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(54) **ORGANIC LIGHT-EMITTING DISPLAY PANEL AND MANUFACTURING METHOD THEREOF**

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(58) **Field of Classification Search**
CPC H01L 27/3246; H01L 51/5209; H01L 27/3283; H01L 51/0023
See application file for complete search history.

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(57) **ABSTRACT**

The present disclosure provides an organic light-emitting display panel and a manufacturing method thereof. The organic light-emitting display panel may include: a first anode layer including a number of first anodes; a pixel definition layer defining a number of pixel regions, wherein one of a first opening and a second opening is defined in each of the pixel regions, the second opening has a depth smaller than that of first opening, an inclination angle is formed between the side wall and the bottom surface, and the inclination angle is larger than 90° and smaller than 180°; a second anode layer arranged in second opening; an organic light-emitting layer arranged in the first opening and the second opening. Accordingly, the resolution of the organic light-emitting display panel is improved.

17 Claims, 4 Drawing Sheets

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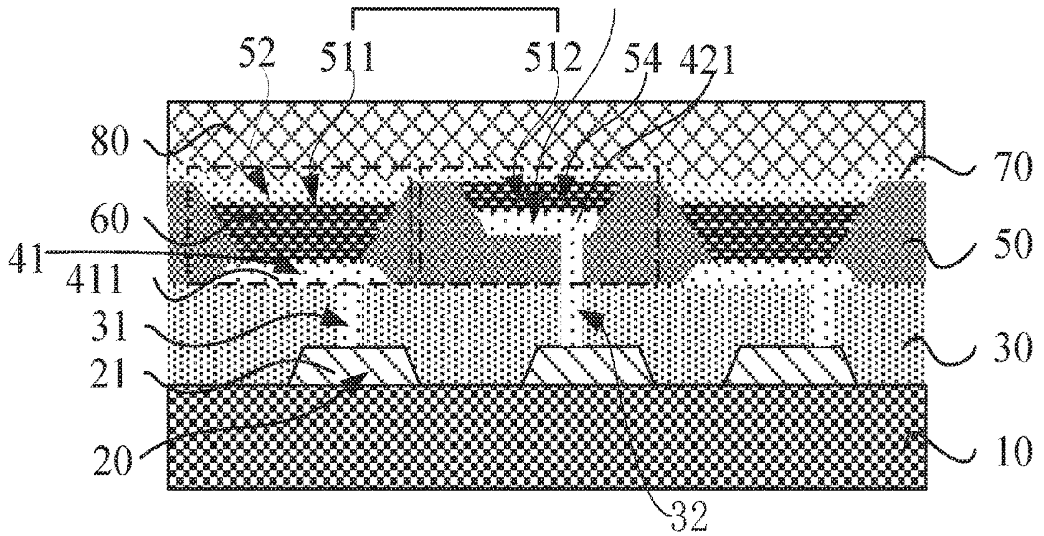

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H01L 51/56 (2006.01)

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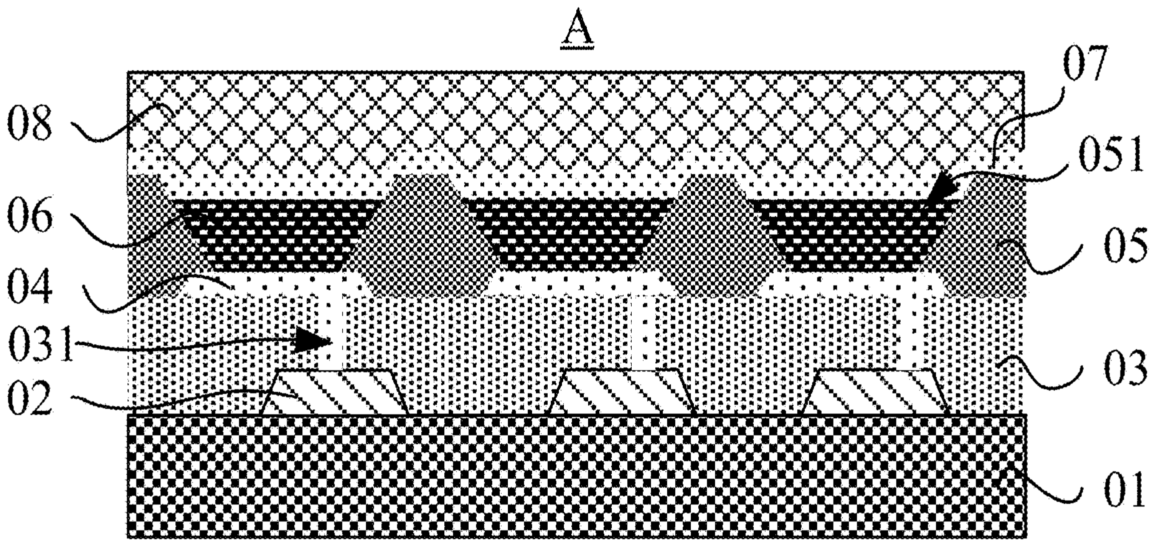

FIG. 1 (Related Art)

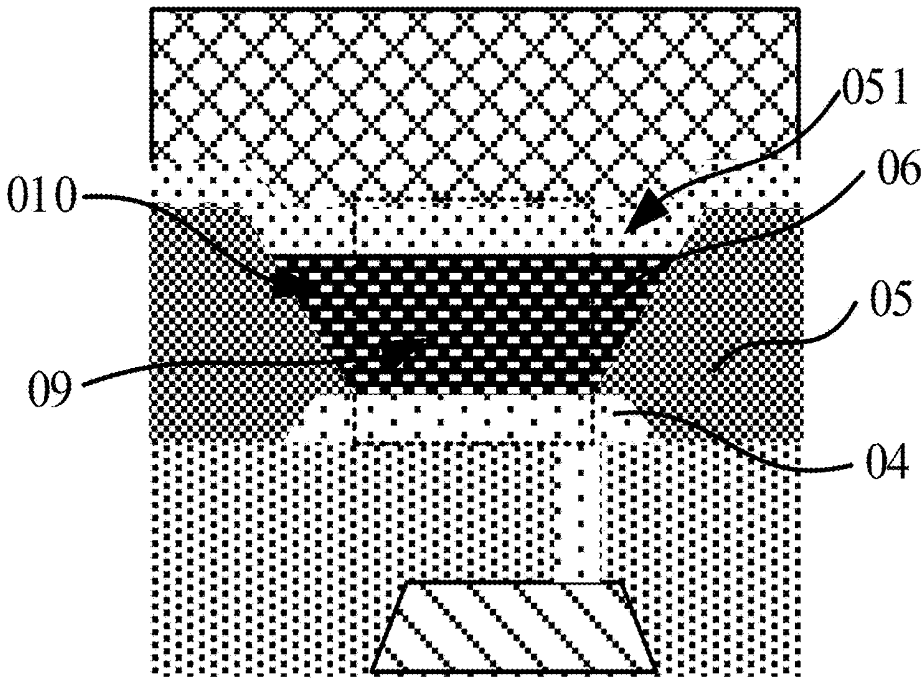

FIG. 2 (Related Art)

