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(54) **OLED PACKAGE SUBSTRATE, MANUFACTURING METHOD THEREOF, OLED DISPLAY PANEL**

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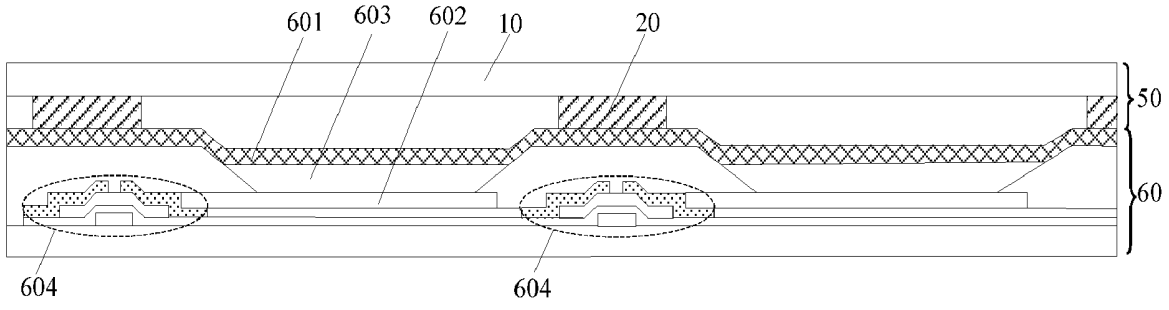
(57) **ABSTRACT**

Embodiments of the present disclosure provide an OLED package substrate, a manufacturing method thereof, and an OLED display panel. The OLED package substrate comprises a display area and a non-display area, the display area comprising a pixel definition area. The OLED package substrate comprises a base substrate, and a conductor on the base substrate and within the pixel definition area. The conductor is configured to be in contact with a cathode or an anode at a surface of an array substrate for assembly with the OLED package substrate.



