition layer structure (210) is etched off to expose the upper surface (a) of the first pixel definition layer structure (210).

14. A display device comprising the organic electroluminescent display panel according to any one of claims 1-7.

Patentansprüche

1. Organische Elektrolumineszenzanzeigetafel, umfassend ein Basissubstrat (100) und eine Pixeldefinitionsschicht (200), lokalisiert auf dem Basissubstrat (100), wobei:

die Pixeldefinitionsschicht (200) hat Öffnungsregionen (300) korrespondierend zu Pixelgebieten der organischen Elektrolumineszenzanzeigetafel, und jede der Öffnungsregionen (300) hat eine Öffnung größer als eine Bodenoberfläche der Öffnungsregion (300);
eine obere Oberfläche (a) der Pixeldefinitionsschicht (200) ist aus einem hydrophoben Material gebildet, und eine Neigungsoberfläche (b) der Pixeldefinitionsschicht (200) korrespondierend zu jeder der Öffnungsregionen (300) ist aus einem hydrophilen Material gebildet,
dadurch gekennzeichnet, dass jede der Öffnungsregionen (300) einen Querschnitt senkrecht zu dem Basissubstrat (100) aufweist mit einer Breite, die zuerst zunimmt und dann abnimmt auf eine kontinuierliche Weise von der Öffnung zu der Bodenoberfläche.

2. Organische Elektrolumineszenzanzeigetafel gemäß Anspruch 1, wobei die Pixeldefinitionsschicht (200) eine erste Pixeldefinitionsschichtstruktur (210), die aus dem hydrophoben Material gebildet

ist, und eine zweite Pixeldefinitionsschicht-struktur (220), die aus dem hydrophilen Material gebildet ist, enthält, wobei eine Seitenoberfläche der zweiten Pixeldefinitionsschichtstruktur (220) mit einer Seitenoberfläche der ersten Pixeldefinitionsschichtstruktur (210) verhaftet ist.

3. Organische Elektrolumineszenzanzeigetafel gemäß Anspruch 2, wobei die erste Pixeldefinitionsschichtstruktur (210) in einem zu dem Basissubstrat (100) senkrechten Querschnitt eine umgekehrte trapezförmige Struktur hat.

4. Organische Elektrolumineszenzanzeigetafel gemäß Anspruch 2 oder 3, wobei die zweite Pixeldefinitionsschichtstruktur (220) in einem zu dem Basissubstrat (100) senkrechten Querschnitt eine dreieckige Struktur hat.

5. Organische Elektrolumineszenzanzeigetafel gemäß einem der Ansprüche 2 - 4, wobei eine Höhe der zweiten Pixeldefinitionsschichtstruktur (220) in ihrem zu dem Basissubstrat (100) senkrechten Querschnitt kleiner ist als eine Höhe der ersten Pixeldefinitionsschichtstruktur (210) in ihrem zu dem Basissubstrat (100) senkrechten Querschnitt.

6. Organische Elektrolumineszenzanzeigetafel gemäß einem der Ansprüche 2 - 5, wobei ein Material für die erste Pixeldefinitionsschichtstruktur (210) ein hydrophobes Material mit negativen Photoresist-Charakteristiken ist.

7. Organische Elektrolumineszenzanzeigetafel gemäß Anspruch 6, wobei ein Material für die zweite Pixeldefinitionsschichtstruktur (220) ein hydrophiles Material mit positiven Photoresist-Charakteristiken ist.

8. Herstellungsverfahren für die organische Elektrolumineszenzanzeigetafel gemäß einem der Ansprüche 1 - 7, einschließend Schritte:

Bilden der Pixeldefinitionsschicht (200) auf dem Basissubstrat (100), wobei die Pixeldefinitionsschicht (200) Öffnungsregionen (300) aufweist korrespondierend zu Pixelgebieten der organischen Elektrolumineszenzanzeigetafel, und wobei jede der Öffnungsregionen (300) eine Öffnung größer als eine Bodenoberfläche der Öffnungsregion (300) aufweist; und eine obere Oberfläche (a) der Pixeldefinitionsschicht (200) wird aus einem hydrophoben Material gebildet, und eine Neigungsoberfläche der Pixeldefinitionsschicht (200) entsprechend zu jeder der Öffnungsregionen (300) wird aus einem hydrophilen Material gebildet, **dadurch gekennzeichnet,**

dass jede der Öffnungsregionen (300) einen zu dem Basissubstrat (100) senkrechten Querschnitt aufweist mit einer Breite, die sich zuerst vergrößert und dann verkleinert auf eine kontinuierliche Weise von der Öffnung zu der Bodenoberfläche.

