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(54) **OLED DISPLAY**

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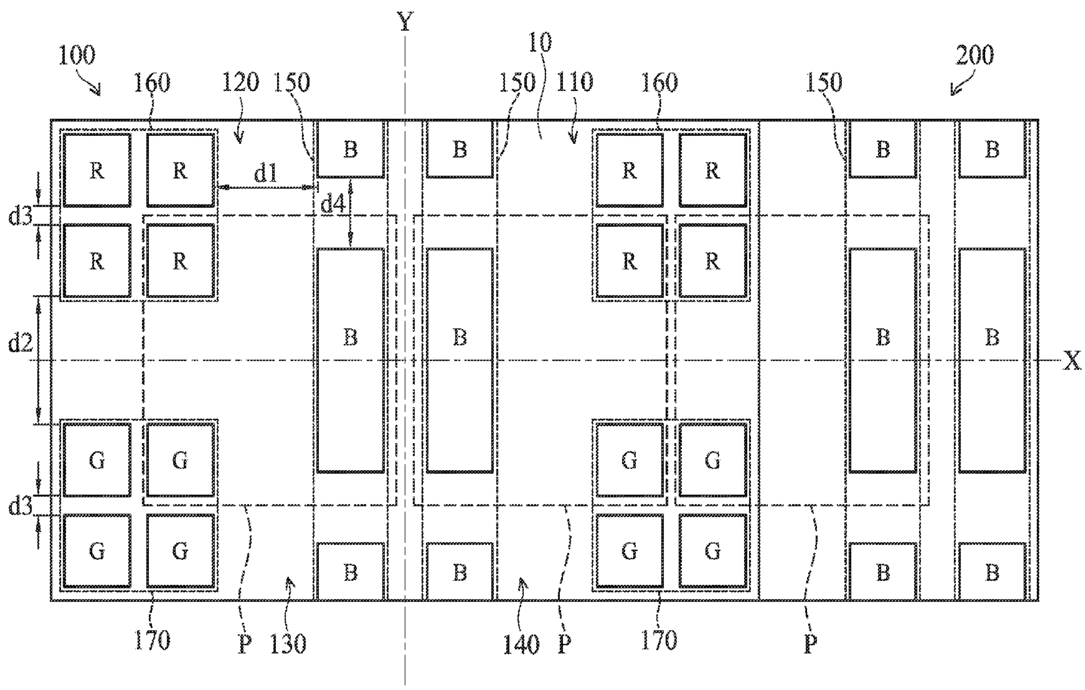
(57) **ABSTRACT**

An OLED display is provided. The OLED display includes a substrate, a first light-emissive layer, a second light-emissive layer, and two third light-emissive layers. The two third light-emissive layers corresponds a first sub-pixel and a second sub-pixel adjacent to the first sub-pixel. An axis passes through the first light-emissive layer and the second light-emissive layer. The axis is between the two third light-emissive layers. The configuration of the first sub-pixel and the second sub-pixel are symmetrical with respect to the axis.