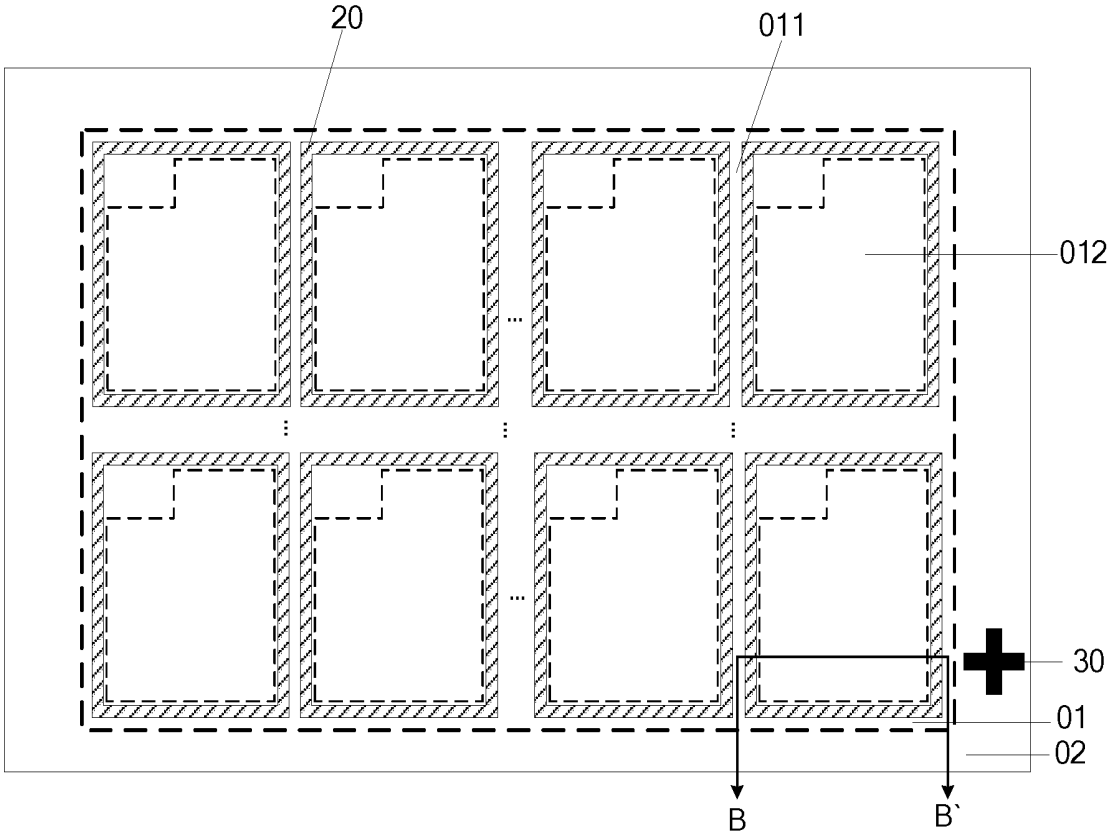


Fig.1

Fig.2

Fig.3

Fig.4A

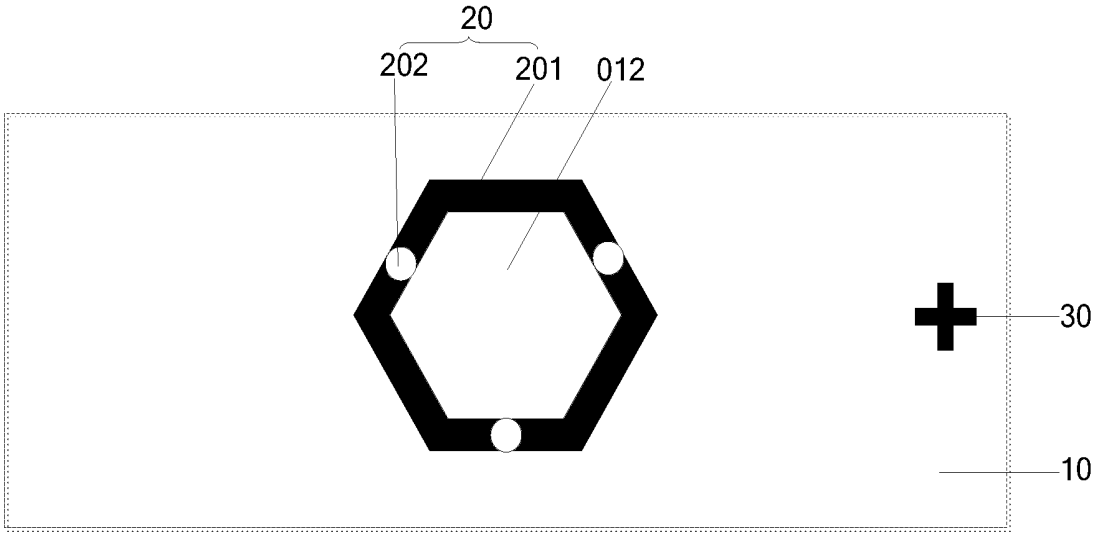


Fig.4B

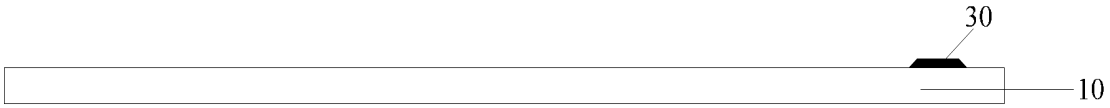


Fig.5

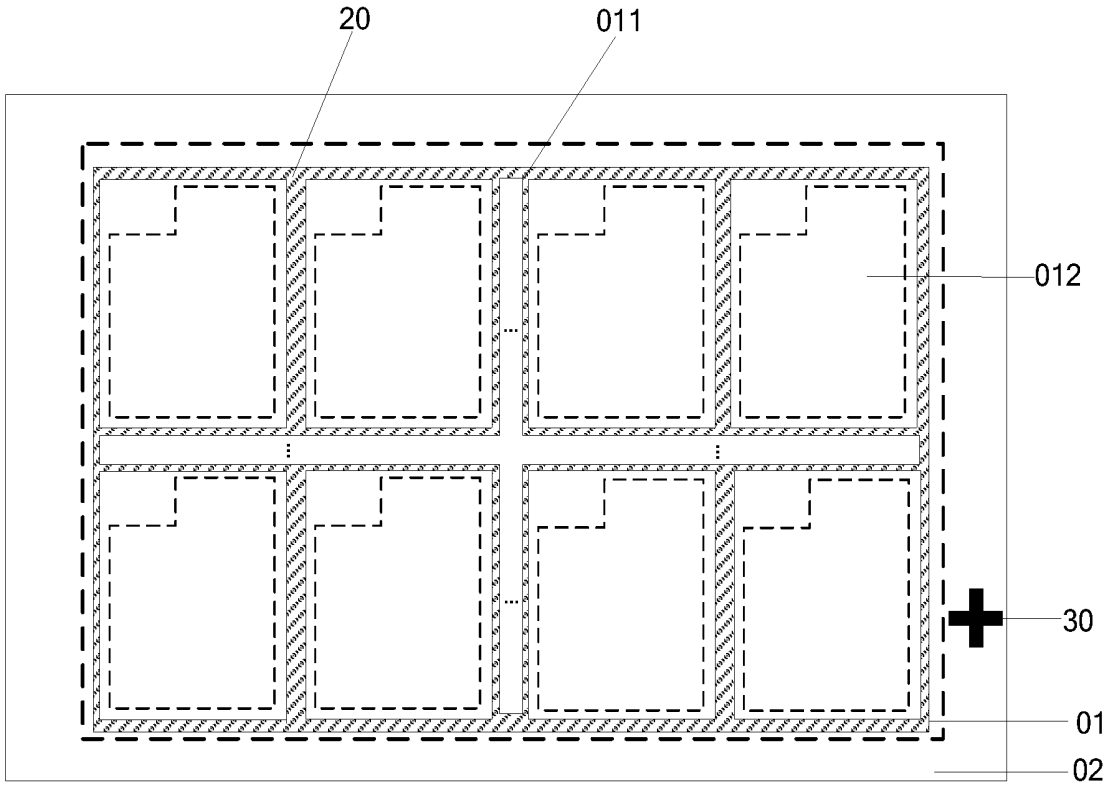
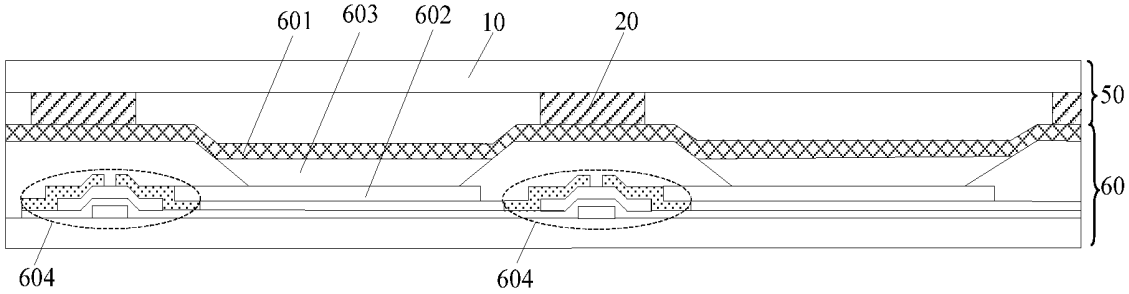


Fig.6

Fig.7


601
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604
604

Fig.8

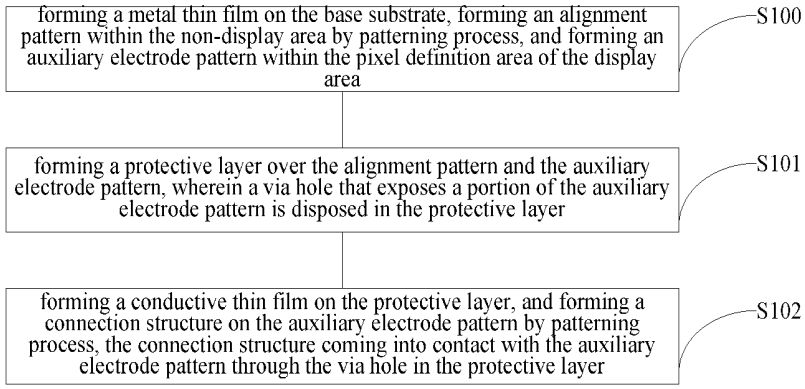
forming a metal thin film on the base substrate, forming an alignment pattern within the non-display area by patterning process, and forming an auxiliary electrode pattern within the pixel definition area of the display area
S100
forming a protective layer over the alignment pattern and the auxiliary electrode pattern, wherein a via hole that exposes a portion of the auxiliary electrode pattern is disposed in the protective layer
S101
forming a conductive thin film on the protective layer, and forming a connection structure on the auxiliary electrode pattern by patterning process, the connection structure coming into contact with the auxiliary electrode pattern through the via hole in the protective layer
S102

Fig.9

OLED PACKAGE SUBSTRATE, MANUFACTURING METHOD THEREOF, OLED DISPLAY PANEL

RELATED APPLICATION

[0001] The present application claims the benefit of Chinese Patent Application No. 201610822682.3, filed on Sep. 13, 2016, the entire disclosure of which is incorporated herein by reference as a part of the present application.

