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(54) LIGHT EMITTING DIODE DISPLAY DEVICE AND MANUFACTURING METHOD THEREOF

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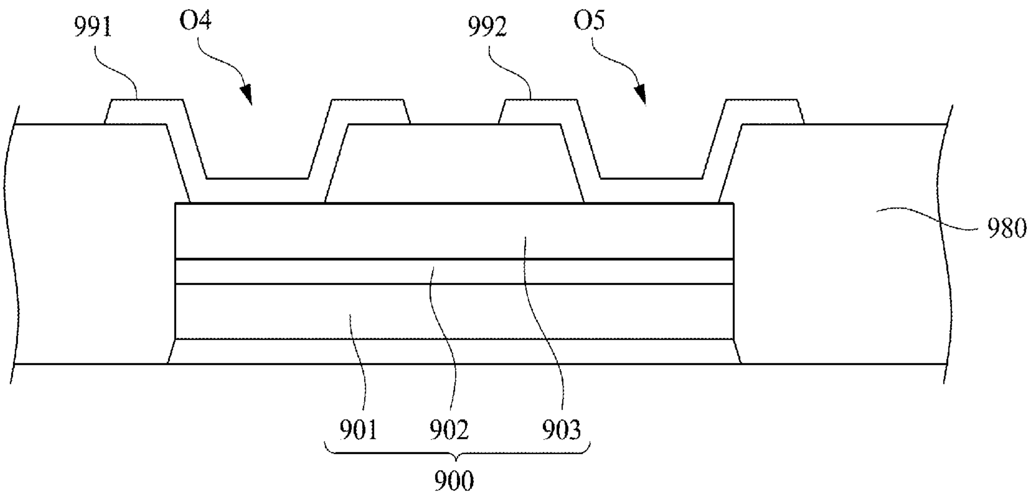
(57) **ABSTRACT**

A manufacturing method of a light emitting diode (LED) display device includes forming at least one sub-pixel circuit on a substrate, forming a primary electrical pad and a first backup electrical pad electrically connected to the sub-pixel circuit, disposing a first micro light emitting device on the primary electrical pad and testing the first micro light emitting device.



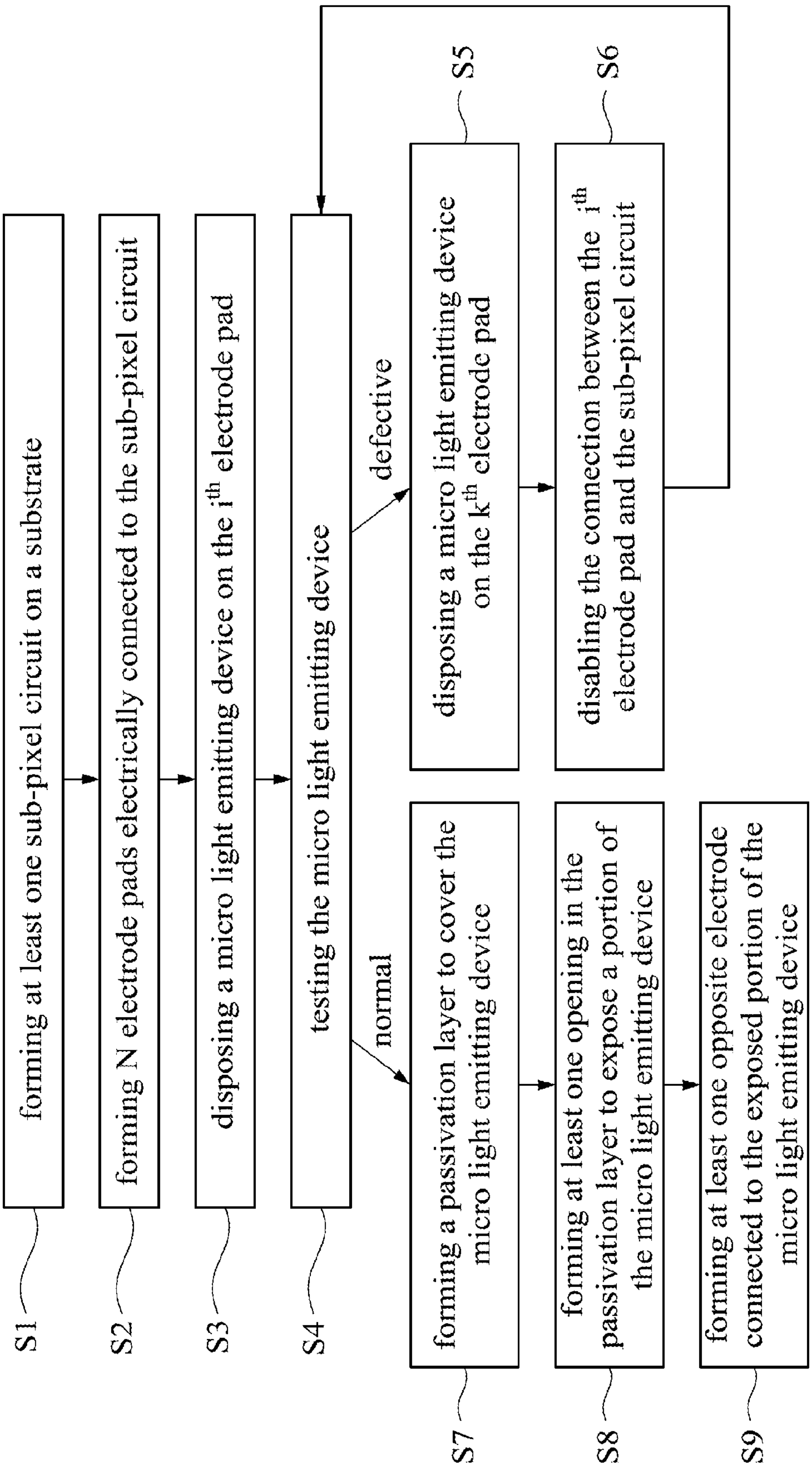
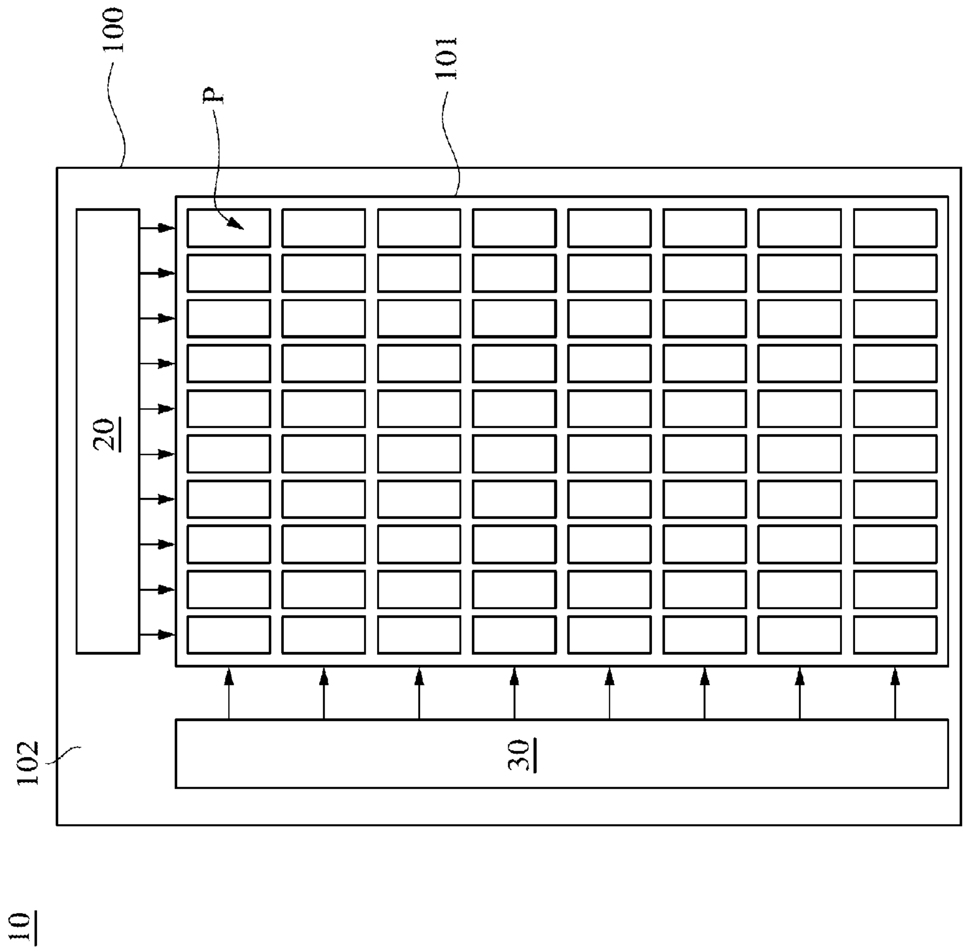