9. Herstellungsverfahren gemäß Anspruch 8, wobei das Bilden der Pixeldefinitionsschicht (200) auf dem Basissubstrat (100) einschließt:

Bilden eines Musters der ersten Pixeldefinitionsschichtstruktur (210) auf dem Basissubstrat (100); und
Bilden eines Musters der zweiten Pixeldefinitionsschichtstruktur (220) auf dem Basissubstrat (100), auf welchem die erste Pixeldefinitionsschichtstruktur (210) gebildet worden ist.

10. Herstellungsverfahren gemäß Anspruch 9, wobei:

eine Schicht des hydrophoben Materials mit negativen Photoresist-Charakteristiken auf dem Basissubstrat (100) abgeschieden wird;
das hydrophobe Material mit negativen Photoresist-Charakteristiken einem Musterbildungsprozess unterzogen wird mittels einer ersten Maskenplatte, um das Muster der ersten Pixeldefinitionsschichtstruktur (210) zu bilden.

11. Herstellungsverfahren gemäß einem der Ansprüche 9 oder 10, wobei:

eine Schicht des hydrophilen Materials mit positiven Photoresist-Charakteristiken auf dem Basissubstrat (100) abgeschieden wird, auf welchem die erste Pixeldefinitionsschichtstruktur (210) gebildet worden ist;
das hydrophile Material mit positiven Photoresist-Charakteristiken einem Musterbildungsprozess unterzogen wird mittels Verwendung des Musters der ersten Pixeldefinitionsschichtstruktur (210) als einer Maskenplatte oder mittels der Maskenplatte, die verwendet wird bei der Bildung der ersten Pixeldefinitionsschichtstruktur (210), um das Muster der zweiten Pixeldefinitionsschichtstruktur (220) zu bilden.

12. Herstellungsverfahren gemäß Anspruch 11, wobei bei der Abscheidung des hydrophilen Materials eine Dicke, bis zu der das hydrophile Material beschichtet wird, kleiner ist als eine Höhe der ersten Pixeldefinitionsschichtstruktur (210).

13. Herstellungsverfahren gemäß Anspruch 11, wobei bei der Abscheidung des hydrophilen Materials das hydrophile Material veranlasst wird, die erste Pixeldefinitionsschichtstruktur (210) vollständig zu bede-

cken, und wobei beim Bilden des Musters der zweiten Pixeldefinitionsschichtstruktur (220) das hydrophile Material, das die Oberseite der ersten Pixeldefinitionsschichtstruktur (210) bedeckt, weggeätzt wird, um die obere Oberfläche (a) der ersten Pixeldefinitionsschichtstruktur (210) freizulegen.

14. Anzeigevorrichtung, umfassend die organische Elektrolumineszenzanzeigetafel gemäß einem der Ansprüche 1 - 7.

Revendications

1. Un panneau d'affichage électroluminescent organique, comprenant un substrat de base (100) et une couche de définition de pixels (200) située sur le substrat de base (100), dans lequel :

la couche de définition de pixels (200) a des régions d'ouverture (300) correspondant aux zones de pixels du panneau d'affichage électroluminescent organique, et chacune des régions d'ouverture (300) a une ouverture plus grande qu'une surface inférieure de la région d'ouverture (300) ;
une surface supérieure (a) de la couche de définition des pixels (200) est formée d'un matériau hydrophobe, et une surface d'inclinaison (b) de la couche de définition des pixels (200) correspondant à chacune des régions d'ouverture (300) est formée d'un matériau hydrophile,
caractérisé en ce que chacune des régions d'ouverture (300) a une section transversale perpendiculaire au substrat de base (100) avec une largeur d'abord augmentée puis diminuée d'une manière continue de l'ouverture à la surface inférieure.

2. Le panneau d'affichage électroluminescent organique selon la revendication 1, dans lequel la couche de définition de pixels (200) comprend une première structure de couche de définition de pixels (210) formée du matériau hydrophobe et une deuxième structure de couche de définition de pixels (220) formée du matériau hydrophile, et une surface latérale de la deuxième structure de couche de définition de pixels (220) adhère à une surface latérale de la première structure de couche de définition de pixels (210).

3. Le panneau d'affichage électroluminescent organique selon la revendication 2, dans lequel la première structure de couche de définition de pixels (210) a une structure trapézoïdale inversée dans une section transversale perpendiculaire au substrat de base (100).

4. Le panneau d'affichage électroluminescent organique selon la revendication 2 ou 3, dans lequel la deuxième structure de couche de définition de pixels (220) a une structure triangulaire dans une section transversale perpendiculaire au substrat de base (100).

5. Le panneau d'affichage électroluminescent organique selon l'une quelconque des revendications 2 à 4, dans lequel une hauteur de la deuxième structure de couche de définition de pixels (220) dans sa section transversale perpendiculaire au substrat de base (100) est inférieure à une hauteur de la première structure de couche de définition de pixels (210) dans sa section transversale perpendiculaire au substrat de base (100).

6. Le panneau d'affichage électroluminescent organique selon l'une quelconque des revendications 2 à 5, dans lequel un matériau pour la première structure de couche de définition est un matériau hydrophobe avec des caractéristiques de résine photosensible négative.