FIELD

[0002] The present disclosure relates to the field of display technology, and particularly to an OLED package substrate, a manufacturing method thereof, and an OLED display panel.

BACKGROUND

[0003] At present, organic light emitting diode (OLED) display devices have been more and more widely used due to their characteristics such as being self-luminous, having a wide viewing angle and a fast response speed, capable of being flexible, and the like.

[0004] In OLED display devices, the top emission structure is the most commonly used structure. A structure of an OLED display device may include, for example, a metal anode, a metal cathode, and an organic material functional layer located therebetween. The organic material functional layer includes a light emitting layer. Taking the case where the metal cathode is disposed at a light emergent side of the OLED display device as an example, light emitted by the light emitting layer would be emitted from the cathode side. In order to reduce the loss of emergent light, in general, the thickness of a metal layer for making the cathode is just a few nanometers to several tens of nanometers. In most cases, the thickness of the metal layer for making the cathode is 20 nm or less.

[0005] It can be seen that, due to the small thickness of the cathode, the cathode often becomes a portion with the largest resistance in the entire OLED display device. During a process of driving the OLED display device to emit light, there is a large voltage drop across the large resistance of the cathode portion. According to the electric power formula $P=I^2R$, the cathode portion consumes a large amount of power under a fixed current, causing an increase in the power consumption of the OLED display device. As a result, the cathode generates heat and thus affects the operation of the OLED display device, resulting in poor characteristics and shortened lifetime of the OLED display device.

SUMMARY

[0006] According to an aspect, an embodiment of the present disclosure provides an OLED package substrate. The OLED package substrate comprises a display area and a non-display area, the display area comprising a pixel definition area. The OLED package substrate comprises: a base substrate, and a conductor on the base substrate and within the pixel definition area. The conductor is configured to be in contact with a cathode or an anode at a surface of an array substrate for assembly with the OLED package substrate.

[0007] According to another embodiment, the conductor comprises: an auxiliary electrode pattern; and a connection structure which is disposed on and in contact with the auxiliary electrode pattern. The connection structure is configured to be in contact with the cathode or anode.

[0008] According to another embodiment, the OLED package substrate further comprises an alignment pattern in the non-display area. The alignment pattern and the auxiliary electrode pattern are located in the same layer and formed of the same material.

[0009] According to another embodiment, the display area further comprises a plurality of sub-pixel areas defined by the pixel definition area, and the auxiliary electrode pattern is of a mesh structure, each mesh in the mesh structure corresponding to one sub-pixel area.

[0010] According to another embodiment, the display area further comprises a plurality of sub-pixel areas defined by the pixel definition area, and the auxiliary electrode pattern includes a plurality of sub-auxiliary electrode patterns, each sub-auxiliary electrode pattern enclosing one sub-pixel area.

[0011] According to another embodiment, the OLED package substrate further comprises a protective layer covering the auxiliary electrode pattern, wherein a via hole is disposed in the protective layer, and the connection structure comes into contact with the auxiliary electrode pattern through the via hole in the protective layer.

[0012] According to another embodiment, the display area further comprises a plurality of sub-pixel areas defined by the pixel definition area, and the auxiliary electrode pattern is of a mesh structure, each mesh in the mesh structure corresponding to one sub-pixel area. The OLED package substrate further comprises a protective layer covering the auxiliary electrode pattern, and a plurality of via holes are disposed in the protective layer over the auxiliary electrode pattern that encloses each mesh. The connection structure comprises multiple connection posts, each connection post is in contact with the auxiliary electrode pattern through a corresponding via hole, and the auxiliary electrode pattern that encloses each mesh is in contact with the cathode or anode at the surface of the array substrate via corresponding multiple connection posts.

[0013] According to another embodiment, the display area further comprises a plurality of sub-pixel areas defined by the pixel definition area, and the auxiliary electrode pattern includes a plurality of sub-auxiliary electrode patterns, each sub-auxiliary electrode pattern enclosing one sub-pixel area. The OLED package substrate further comprises a protective layer covering the auxiliary electrode pattern, and a plurality of via holes are disposed in the protective layer over each sub-auxiliary electrode pattern. The connection structure comprises multiple connection posts, each connection post is in contact with a corresponding sub-auxiliary electrode pattern through a corresponding via hole, and each sub-auxiliary electrode pattern is in contact with the cathode or anode at the surface of the array substrate via corresponding multiple connection posts.

[0014] According to another embodiment, a height of the connection structure is 0.05 μm to 100 μm.

[0015] According to another embodiment, the connection structure is formed of a transparent conductive material.

[0016] According to another aspect, an embodiment of the present disclosure provides an OLED display panel comprising a package substrate and an array substrate assembled with each other, wherein the array substrate comprises a cathode or an anode formed at a surface thereof, and the package substrate is the OLED package substrate described above.

[0017] According to a further aspect, an embodiment of the present disclosure provides a method of manufacturing an OLED package substrate, the OLED package substrate comprising a display area and a non-display area, the display area comprising a pixel definition area. The method comprises: providing a base substrate; and forming a conductor on the base substrate. The conductor is within the pixel definition area, and the conductor is configured to be in contact with a cathode or anode at a surface of an array substrate for assembly with the OLED package substrate.

[0018] According to another embodiment, the conductor comprises: an auxiliary electrode pattern; and a connection structure which is disposed on and in contact with the auxiliary electrode pattern. Forming a conductor on the base substrate comprises: forming a metal thin film on the base substrate, forming an auxiliary electrode pattern within the pixel definition area of the display area by patterning process, and forming a connection structure on the auxiliary electrode pattern by patterning process.