S1
forming at least one sub-pixel circuit on a substrate
S2
forming N electrode pads electrically connected to the sub-pixel circuit
S3
disposing a micro light emitting device on the i^th electrode pad
S4
testing the micro light emitting device
defective
S5
disposing a micro light emitting device on the k^th electrode pad
S6
disabling the connection between the i^th electrode pad and the sub-pixel circuit
normal
S7
forming a passivation layer to cover the micro light emitting device
S8
forming at least one opening in the passivation layer to expose a portion of the micro light emitting device
S9
forming at least one opposite electrode connected to the exposed portion of the micro light emitting device

Fig. 1

Fig. 2



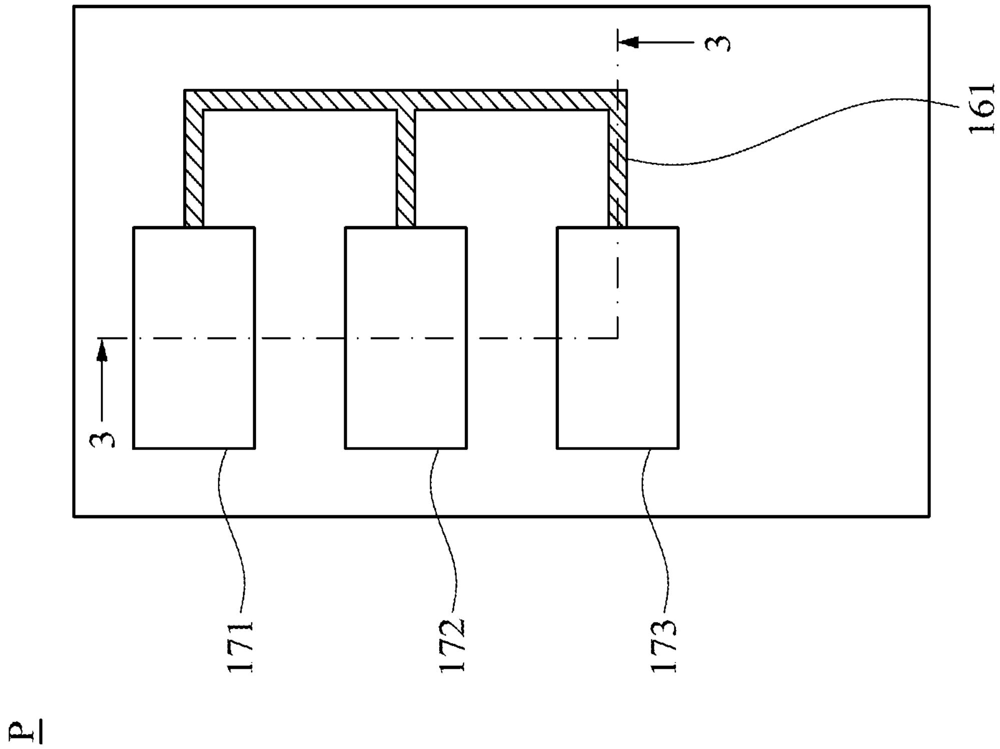


Fig. 3A

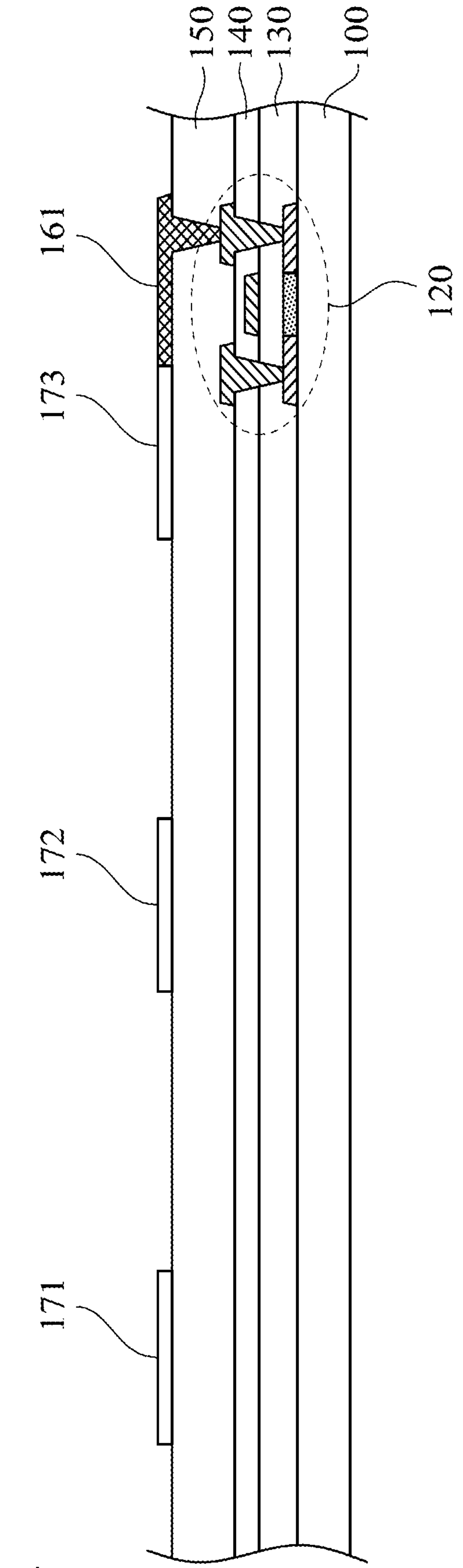


Fig. 3B

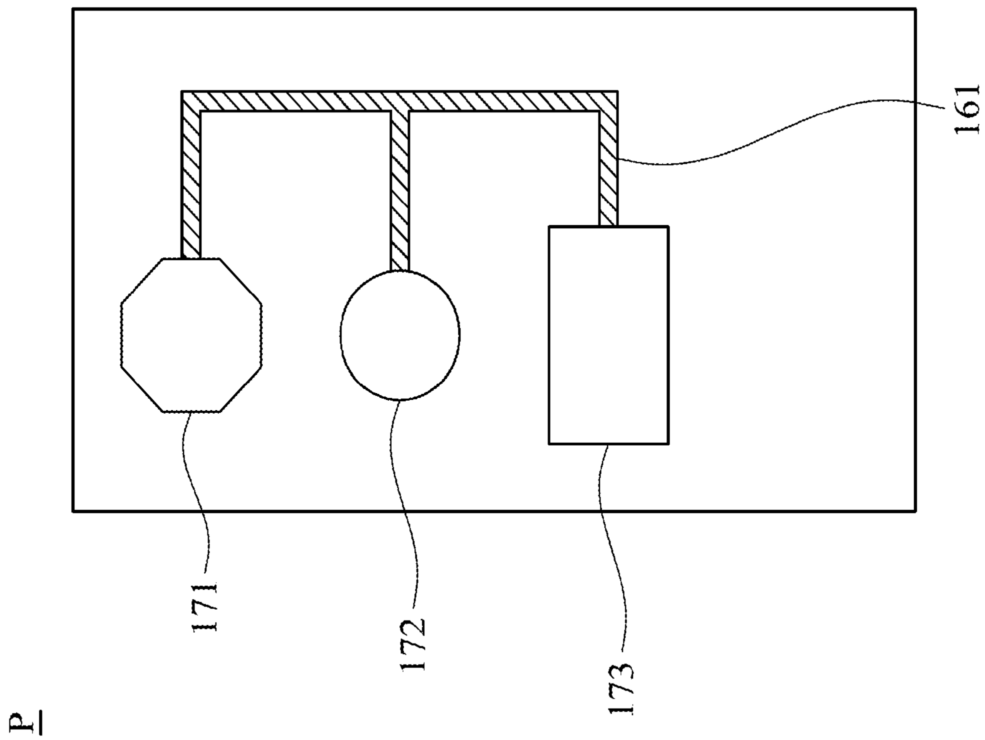


Fig. 3C

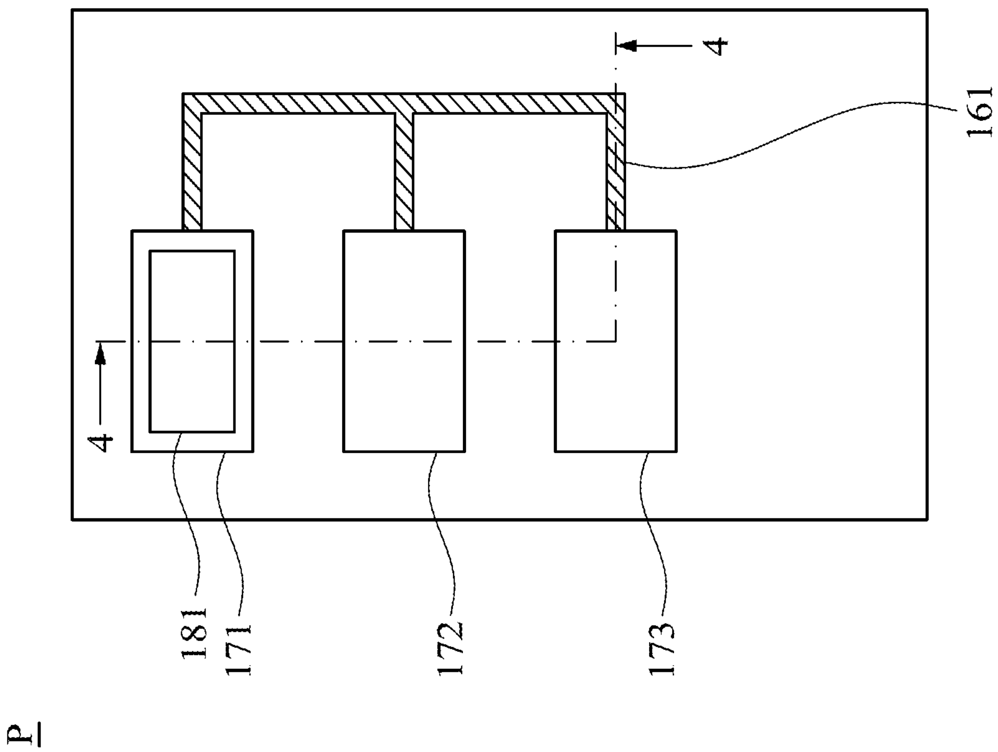


Fig. 4A

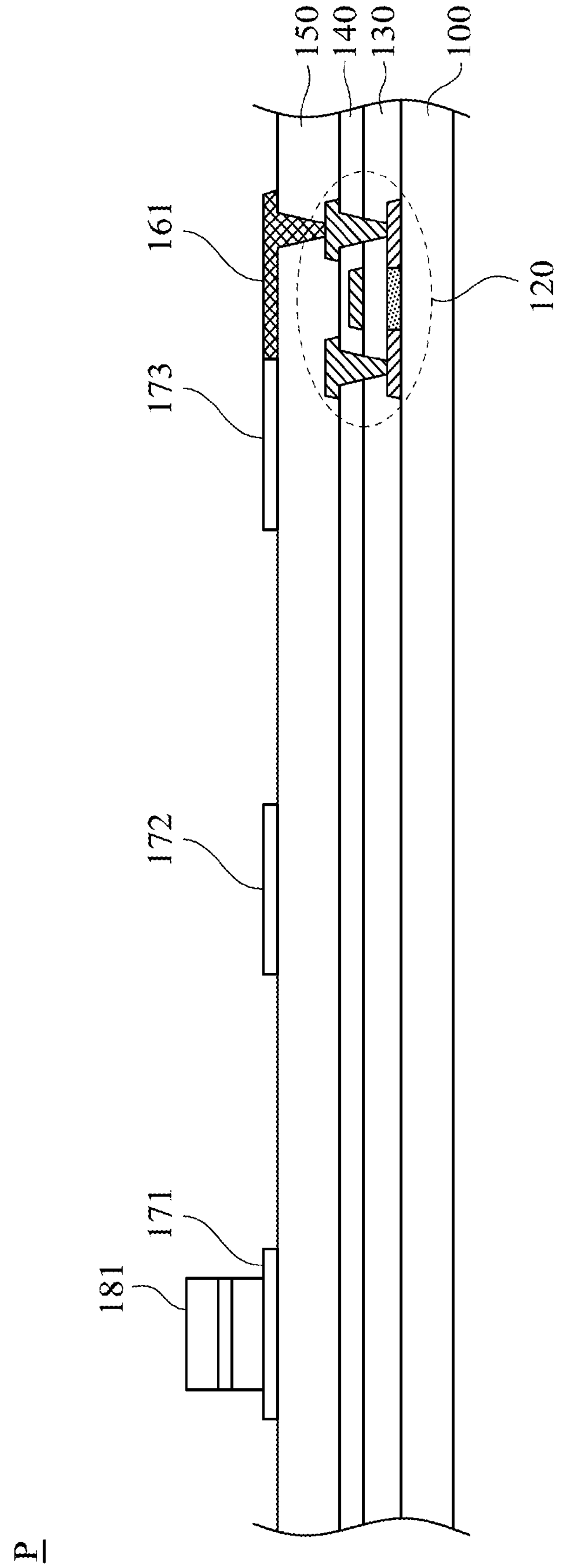


Fig. 4B

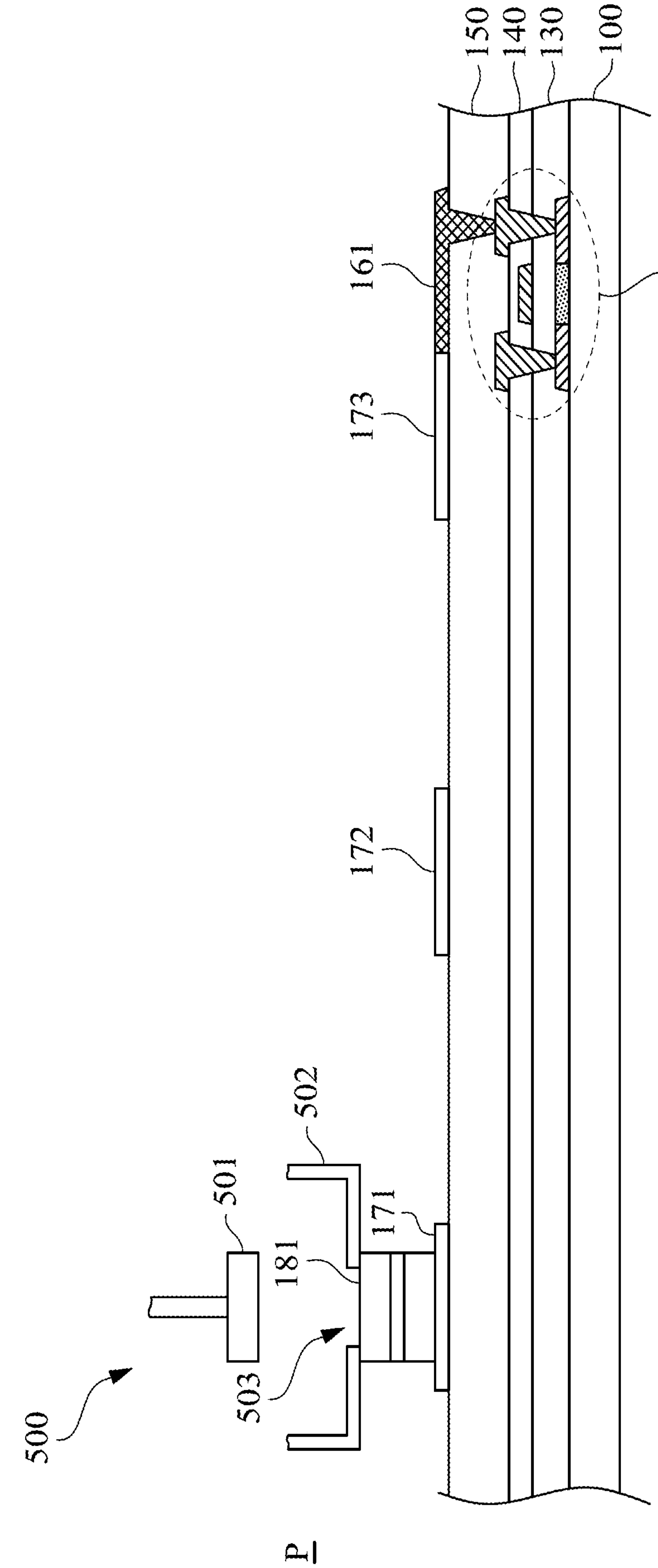


Fig. 5

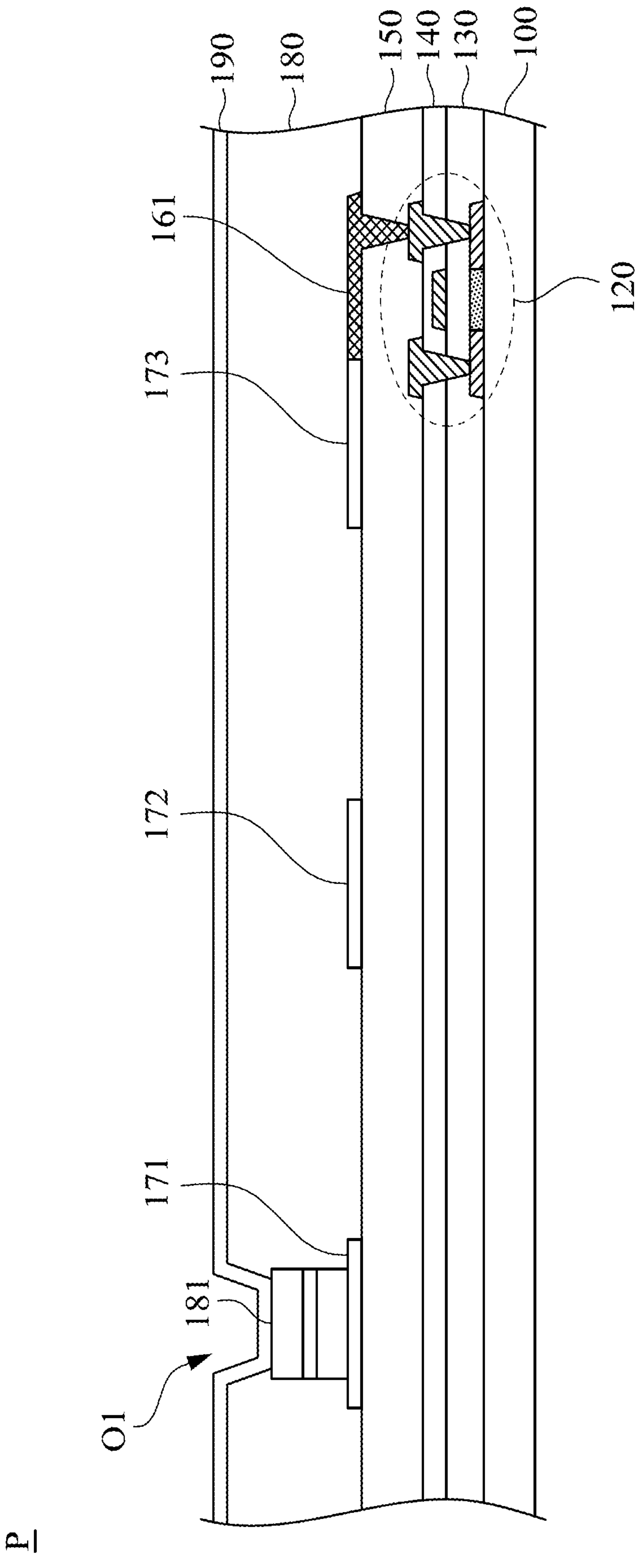


Fig. 6

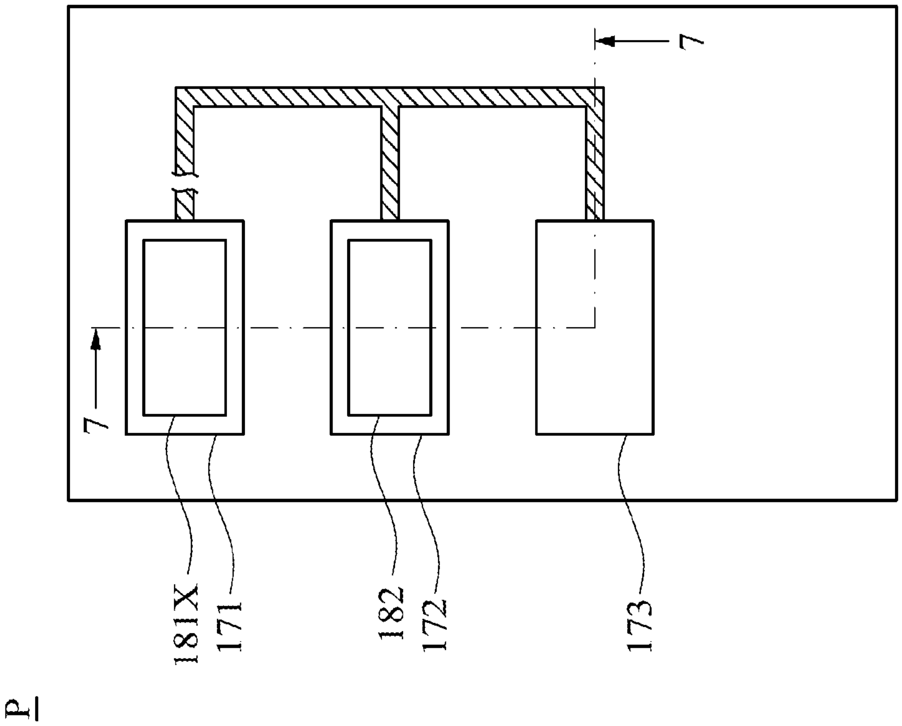


Fig. 7A

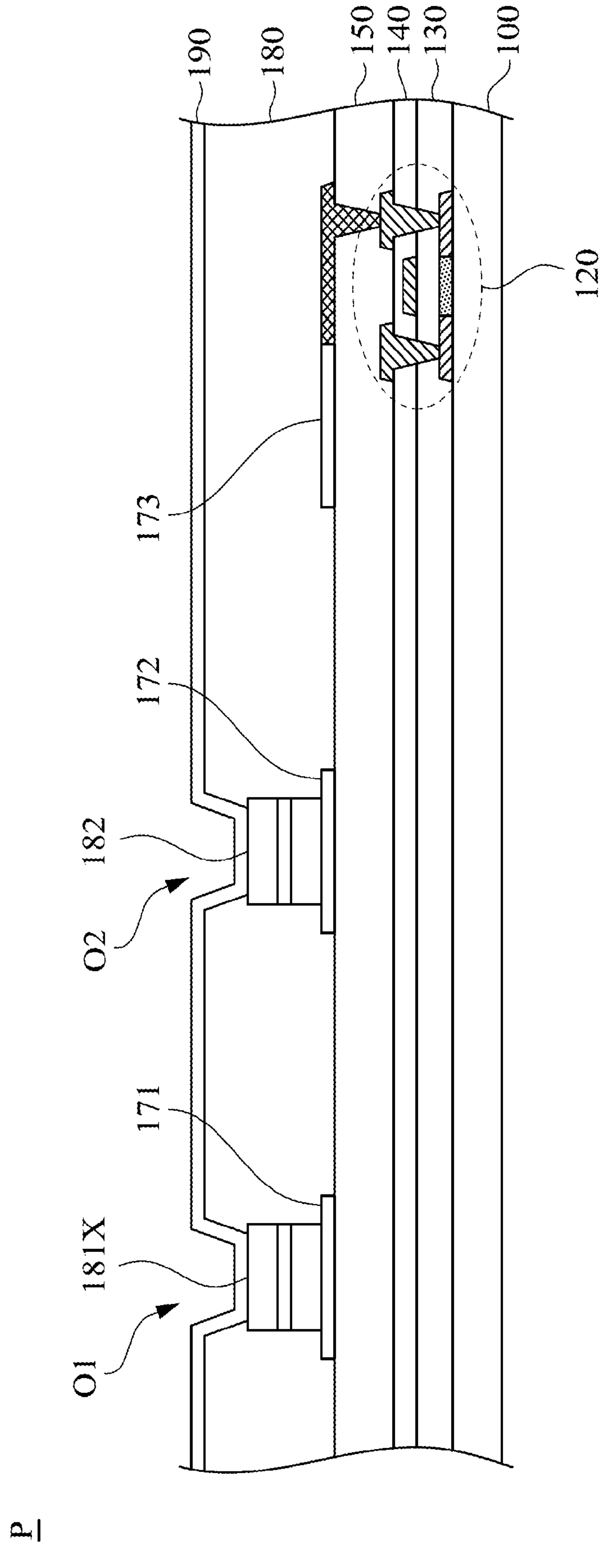


Fig. 7B

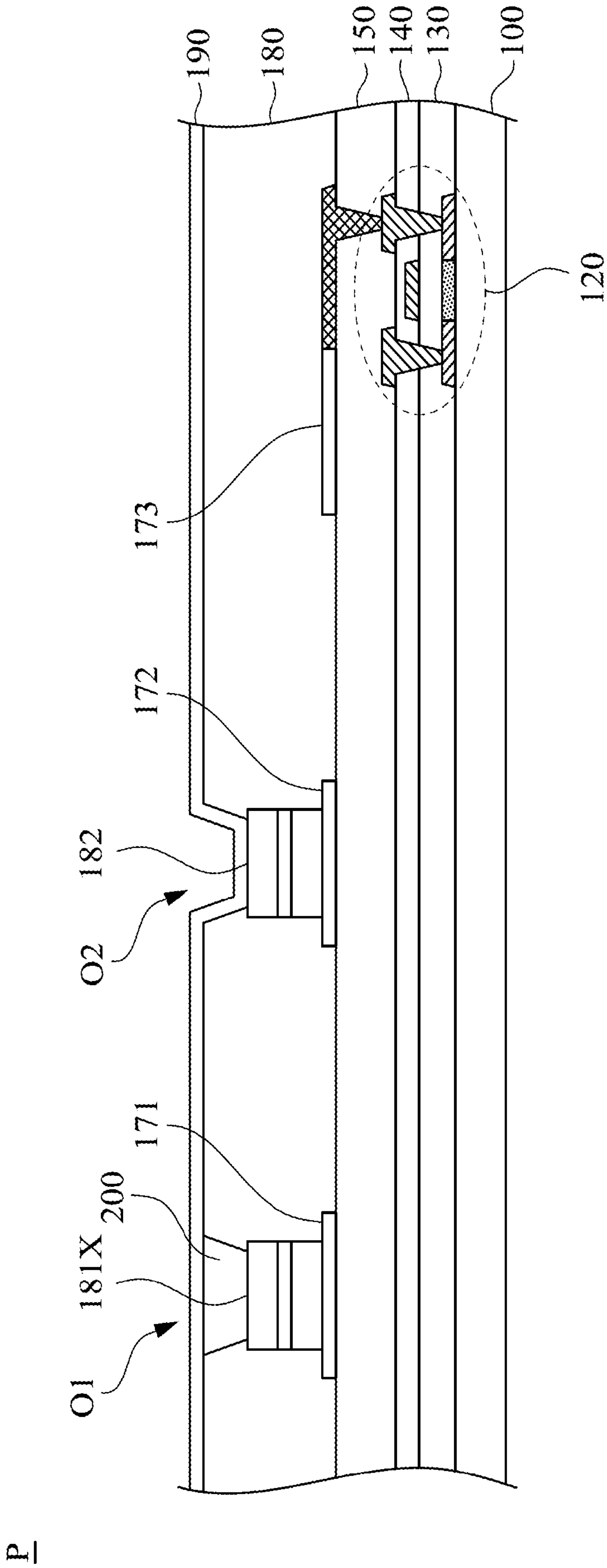


Fig. 7C

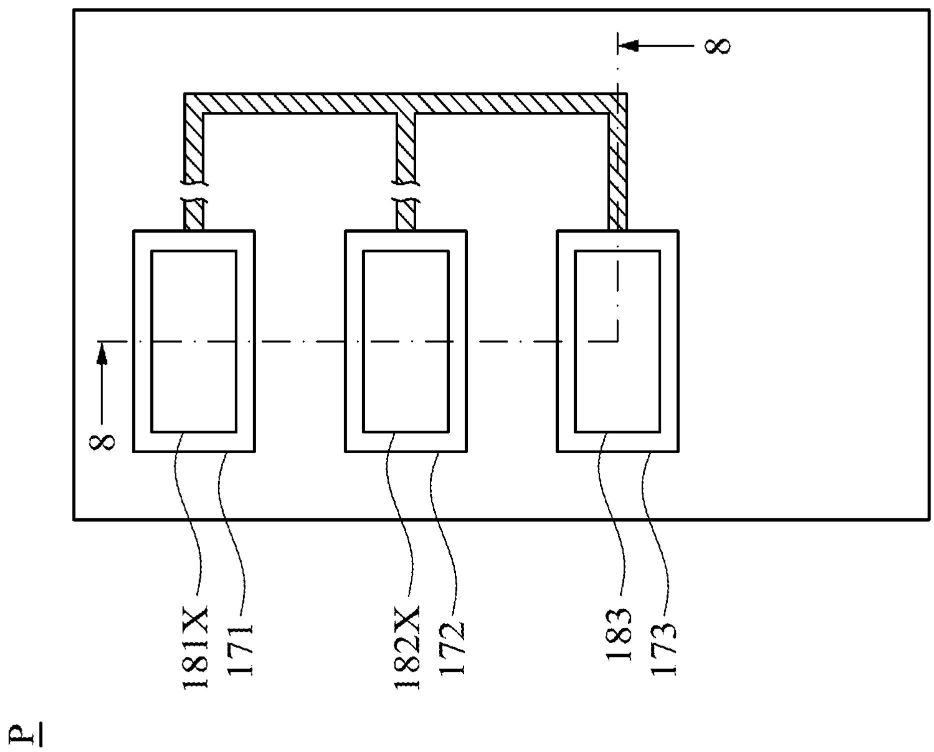


Fig. 8A

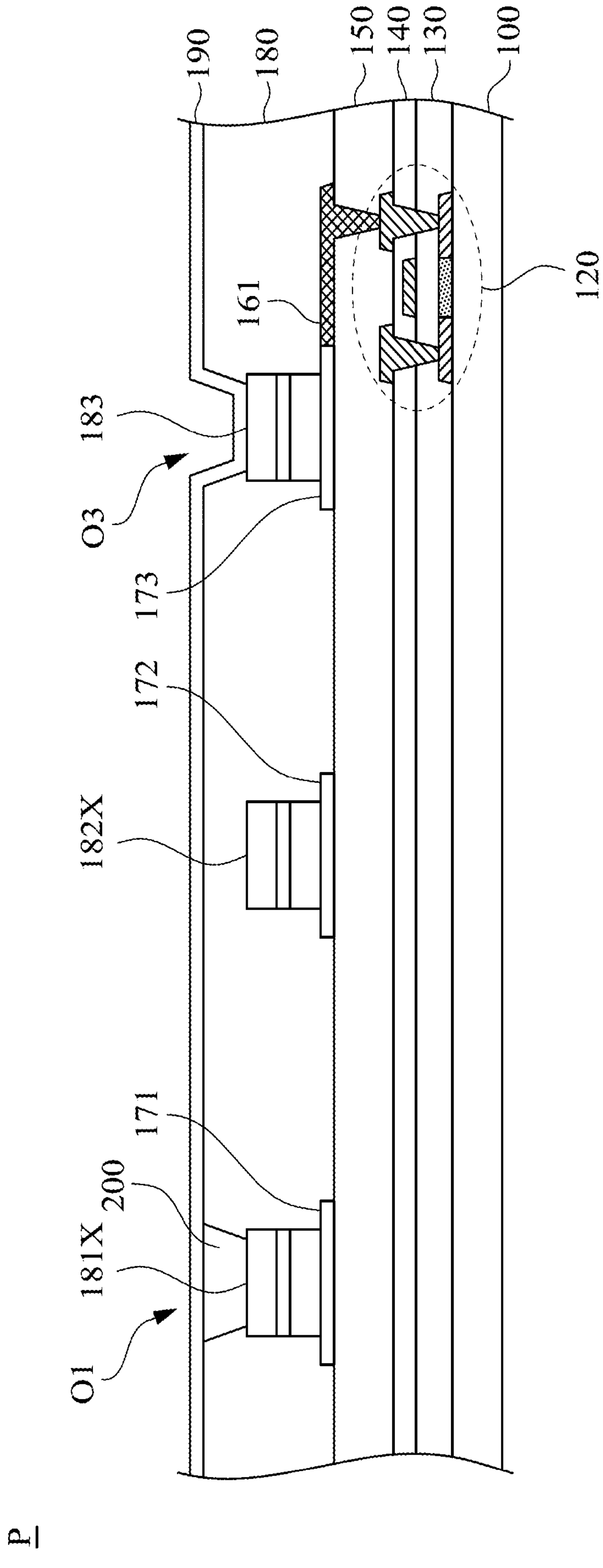

190
180
150
140
130
100
120
161
183
O3
173
172
182X
171
200
181X
O1
P

Fig. 8B

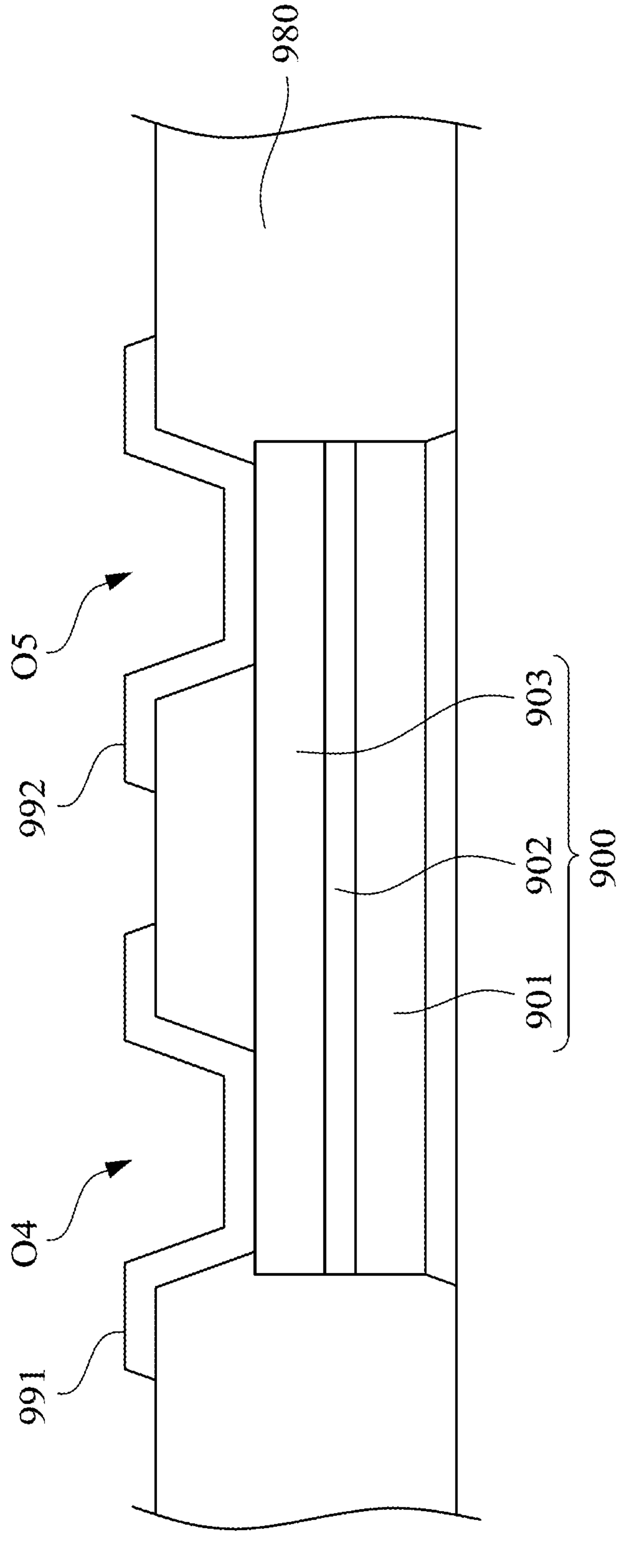


Fig. 9

LIGHT EMITTING DIODE DISPLAY DEVICE AND MANUFACTURING METHOD THEREOF

BACKGROUND

[0001] Technical Field

[0002] The present disclosure relates to a light-emitting diode display device.

[0003] Description of Related Art

[0004] In recent years, advances in LED technology have made dramatic improvement in luminance intensity and color fidelity. Due to theses improved technology, a full color LED display device has become available and in common use.