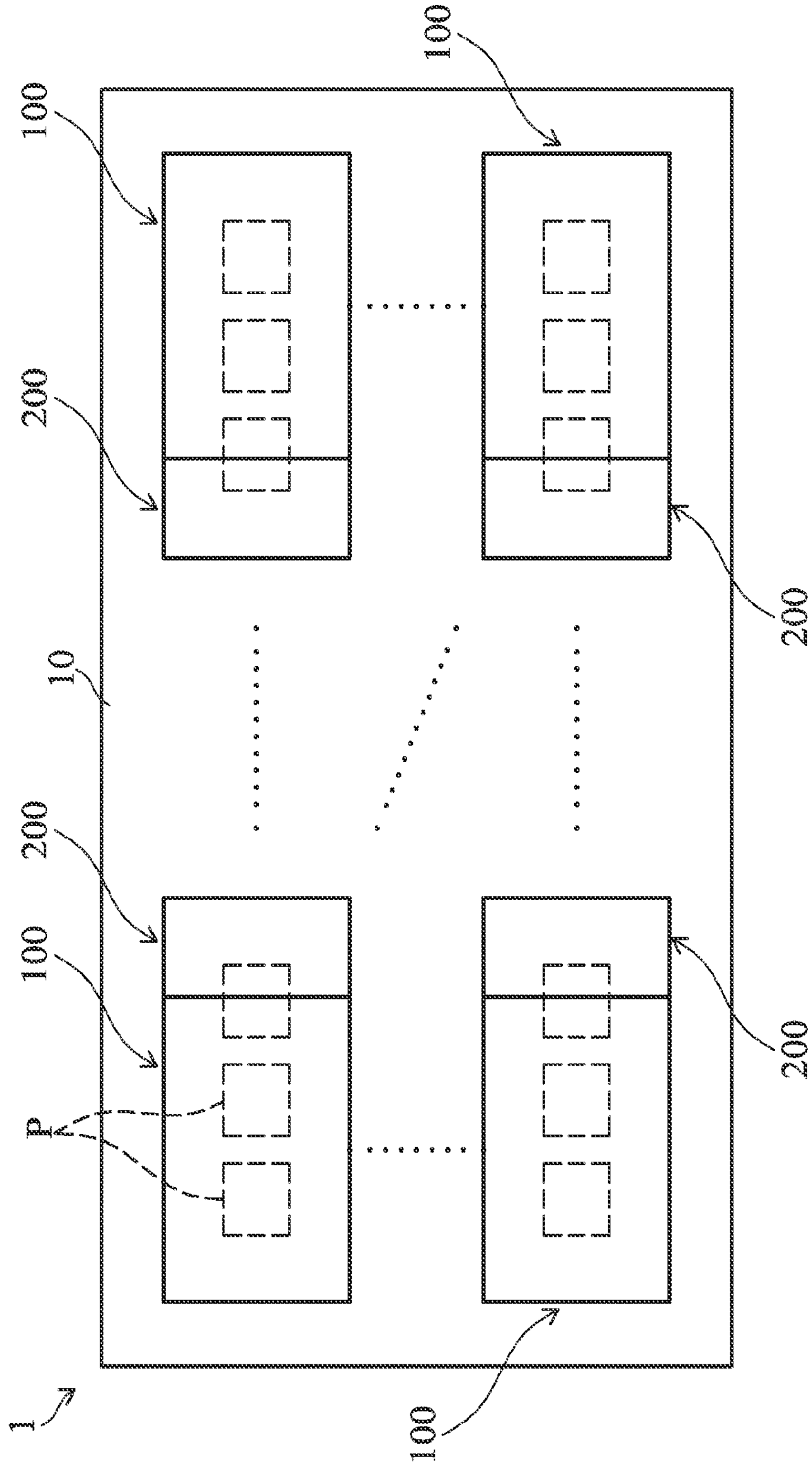


FIG. 1

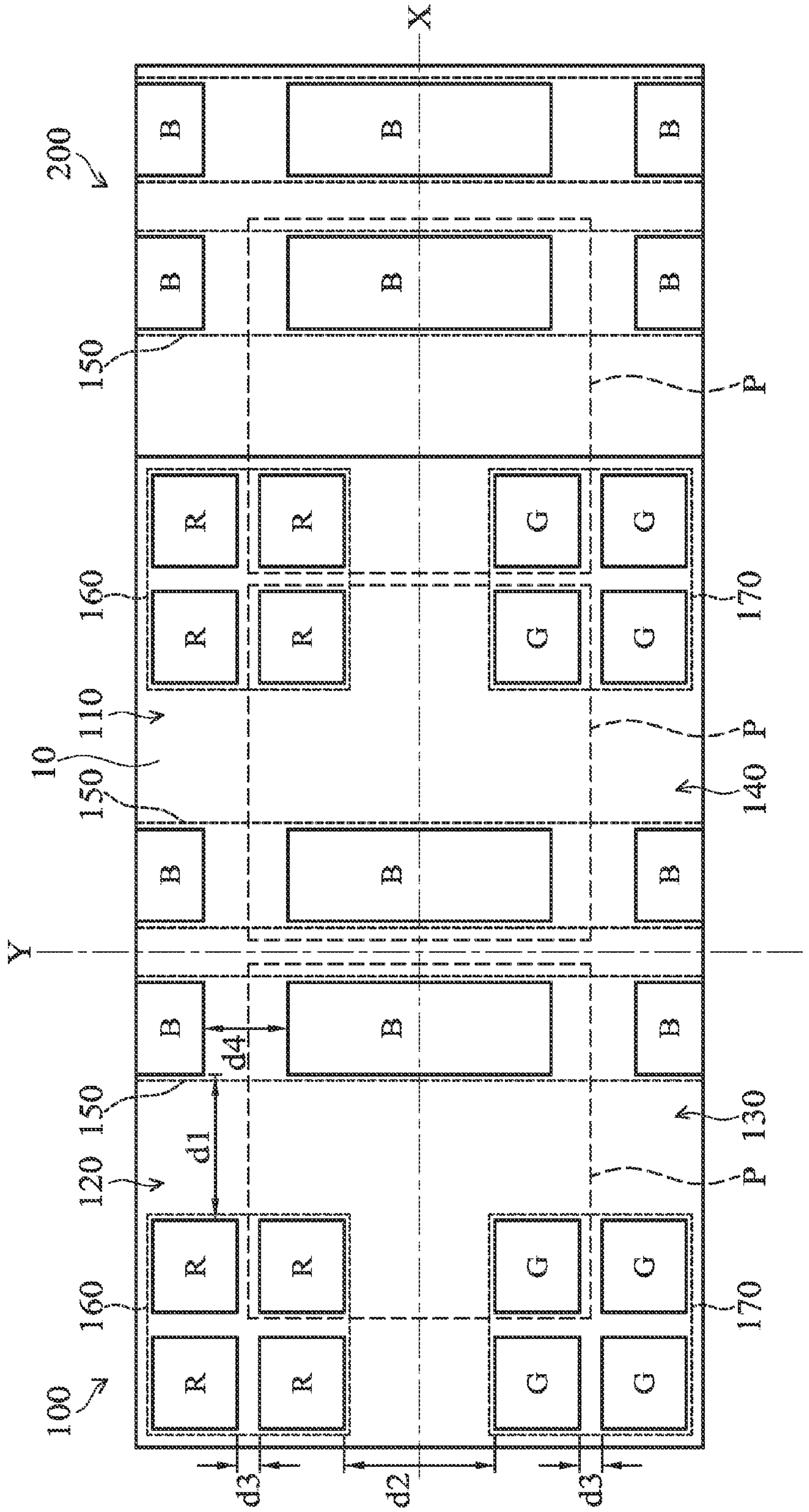


FIG. 2

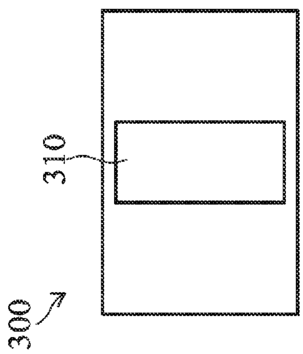


FIG. 3A(1)

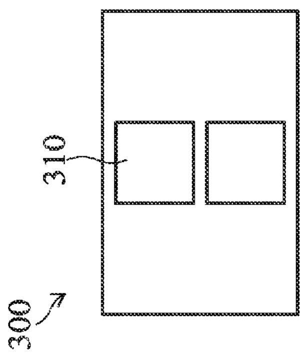


FIG. 3A(2)