7. Le panneau d'affichage électroluminescent organique selon la revendication 6, dans lequel un matériau pour la deuxième structure de couche de définition des pixels (220) est un matériau hydrophile avec des caractéristiques de résine photosensible positive.

8. Un procédé de fabrication d'un panneau d'affichage électroluminescent organique selon l'une quelconque des revendications 1 à 7, comprenant les étapes de :
formation de la couche de définition de pixels (200) sur le substrat de base (100), dans lequel la couche de définition de pixels (200) a des régions d'ouverture (300) correspondant à des zones de pixels du panneau d'affichage électroluminescent organique, et chacune des régions d'ouverture (300) a une ouverture plus grande qu'une surface inférieure de la région d'ouverture (300) ; et une surface supérieure (a) de la couche de définition de pixels (200) est formée d'un matériau hydrophobe, et une surface d'inclinaison de la couche de définition de pixels (200) correspondant à chacune des régions d'ouverture (300) est formée d'un matériau hydrophile, **caractérisé en ce que** chacune des régions d'ouverture (300) a une section transversale perpendiculaire au substrat de base (100) avec une largeur d'abord augmentée puis diminuée d'une manière continue de l'ouverture à la surface inférieure.

9. Le procédé de fabrication selon la revendication 8, dans lequel la formation de la couche de définition de pixels (200) sur le substrat de base (100) comprend :

la formation d'un motif de la première structure de couche de définition de pixels (210) sur le substrat de base (100) ; et
la formation d'un motif de la deuxième structure de couche de définition de pixels (220) sur le substrat de base (100) sur lequel la première structure de couche de définition de pixels (210) a été formée.

10. Le procédé de fabrication selon la revendication 9, dans lequel :

une couche du matériau hydrophobe ayant des caractéristiques de résine photosensible négative est déposée sur le substrat de base (100) ; le matériau hydrophobe avec des caractéristiques de résine photosensible négative est soumis à un processus de formation de motifs par une première plaque de masque pour former le motif de la première structure de couche de définition de pixels (210).

11. Le procédé de fabrication selon la revendication 9 ou 10, dans lequel :

une couche du matériau hydrophile ayant des caractéristiques de résine photosensible positive est déposée sur le substrat de base (100) sur lequel la première structure de couche de définition de pixel (210) a été formée ;
le matériau hydrophile ayant des caractéristiques de résine photosensible positive est soumis à un processus de formation de motifs en utilisant le motif de la première structure de couche de définition de pixels (210) comme plaque de masque ou en utilisant la plaque de masque utilisée dans la formation de la première structure de couche de définition de pixels (210), pour former le motif de la deuxième structure de couche de définition de pixels (220).

12. Le procédé de fabrication selon la revendication 11, dans lequel, lors du dépôt du matériau hydrophile, une épaisseur de revêtement par le matériau hydrophile est inférieure à une hauteur de la première structure de couche de définition des pixels (210).

13. Le procédé de fabrication selon la revendication 11, dans lequel, lors du dépôt du matériau hydrophile, le matériau hydrophile est amené à couvrir entièrement la première structure de couche de définition de pixels (210), et lors de la formation du motif de la deuxième structure de couche de définition de pixels (220), le matériau hydrophile couvrant le dessus de la première structure de couche de définition de pixels (210) est gravé pour exposer la surface supérieure (a) de la première structure de couche de définition de pixels (210).

14. Un dispositif d'affichage comprenant le panneau d'affichage électroluminescent organique selon l'une quelconque des revendications 1 à 7.