[0005] The full color LED display device can be performed by attaching different colors of micro light emitting devices onto a display substrate. These different colors of micro light emitting devices emit different light colors, and thus a color image can be displayed according to the combination of different colored light. However, when a micro light emitting device is found to be defective, it is hard to replace the defective micro light emitting device because the detaching process is hard to perform and may cause damage to the display substrate or other micro light emitting devices.

SUMMARY

[0006] According to one embodiment of the present invention, a manufacturing method of a light emitting diode (LED) display device is provided. The method includes forming at least one sub-pixel circuit on a substrate, forming a primary electrical pad and a first backup electrical pad electrically connected to the sub-pixel circuit, disposing a first micro light emitting device on the primary electrical pad and testing the first micro light emitting device.

[0007] According to another embodiment of the present invention, a manufacturing method of an LED display device is provided. The method includes forming an array of sub-pixels on a substrate, in which the formation of each of the sub-pixel includes forming at least one sub-pixel circuit on the substrate, forming a primary electrical pad and a first backup electrical pad electrically connected to the sub-pixel circuit, and disposing a first micro light emitting device on the primary electrical pad. Thereafter, the manufacturing method of the LED display device includes testing the first micro light emitting device of each of the sub-pixels and collecting test result and position information of the first micro light emitting device of each of the sub-pixels.

[0008] According to yet another embodiment of the present invention, an LED display device is provided. The LED display device includes a substrate, at least one sub-pixel circuit, a plurality of electrical pads and a micro light emitting device. The substrate includes at least one sub-pixel. The sub-pixel circuit is disposed on the substrate. The electrical pads are disposed inside the sub-pixel and are electrically connected with the sub-pixel circuit. The micro light emitting device is disposed on one of the electrical pads.