[0019] According to another embodiment, the method of manufacturing an OLED package substrate further comprises: forming an alignment pattern within the non-display area while forming the auxiliary electrode pattern within the pixel definition area of the display area by patterning process.

[0020] According to another embodiment, the method of manufacturing an OLED package substrate further comprises: after forming the auxiliary electrode pattern within the pixel definition area of the display area by patterning process and forming the alignment pattern in the non-display area, forming a protective layer over the alignment pattern and the auxiliary electrode pattern, wherein a via hole that exposes a portion of the auxiliary electrode pattern is disposed in the protective layer. Forming a connection structure on the auxiliary electrode pattern by patterning process comprises: forming a conductive thin film on the protective layer, and forming a connection structure on the auxiliary electrode pattern by patterning process, the connection structure being in contact with the auxiliary electrode pattern through the via hole in the protective layer.

BRIEF DESCRIPTION OF DRAWINGS

[0021] To illustrate embodiments of the present disclosure more clearly, the accompanying drawings required for describing the embodiments will be briefly introduced below. Obviously, the drawings in the description below are merely some embodiments of the present disclosure. For those ordinarily skilled in the art, other drawings may also be obtained based on these drawings without spending inventive efforts.

[0022] FIG. **1** is a schematic view showing a planar structure of an OLED package substrate provided by embodiments of the present disclosure;

[0023] FIG. **2** is a schematic sectional view taken along a direction BB' in FIG. **1**;

[0024] FIG. **3** is a schematic structural view of another OLED package substrate provided by embodiments of the present disclosure;

[0025] FIG. **4**A is a schematic structural view of another OLED package substrate comprising an alignment pattern and a conductor as provided by embodiments of the present disclosure;

[0026] FIG. **4**B is a schematic view showing a planar structure of another OLED package substrate comprising an alignment pattern and a conductor as provided by embodiments of the present disclosure;

[0027] FIG. **5** is a schematic view of forming an alignment pattern on a base substrate as provided by the prior art;

[0028] FIG. **6** is a schematic view showing a planar structure of an auxiliary electrode pattern provided by embodiments of the present disclosure;

[0029] FIG. **7** is a schematic structural view of another OLED package substrate provided by embodiments of the present disclosure;

[0030] FIG. **8** is a schematic structural view of an OLED display panel provide by embodiments of the present disclosure;

[0031] FIG. **9** is a schematic flow chart illustrating a specific example of a method of manufacturing an OLED package substrate as provided by embodiments of the present disclosure.

DETAILED DESCRIPTION

[0032] Technical solutions in embodiments of the present disclosure will be clearly and completely described below with reference to the accompanying drawings in the embodiments of the present disclosure. Obviously, the described embodiments are merely a part but not all of the embodiments of the present disclosure. All other embodiments obtained by those ordinarily in the art based on the embodiments of the present disclosure without spending inventive efforts fall within the protection scope of the present disclosure.

[0033] As described above, in an existing OLED display device, the cathode tends to become a portion with the largest resistance in the entire OLED display device. The inventors have found from research that, since the cathode at a surface of the array substrate in the OLED display device is usually in a form of an electrode with a relatively large area, when a voltage is applied at one end of the cathode, the current generated all over the cathode with a relatively large area would produce great power consumption due to the resistance of the cathode. Moreover, due to the resistance generated by the cathode with a relatively large area, when a voltage is applied at one end of the cathode, the voltage generated at the other end of the cathode often differs from the applied voltage. In addition, this problem also arises in the case where the anode with a relatively large area is located at a surface of the array substrate.

[0034] In view of this cognition, the inventors propose an OLED package substrate. The OLED package substrate comprises a display area and a non-display area. The display area comprises a pixel definition area. The OLED package substrate may comprise a base substrate, and a conductor on the base substrate and in the pixel definition area. The conductor is configured to be in contact with a cathode or an anode at a surface of an array substrate for assembly with the OLED package substrate.

[0035] Since the conductor is disposed on the OLED package substrate, when the OLED package substrate is assembled with the array substrate, the conductor can contact the anode or cathode located at the surface of the array substrate. This gives a resistor in parallel to the anode or cathode located at the surface of the array substrate. As a result, the resistance of the anode or cathode located at the surface of the array substrate is reduced, thereby avoiding the large power consumption caused by the anode or cath-

ode. This can reduce the overall power consumption of the OLED display device, improve the characteristics of the OLED display device, and prolong the service lifetime thereof.

[0036] More specifically, embodiments of the present disclosure provide an OLED package substrate. As shown in FIG. **1**, the OLED package substrate comprises a display area **01** and a non-display area **02**. The display area (or, active area (AA)) **01** comprises a pixel definition area **011**. As shown in FIG. **1** and FIG. **2**, the OLED package substrate comprises: a base substrate **10**; and a conductor **20** disposed on the base substrate **10** and located in the pixel definition area **011**. The conductor **20** is configured to be in contact with a cathode or an anode located at a surface of an array substrate for assembly with the OLED package substrate.

[0037] It is to be noted that, firstly, the display area **01** of the OLED package substrate, the non-display area **02** thereof, the pixel definition area **011** thereof, and a sub-pixel area **012** defined by the pixel definition area **011** are all divided according to corresponding areas of the array substrate for assembly with the OLED package substrate, or divided according to corresponding areas of an OLED display panel comprising the OLED package substrate and the array substrate. There is no physical boundary for these areas on the OLED package substrate.

[0038] Secondly, the type of the array substrate for assembly with the OLED package substrate is not limited. The array substrate may be a Passive Matrix Driving OLED (PMOLED) array substrate or a Active Matrix Driving OLED (AMOLED) array substrate. When the array substrate for assembly with the OLED package substrate is a PMOLED array substrate, an electrode at the surface of the array substrate may be an anode or a cathode. When the array substrate for assembly with the OLED package substrate is an AMOLED array substrate, the electrode at the surface of the array substrate is typically a cathode.

[0039] Thirdly, the pixel definition area **011** is an area to which a pixel definition layer on the array substrate for assembly with the OLED package substrate corresponds. That is, the pixel definition area **011** corresponds to a non-light emitting area in a display area of the array substrate.