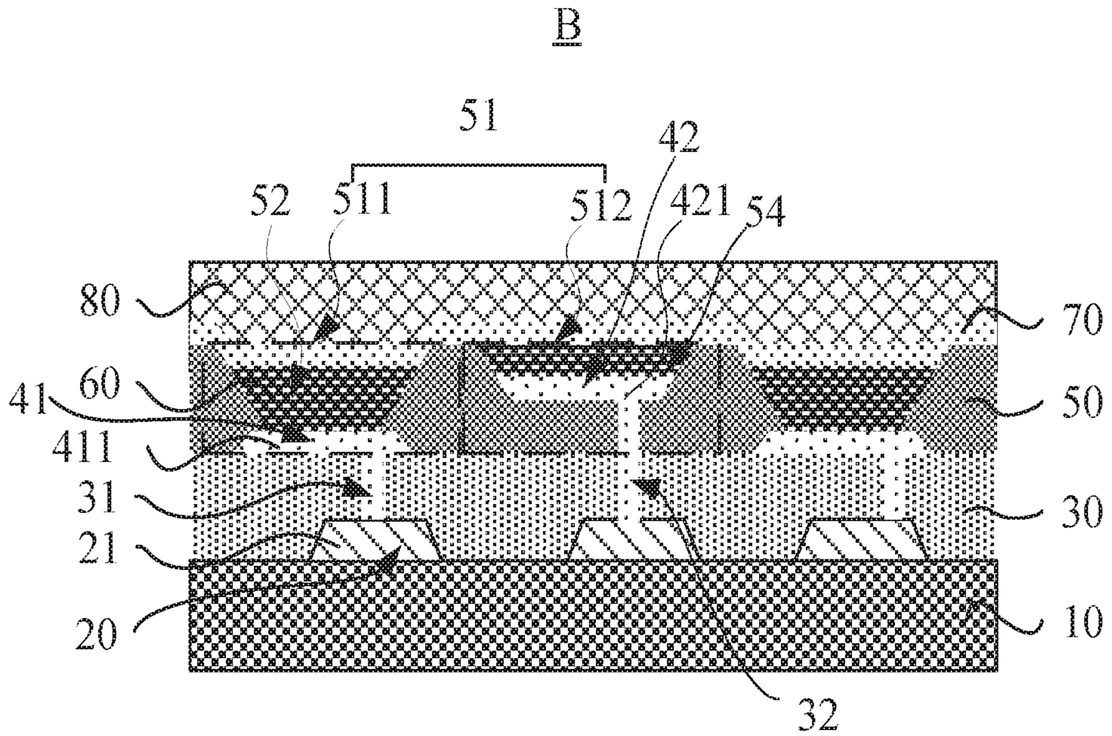
B
51
52
511
512
42
421
54
80
70
60
50
41
411
31
30
21
20
10
32

FIG. 3

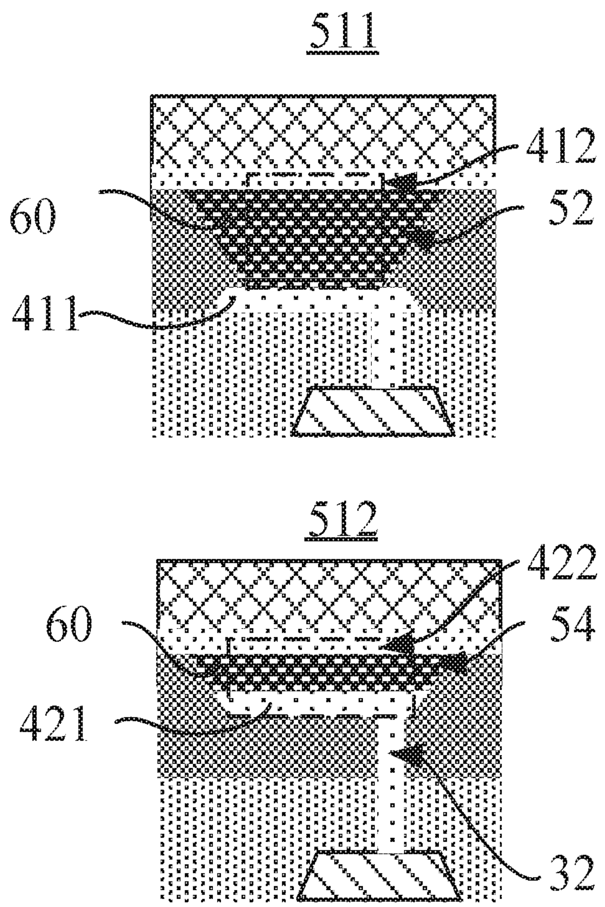
511
412
60
52
411
512
422
60
54
421
32

FIG. 4

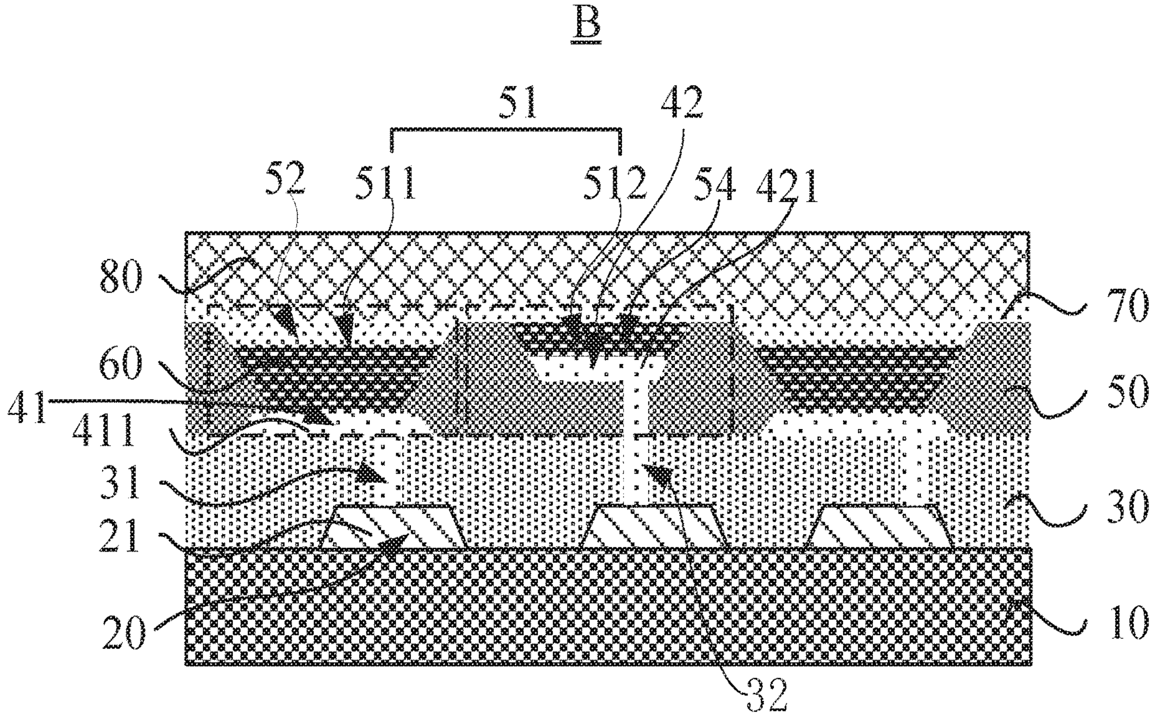
B
51
42
52
511
512
54
421
80
70
60
50
41
411
31
30
21
20
10
32