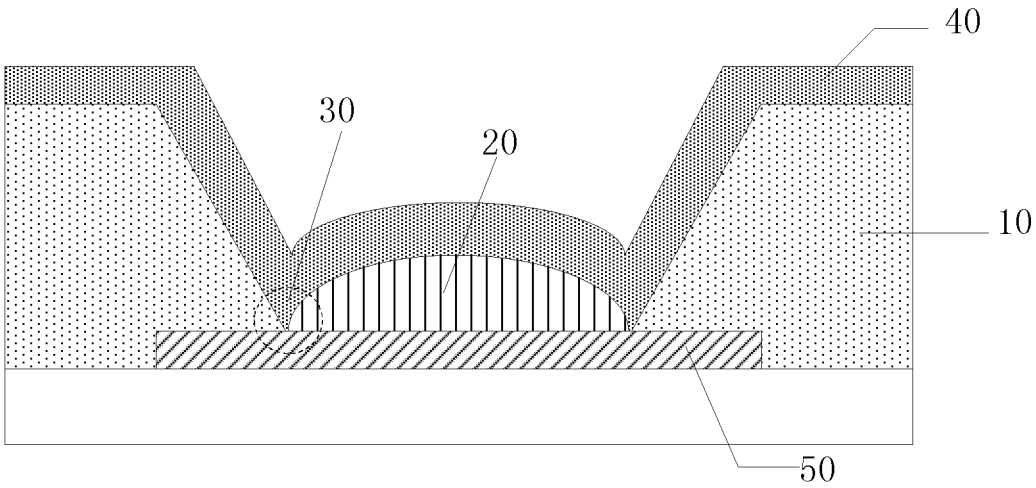

FIG.1a

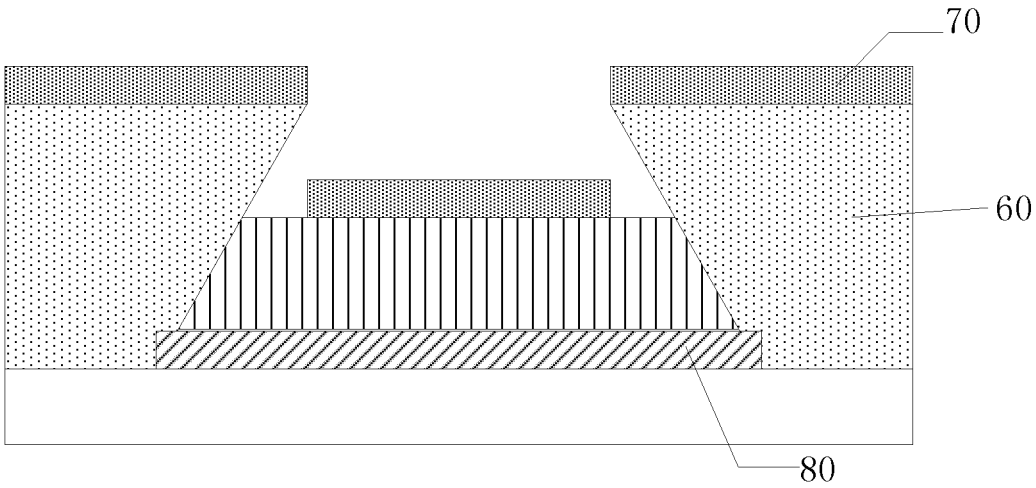

FIG.1b

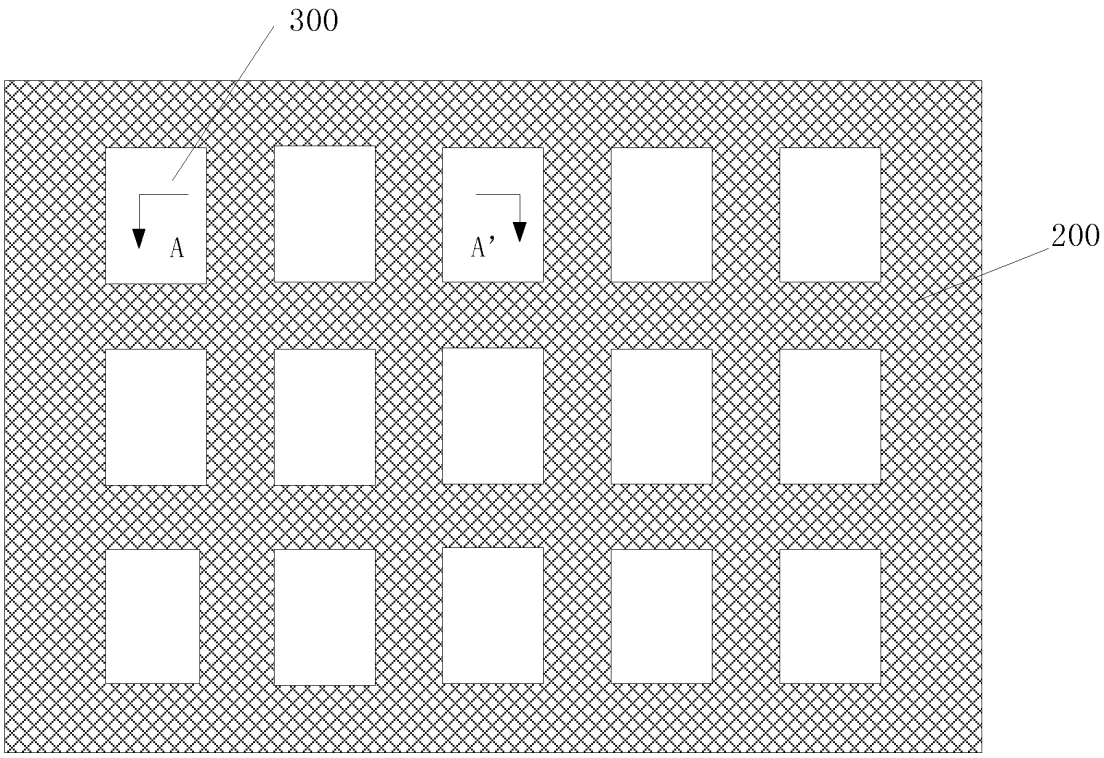

FIG.2a

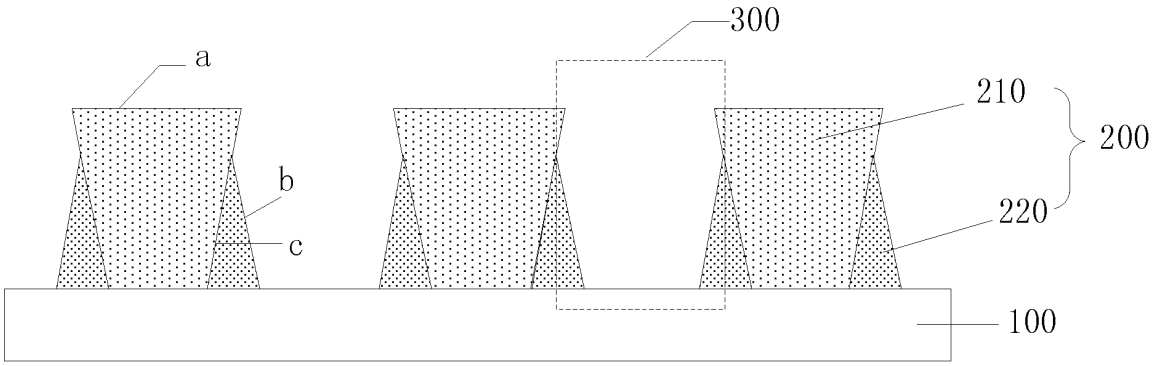

FIG.2b

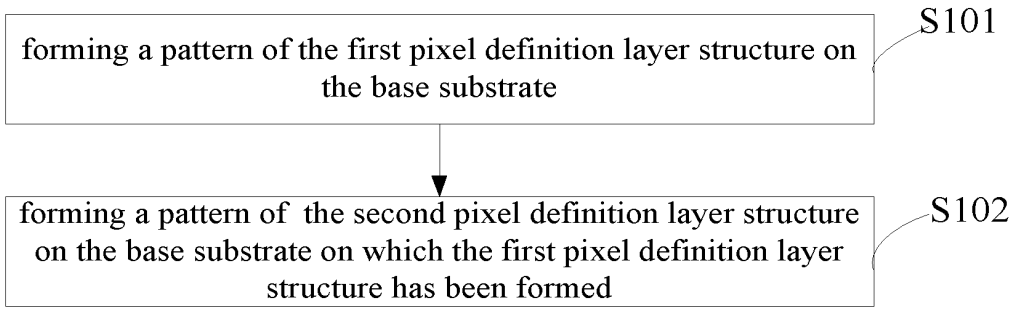

FIG.3

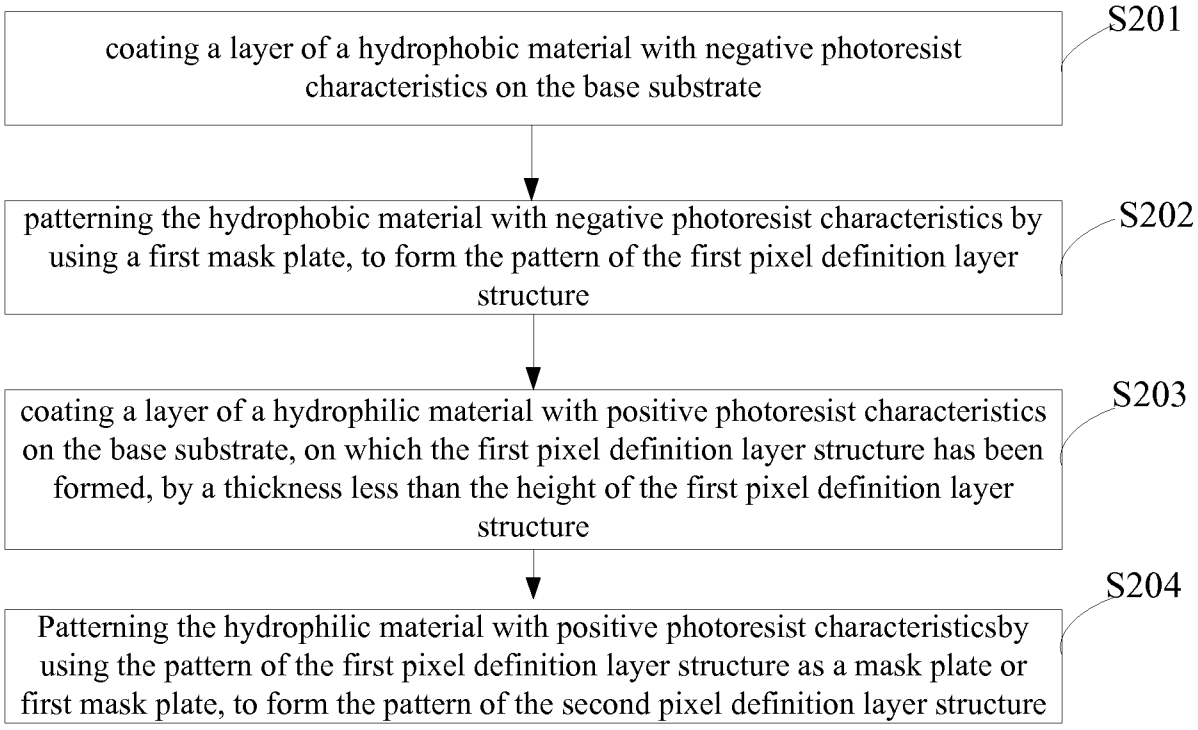
coating a layer of a hydrophobic material with negative photoresist characteristics on the base substrate
S201
patterning the hydrophobic material with negative photoresist characteristics by using a first mask plate, to form the pattern of the first pixel definition layer structure
S202
coating a layer of a hydrophilic material with positive photoresist characteristics on the base substrate, on which the first pixel definition layer structure has been formed, by a thickness less than the height of the first pixel definition layer structure
S203
Patterning the hydrophilic material with positive photoresist characteristicsby using the pattern of the first pixel definition layer structure as a mask plate or first mask plate, to form the pattern of the second pixel definition layer structure
S204