[0009] Since each of the sub-pixel includes a plurality of electrical pads, when a micro light emitting device is tested to be defective, it is only needs to attach another micro light emitting device onto another electrical pad. As a result, there is no need to perform detaching process which may cause damage to the substrate or to other micro light emitting devices. Therefore, the yield rate of manufacturing the LED display device is increased.

[0010] It is to be understood that both the foregoing general description and the following detailed description are by examples, and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. **1** is a flow chart of manufacturing method of a light emitting diode (LED) display device in accordance with an embodiment of the present invention.

[0012] FIG. **2** is a top view of an LED display device in accordance with an embodiment of the present invention.

[0013] FIG. **3**A is a top view of the sub-pixel illustrating manufacturing steps S**1** and S**2** in FIG. **1**.

[0014] FIG. **3**B is a cross-sectional view of FIG. **3**A taken along line **3**.

[0015] FIG. **3**C is a top view of the sub-pixel with different shapes of electrical pads.

[0016] FIG. **4**A is a top view of the sub-pixel illustrating manufacturing step S**3** in FIG. **1**.

[0017] FIG. **4**B is a cross-sectional view of FIG. **4**A taken along line **4**.

[0018] FIG. **5** illustrates a test device for testing the micro light emitting device in accordance with an embodiment of the present invention.

[0019] FIG. **6** is a cross-sectional view of the sub-pixel illustrating manufacturing steps S**5**~S**7** in FIG. **1**.

[0020] FIG. **7**A is a top view of the sub-pixel illustrating manufacturing steps S**8** and S**9** in FIG. **1** after testing of a defective first micro light emitting device.

[0021] FIG. **7**B is a cross-sectional view of FIG. **7**A taken along line **7** in accordance with an embodiment of the present invention.