FIG. 5

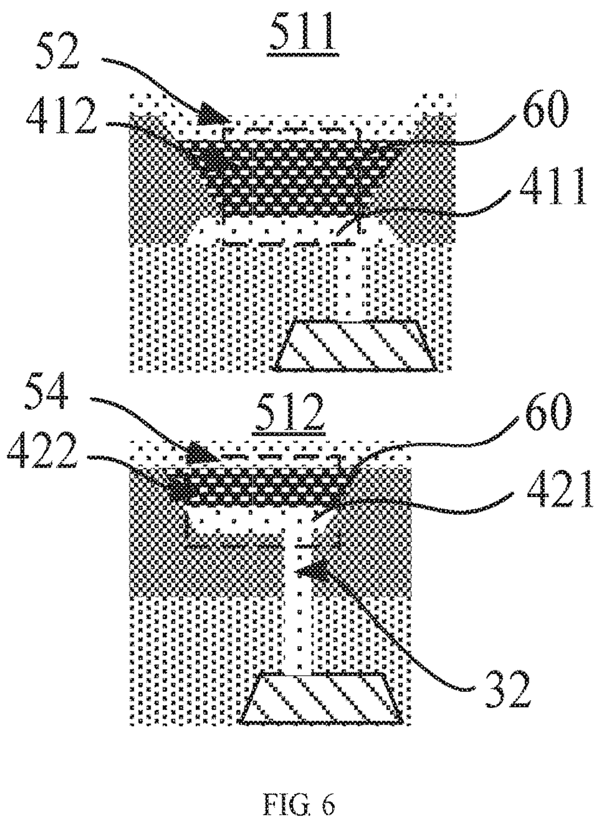
511
52
412
60
411
54
512
60
422
421
32

FIG. 6

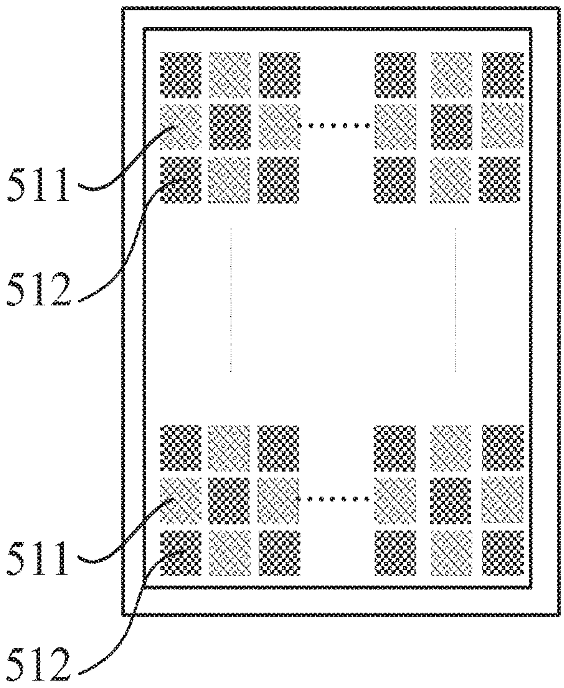
511
512
511
512

FIG. 7

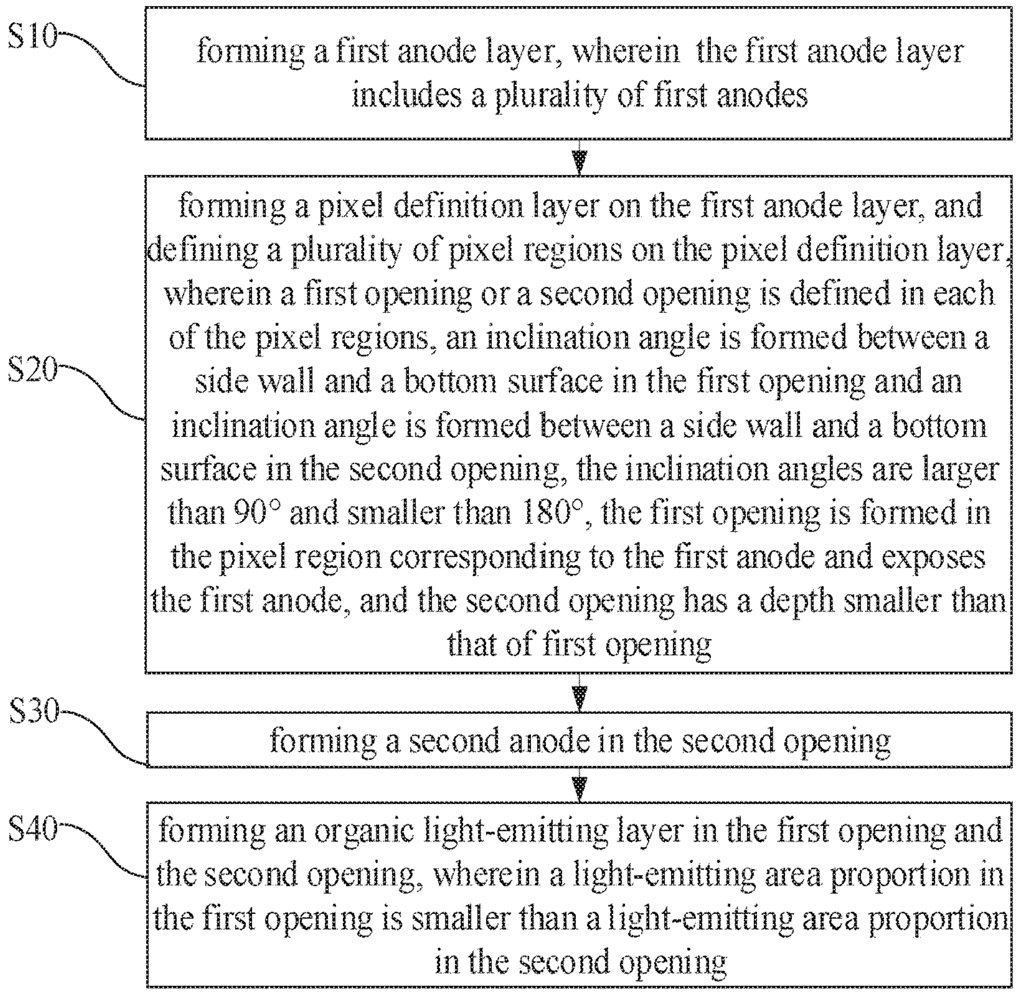
S10
forming a first anode layer, wherein the first anode layer includes a plurality of first anodes
S20
forming a pixel definition layer on the first anode layer, and defining a plurality of pixel regions on the pixel definition layer, wherein a first opening or a second opening is defined in each of the pixel regions, an inclination angle is formed between a side wall and a bottom surface in the first opening and an inclination angle is formed between a side wall and a bottom surface in the second opening, the inclination angles are larger than 90° and smaller than 180°, the first opening is formed in the pixel region corresponding to the first anode and exposes the first anode, and the second opening has a depth smaller than that of first opening
S30
forming a second anode in the second opening
S40
forming an organic light-emitting layer in the first opening and the second opening, wherein a light-emitting area proportion in the first opening is smaller than a light-emitting area proportion in the second opening

FIG. 8

ORGANIC LIGHT-EMITTING DISPLAY PANEL AND MANUFACTURING METHOD THEREOF

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a continuation-application of International (PCT) Patent Application No. PCT/CN2018/087841 filed May 22, 2018, which claims foreign priority of Chinese Patent Application No. 201810355798.X, filed on Apr. 19, 2018 in the State Intellectual Property Office of China, the entire contents of which are hereby incorporated by reference.