[0040] Fourthly, the shape and size of the conductor **20** are not limited, as long as the conductor **20** can contact the cathode or anode located at the surface of the array substrate for assembly with the OLED package substrate. The conductor **20** may enclose the sub-pixel area **012** defined by the pixel definition area **011**, or may not enclose the sub-pixel area **012**. FIG. **1** illustrates the case where the conductor **20** encloses the sub-pixel area **012**. The material of the conductor **20** is not limited, as long as the material can reduce the resistance of the anode or cathode located at the surface of the array substrate after the conductor **20** contacts the anode or cathode.

[0041] Fifthly, the material of the base substrate **10** is not limited. It should be understood by those skilled in the art that, for a top emission type OLED display device, in order not to affect normal emission of the light emitted by a light emitting layer, the OLED package substrate should be transparent. The base substrate **10** may also be transparent. For example, the base substrate **10** may be made of glass.

[0042] An embodiment of the present disclosure provides an OLED package substrate. Since the conductor **20** is disposed on the OLED package substrate, when the OLED package substrate is assembled with the array substrate, the conductor **20** can contact the anode or cathode located at the surface of the array substrate. This gives a resistor in parallel to the anode or cathode located at the surface of the array substrate. As a result, the resistance of the anode or cathode located at the surface of the array substrate is reduced, thereby avoiding the large power consumption caused by the anode or cathode. This can reduce the overall power consumption of the OLED display device, improve the characteristics of the OLED display device and prolong the service lifetime thereof.

[0043] According to another embodiment, as shown in FIG. **3**, the conductor **20** comprises an auxiliary electrode pattern **201**; and a connection structure **202** disposed on and in contact with the auxiliary electrode pattern **201**. The connection structure **202** is configured to be in contact with the cathode or anode at the surface of the array substrate for assembly with the OLED package.

[0044] The shape and size of the auxiliary electrode pattern **201** are not limited. The shape of the auxiliary electrode pattern **201** may be, for example, a shape made up of a plurality of hexagons, a plurality of stars, a plurality of circles, or a plurality of other irregular shapes.

[0045] In addition, the material of the auxiliary electrode pattern **201** is not limited as long as the resistance of the anode or cathode of the array substrate can be reduced after the auxiliary electrode pattern **201** contacts the anode or cathode. The material of the auxiliary electrode pattern **201** may be a material with a smaller resistance. In this way, after the auxiliary electrode pattern **201** contacts the anode or cathode at the surface of the array substrate via the connection structure **202**, the resistance of the anode or cathode can be greatly reduced.

[0046] Exemplarily, the material of the auxiliary electrode pattern **201** may be at least one selected from the group comprising a metal element, a metal oxide and an alloy. The metal element may be, for example, Mo (molybdenum), Al (aluminum), Ag (silver), Cu (copper) or the like.

[0047] The material of the connection structure **202** is not limited. Since the conductive resin is transparent and has a smaller resistance, the material of the connection structure **202** may be a conductive resin. As for the height of the connection structure **202**, the connection structure **202** may contact the anode or cathode located at the surface of the array substrate at least after the OLED package substrate is assembled with the array substrate.

[0048] In this embodiment, the auxiliary electrode pattern **201** is connected to the anode or cathode located at the surface of the array substrate via the connection structure **202**. After the auxiliary electrode pattern **201** is connected to the anode or cathode located at the surface of the array substrate, the resistance of the anode or cathode can be reduced.

[0049] According to another embodiment, as shown in FIG. **1**, FIG. **4**A and FIG. **4**B, the OLED package substrate further comprises an alignment pattern **30** located in the non-display area **02**. The alignment pattern **30** and the auxiliary electrode pattern **201** are located in the same layer and formed of the same material.

[0050] In order to ensure precise alignment of the OLED package substrate with the array substrate during the assembling process, as shown in FIG. **5**, the alignment pattern **30** is usually fabricated on the OLED package substrate and the array substrate respectively. In this way, according to the

alignment pattern **30**, accurate alignment of the OLED package substrate with the array substrate can be ensured.

[0051] According to embodiments of the present disclosure, the OLED package substrate may be provided with an alignment pattern **30**, or provided with a plurality of alignment patterns **30**.

[0052] The alignment pattern **30** is generally formed of a metal material, for example, a metal such as Mo, Al, Ag, Cu and the like or an alloy. The alignment pattern **30** may generally have a thickness of 30 nm to 1000 nm. In addition, the shape of the alignment pattern **30** is not limited as long as the shape is convenient for alignment. For example, the alignment pattern **30** may be in a cross shape.

[0053] It is to be noted that, FIG. **4**B only illustrates a part of the OLED package substrate, rather than the entire OLED package substrate. In addition, FIG. **4**B illustrates an example in which the auxiliary electrode pattern **201** is hexagonal and encloses the sub-pixel area **012**.

[0054] In this embodiment, since the alignment pattern **30** and the auxiliary electrode pattern **201** are located in the same layer and formed of the same material, the auxiliary electrode pattern **201** can be fabricated while fabricating the alignment pattern **30**, thereby simplifying the manufacturing process of the OLED package substrate and improving the production efficiency.

[0055] According to another embodiment, as shown in FIG. **6**, the display area **01** further comprises a plurality of sub-pixel areas **012** defined by the pixel definition area **011**. The auxiliary electrode pattern **201** is of a mesh structure, and each mesh in the mesh structure corresponds to one sub-pixel area **012**.

[0056] According to another embodiment, as shown in FIG. **1**, the display area **01** further comprises a plurality of sub-pixel areas **012** defined by the pixel definition area **011**. The auxiliary electrode pattern **201** includes a plurality of sub-auxiliary electrode patterns, each sub-auxiliary electrode pattern enclosing one sub-pixel area **012**.

[0057] The shape of each mesh in the mesh structure or the shape of the sub-auxiliary electrode pattern is related to the shape of the sub-pixel area **012**. Exemplarily, as shown in FIG. **4**B, when the shape of the sub-pixel area **012** is a hexagon, the shape of each mesh or the shape of the sub-auxiliary electrode pattern may be a hexagon. In addition, the spacing between adjacent meshes in the mesh structure and the width of each sub-auxiliary electrode pattern are not limited. For example, the spacing between adjacent meshes in the mesh structure may be 2 μm to 1000 μm. The width of each sub-auxiliary electrode pattern may be 2 μm to 1000 μm.

[0058] In order to prevent the auxiliary electrode pattern **201** from affecting the light emitted by the sub-pixel area **012**, the auxiliary electrode pattern **201** should be spaced apart from the sub-pixel area **012** by a certain distance. According to another embodiment, the distance between the auxiliary electrode pattern **201** and the sub-pixel area **012** is 3 μm.