[0022] FIG. **7**C is a cross-sectional view of FIG. **7**A taken along line **7** in accordance with another embodiment of the present invention.

[0023] FIG. **8**A is a top view of the sub-pixel illustrating manufacturing steps S**8** and S**9** in FIG. **1** after testing of defective second micro light emitting device.

[0024] FIG. **8**B is a cross-sectional view of FIG. **8**A taken along line **8**.

[0025] FIG. **9** is an enlarged cross-sectional of the sub-pixel with multiple openings and opposite electrodes on the micro light emitting device in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION

[0026] In the following detailed description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the disclosed embodiments. It will be apparent, however, that one or more embodiments may be practiced without these specific details. In other instances, well-known structures and devices are schematically shown in order to simplify the drawing.

[0027] The terms "micro" device or "micro" LED as used herein may refer to the descriptive size of certain devices in accordance with embodiments of the present invention. As used herein, the terms "micro" device or "micro" LED are meant to refer to the scale of 1 micrometer to 1 millimeter. However, it is to be appreciated that embodiments of the present invention are not necessarily so limited, and that certain aspects of the embodiments may be applicable to larger, and possibly smaller size scales.

[0028] It will be understood that when an element is referred to as being "on" another element, it can be directly on the other element or intervening elements may be present there between. In contrast, when an element is referred to as being "directly on" another element, there are no intervening elements present.

[0029] FIG. **1** is a flow chart of manufacturing method of a light emitting diode (LED) display device in accordance with an embodiment of the present invention. As shown in FIG. **1**, the manufacturing method includes following steps:

[0030] Step S**1**: forming at least one sub-pixel circuit on a substrate;