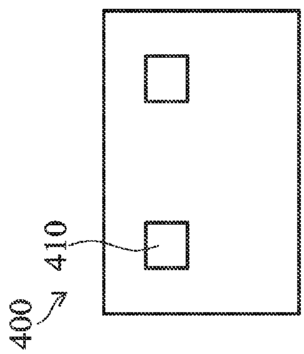


FIG. 3B

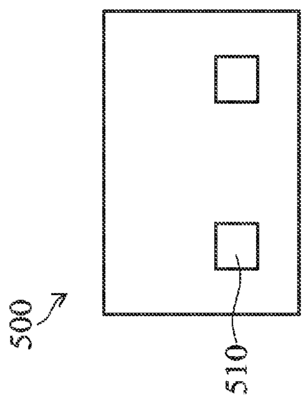


FIG. 3C

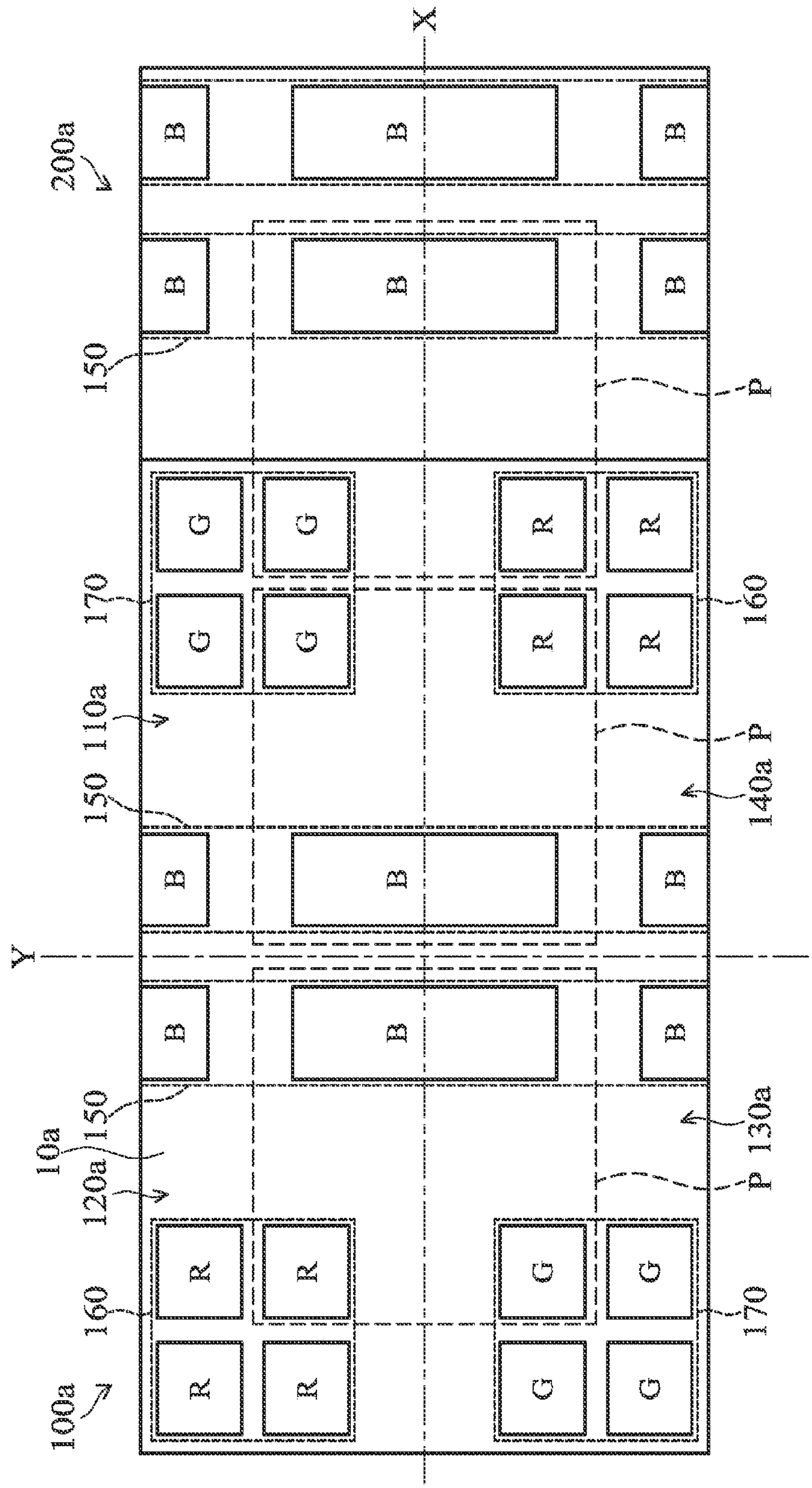

X
Y
200a
150
170
110a
150
10a
120a
150
160
100a
P
160
P
140a
130a
P
170
B
G
R

FIG. 4

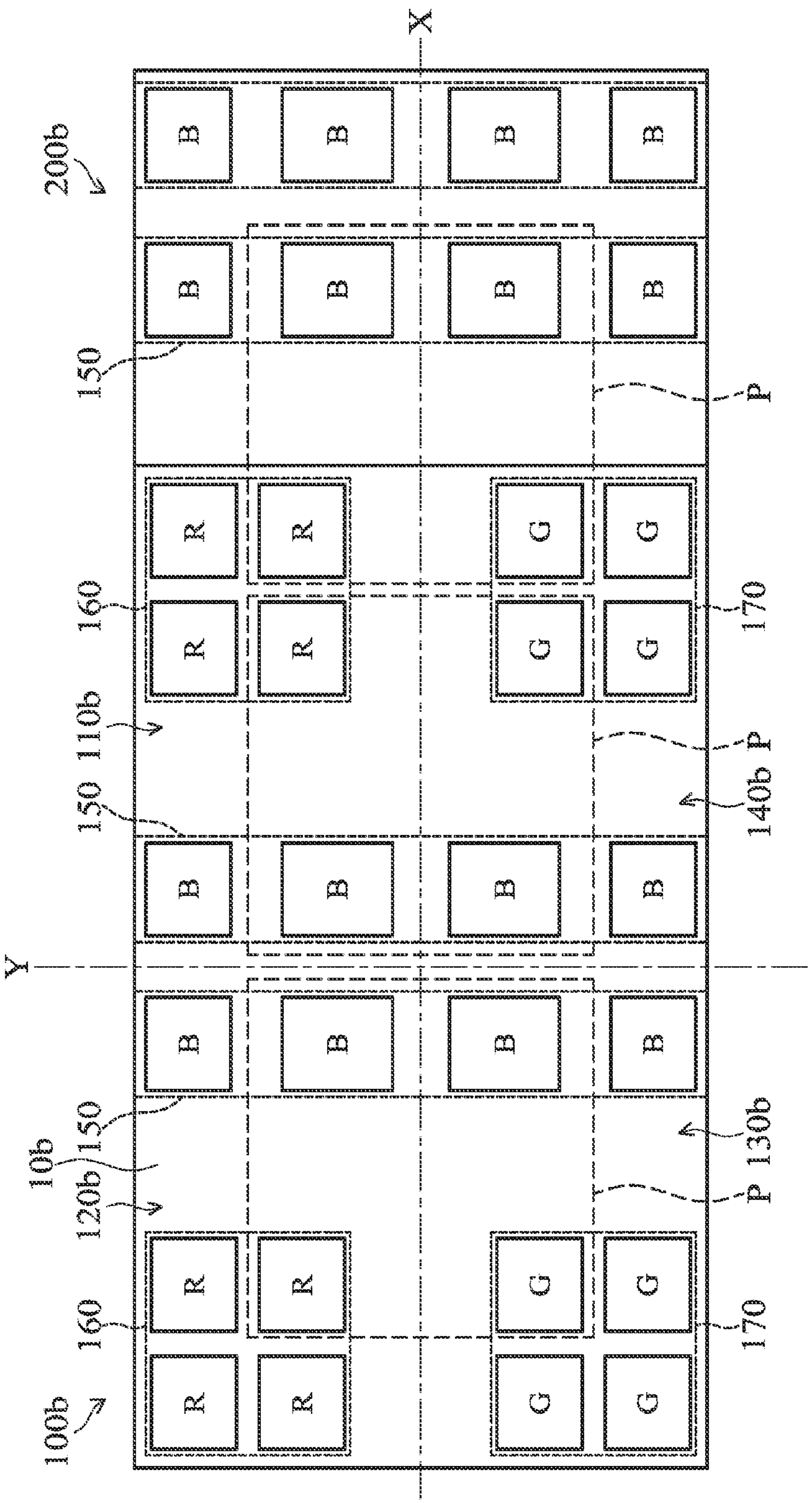

X
Y
200b
150
160
110b
150
10b
150
120b
160
100b
P
170
P
140b
P
130b
170
B
R
G

FIG. 5

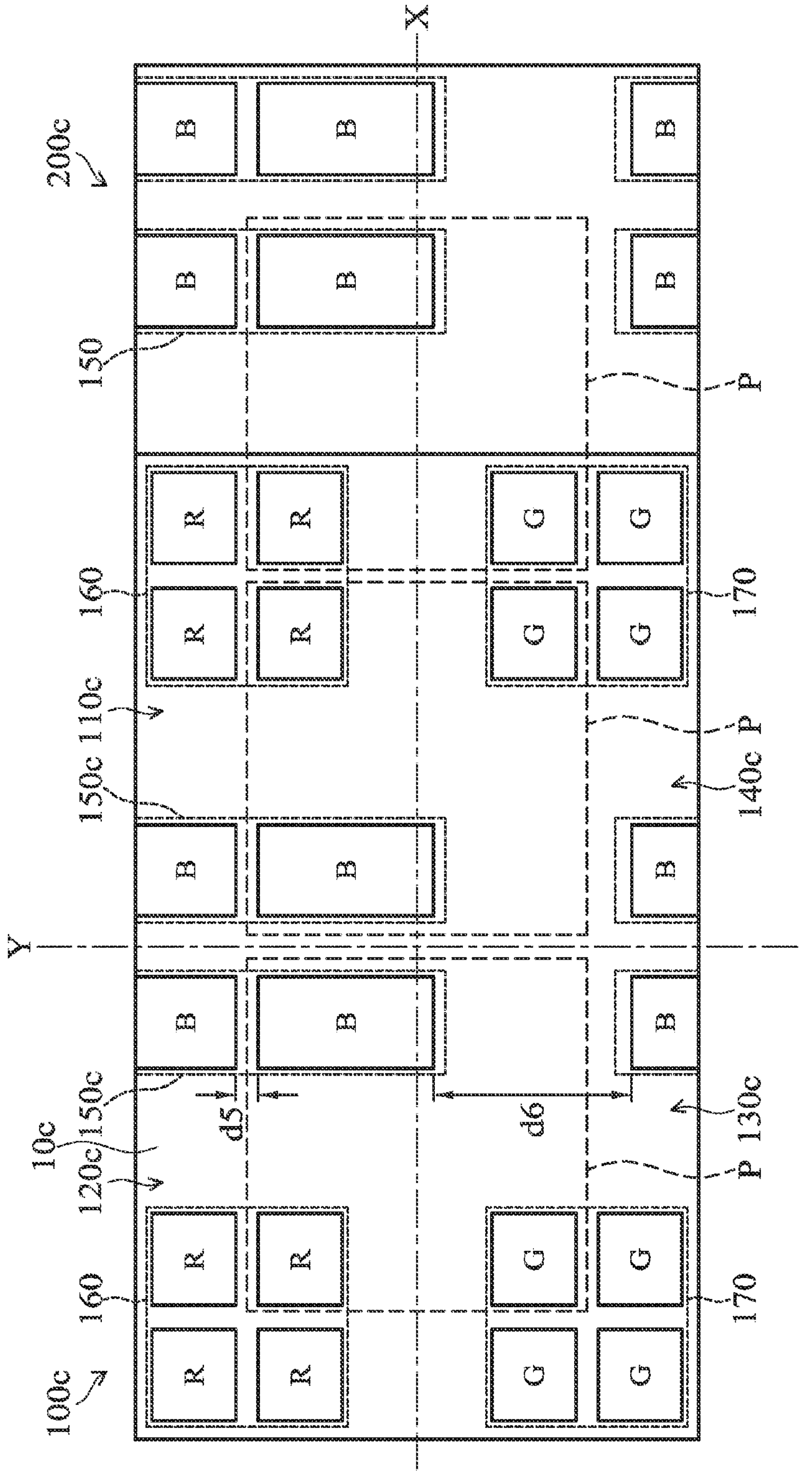

X
Y
200c
150
160
150c
110c
10c
120c
150c
160
100c
d5
d6
P
170
P
140c
130c
P
170
B
R
G

FIG. 6

OLED DISPLAY

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This Application is a continuation of U.S. patent application Ser. No. 14/132,247, filed Dec. 18, 2013, which claims priority to Taiwan Patent Application No. 102107438, filed on Mar. 4, 2013. The contents of these prior applications are incorporated herein by reference.

BACKGROUND

[0002] 1. Field of the Invention

[0003] The disclosure relates to a color organic light emitting diode (OLED) display, and in particular relates to an OLED display having better display resolution by adjusting an arrangement of pixel units thereof.

[0004] 2. Description of the Related Art

[0005] An organic light emitting diode (OLED) generally includes a cathode, and an anode and organic materials disposed between the cathode and the anode. The illuminance of the OLED is determined by the electric current flowing from the anode to the cathode. Therefore, in order to improve the illuminance of an OLED, a large driving voltage should be applied thereto so as to increase the electric current passing therethrough and enable the formation of an exciton, i.e. a recombination of the "electron-hole".

[0006] The manufacturing of an OLED display involves the use of a metal mask when evaporating organic materials. However, as the precision of the metal mask cannot be improved, the current technology can only produce products with display resolution of 200-250 pixels per inch (PPI). Therefore, the competitiveness of OLED products is hindered due to limitation in display resolution.