FIG.4

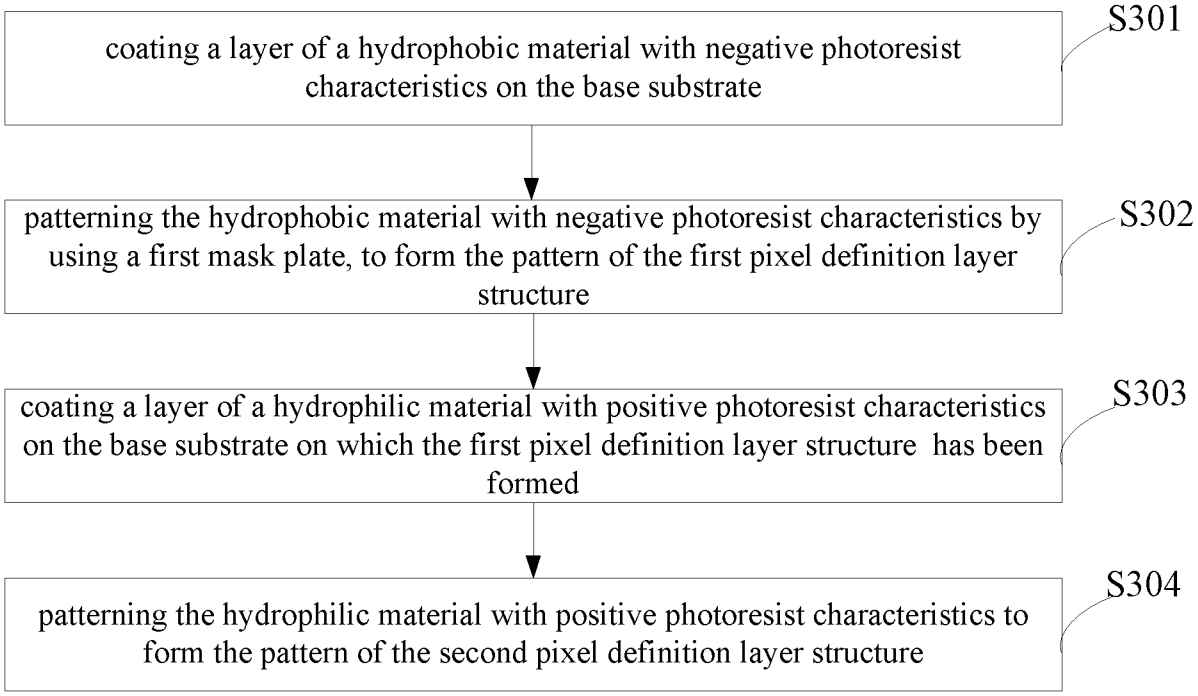
coating a layer of a hydrophobic material with negative photoresist characteristics on the base substrate
S301
patterning the hydrophobic material with negative photoresist characteristics by using a first mask plate, to form the pattern of the first pixel definition layer structure
S302
coating a layer of a hydrophilic material with positive photoresist characteristics on the base substrate on which the first pixel definition layer structure has been formed
S303
patterning the hydrophilic material with positive photoresist characteristics to form the pattern of the second pixel definition layer structure
S304