[0031] Step S**2**: forming N electrode pads electrically connected to the sub-pixel circuit, wherein N is a natural number and N≥2;

[0032] Step S**3**: disposing a micro light emitting device on the i^{th} electrode pad, wherein i is a natural number and i≤N;

[0033] Step S**4**: testing the micro light emitting device;

[0034] Step S**5**: disposing a micro light emitting device on the k^{th} electrode pad, wherein k is a natural number, k≤N and k≠i; and

[0035] Step S**6**: disabling the connection between the i^{th} electrode pad and the sub-pixel circuit.

[0036] Step S**7**: forming a passivation layer to cover the micro light emitting device;

[0037] Step S**8**: forming at least one opening in the passivation layer to expose a portion of the micro light emitting device;

[0038] Step S**9**: forming at least one opposite electrode connected to the exposed portion of the micro light emitting device.

[0039] Through the aforementioned manufacturing steps S**1**~S**9**, when a micro light emitting device is tested to be defective, there is no necessary to detach the defective micro light emitting device from the electrode pad. Because there are multiple electrode pads within the sub-pixel, it only needs to attach another micro light emitting device to another electrode pad. As a result, the damage caused by the detaching process can be avoided, and the yield rate of manufacturing the LED display device is improved.

[0040] The following description illustrates how to perform the aforementioned steps S**1**-S**9** with reference made to FIGS. **2**-**8**. FIG. **2**, FIGS. **3**A, **3**B and **3**C illustrate the manufacturing steps S**1**, S**2** of an LED display device. FIGS. **4**A and **4**B illustrate the manufacturing step S**3** of an LED display device. FIG. **5** illustrates the manufacturing step S**4** of an LED display device. FIG. **6** illustrates the manufacturing steps S**7**~S**9**. FIGS. **7**A, **7**B, **7**C, **8**A and **8**B illustrate the manufacturing steps S**5**~S**9**. FIG. **9** illustrates the manufacturing steps S**7**~S**9** with multiple openings and opposite electrodes.