SUMMARY

[0007] In light of the foregoing, one of the disclosed embodiments provides an OLED display in which a conventional metal mask is used to evaporate organic materials on a substrate which is arranged with pixel electrodes to define sub-pixels with special patterns so as to improve display resolution.

[0008] According to one embodiment, the OLED display includes a substrate, a first light-emissive layer, a second light-emissive layer, and two third light-emissive layers. The two third light-emissive layers corresponds a first sub-pixel and a second sub-pixel adjacent to the first sub-pixel. An axis passes through the first light-emissive layer and the second light-emissive layer. The axis is between the two third light-emissive layers. The configuration of the first sub-pixel and the second sub-pixel are symmetrical with respect to the axis.

[0009] In the above-mentioned embodiments, the OLED display further includes a third sub-pixel corresponding to the first light-emissive layer, and a fourth sub-pixel corresponding to the second light-emissive layer, wherein the first sub-pixel, the second sub-pixel, the third sub-pixel, and the fourth sub-pixel compose of a pixel unit.

[0010] In the above-mentioned embodiments, an area of the third sub-pixel is equal to an area of the fourth sub-pixel.

[0011] In the above-mentioned embodiments, the light emitted from the first light-emissive layer in an excited state is blue light, the light emitted from the second light-emissive layer in an excited state is red light, and the light emitted from the two third light-emissive layers in an excited state is green light.

[0012] In the above-mentioned embodiments, an area of the first sub-pixel is equal to an area of the second sub-pixel.

[0013] According to one another embodiment, the OLED display includes a substrate and a plurality of pixel units. The pixel units are arranged in a number of directions on the substrate. Each of the plurality of pixel units includes a first sub-pixel, a second sub-pixel, a third sub-pixel, and a fourth sub-pixel. The configuration of the first, second, third and fourth sub-pixels in each of the two neighboring pixel units along a first direction of the directions are symmetrical with each other.

[0014] In the above-mentioned embodiments, the third sub-pixel and the fourth sub-pixel are the same color, and the third sub-pixel and the fourth sub-pixel are arranged parallel to the first direction. The third sub-pixel and the fourth sub-pixel are the same color, wherein the first direction passes through the third sub-pixel and the fourth sub-pixel.

[0015] In the above-mentioned embodiments, the light emitted from the first sub-pixel in an excited state is blue light, the light emitted from the second sub-pixel in an excited state is red light, and the light emitted from the third sub-pixel and the fourth sub-pixel in an excited state is green light.

[0016] In the above-mentioned embodiments, an area of the first sub-pixel is equal to an area of the second sub-pixel.

[0017] In the above-mentioned embodiments, an area of the third sub-pixel is equal to an area of the fourth sub-pixel.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The present invention is more fully understood by reading the subsequent detailed description and examples with references made to the accompanying drawings, wherein:

[0019] FIG. **1** shows a top view of an OLED display of an embodiment of the present disclosure;

[0020] FIG. **2** shows a schematic view of a first and a second lighting element of the OLED display of the embodiment of the present disclosure;

[0021] FIGS. **3**A(**1**), **3**A(**2**), **3**B and **3**C show masks of some embodiments of the present disclosure;

[0022] FIG. **4** shows a schematic view of a first and a second lighting element of the other embodiment of the present disclosure;

[0023] FIG. **5** shows a schematic view of a first and a second lighting element of the other embodiment of the present disclosure; and

[0024] FIG. **6** shows a schematic view of a first and a second lighting element of the other embodiment of the present disclosure.

DETAILED DESCRIPTION

[0025] Several exemplary embodiments of the application are described with reference to FIGS. **1** through **6**. It is to be understood that the following disclosure provides various different embodiments as examples for implementing different features of the application. This description is made for the purpose of illustrating the general principles of the invention and should not be taken in a limiting sense.

[0026] Referring to FIG. **1**, in accordance with one embodiment of the present disclosure, the OLED display **1** includes a substrate **10**, a plurality of first light-emitting units **100** and a plurality of second light-emitting units **200**. Before the plurality of first light-emitting units **100** and plurality second light-emitting units **200** are disposed on the substrate **10**, a plurality of pixel electrodes (not shown in figure) are disposed on the substrate **10** in advance, wherein the pixel electrodes are controlled by suitable means so as to implement the operation of the pixels of the OLED display **1**.

[0027] In the embodiment, the plurality of first light-emitting units **100** and plurality second light-emitting units **200** arranged in a matrix are formed on the electrode pixels of the substrate **10** by vaporizing, wherein the plurality of first light-emitting units **100** and plurality second light-emitting units **200** are arranged alternatively in a traversal direction to successively define a plurality of pixel unit P on the substrate **10**.

[0028] Specifically, referring to FIG. **2**, a transverse axis X and a longitudinal axis Y orthogonal to the transverse axis X divide each of the plurality of first light-emitting units **100** into a first region **110**, a second region **120**, a third region **130** and a fourth region **140**, wherein the first and third regions **110**, **130** are located at opposite corners of each of the plurality of first light-emitting units **100**, and the second and fourth regions **120**, **140** are diagonally located at the other opposite corners of the plurality of first light-emitting units **100**.