TECHNICAL FIELD

The present disclosure relates to the field of display technologies, and in particular, to an organic light-emitting display panel and a manufacturing method thereof.

BACKGROUND

Among display devices, organic light-emitting display devices have become one of the most competitive technologies in a new generation of display devices because of their wide color gamut, high contrast, energy saving, foldability, etc. With continuous development of information society, people are increasingly demanding resolution and display accuracy of the display devices. In particular, a head-mounted displayer including an organic light-emitting display device has a relatively short distance from user's eye to its focus. Therefore, if the resolution of the organic light-emitting display device is low, a distance between two adjacent display regions will be too large, which makes user eyes easily see non-display regions as panes and hereby affects the effect of use. Therefore, how to improve the resolution of the display device becomes a technical problem that needs to be solved.

SUMMARY

An organic light-emitting display panel and a manufacturing method thereof are provided in the present disclosure, in order to solve the technical problem that the resolution of a conventional organic light-emitting display panel is low.

In order to solve the technical problem above, a technical solution adopted in the present disclosure is to provide an organic light-emitting display panel. The organic light-emitting display panel includes a first anode layer, a pixel definition layer, a second anode layer and an organic light-emitting layer. The first anode layer includes a plurality of patterned first anodes. The pixel definition layer is arranged on the first anode layer, and defines a plurality of pixel regions. One of a first opening and a second opening is defined in each of the pixel regions, each of the pixel regions comprises a side wall and a bottom wall in each first opening and each second opening, an inclination angle is formed between the side wall and the bottom surface the inclination angle is larger than 90° and smaller than 180°, the first opening is configured to correspond to the first anode and expose the first anode, and the second opening has a depth smaller than that of first opening. The second anode layer includes a plurality of patterned second anodes, wherein the second anode is arranged in the second opening. The organic light-emitting layer is arranged in the first opening and the second opening. A light-emitting area proportion in the first opening is smaller than a light-emitting area proportion in the second opening, wherein the light-emitting area proportion is a percentage of a light-emitting area of a pixel region to an area of the pixel region, and the light-emitting area is a contact area between the organic light-emitting layer and the first anode or the second anode in each of the pixel regions.

In order to solve the technical problem above, another technical solution adopted in the present disclosure is to provide an organic light-emitting display panel. The organic light-emitting display panel includes: a first anode layer, including a plurality of patterned first anodes; a pixel definition layer, arranged on the first anode layer, wherein the pixel definition layer defines at least a first pixel region and a second pixel region adjacent to the first pixel region, a first opening is defined in the first pixel region, a second opening is defined in the second pixel region, an obtuse angle is formed between a side wall and a bottom surface in the first opening and an obtuse angle is formed between a side wall and a bottom surface in the second opening, the second opening has a depth smaller than that of first opening such that the bottom surface in the second opening is higher than the bottom surface of the first opening; a second anode layer, including a plurality of patterned second anodes, wherein the second anode is arranged in the second opening; an organic light-emitting layer, arranged in the first opening and the second opening, wherein the organic light-emitting layer in the first opening contacts the first anode, and the organic light-emitting layer in the second opening is disposed on the second anode and contacts the second anode.

In order to solve the technical problem above, a further technical solution adopted in the present disclosure is to provide a manufacturing method of an organic light-emitting display panel. The manufacturing method includes: forming a first anode layer, wherein the first anode layer includes a plurality of first anodes; forming a pixel definition layer on the first anode layer, and defining a plurality of pixel regions on the pixel definition layer, wherein one of a first opening and a second opening is defined in each of the pixel regions, each of the pixel regions includes a side wall and a bottom surface in each first opening and each second opening, an inclination angle is formed between the side wall and the bottom, the inclination angle is larger than 90° and smaller than 180°, the first opening is configured to correspond to the first anode and expose the first anode, and the second opening has a depth smaller than that of first opening; forming a second anode in the second opening; forming an organic light-emitting layer in the first opening and the second opening, wherein a light-emitting area proportion in the first opening is smaller than a light-emitting area proportion in the second opening, the light-emitting area proportion is a percentage of a light-emitting area of a pixel region to an area of the pixel region, and the light-emitting area is a contact area between the organic light-emitting layer and the first anode or the second anode in each of the pixel regions.

Embodiments of the present disclosure may have the following advantages: by forming the first opening and the second opening with different depths (i.e., the depth of the second opening is smaller than that of the first opening) in the pixel regions of the pixel definition layer and forming the inclination angle between the side wall and the bottom surface in the first opening and the inclination angle between the side wall and the bottom surface in the second opening (wherein the inclination angles are larger than 90° and smaller than 180°), the light-emitting area proportion in the second opening is larger than the light-emitting area proportion in the first opening; wherein the light-emitting area proportion is the percentage of the light-emitting area of the pixel region to the area of the pixel region, and the light-emitting area is the contact area between the organic light-emitting layer and the first anode or the second anode in each of the pixel regions. Therefore, by increasing light-emitting area proportion in the pixel region of the second opening, the light-emitting area of the entire display panel is increased. Accordingly, the resolution of the organic light-emitting display panel is improved.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to make the technical solution of embodiments of the present disclosure more clearly, drawings used for the description of the embodiments will be briefly described. Apparently, the drawings described above are only some exemplary embodiments of the present disclosure. One skilled in the art may acquire other drawings based on these drawings without any inventive work. In the drawings:

FIG. **1** is a schematic sectional view of an organic light-emitting display panel of related art.

FIG. **2** is a schematic enlarged view of a single pixel region shown in FIG. **1**.

FIG. **3** is a schematic sectional view of an organic light-emitting display panel according to a first embodiment of the present disclosure.

FIG. **4** is a schematic view of two pixel regions according to the first embodiment of the present disclosure, for comparing with the single pixel region of the conventional organic light-emitting display panel.

FIG. **5** is a schematic sectional view of an organic light-emitting display panel according to a second embodiment of the present disclosure.

FIG. **6** is a schematic view of two pixel regions according to the second embodiment of the present disclosure, for comparing with the single pixel region of the conventional organic light-emitting display panel.

FIG. **7** is a schematic view of an overall structure of an organic light-emitting display panel according to an embodiment of the present disclosure.