[0059] According to the above embodiment, regardless of whether the auxiliary electrode pattern **201** is of a mesh structure and each mesh in the mesh structure corresponds to one sub-pixel area **012**, or the auxiliary electrode pattern **201** includes a plurality of sub-auxiliary electrode patterns and each of the sub-auxiliary electrode patterns encloses one sub-pixel area **012**, a corresponding auxiliary electrode pattern **201** can be disposed around each sub-pixel area. In this way, not only the area of the auxiliary electrode pattern **201** is increased, but also the resistance of the anode or cathode located at the surface of the array substrate can be more uniformly reduced.

[0060] According to another embodiment, as shown in FIG. **7**, the OLED package substrate further comprises a protective layer **40** covering the auxiliary electrode pattern **201**. A via hole is disposed in the protective layer **40**. The connection structure **202** comes into contact with the auxiliary electrode pattern **201** through the via hole in the protective layer **40**.

[0061] The material of the protective layer **40** is not limited as long as it can seal the OLED package substrate during the assembling with the array substrate and does not affect emission of the light emitted by the light emitting layer on the array substrate. Exemplarily, the material of the protective layer **40** may be SiOx, SiNx, or a composite structure of them.

[0062] In addition, the protective layer **40** may be of a monolayer structure or a multilayer structure.

[0063] According to this embodiment, the protective layer **40** covering the auxiliary electrode pattern **201** is provided. The protective layer **40** can seal the package substrate and the array substrate when the OLED package substrate is assembled with the array substrate, thereby preventing the performance of the light emitting layer on the array substrate from being affected by entrance of oxygen or moisture.

[0064] According to another embodiment, the OLED package substrate further comprises a protective layer **40** covering the auxiliary electrode pattern **201**. A plurality of via holes are disposed in the protective layer **40** over the auxiliary electrode pattern **201** that encloses each mesh. Moreover, as shown in FIG. **7**, the connection structure **202** may comprise multiple connection posts, each of which comes into contact with the auxiliary electrode pattern through a corresponding via hole. The auxiliary electrode pattern **201** that encloses each mesh comes into contact with the anode or cathode at the surface of the array substrate via corresponding multiple connection posts.

[0065] According to another embodiment, the OLED package substrate further comprises a protective layer **40** covering the auxiliary electrode pattern **201**. A plurality of via holes are disposed in the protective layer **40** over each sub-auxiliary electrode pattern. Moreover, the connection structure **202** comprises multiple connection posts, each of which comes into contact with a corresponding sub-auxiliary electrode pattern through a corresponding via hole. As shown in FIG. **4**B, each sub-auxiliary electrode pattern is in contact with the anode or cathode at the surface of the array substrate via corresponding multiple connection posts.

[0066] Since each via hole corresponds to one connection post, the number of via holes is the same as the number of connection posts. In addition, the number of connection posts correspondingly disposed around each sub-pixel area **012** is not limited (FIG. **4**B illustrates an example in which three connection posts are disposed). For example, 2 to 10 connection posts can be disposed. Accordingly, 2 to 10 via holes should be disposed in the protective layer **40**.

[0067] In the above embodiment, corresponding auxiliary electrode patterns or sub-auxiliary electrode patterns around each sub-pixel area **012** are connected to the anode or cathode at the surface of the array substrate by multiple connection posts. The multiple connection posts can serve to support the package substrate.

[0068] According to another embodiment, the connection structure **202** has a height of 0.05 μm to 100 μm.

[0069] It is to be noted that, when the OLED package substrate is assembled with the array substrate, a photo spacer (PS) needs to be disposed between the OLED package substrate and the array substrate so as to maintain a certain distance between the OLED package substrate and the array substrate. In general, the separation of the OLED package substrate from the array substrate is achieved by forming a PS layer on the array substrate.

[0070] According to this embodiment, when the height of the connection structure **202** is 0.05 μm to 100 μm, the connection structure **202** itself may function as a photo spacer. Therefore, there is no need to form a PS layer on the array substrate. As a result, the manufacturing process of an OLED display device comprising the package substrate and the array substrate can be simplified.

[0071] According to another embodiment, the connection structure **202** is formed of a transparent conductive material.

[0072] For example, the connection structure **202** may be formed of a conductive resin or other conductive organic film layers.

[0073] According to this embodiment, since the connection structure **202** is formed of a transparent conductive material, the connection structure can not only connect the auxiliary electrode pattern **201** to the anode or cathode located at the surface of the array substrate, but also prevent the light emitted by the light emitting layer on the array substrate from being blocked, thereby improving the light extraction efficiency of the light emitting layer on the array substrate.

[0074] According to another embodiment of the present disclosure, there is provided an OLED display panel. As shown in FIG. **8**, the OLED display panel comprises a package substrate **50** and an array substrate **60** assembled with each other. The array substrate **60** comprises a cathode **601** or an anode **602** formed at its surface (FIG. **8** illustrates an example in which the array substrate **60** comprises a cathode **601** formed at its surface). The package substrate **50** is the OLED package substrate described above.

[0075] The array substrate may be a PMOLED array substrate or an AMOLED array substrate (FIG. **8** illustrates an example in which the array substrate is an AMOLED array substrate). When the array substrate is a PMOLED array substrate, the PMOLED array substrate comprises a cathode **601**, an anode **602**, and an organic material functional layer **603** disposed between the anode **602** and the cathode **601**. When the array substrate is an AMOLED array substrate, as shown in FIG. **8**, the AMOLED array substrate further comprises a thin film transistor **604** in addition to the anode **602**, the cathode **601**, and the organic material functional layer **603** disposed between the anode **602** and the cathode **601**. The thin film transistor **604** includes a gate, a gate insulating layer, a source, a drain, and an active layer. The drain is electrically connected to the anode **602**.

[0076] In this embodiment, since the conductor **20** is disposed on the base substrate **10** of the OLED package substrate, when the OLED package substrate is assembled with the array substrate **60**, the conductor **20** of the OLED package substrate can contact the anode or cathode located at the surface of the array substrate **60**. This gives a resistor in parallel to the anode or cathode located at the surface of the array substrate **60**. As a result, the resistance of the anode or cathode located at the surface of the array substrate **60** is reduced, thereby avoiding the large power consumption caused by the anode or cathode at the surface of the array substrate. This can reduce the overall power consumption of the OLED display device and prolong the service lifetime thereof.