[0041] FIG. **2** is a top view of an LED device in accordance with an embodiment of the present invention. In step S**1**, at least one sub-pixel circuit is formed on a substrate. As shown in FIG. **2**, the LED display device **10** includes an array of sub-pixels P formed on the substrate **100**. More specifically, the substrate **100** may support a pixel area **101** and a non-pixel area **102**. The pixel area **101** includes the array of sub-pixels P arranged in a matrix. The non-pixel area **102** includes a data driver circuit **20** and a scan driver circuit **30**. The data driver circuit **20** and the scan driver circuit **30** are electrically connected to each sub-pixel P.

[0042] FIG. **3**A is a top view of the sub-pixel P illustrating manufacturing steps S**1** and S**2**. FIG. **3**B is a cross-sectional view of FIG. **3**A taken along line **3**. As shown in FIG. **3**A and FIG. **3**B, the formation of each of the sub-pixels P includes forming a sub-pixel circuit **120** on the substrate **100**. More specifically, the formation of each of the sub-pixel P includes forming interlayer insulating layers **130**, **140**, and the sub-pixel circuit **120** is formed in the interlayer insulating layers **130**, **140**. In the embodiment of FIG. **3**B, the sub-pixel circuit **120** is directly formed on the substrate **100**, but the present invention is not limited thereto. In some embodiments, the sub-pixel circuit **120** may be indirectly formed on the substrate **100**. That is, there may be another layer disposed between the sub-pixel circuit **120** and the substrate **100**.

[0043] In step S**2**, N electrode pads are formed and are electrically connected to the sub-pixel circuit **120**. With reference made to FIG. **3**A and FIG. **3**B, after forming the sub-pixel circuit **120**, a planarization layer **150** is formed to cover the sub-pixel circuit **120**. A control line **161** is formed on the planarization layer **150** and is electrically connected to the sub-pixel circuit **120**. As shown in FIGS. **3**A, **3**B and **3**C, **3** electrode pads including a primary electrical pad **171**, a first backup electrical pad **172** and a second backup electrical pad **173** are formed on the planarization layer **150**, and the primary electrical pad **171**, the first backup electrical pad **172** and the second backup electrical pad **173** are electrically connected to the sub-pixel circuit **120** through the control line **161**. In various embodiments, the primary electrical pad **171**, the first backup electrical pad **172** and the second backup electrical pad **173** can be acted as a pixel electrode. It should be understood that, the number of the electrical pads of the present invention are not limited to 3. In other embodiments, the number of the electrical pads may be 2 including the primary electrical pad **171** and the first backup electrical pad **172**. In some embodiments, the number of the electrical pads may greater than 4 including the primary electrical pad **171**, the first backup electrical pad **172**, the second backup electrical pad **173**, the third backup electrical pad (not illustrated) and so on.

[0044] In some embodiments, the planarization layer **150** is optional. In this case, the control line **161**, the primary electrical pad **171**, the first backup electrical pad **172** and the second backup electrical pad **173** are formed on the interlayer insulating layer **140**, and the primary electrical pad **171**, the first backup electrical pad **172** and the second backup electrical pad **173** are electrically connected with the sub-pixel circuit **120** through the control line **161**.

[0045] As shown in FIG. **3**A, the primarily electrode pad **171**, the first backup electrical pad **172** and the second backup electrical pad **173** have substantially the same shape, e.g. a rectangular shape. However, the present invention is not limited thereto. FIG. **3**C is a top view of the sub-pixel P illustrating manufacturing step S**2** in accordance with another embodiment of the present invention. As shown in FIG. **3**C, the primarily electrode pad **171**, the first backup electrical pad **172** and the second backup electrical pad **173** have variety of shapes, e. g. an octagonal shape, a circular shape, and a rectangular shape. It should be understood that the shapes of the electrical pads can be different or be the same depending on the shapes of the micro light emitting device to be formed thereon. For example, in some embodiments, the shapes of the electrical pads inside the sub-pixel P can be selected from the group consisting of circle, triangle, square, pentangle, hexagon or other polygon.

[0046] FIG. **4**A is a top view of the sub-pixel P illustrating manufacturing step S**3** in accordance with an embodiment of the present invention. FIG. **4**B is a cross-sectional view of FIG. **4**A taken along line **4**. In step S**3**, a micro light emitting device is disposed on the i^{th} electrode pad. As shown in FIG. **4**A and FIG. **4**B, a first micro light emitting device **181** is disposed on the primary electrical pad **171**. In the present embodiment, the first micro light emitting device **181** can be a micro light emitting diode (LED), and the micro LED can be disposed on the primary electrical pad **171** through a transfer device (not illustrated). The transfer device may have a transfer head for gripping the micro LED from an LED carrier substrate. Then, the transfer device can transfer the micro LED onto the primary electrical pad **171** from the LED carrier substrate.

[0047] FIG. **5** illustrates a test device **500** for testing the micro light emitting device in accordance with an embodiment of the present invention. In step S**4**, the micro light emitting device is tested. As shown in FIG. **5**, a test device **500** is provided. The test device **500** may include a photo sensor **501** and an electrode **502**. The electrode **502** may have an opening part **503**. As shown in FIG. **5**, when testing the first micro light emitting device **181**, the electrode **502** is electrically connected to the first micro light emitting device **181**, and the opening part **503** can expose at least a portion of the first micro light emitting device **181**. The photo sensor **501** can detect the emission of the first micro light emitting device **181** through the opening part **503**, and an analyzer (not illustrated) can analyze the luminance of the first micro light emitting device **181**. If the first micro light emitting device **181** exhibits no luminance or irregular luminance, the first micro light emitting device **181** may be defective. In some embodiments, the analyzer can further analyze the current flow of the electrode **502**. For example, an I-V (current-voltage) curve or a leakage current can be obtained through the current flow of the electrode **502**. If the first micro light emitting device **181** exhibits irregular I-V curve or abnormal leakage current, the first micro light emitting device **181** may be defective.

[0048] Referring to FIG. **2** and FIG. **5**, the testing is performed on each of the sub-pixels P on the substrate **100**. After the testing, a data acquisition module (not illustrated) can collect the test result and the position information of the first micro light emitting device **181** of each of the sub-pixels P. Thereafter, if most or all of the first micro light emitting device **181** is tested to be normal, the steps S**7**~S**9** are performed. In certain application, if 99.8% of the first micro light emitting devices **181** are tested to be normal, the steps S**7**~S**9** may be performed. On the other hand, if at least a predetermined percentage of the first micro light emitting device **181** is tested to be defective, the steps S**5**~S**6** are performed. In practical application, if at least 0.2% of the first micro light emitting device **181** is tested to be defective, the steps S**5**~S**6** may be performed. It should be understood that, the defect rate of performing S**5**-S**6** could be set to meet the product specification.

[0049] FIG. **6** is a cross-sectional view of the sub-pixel P illustrating manufacturing steps S**7**~S**9** in accordance with an embodiment of the present invention. In step S**7**, a passivation layer is formed to cover the micro light emitting device. In step S**8**, at least one opening is formed in the passivation layer to expose a portion of the micro light emitting device. In step S**9**, at least one opposite electrode is formed to connect to the exposed portion of the micro light emitting device.

[0050] As shown in FIG. **6**, the passivation layer **180** is formed around the first micro light emitting device **181** and the passivation layer **180** partially covers the first micro light emitting device **181**. In the present embodiment, the passivation layer **180** also covers the control line **161** within the sub-pixel P. There is an opening O1 in the passivation layer **180** to expose a portion of the first micro light emitting device **181**, and an opposite electrode **190** is electrically connected to the exposed portion of the first micro light emitting device **181**. More specifically, after the passivation layer **180** covers the first light emitting device **181** and the control line **161**, an exposing, a developing and/or an etching process can be performed to open the passivation layer **180**, ensuring at least a portion of the top surface of the first micro light emitting device **181** is exposed, so as to enable the opposite electrode **190** to make an electrical contact with the first micro light emitting device **181**.

[0051] FIG. **7**A is a top view of the sub-pixel P illustrating manufacturing steps S**5** and S**6** after testing of a defective first micro light emitting device **181**X. FIGS. **7**B and **7**C are a cross-sectional view of FIG. **7**A taken along line **7**. In step S**5**, a micro light emitting device is disposed on the k^{th} electrode pad. In step S**6**, the connection between the i^{th} electrode pad and the sub-pixel circuit is disabled. However, in some embodiments, the step S**6** may be optional, if the defective micro LED is open circuit or merely has minor influence on the pixel electric characteristic.