FIG. **8** is a schematic flowchart of a manufacturing method of an organic light-emitting display panel according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

The technical solutions of embodiments of the present disclosure will be described more clearly and completely with reference to the accompanying drawings. Apparently, the embodiments described here only are some exemplary embodiments, not all the embodiments. Based on the embodiments described in the present disclosure, one skilled in the art may acquire all other embodiments without any creative work. All these shall be covered within the protection scope of the present disclosure.

The terms "first" and "second" in the present disclosure are used herein for purposes of description and are not intended to indicate or imply relative importance or to imply the number of indicated technical features. Thus, the feature defined with "first" and "second" may explicitly or implicitly include at least one such feature. In the description of the present disclosure, the term "a plurality of" means at least two, such as two, three, etc., unless specified otherwise. All directional indications (such as up, down, left, right, front, rear, etc.) in the embodiments of the present disclosure are only used to explain the relative positional relationship among the components in a specific posture (as shown in the drawings), sports situations, etc. If the specific posture changes, the directional indication changes accordingly. Further, the terms "include" and "have" and any variants thereof are intended to cover non-exclusive inclusions. For example, a process, method, system, product, or apparatus that includes a series of steps or components is not limited to the listed steps or components, but may optionally include steps or components that are not listed, or alternatively include other steps or components inherent to the process, method, product, or apparatus.

References herein to "embodiment" mean that a particular feature, structure, or characteristic described in connection with an embodiment may be included in at least one embodiment of the present disclosure. The appearances of such phrases in various places of the specification are not necessarily referring to the same embodiment, nor mean separate or alternative embodiments mutually exclusive of other embodiments. It will be understood by those skilled in the art, both explicitly and implicitly, that an embodiment described herein may be combined with other embodiments.

Referring to FIG. **1**, a schematic sectional view of an organic light-emitting display panel A of the related art is shown.

The organic light-emitting display panel A may include: a metal layer **02**, a planarization layer **03**, an anode layer **04**, a pixel definition layer **05**, an organic light-emitting layer **06**, a cathode layer **07** and an encapsulation layer **08**, which may be sequentially formed on the a substrate **01**.

A plurality of through holes **031** may be defined in the planarization layer **03**. The anode layer **04** arranged on the planarization layer **03** may connect with the metal layer **02** via the through hole **031**.

At positions on the pixel definition layer **05** corresponding to the anode layer **04**, a plurality of openings **051** extending to the anode layer **04** may be formed by etching. Because the pixel definition layer **05** may be etched by etching liquid from the outside to the inside, an inclination angle may be formed between a side wall and a bottom surface in the opening **051** of the pixel definition layer **05**. The bottom surface may overlap with the top surface of the anode layer **04**. Thus, an inverted trapezoidal section may be formed. The organic light-emitting layer **06** may be arranged in the regions of the openings **051** of the pixel definition layer **05**.

Referring to FIG. **2**, a schematic enlarged view of a single pixel region in FIG. **1** is shown.

In the single pixel region, because the inclination angle θ may be formed between the side wall and the bottom surface in the opening **051** of the pixel definition layer **05**, a light-emitting region **09** may be only a region corresponding to an area where the organic light-emitting layer **06** contacts the anode layer **04**. The rest of the organic light-emitting layer **06** may be a non-luminous region **010**.

Referring to FIGS. **3** and **4**, FIG. **3** is a schematic sectional view of an organic light-emitting display panel according to a first embodiment of the present disclosure; and, FIG. **4** is a schematic view of two pixel regions according to the first embodiment of the present disclosure, for comparing with the single pixel region of the organic light-emitting display panel of related art.

In this embodiment, the organic light-emitting display panel B may include: a substrate **10**, a metal layer **20**, a planarization layer **30**, a first anode layer **41**, a pixel definition layer **50**, a second anode layer **42**, an organic light-emitting layer **60**, a cathode layer **70**, and an encapsulation layer **80**.

The substrate **10** may include a base substrate, a polysilicon layer, an inorganic insulating layer, and a gate layer. The base substrate may be a transparent material. Specifically, the base substrate may include, but not limit to, a glass, a ceramic substrate, or a transparent plastic, etc.

The metal layer **20** may be arranged on the substrate **10** and may be composed of a plurality of metal wires **21**. A manufacturing method of the metal layer **20** may include: providing a complete metal layer on the substrate **10**; exposing, developing and etching the complete metal layer via a mask with a specific electrode pattern to form a plurality of patterned metal wires **21**. The manufacturing method of the metal layer **20** may belong to well-known technology for those skilled in the art, and may refer to the preparation method in the prior art, which is not specifically limited in the present disclosure.

The planarization layer **30** may be arranged on the metal layer **20**, and a plurality of first through holes **31** may be defined in the planarization layer **30**.

The first anode layer **41** may be arranged on the planarization layer **30**, and may include a plurality of patterned first anodes **411**. The first anode **411** may connect with the metal wire **21** via the first through hole **31**.

The pixel definition layer **50** may be arranged on the first anode layer **41**, and a plurality of pixel regions **51** may be defined on the pixel definition layer **50**. A first opening **52** or a second opening **54** may be defined in each of the pixel regions **51**. An inclination angle θ may be formed between a side wall and a bottom surface in the first opening **52**, and an inclination angle θ may be formed between a side wall and a bottom surface in the second opening **54**. The bottom surface in the first opening **52** may overlap with the top surface of the first anode **411**. The first opening **52** may be defined in the pixel region **51** corresponding to the first anode **411**, and expose part of the first anode **411**. The second opening **54** may be defined in the pixel region **51** where the first opening **52** is not provided, and the depth of the second opening **54** may be smaller than the depth of the first opening **52**. A second through hole **32** may be defined at the bottom in the second opening **54** and extend to the metal layer **20**.

The first opening **52** and the second opening **54** may be formed by applying an etching liquid on the pixel definition layer **50**. Since the pixel definition layer **50** may be gradually etched by the etching liquid inward from the outermost layer, the diameters of the first opening **52** and the second opening **54** may be decreased in the depth direction. Therefore, the inclination angles θ may be formed between the side walls and bottom surfaces in the first opening **52** and the second opening **54**, wherein the inclination angles may be larger than 90° and smaller than 180°.

The second anode layer **42** may include a plurality of patterned second anodes **421**. The second anode **421** may be arranged in the second opening **54**, and connect with the metal wire **21** via the second through hole **32**.

The organic light-emitting layer **60** may be arranged in the first opening **52** and the second opening **54**. A light-emitting area proportion of the organic light-emitting layer **60** in the first opening **52** may be smaller than a light-emitting area proportion of the organic light-emitting layer **60** in the second opening **54**, wherein the light-emitting area proportion may be a percentage of a light-emitting area of a pixel region **51** to an area of the pixel region **51**, and the light-emitting area may be a contact area between the organic light-emitting layer **60** and the first anode **411** or the second anode **421** in each of the pixel regions **51**.

The cathode layer **70** may be completely covered on the organic light-emitting layer **60** and the pixel definition layer **50**. The encapsulation layer **80** may be arranged on the cathode layer **70**, for packaging and finally forming the organic light-emitting display panel B.