[0077] According to an embodiment of the present disclosure, there is further provided a method of manufacturing an OLED package substrate. The OLED package substrate comprises a display area and a non-display area. The display area includes a pixel definition area. The method of manufacturing an OLED package substrate comprises: providing a base substrate; and forming a conductor on the base substrate. A conductor is located within the pixel definition region and configured to be in contact with a cathode or an anode at a surface of an array substrate for assembly with the OLED package substrate.

[0078] According to another embodiment, the conductor comprises: an auxiliary electrode pattern; and a connection structure disposed on and in contact with the auxiliary electrode pattern. Moreover, forming a conductor on the base substrate comprises: forming a metal thin film on the base substrate, forming an auxiliary electrode pattern within the pixel definition area of the display area by patterning process, and forming a connection structure on the auxiliary electrode pattern by patterning process.

[0079] According to another embodiment, the method of manufacturing an OLED package substrate further comprises: forming an alignment pattern within the non-display area while forming the auxiliary electrode pattern within the pixel definition area of the display area by patterning process.

[0080] According to another embodiment, the method of manufacturing an OLED package substrate further comprises: after forming the auxiliary electrode pattern within the pixel definition area of the display area by patterning process and forming the alignment pattern within the non-display area, forming a protective layer over the alignment pattern and the auxiliary electrode pattern, wherein a via hole that exposes a portion of the auxiliary electrode pattern is disposed in the protective layer. Moreover, forming a connection structure on the auxiliary electrode pattern by patterning process comprises: forming a conductive thin film on the protective layer, and forming a connection structure on the auxiliary electrode pattern by patterning process. The connection structure comes into contact with the auxiliary electrode pattern through the via hole in the protective layer.

[0081] FIG. **9** is a schematic flow chart illustrating a specific example of a method of manufacturing an OLED package substrate as provided by embodiments of the present disclosure. The OLED package substrate comprises a display area **01** and a non-display area **02**. The display area **01** comprises a pixel definition area **011**. As shown in FIG. **9**, the specific example of the method of manufacturing an OLED package substrate may comprise the following steps.

[0082] At S**100**, a metal thin film is formed on the base substrate **10**, an alignment pattern **30** is formed within the non-display area **02** by patterning process, and an auxiliary electrode pattern **201** is formed within the pixel definition area **011** of the display area **01**.

[0083] Here, the patterning process specifically refers to a process of coating a photoresist, exposure, development, etching, and removing the photoresist.

[0084] The material of the base substrate **10** is not limited. It should be understood by those skilled in the art that, for

a top emission type OLED display device, the OLED package substrate should be transparent in order not to affect normal emission of the light emitted by a light emitting layer on the array substrate. The base substrate **10** may also be transparent. For example, the base substrate **10** may be made of glass.

[0085] In addition, the material of the metal thin film is not limited. The material of the metal thin film may be at least one selected from the group comprising a metal element, a metal oxide and an alloy.

[0086] The shapes and sizes of the formed alignment pattern **30** and auxiliary electrode pattern **201** are not limited. The shapes and sizes of the alignment pattern **30** and the auxiliary electrode pattern **201** may be set as needed. For example, the alignment pattern **30** may be in a cross shape. The shape of the auxiliary electrode pattern **201** may be, for example, a shape made up of a plurality of hexagons, a plurality of stars, a plurality of circles, or a plurality of other irregular shapes.

[0087] At S**101**, a protective layer **40** is formed over the alignment pattern **30** and the auxiliary electrode pattern **201**, wherein a via hole that exposes a portion of the auxiliary electrode pattern **201** is disposed in the protective layer **40**.

[0088] The material of the protective layer **40** is not limited as long as it can seal the OLED package substrate and the array substrate during the assembling process and does not affect emission of the light emitted by the light emitting layer on the array substrate. Exemplarily, the material of the protective layer **40** may be SiOx, SiNx, or a composite structure of them. The protective layer **40** may be a monolayer structure or a multilayer structure.

[0089] In this step, a protective thin film may be first formed on the alignment pattern **30** and the auxiliary electrode pattern **201**, and then via holes are formed in the protective thin film by etching process to form the protective layer **40**.

[0090] At S**102**, a conductive thin film is formed on the protective layer **40**, and a connection structure **202** is formed on the auxiliary electrode pattern **201** by patterning process. The connection structure **202** comes into contact with the auxiliary electrode pattern **201** through the via hole in the protective layer **40**.

[0091] The patterning process specifically refers to a process of coating a photoresist, exposure, development, etching, and removing a photoresist.

[0092] The size and shape of the connection structure **202** are not limited. The size and shape of the connection structure **202** may be set as needed. When the height of the connection structure **202** is 0.05 μm to 100 μm, the connection structure **202** may also serve as a photo spacer disposed between the OLED package substrate and the array substrate. The material of the connection structure **202** is not limited. For example, the connection structure **202** may be formed of a transparent conductive material.

[0093] In addition, the display area **01** further comprises, for example, a plurality of sub-pixel areas **012** defined by the pixel definition area **011**. The number of via holes disposed around each of the sub-pixel areas **012** is not limited. For example, two to ten via holes may be disposed in the protective layer around each of the sub-pixel areas **012**.

[0094] In the above specific example of the method of manufacturing the OLED package substrate, since the auxiliary electrode pattern **201** and the connection structure **202** in contact with the auxiliary electrode pattern **201** are disposed on the base substrate of the OLED package substrate, when the OLED package substrate is assembled with the array substrate, the connection structure **202** may contact the anode or cathode at the surface of the array substrate. This gives a resistor in parallel to the anode or cathode located at the surface of the array substrate. As a result, the resistance of the anode or cathode located at the surface of the array substrate is reduced, thereby avoiding the large power consumption caused by the anode or cathode. This can reduce the overall power consumption of the OLED display device and prolong the service lifetime of the OLED display device.

[0095] The above embodiments are only specific embodiments of the present disclosure, while the protection scope of the present disclosure is not so limited. Variations or replacements that can be easily conceived by any skilled person familiar with this technical field within the technical scope revealed by the present disclosure shall be encompassed within the protection scope of the present disclosure. Thus, the protection scope of the present disclosure shall be based on the protection scope of the attached claims.