FIG.5

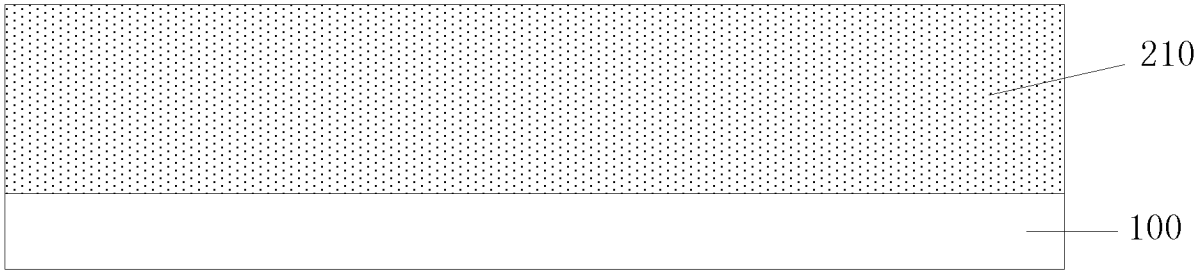

FIG.6a

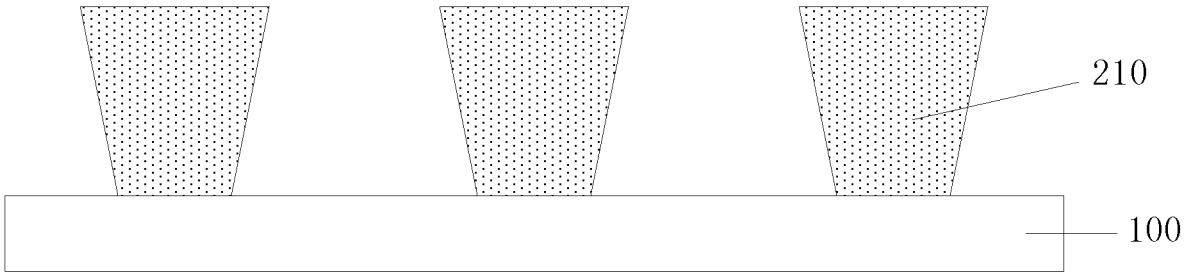

FIG.6b

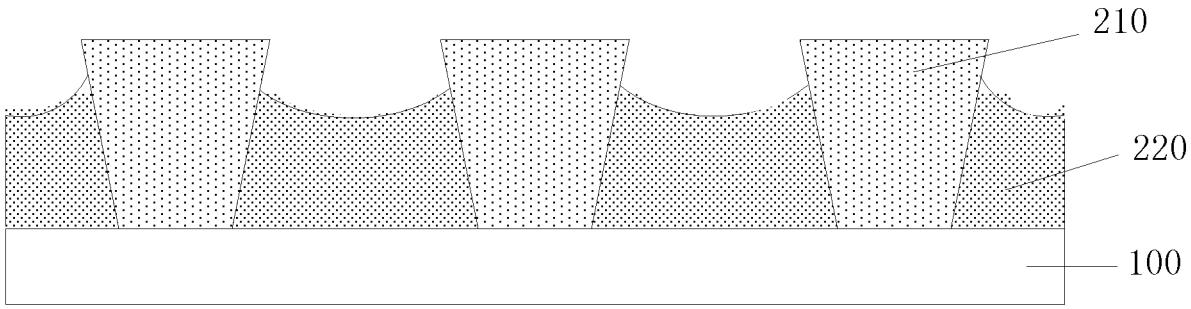

FIG.6c

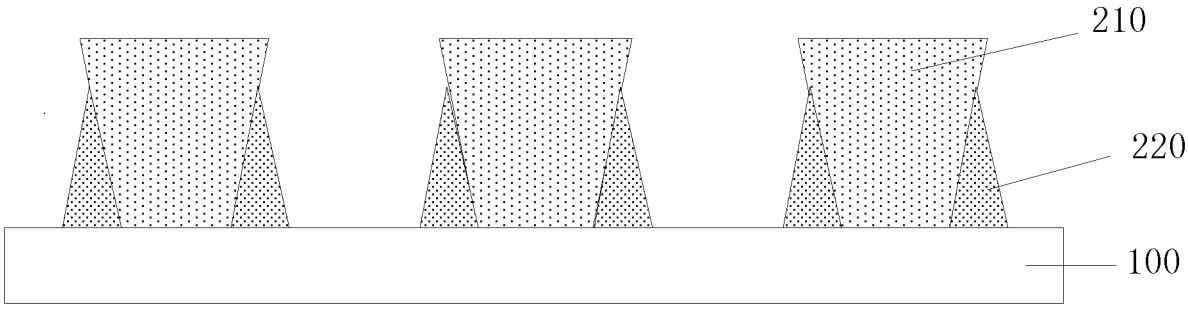

FIG.6d

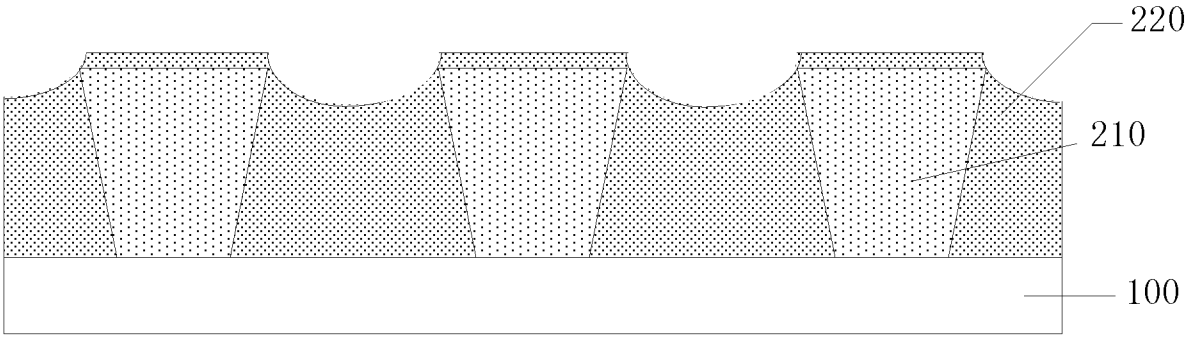

FIG.7a

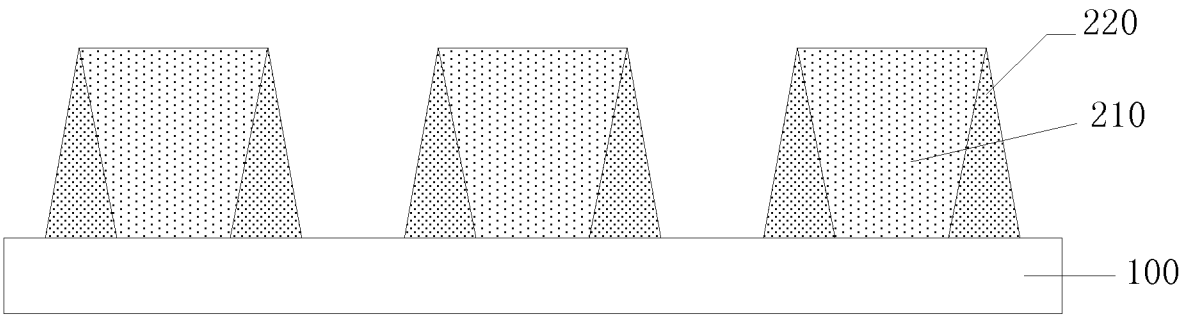

FIG.7b

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 2005057151 A1 **[0003]**
- US 2010062147 A1 **[0003]**
- JP 002009176590 A **[0003]**

专利名称(译)	有机电致发光显示板，其生产方法和显示装置		
公开(公告)号	EP3179513B1	公开(公告)日	2020-05-13
申请号	EP2014882128	申请日	2014-11-05
[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	SONG YINGYING HUNG HSIAO WEN HUNG HAO CHIH		