In this embodiment, the thickness of the organic light-emitting layer **60** in the first opening **52** and the thickness of the organic light-emitting layer **60** in the second opening **54** may be different. However, it should be ensured that the depths of the first opening **52** and the second opening **54** are larger than the minimum thickness of the organic light-emitting layer **60** required for normal light-emission. Thus, after the depth of the second opening **54** is reduced, the organic light-emitting layer **60** in the second opening **54** may emit light normally and hereby achieve the normal function of the organic light-emitting layer **60**.

Further, in this embodiment, the first opening **52** and the second opening **54** may be alternately disposed within at least part of the pixel regions **51**. Specifically, when the first anode layer **41** is disposed on the planarization layer **30**, the first anodes **411** may be disposed within at least part of the pixel regions **51** at interval of one metal line **21**. The first openings **52** may be formed in the pixel regions **51** corresponding to the first anodes **411**, so the pixel regions **51** provided with the first openings **52** may be the same as the pixel regions **51** provided with the first anodes **411**. This may cause the first openings **52** to be disposed in at least part of the pixel regions **51** at interval of one pixel area **51**. The second openings **54** may be disposed in the pixel regions **51** where the first openings **52** are not provided, causing the first openings **52** and the second openings **54** to be alternately arranged in at least part of the pixel regions **51**.

Referring to FIG. **2**, assuming that a single pixel region is a square with a side length of D, the inclination angle between the side wall and the bottom surface in the opening **051** is θ, and the depth of the opening **051** is L, it may be calculated that the area of the single pixel region is:

$$S=D^2 \quad (1).$$

The organic light-emitting layer **06** contacts with the anode layer **04**, so the light-emitting area S1 is:

$$S1=[D-2L\tan(\theta-90°)]^2 \quad (2).$$

A light-emitting area proportion of the organic light-emitting layer **06** is:

$$\gamma = S1/S = \frac{[D-2L\tan(\theta-90°)]^2}{D^2}. \quad (3)$$

From this, it may be seen that the light-emitting area proportion of the organic light-emitting layer **06** relates to the area of the single pixel region, the depth of the opening **051**, and the inclination angle θ.

Referring to FIGS. **3** and **4**, in this embodiment, the area of the first pixel region **511** where the first opening **52** is disposed may be equal to the area of the second pixel region **512** where the second opening **54** is disposed, and the inclination angle between the side wall and the bottom surface in the first opening **52** may be equal to the inclination angle between the side wall and the bottom surface in the second opening **54**, i.e., $D_1=D_2$, and $\theta_1=\theta_2$. The depth of the second opening **54** may be smaller than the depth of the first opening **52**, i.e., $L_1>L_2$. According to the equation (2), it may be seen that the light-emitting area **412** in the first pixel region **511** may be smaller than the light-emitting area **422** in the second pixel region **512**. According to the equation (3), it may be obtained that the light-emitting area proportion of the organic light-emitting layer **60** in the first opening **52** may be smaller than the light-emitting area proportion of the organic light-emitting layer **60** in the second opening **54**, i.e., $\gamma_1 \leq \gamma_2$.

From this, it may be seen that in the pixel regions **51** having the same areas, since the depth of the second opening **54** is smaller than the depth of the first opening **52**, the light-emitting area **422** of the organic light-emitting layer **60** provided in the second opening **54** may be larger than the light-emitting area **412** of the organic light-emitting layer **60** provided in the first opening **52**. Thus, the non-luminous area between the first pixel region **511** provided in the first opening **52** and the adjacent second pixel region **512** provided in the second opening **54** may be reduced, and the resolution may be increased.

In another embodiment, the area of the first pixel region **511** where the first opening **52** is disposed may be equal to the area of the second pixel region **512** where the second opening **54** is disposed, the depth of the second opening **54** may be smaller than the depth of the first opening **52**, and the inclination angle between the side wall and the bottom surface in the second opening **54** may be smaller than the inclination angle between the side wall and the bottom surface in the first opening **52**. That is to say, $L_1>L_2$, and $\theta_1>\theta_2$. Then, it may be seen that $\gamma_1<\gamma_2$ according the following equation:

$$\gamma = S1/S = \frac{[D - 2L\tan(\theta - 90°)]^2}{D^2}.$$

Therefore, it may be seen that, when the area of the first pixel region **511** where the first opening **52** is disposed and the area of the second pixel region **512** where the second opening **54** is disposed are equal, and the depth of the second opening **54** is smaller than the depth of the first opening **52**, the smaller the inclination angle θ between the side wall and the bottom surface, the higher the light-emitting area proportion of the organic light-emitting layer **60**, and the higher the resolution of the organic light-emitting display panel B.

Referring to FIGS. **5** and **6**, FIG. **5** is a schematic sectional view of an organic light-emitting display panel according to a second embodiment of the present disclosure; and, FIG. **6** is a schematic view of two pixel regions according to the second embodiment of the present disclosure, for comparing with the single pixel region of the conventional organic light-emitting display panel.

In this embodiment, a contact area between the organic light-emitting layer **60** in the first opening **52** and the first anode **411** may be equal to a contact area between the organic light-emitting layer **60** in the second opening **54** and the second anode **421**.

Specifically, because the contact area between the organic light-emitting layer **60** and the first anode **411** and the contact area between the organic light-emitting layer **60** and the second anode **421** may be equal, the light-emitting areas may be equal.

As noted above, the light-emitting area proportion of the organic light-emitting layer may be defined according to the below equation:

$$\gamma = S1/S = \frac{[D - 2L\tan(\theta - 90°)]^2}{D^2}.$$

Based on this equation, when the inclination angle θ between the side wall and the bottom surface in the first opening **52** is equal to the inclination angle θ between the side wall and the bottom surface in the second opening **54**, and the depth of the first opening **52** is larger than the depth of the second opening **54**, the area of the second pixel region **512** must be reduced in order to ensure that the light-emitting area proportion of the organic light-emitting layer **60** in the second opening **54** is higher than the light-emitting area proportion of the organic light-emitting layer **60** in the first opening **52**.

Therefore, in this embodiment, it may be seen that when the depth of the second opening **54** is smaller than the depth of the first opening **52** and the light-emitting areas of the pixel regions **51** are equal, a spacing between adjacent pixel areas **51** may be reduced by disposing the second pixel region **512** having an area smaller than that of the first pixel region **511**. Accordingly, a distance between adjacent pixel points may be shortened, and resolution of the organic light-emitting display panel B may be improved.

The above mentioned embodiments may have the following advantages: by forming the first opening **52** and the second opening **54** with different depths (i.e., the depth of the second opening **54** may be smaller than that of the first opening **52**) in the pixel regions **51** of the pixel definition layer **50** and forming the inclination angle between the side wall and the bottom surface in the first opening **52** and the inclination angle between the side wall and the bottom surface in the second opening **54** (wherein the inclination angles are larger than 90° and smaller than 180°), the light-emitting area proportion in the second opening **54** may be larger than the light-emitting area proportion in the first opening **52**. The light-emitting area proportion may be the percentage of the contact area between the organic light-emitting layer **60** in each pixel region **51** and the first anode **411** (or the second anode **421**) to the area of the pixel region **51**. Therefore, by increasing light-emitting area proportion in the pixel region **51** of the second opening **54**, the light-emitting area of the entire display panel B may be increased. Accordingly, the resolution of the organic light-emitting display panel B may be improved.