1. An OLED package substrate, comprising a display area and a non-display area, the display area comprising a pixel definition area, the OLED package substrate comprising:

a base substrate; and

a conductor on the base substrate and within the pixel definition area,

wherein the conductor is configured to be in contact with one of a cathode and an anode at a surface of an array substrate for assembly with the OLED package substrate.

2. The OLED package substrate according to claim **1**, wherein the conductor comprises: an auxiliary electrode pattern; and a connection structure which is disposed on and in contact with the auxiliary electrode pattern, and

wherein the connection structure is configured to be in contact with the one of the cathode and the anode.

3. The OLED package substrate according to claim **2**, further comprising an alignment pattern in the non-display area,

wherein the alignment pattern and the auxiliary electrode pattern are located in a same layer and formed of a same material.

4. The OLED package substrate according to claim **2**, wherein the display area further comprises a plurality of sub-pixel areas defined by the pixel definition area, and the auxiliary electrode pattern is of a mesh structure, each mesh in the mesh structure corresponding to one sub-pixel area.

5. The OLED package substrate according to claim **2**, wherein the display area further comprises a plurality of sub-pixel areas defined by the pixel definition area, and the auxiliary electrode pattern includes a plurality of sub-auxiliary electrode patterns, each sub-auxiliary electrode pattern enclosing one sub-pixel area.

6. The OLED package substrate according to claim **2**, further comprising a protective layer covering the auxiliary electrode pattern, wherein a via hole is disposed in the protective layer, and

wherein the connection structure comes into contact with the auxiliary electrode pattern through the via hole in the protective layer.

7. The OLED package substrate according to claim **4**, further comprising a protective layer covering the auxiliary electrode pattern,

wherein a plurality of via holes are disposed in the protective layer over the auxiliary electrode pattern that encloses each mesh, and

wherein the connection structure comprises multiple connection posts, each connection post is in contact with the auxiliary electrode pattern through a corresponding via hole, and the auxiliary electrode pattern that encloses each mesh is in contact with the one of the cathode and the anode at the surface of the array substrate via corresponding multiple connection posts.

8. The OLED package substrate according to claim **5**, further comprising a protective layer covering the auxiliary electrode pattern,

wherein a plurality of via holes are disposed in the protective layer over each sub-auxiliary electrode pattern, and

wherein the connection structure comprises multiple connection posts, each connection post is in contact with a corresponding sub-auxiliary electrode pattern through a corresponding via hole, and each sub-auxiliary electrode pattern is in contact with the one of the cathode and the anode at the surface of the array substrate via corresponding multiple connection posts.

9. The OLED package substrate according to claim **2**, wherein a height of the connection structure is 0.05 μm to 100 μm.

10. The OLED package substrate according to claim **2**, wherein the connection structure is formed of a transparent conductive material.

11. An OLED display panel comprising a package substrate and an array substrate assembled with each other, wherein the array substrate comprises one of a cathode and an anode formed at a surface thereof, and the package substrate is the OLED package substrate according to claim **1**.

12. A method of manufacturing an OLED package substrate, the OLED package substrate comprising a display area and a non-display area, the display area comprising a pixel definition area, the method comprising:

providing a base substrate; and

forming a conductor on the base substrate,

wherein the conductor is within the pixel definition area, and the conductor is configured to be in contact with one of a cathode and an anode at a surface of an array substrate for assembly with the OLED package substrate.

13. The method of manufacturing an OLED package substrate according to claim **12**, wherein the conductor comprises: an auxiliary electrode pattern; and a connection structure which is disposed on and in contact with the auxiliary electrode pattern, and

wherein said forming a conductor on the base substrate comprises:

forming a metal film on the base substrate, and forming an auxiliary electrode pattern within the pixel definition area of the display area by patterning process; and

forming a connection structure on the auxiliary electrode pattern by patterning process.

14. The method of manufacturing an OLED package substrate according to claim **13**, further comprising: forming an alignment pattern within the non-display area while forming the auxiliary electrode pattern within the pixel definition area of the display area by patterning process.

15. The method of manufacturing an OLED package substrate according to claim **14**, further comprising: after forming the auxiliary electrode pattern within the pixel definition area of the display area by patterning process and forming the alignment pattern in the non-display area, forming a protective layer over the alignment pattern and the auxiliary electrode pattern, wherein a via hole that exposes a portion of the auxiliary electrode patter is disposed in the protective layer, and

wherein said forming a connection structure on the auxiliary electrode pattern by patterning process comprises: forming a conductive film on the protective layer, and forming a connection structure on the auxiliary electrode pattern by patterning process, the connection structure being in contact with the auxiliary electrode pattern through the via hole in the protective layer.

16. The OLED display panel according to claim **11**, wherein the conductor comprises: an auxiliary electrode pattern; and a connection structure which is disposed on and in contact with the auxiliary electrode pattern, and

wherein the connection structure is configured to be in contact with the one of the cathode and the anode.

17. The OLED display panel according to claim **16**, further comprising an alignment pattern in the non-display area,

wherein the alignment pattern and the auxiliary electrode pattern are located in a same layer and formed of a same material.

18. The OLED display panel according to claim **16**, wherein the display area further comprises a plurality of sub-pixel areas defined by the pixel definition area, and the auxiliary electrode pattern is of a mesh structure, each mesh in the mesh structure corresponding to one sub-pixel area.

19. The OLED display panel according to claim **16**, wherein the display area further comprises a plurality of sub-pixel areas defined by the pixel definition area, and the auxiliary electrode pattern includes a plurality of sub-auxiliary electrode patterns, each sub-auxiliary electrode pattern enclosing one sub-pixel area.

20. The OLED display panel according to claim **16**, further comprising a protective layer covering the auxiliary electrode pattern, wherein a via hole is disposed in the protective layer, and

wherein the connection structure comes into contact with the auxiliary electrode pattern through the via hole in the protective layer.

* * * * *

专利名称(译)	OLED封装基板及其制造方法,OLED显示面板		
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摘要(译)

本公开的实施方式提供了一种OLED封装基板,其制造方法以及OLED显示面板。 OLED封装基板包括显示区域和非显示区域,该显示区域包括像素限定区域。 OLED封装基板包括基底基板以及在基底基板上并且在像素限定区域内的导体。 导体被配置为在阵列基板的表面处与阴极或阳极接触,以与OLED封装基板组装。