[0029] The plurality of first light-emitting units **100** each include a first light-emissive layer **150**, two second light-emissive layers **160** and two third light-emissive layers **170**, and the second light-emitting units **200** each include a first light-emissive layer **150**. The first light-emissive layer **150** of the plurality of first light-emitting units **100** overlaps with the longitudinal axis Y. The two second light-emissive layers **160** are disposed in the first and second regions **110**, **120** and spaced apart from the first light-emissive layer **150** by a distance d1. The two third light-emissive layers **170** are disposed in the third and fourth regions **130**, **140** and spaced apart from the first light-emissive layer **150** at a distance d1. Additionally, each second light-emissive layer **160** and each of third light-emissive layer **170** are spaced apart from each other at a distance d2 in a direction parallel to the longitudinal axis Y. The first light-emissive layer **150** of each of the plurality of second light-emitting units **200** has the same arrangement as that of the first light-emissive layer **150** of each of the plurality of first light-emitting units **100** and are adjacent to one of the plurality of first light-emitting units **100** in a direction parallel to the transverse axis X.

[0030] As shown in FIG. **2**, the first, second and third light-emissive layers **150**, **160** and **170** of each of the plurality of first light-emitting units **100** and the first light-emissive layer **150** of each of the plurality of second light-emitting units **200**, respectively, correspond to a plurality of first, second and third sub-pixels B, R and G, wherein each of the first light-emissive layer **150** corresponds to a plurality of first sub-pixels B which are spaced apart at a distance d4, and each second light-emissive layer **160** corresponds to four second sub-pixels R which are spaced apart at a distance d3, and each of third light-emissive layer **170** corresponds to four third sub-pixels G which are spaced apart at a distance d3. In the embodiment, the light emitted from the first light-emissive layers **150** in an excited state is blue light, the light emitted from the second light-emissive layers **160** in an excited state is red light, and the light emitted from the third light-emissive layers **170** in an excited state is green light.

[0031] One skilled in the art will appreciate that while the first, second and third light-emissive layers **150**, **160** and **170** are successively extended on the regions of the substrate **10**, lights with specific wavelengths can only be able to be emitted from the first, second and third sub-pixels B, R and G when the first, second and third sub-pixels B, R and G, which corresponds to the pixel electrodes (not shown in figure) of the substrate **10**, are excited by electric current. Thus, in FIG. **1**, the first, second and third light-emissive layers **150**, **160** and **170** are shown in dashed line, and the first, second and third sub-pixels B, R and G which are capable of emitting light is shown in solid line.

[0032] In this regard, in each of the plurality of first light-emitting units **100** the sub-pixels in the first and fourth regions **110**, **140** and the sub-pixels in the second and third regions **120**, **130** are symmetrical with each other with respect to the longitudinal axis Y, thereby defining two pixel units P in each side of the longitudinal axis Y, wherein each pixel unit P includes one first sub-pixel B, one second sub-pixel R and one third sub-pixel G. Additionally, referring to FIGS. **1** and **2**, a plurality of pixel units are defined in between each of the plurality of first light-emitting units **100** and the neighboring first light-emitting unit **100** in a longitudinal axis Y and in between each of the plurality of first light-emitting units **100** and the neighboring second light-emitting unit **200** in a transverse axis X. Moreover, the arrangement of the first, second and third sub-pixels B, R and G in two neighboring pixel units P are symmetrical with each other in the direction parallel to the longitudinal axis Y.

[0033] Due to drawbacks where the blue light-emissive layers tend to malfunction when operating with high electric currents, a method is provided in the embodiment. As shown in FIG. **2**, a length of the first sub-pixels B in the direction parallel to the longitudinal axis Y is larger than a length of the second sub-pixels G or a length of the third sub-pixels R in the direction parallel to the longitudinal axis Y. In a single pixel unit P an area of the first sub-pixel B is larger than an area of the second sub-pixel G, and the area of the first sub-pixel is larger than an area of the third sub-pixel R. Thus, a smaller electric current is applied to the first sub-pixels B than that applied to the second and third sub-pixels R and G, and the first, second and third sub-pixels B, R and G may emit lights with same illuminance.

[0034] The manufacturing method of the OLED display **1** is described in detail. Firstly, driving circuits and pixel electrodes (not shown in figures) are formed on the substrate **10**, and metal masks **300**, **400** and **500** shown in FIG. **3A(1)-3C** are configured to evaporate organic materials on the substrate **10**. Specifically, the metal mask **300** includes an opening **310** with a rectangular shape, wherein the size and position of the opening **310** are determined according to the size and positions of the first light-emissive layers **150**. The metal mask **400** includes two rectangular shaped openings **410** and, the sizes and positions of the openings **410** are determined according to the size and positions of the second light-emissive layers **160**. The metal mask **500** includes two rectangular shapes openings **510**, and the sizes and positions of the openings **510** are determined according to the size and positions of the third light-emissive layers **170**.