Referring to FIG. **7**, a schematic view of an overall structure of an organic light-emitting display panel according to an embodiment of the present disclosure is shown.

In this embodiment, the pixel regions may be arranged, but not limited to, in an array structure as shown in FIG. **7** or in a diamond structure.

The present disclosure also provides a manufacturing method of the organic light-emitting display panel B. Referring to FIG. **8**, FIG. **8** is a schematic flowchart of a manufacturing method of the organic light-emitting display panel according to an embodiment of the present disclosure. The manufacturing method may be described below referring to FIGS. **2-7**.

At block S**10**: the first anode layer **41** may be formed, and the first anode layer **41** may include a plurality of first anodes **411**.

The material of the first anode layer **41** may be a pure metal such as copper, silver, aluminum, etc., or an alloy made of copper and one or more of iron, silver, zinc, nickel, aluminum, magnesium, etc.

The first anode layer **41** including the plurality of first anodes **411** may be formed by exposing, developing and etching a complete anode layer via a mask with a specific electrode pattern.

At block S**20**: the pixel definition layer **50** may be formed on the first anode layer **41**, and the plurality of pixel regions

51 may be defined on the pixel definition layer 50. The first opening 52 or the second opening 54 may be formed in each of the pixel regions 51. The inclination angle larger than 90° and smaller than 180° may be formed between the side wall and the bottom surface in the first opening 52, and the inclination angle larger than 90° and smaller than 180° may be formed between the side wall and the bottom surface in the second opening 54. The first opening 52 may be formed in the pixel region 51 corresponding to the first anode 411, and expose part of the first anode 411. The depth of the second opening 54 may be smaller than the depth of the first opening 52.

A method for forming the first opening 52 or the second opening 54 in the pixel region 51 of the pixel definition layer 50 may include: forming the first opening 52 in the pixel region 51 corresponding to the first anode 411 by etching, wherein the first opening 52 may extend to the first anode 411 and expose the first anode 411; forming the second opening 54 between the pixel regions 51 of at least some adjacent first openings 52 by etching, wherein the depth of the second opening 54 may be smaller than the depth of the first opening 52.

Further, the second opening 54 having a smaller depth than the first opening 52 may be obtained by controlling the etching time of the first opening 52 to be greater than the etching time of the second opening 54. In other embodiments, the first opening 52 and the second opening 54 may also be formed by other implementation manners. However, it should be ensured that the sidewall and the bottom surface in the first opening 52 form the inclination angle, and the sidewall and the bottom surface in the second opening 54 form the inclination angle, and the inclination angles are larger than 90° and smaller than 180°.

At block S30: the second anode 421 may be formed in the second opening 54.

The material and the property of the second anode 421 may be completely the same with those of the first anode 411, and will not be repeated here.

At block S40: the organic light-emitting layer 60 may be formed in the first opening 52 and the second opening 54, and the light-emitting area proportion of the organic light-emitting layer 60 in the first opening 52 may be smaller than the light-emitting area proportion of the organic light-emitting layer 60 in the second opening 54, wherein the light-emitting area proportion may be the percentage of the light-emitting area of the pixel region 51 to the area of the pixel region 51, and the light-emitting area may be the contact area between the organic light-emitting layer 60 and the first anode 411 or the second anode 421 in each of the pixel regions 51.

The organic light-emitting layer 60 may be made of an organic photoresist material. The regions where the organic light-emitting layer 60 contacts with the first anodes 411 and the second anodes 421 may be display regions, and the non-contact regions may be non-display regions. In this embodiment, the first pixel region 511 with the first opening 52 and the second pixel region 512 with the second opening 54 have the same area, and the inclination angle between the side wall and the bottom surface in the first opening 52 may be equal to the inclination angle between the side wall and the bottom surface in the second opening 54, while the depth of the second opening 54 may be smaller than the depth of the first opening 52. This may cause the contact area between the organic light-emitting layer 60 in the first opening 52 and the first anode 411 to be smaller than the contact area between the organic light-emitting layer 60 in the second opening 54 and the second anode 421. Accordingly, the light-emitting area proportion of the first opening 52 may be lower than the light-emitting area proportion of the second opening 54.

In another embodiment, the first pixel region 511 with the first opening 52 and the second pixel region 512 with the second opening 54 may have the same area, and the inclination angle between the side wall and the bottom surface in the first opening 52 may be larger than the inclination angle between the side wall and the bottom surface in the second opening 54, and the depth of the second opening 54 may be smaller than the depth of the first opening 52. This may cause the contact area between the organic light-emitting layer 60 in the first opening 52 and the first anode 411 to be smaller than the contact area between the organic light-emitting layer 60 in the second opening 54 and the second anode 421. Accordingly, the light-emitting area proportion of the first opening 52 may be lower than the light-emitting area proportion of the second opening 54.

In a further embodiment, the contact area between the organic light-emitting layer 60 in the first opening 52 and the first anode 411 may be equal to the contact area between the organic light-emitting layer 60 in the second opening 54 and the second anode 421, while the depth of the second opening 54 may be smaller than the depth of the first opening 52. This may cause the area of the first pixel region 511 where the first opening 52 is disposed to be larger than the area of the second pixel region 512 where the second opening 54 is disposed. Accordingly, the light-emitting area proportion of the first opening 52 may be lower than the light-emitting area proportion of the second opening 54.

The descriptions above are merely the embodiments of the present disclosure, and are not intended to limit the protection scope of the present disclosure. In fact, one skilled in the art may make many equivalents and modifications based on the specification and the drawings of the present disclosure, or directly or indirectly apply the technical solution to other relevant technical field. All these shall all be covered within the protection of the disclosure.

What is claimed is:

1. An organic light-emitting display panel, comprising:

a first anode layer, comprising a plurality of patterned first anodes;

a pixel definition layer, arranged on the first anode layer, wherein the pixel definition layer defines a plurality of pixel regions, one of a first opening and a second opening is defined in each of the pixel regions, each of the pixel regions comprises a side wall and a bottom surface in each first opening and each second opening, an inclination angle is formed between the side wall and the bottom surface, the inclination angle is larger than 90° and smaller than 180°, the first opening is configured to correspond to the first anode and expose the first anode, and the second opening has a depth smaller than that of first opening;

a second anode layer, comprising a plurality of patterned second anodes, wherein the second anode is arranged in the second opening;

an organic light-emitting layer, arranged in the first opening and the second opening, wherein a light-emitting area proportion in the first opening is smaller than a light-emitting area proportion in the second opening, the light-emitting area proportion is a percentage of a light-emitting area of a pixel region to an area of the pixel region, and the light-emitting area is a contact area between the organic light-emitting layer and the first anode or the second anode in each of the pixel regions;

wherein a contact area between the organic light-emitting layer in the first opening and the first anode is equal to a contact area between the organic light-emitting layer in the second opening and the second anode.