[0052] As shown in FIG. **7**A and FIG. **7**B, the first micro light emitting device **181**X is tested to be defective in step S**4**. In more detail, the detection test in step S**4** may indicate that the first micro light emitting device **181**X is defective if the first micro light emitting device **181**X, for example, exhibits irregular luminance. Thereafter, the step S**5** can be performed and a second micro light emitting device **182** can be disposed on the first backup electrical pad **172**. The details of disposing the second micro light emitting device **182** is similar to the first micro light emitting device **181** described in step S**3**, and therefore are not repeated here to avoid duplicity.

[0053] Referring to FIG. **2** and FIGS. **7**A and **7**B, in an embodiment, the second micro light emitting device **182** is disposed according to the test result and the position information collected by the data acquisition module in step S**4**. More specifically, according to the test result and the position information of each of the first micro light emitting device **181**, the position of each defective first micro light emitting device **181**X can be obtained. As a result, a transfer device can dispose the second micro light emitting device **182** into each sub-pixel P having the defective first micro light emitting device **181**X according to the position information of each defective first micro light emitting device **181**X.

[0054] As shown in FIGS. **7**A and **7**B, after disposing the second micro light emitting device **182**, the connection between the primary electrical pad **171** and the sub-pixel circuit **120** is disabled. More specifically, the control line **161** between the defective first micro light emitting device **181**X and the sub-pixel control circuit **120** can be cut off. In one embodiment, the disabling process can be performed by a laser cutting process, but the present invention is not limited thereto.

[0055] In an embodiment, after disabling the connection between the primary electrode **171** and the sub-pixel circuit **120**, the manufacturing method of the LED display device **10** proceeds back to the step **S4** where the second micro light emitting device **182** is tested. Similarly, if the second micro light emitting device **182** is tested to be normal, the steps S7~S9 are performed. That is, the passivation layer **180** is formed to cover the defective first micro light emitting device **181**X and the second micro light emitting device **182**. In the embodiment of FIG. **7**B, the openings O1 and O2 are formed in the passivation layer **180** to expose a portion of the defective first micro light emitting device **181**X and the second micro light emitting device **182**. The opposite electrode **190** is formed to electrically connect the exposed portion of the defective first micro light emitting device **181**X and the second micro light emitting device **182**. The details of performing step S7~S9 to the second micro light emitting diode **182** is similar to the first micro light emitting diode **181**, and therefore are not repeated here to avoid duplicity.

[0056] Referring to FIG. **7**C, in some embodiments, before forming the opposite electrode **190**, an insulating layer **200** is formed in the opening O**1**. More specifically, the insulating layer **200** covers the exposed portion of the defective first micro light emitting device **181**X, so as to insulate the opposite electrode **190** from the defective first micro light emitting device **181**X. As a result, in the embodiment of FIG. **7**C, the disabling step **S6** may be optional. In various embodiments, the insulating layer **200** may be made of organic material or inorganic material, and the insulating layer **200** may be formed by, for example, an inkjet printing process.

[0057] FIG. **8**A is a top view of the sub-pixel P illustrating manufacturing steps **S5** and **S6** after testing of defective second micro light emitting device **182**X. FIG. **8**B is a cross-sectional view of FIG. **8**A taken along line **8**. Similarly, if the detection test in step S4 indicates that the second micro light emitting device **182**X is defective, the steps S5~S6 are performed. That is, a third micro light emitting device **183** is disposed on the second backup electrical pad **173**. The connection between the sub-pixel circuit **120** and the first backup electrical pad **172** is disabled. The details of performing the steps S5~S6 to the third micro light emitting diode **183** is similar to the second micro light emitting diode **182**, and therefore are not repeated here to avoid duplicity.

[0058] With reference made to FIG. **8**B, after disabling the connection between the sub-pixel circuit **120** and the first backup electrical pad **172**, the manufacturing method of the LED display device **10** proceeds back to the step **S4** where the third micro light emitting device **183** is tested. Then, according to the test result of the third micro light emitting device **183**, the manufacturing method of the LED display device **10** selectively proceeds to steps **S5**~**S6** or steps S7~**S9**. Taking FIG. **8**B as an example, the third micro light emitting device **183** is tested to be normal. Thereafter, the passivation layer **180** covers the third micro light emitting device **183** and also covers the defective first micro light emitting device **181**X and the defective second micro light emitting device **182**X. Openings O1 and O3 in the passivation layer **180** are formed to respectively expose a portion of the defective first micro light emitting device **181**X, and the third micro light emitting device **183**. An opposite electrode **190** is formed to connect the exposed portion of the third micro light emitting device **183**. In some embodiments, an insulating layer **200** is formed in the openings O1, so as to insulate the opposite electrode **190** from the defective first micro light emitting devices **181**X. In this case, the disabling step **S6** may be optional because the defective first micro light emitting devices **181**X is not electrically connected with the opposite electrode **190**. However, in another embodiments, if the disabling step **S6** is performed, the insulating layer **200** may be optional, and the opposite electrode **190** may be contacted with the exposed part of the defective first micro light emitting device **181**X through the opening O**1**.

[0059] Referring back to FIG. **2**, in practical application, some of the sub-pixels P may include only one normal light emitting device (for example, FIG. **6**) and some of the sub-pixels P may include one normal light emitting diode and at least one defective light emitting device (for example, FIGS. **7**B and **8**B). As a result, after the passivation layer **180** covers all of the micro light emitting device within each sub-pixel P, a photo mask may be used to form the opening O1 in each sub-pixel P first. Thereafter, the opening O2 and the opening O3 are selectively formed if the first backup electrical pad **172** and/or the second backup electrical pad **173** has a light emitting device thereon. In some embodiments, the opening O2 and the opening O3 can be formed by using the laser beam to exposure the passive layer **180** made of positive photoresist materials. In other embodiments, after ensuring the third micro light emitting device **183** on the second backup electrical pad **173** is tested to be normal, the opening O3 can be formed individually.

[0060] FIG. **9** is an enlarged cross-sectional of the sub-pixel with multiple openings and opposite electrodes on the micro light emitting device in accordance with an embodiment of the present invention. As shown in FIG. **9**, in the present embodiment, the micro light emitting device **900** is a vertical type micro LED, which including a first type semiconductor layer **901**, an active layer **902** and a second type semiconductor layer **903**, in which the active layer is disposed between the first type semiconductor layer **901** and the second type semiconductor layer **903**. In the present embodiment, two openings O4, O5 may be formed in the passivation layer **980**, and two opposite electrodes **991** and **992** cover the openings O4, O5 and are separated from each other. By such configuration, electrical potential of the opposite electrodes **991** and **992** can be individually controlled. As a result, the current flowing through the micro light emitting device **900** is controllable and variable, and the brightness of the micro light emitting device **900** can be adjusted accordingly.

[0061] All the features disclosed in this specification (including any accompanying claims, abstract, and drawings) may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

[0062] Any element in a claim that does not explicitly state "means for" performing a specified function, or "step for" performing a specific function, is not to be interpreted as a "means" or "step" clause as specified in 35 U.S.C. §112, 6th paragraph. In particular, the use of "step of" in the claims is not intended to invoke the provisions of 35 U.S.C. §112, 6th paragraph.

1-18. (canceled)

19. An LED display device, comprising:

a substrate comprising at least one sub-pixel;

at least one sub-pixel circuit disposed on the substrate;

a plurality of electrical pads disposed inside the sub-pixel and electrically connected with the sub-pixel circuit; and

a micro light emitting device disposed on one of the electrical pads.

20. The LED display device of claim **19**, further comprising:

a defective micro light emitting device disposed on another one of the electrical pads, wherein the sub-pixel circuit is unconnected with said another one of the electrical pads.

21. The LED display device of claim **20**, further comprising:

a passivation layer covers the micro light emitting device and the defective micro light emitting device, wherein the passivation layer has at least one opening to expose a portion of the micro light emitting device; and

at least one opposite electrode electrically connected to the exposed portion of the micro light emitting device.

22. The LED display device of claim **21**, wherein the at least one opening exposes a portion of the defective micro light emitting device, and the LED display device further comprises an insulating layer to cover the exposed portion of the defective micro light emitting device.

23. The LED display device of claim **20**, wherein the micro light emitting device and the defective micro light emitting device are a micro LED.

24. The LED display device of claim **19**, wherein the plurality of the electrical pads have substantially the same shape.

25. The LED display device of claim **19**, wherein the plurality of the electrical pads have variety of shapes.

* * * * *

专利名称(译)	发光二极管显示装置及其制造方法		
公开(公告)号	US20160351548A1	公开(公告)日	2016-12-01
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[标]申请(专利权)人(译)	美科米尚技术有限公司		
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摘要(译)

一种发光二极管显示装置的制造方法，包括在一基板上形成至少一子像素电路，形成一主要电性接触垫以及一电性连接该子像素电路的一第一备用电性接触垫，发光器件在所述主电垫上并测试所述第一微发光器件。