发明人	SONG, YINGYING HUNG, HSIAO WEN HUNG, HAO CHIH		
IPC分类号	H01L27/32 H01L51/56		
CPC分类号	H01L27/3246 H01L51/0005 H01L51/0012 H01L51/5012 H01L2227/323		
优先权	201410389844.X 2014-08-08 CN		
其他公开文献	EP3179513A1 EP3179513A4		
外部链接	Espacenet		

摘要(译)

公开了一种有机电致发光显示面板，其制造方法和显示装置。 在有机电致发光显示面板中，其中提供的像素限定层（200）具有与OLED中的像素区域相对应的开口区域（300），并且每个开口区域（300）具有大于开口的底表面的开口。 地区（300）。 像素限定层（200）的上表面（a）由疏水性材料形成，并且像素限定层（200）的与每个开口区域（300）相对应的倾斜表面（b）由a形成。 亲水材料。 上述OLED可以确保在可以确保像素限定层（200）以改善OLED的发光性能之后形成的膜层的均匀性。

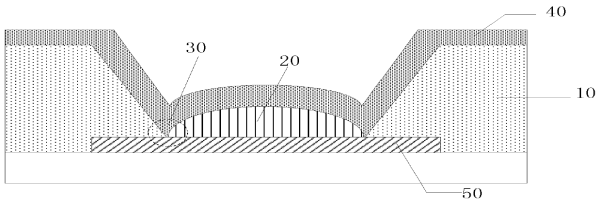

FIG. 1a

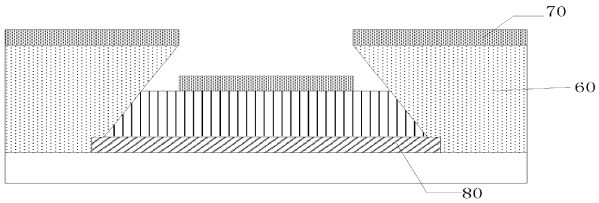

FIG. 1b