2. The organic light-emitting display panel as described in claim **1**, wherein at least part of the first openings and the second openings are alternately arranged.

3. The organic light-emitting display panel as described in claim **1**, wherein the pixel regions comprise a first pixel region where the first opening is disposed and a second pixel region where the second opening is disposed, an area of the first pixel region is equal to an area of the second pixel region, and the inclination angle between the side wall and the bottom surface in the first opening is equal to the inclination angle between the side wall and the bottom surface in the second opening.

4. The organic light-emitting display panel as described in claim **1**, wherein the inclination angle between the side wall and the bottom surface in the first opening is equal to or larger than the inclination angle between the side wall and the bottom surface in the second opening.

5. The organic light-emitting display panel as described in claim **1**, wherein the organic light-emitting display panel further comprises:

a substrate;

a metal layer arranged on the substrate, comprising a plurality of patterned metal wires;

a planarization layer arranged on the metal layer, wherein a plurality of first through holes is formed in the planarization layer; the first anode layer being arranged on the planarization layer, and the first anode being electrically connected with the metal wire via the first through hole;

a plurality of second through holes, arranged at the bottom in the second opening and extending to the metal layer; the second anode layer being electrically connected with the metal wire via the second through holes;

a cathode layer, completely covered on the organic light-emitting layer and the pixel definition layer; and

an encapsulation layer, arranged on the cathode layer, for packaging and forming the organic light-emitting display panel.

6. The organic light-emitting display panel as described in claim **1**, wherein the pixel regions comprise a first pixel region where the first opening is disposed and a second pixel region where the second opening is disposed, an area of the first pixel region is equal to an area of the second pixel region, and the inclination angle between the side wall and the bottom surface in the first opening is larger than the inclination angle between the side wall and the bottom surface in the second opening.

7. The organic light-emitting display panel as described in claim **1**, wherein the plurality of pixel regions is arranged in an array structure.

8. An organic light-emitting display panel, comprising:

a first anode layer, comprising a plurality of patterned first anodes;

a pixel definition layer, arranged on the first anode layer, wherein the pixel definition layer defines at least a first pixel region and a second pixel region adjacent to the first pixel region, a first opening is defined in the first pixel region, a second opening is defined in the second pixel region, an obtuse angle is formed between a side wall and a bottom surface in the first opening and an obtuse angle is formed between a side wall and a bottom surface in the second opening, the second opening has a depth smaller than that of first opening such that the bottom surface in the second opening is higher than the bottom surface of the first opening;

a second anode layer, comprising a plurality of patterned second anodes, wherein the second anode is arranged in the second opening;

an organic light-emitting layer, arranged in the first opening and the second opening, wherein the organic light-emitting layer in the first opening contacts the first anode, and the organic light-emitting layer in the second opening is disposed on the second anode and contacts the second anode;

wherein a contact area between the organic light-emitting layer in the first opening and the first anode is equal to a contact area between the organic light-emitting layer in the second opening and the second anode.

9. The organic light-emitting display panel as described in claim **8**, wherein an area of the first pixel region is equal to an area of the second pixel region, and the obtuse angle between the side wall and the bottom surface in the first opening is equal to or larger than the obtuse angle between the side wall and the bottom surface in the second opening.

10. The organic light-emitting display panel as described in claim **8**, wherein the obtuse angle between the side wall and the bottom surface in the first opening is equal to the obtuse angle between the side wall and the bottom surface in the second opening.

11. The organic light-emitting display panel as described in claim **8**, further comprising:

a substrate;

a metal layer arranged on the substrate, comprising a plurality of patterned metal wires;

a planarization layer arranged on the metal layer, wherein a plurality of first through holes is formed in the planarization layer;

the first anode layer being arranged on the planarization layer, and the first anode being electrically connected with the metal wire via the first through hole;

a plurality of second through holes, arranged at the bottom of the second opening and extending to the metal layer; the second anode layer being electrically connected with the metal wire via the second through holes;

a cathode layer, completely covered on the organic light-emitting layer and the pixel definition layer; and

an encapsulation layer, arranged on the cathode layer, for packaging and forming the organic light-emitting display panel.

12. The organic light-emitting display panel as described in claim **8**, wherein the pixel definition layer defines a plurality of pixel regions, and the plurality of pixel regions is arranged in an array structure.

13. A manufacturing method of an organic light-emitting display panel, comprising:

forming a first anode layer, wherein the first anode layer comprises a plurality of first anodes;

forming a pixel definition layer on the first anode layer, and defining a plurality of pixel regions on the pixel definition layer, wherein one of a first opening and a second opening is defined in each of the pixel regions, each of the pixel regions comprises a side wall and a bottom surface in each first opening and each second opening, an inclination angle is formed between the side wall and the bottom surface, the inclination angle is larger than 90° and smaller than 180°, the first opening is configured to correspond to the first anode and expose the first anode, and the second opening has a depth smaller than that of first opening;

forming a second anode in the second opening; and forming an organic light-emitting layer in the first opening and the second opening, wherein a light-emitting area proportion in the first opening is smaller than a light-emitting area proportion in the second opening, the light-emitting area proportion is a percentage of a light-emitting area of a pixel region to an area of the pixel region, and the light-emitting area is a contact area between the organic light-emitting layer and the first anode or the second anode in each of the pixel regions;

wherein a contact area between the organic light-emitting layer in the first opening and the first anode is equal to a contact area between the organic light-emitting layer in the second opening and the second anode.

14. The manufacturing method as described in claim **13**, wherein the second opening having a smaller depth than the first opening is formed by controlling the etching time of the first opening to be greater than the etching time of the second opening.

15. The manufacturing method as described in claim **13**, wherein the pixel regions comprise a first pixel region where the first opening is disposed and a second pixel region where the second opening is disposed, an area of the first pixel region is equal to an area of the second pixel region, and the inclination angle between the side wall and the bottom surface in the first opening is equal to the inclination angle between the side wall and the bottom surface in the second opening.

16. The manufacturing method as described in claim **13**, wherein the pixel regions comprise a first pixel region where the first opening is disposed and a second pixel region where the second opening is disposed, an area of the first pixel region is equal to an area of the second pixel region, and the inclination angle between the side wall and the bottom surface in the first opening is larger than the inclination angle between the side wall and the bottom surface in the second opening.

17. The manufacturing method as described in claim **13**, wherein the inclination angle between the side wall and the bottom surface in the first opening is equal to or larger than the inclination angle between the side wall and the bottom surface in the second opening.

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专利名称(译)	有机发光显示面板及其制造方法		
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摘要(译)

本公开提供了一种有机发光显示面板及其制造方法。 该有机发光显示面板可以包括:第一阳极层,其包括多个第一阳极;以及第二阳极层。 像素定义层,其定义了多个像素区域,其中,在每个像素区域中定义有第一开口和第二开口中的一个,所述第二开口的深度小于所述第一开口的深度,所述第二开口之间形成倾斜角。 侧壁和底面,倾斜角大于90°且小于180°。 布置在第二开口中的第二阳极层; 有机发光层布置在第一开口和第二开口中。 因此,提高了有机发光显示面板的分辨率。