[0035] In order to allow for tolerance during alignment, the distances between the first, second and third light-emissive layers **150**, **160** and **170** are larger than the distance between the sub-pixels in corresponding light-emissive layers. Specifically, the distance d2 between one of the second light-emissive layers **160** and one of the third light-emissive layers **170** in a direction parallel to the longitudinal axis Y is larger than the distance d3 between the second sub-pixels R in each of the second light-emissive layer **160** and is larger than the distance d3 between the third sub-pixels G in each of the third light-emissive layer **170**. Additionally, the distance d1 between each of the second light-emissive layer **160** and one of the closest first light-emissive layers **150** in the direction parallel to the transverse axis X or the distance d1 between each of the third light-emissive layers **170** and one of the closest first light-emissive layers **150** in the direction parallel to the transverse axis X is larger than the distance d3 between the second sub-pixels R in each of the second light-emissive layer **160** and is larger than the distance d3 between the third sub-pixels G in each of the third light-emissive layer **170** and is larger than a distance d4 between the first sub-pixels B in each of the first light-emissive layer **150**.

[0036] Note that, the metal masks **300**, **400** and **500** each have a resolution of 200 pixels per inch (PPI), which are commercially available. In one exemplary embodiment, the distance dl ranges about 24.3±12 mm, the distance d2 ranges about 23.0±12 mm, the distance d3 ranges about 8±12 mm, and the distance d4 ranges about 14±12 mm. A width of each pixel unit P ranges about 55±12 mm, such that a display resolution of the OLED display **1** is 460 PPI.

[0037] Referring to FIG. **4**, a schematic view of a first and a second light-emitting unit **100***a*, **200***a* of an OLED display in accordance with another embodiment is shown in FIG. **4**, in which elements similar with that of the first and second light-emitting units **100**, **200** shown in FIG. **2** are provided with the same reference numbers, and the features thereof are not reiterated in the interest of brevity. The plurality of first and second light-emitting units **100***a*, **200***a* differ from the plurality of first and second light-emitting units **100**, **200** in that the two second light-emissive layers **160** are disposed in the second and fourth regions **120***a* and **140***a*, and the two third light-emissive layers **170** are disposed in the first and third regions **110***a* and **130***a*. That is, the sub-pixels in the first region **110***a* and the sub-pixels in the third region **130***a* are point symmetric to a center of each of the plurality of first light-emitting units **100***a* and arranged such that the metal mask for vaporizing the organic material may have a better mechanical strength.

[0038] Referring to FIG. **5**, a schematic view of a first and a second light-emitting unit **100***b*, **200***b* of an OLED display in accordance with another embodiment is shown in FIG. **5**, in which elements similar with that of the plurality of first and second light-emitting units **100**, **200** shown in FIG. **2** are provided with the same reference numbers, and the features thereof are not reiterated in the interest of brevity. The plurality of first and second light-emitting units **100***b*, **200***b* differ from the plurality of first and second light-emitting units **100**, **200** in that each pixel unit P includes two first sub-pixels B, one second sub-pixel R and one sub-pixel G, thereby improving uniformity of illuminance of each pixel unit.

[0039] Referring to FIG. **6**, a schematic view of a first and a second light-emitting unit **100***c*, **200***c* of an OLED display in accordance with another embodiment is shown in FIG. **6**, in which elements similar with that of the plurality of first and second light-emitting units **100**, **200** shown in FIG. **2** are provided with the same reference numbers, and the features thereof are not reiterated in the interest of brevity. The plurality of first and second light-emitting units **100***c*, **200***c* differ from the plurality of first and second light-emitting units **100**, **200** in that in the direction parallel to the longitudinal axis Y the first sub-pixels **150***c* are spaced by a first distance d5 and a second distance d6 different from the first distance d5, periodically. While being manufactured, the first light-emissive layers **150***c* of the embodiment are evaporated by using a metal mask as shown in FIG. **3**A(**2**).

[0040] By the arrangement of the sub-pixels, the OLED display manufactured by the same processing means as that of a conventional one may have a better display resolution, so as to improve the competitiveness of the OLED display.

[0041] While the invention has been described by way of example and in terms of the embodiment, it is to be understood that the invention is not limited thereto. To the contrary, it is intended to cover various modifications and similar arrangements (as would be apparent to those skilled in the art). Therefore, the scope of the appended claims should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements.

What is claimed is:

1. An OLED display, comprising:

a substrate;

a first light-emissive layer;

a second light-emissive layer; and

two third light-emissive layers, corresponding to a first sub-pixel and a second sub-pixel adjacent to the first sub-pixel, wherein an axis passes through the first light-emissive layer and the second light-emissive layer, and the axis is between the two third light-emissive layers, the configuration of the first sub-pixel and the second sub-pixel are symmetrical with respect to the axis.

2. The OLED display as claimed in claim **1**, further comprising a third sub-pixel corresponding to the first light-emissive layer, and a fourth sub-pixel corresponding to the second light-emissive layer, wherein the first sub-pixel, the second sub-pixel, the third sub-pixel, and the fourth sub-pixel compose of a pixel unit.

3. The OLED display as claimed in claim **2**, wherein an area of the third sub-pixel is substantially equal to an area of the fourth sub-pixel.

4. The OLED display as claimed in claim **1**, wherein the light emitted from the first light-emissive layer in an excited state is blue light, the light emitted from the second light-emissive layer in an excited state is red light, and the light emitted from the two third light-emissive layers in an excited state is green light.

5. The OLED display as claimed in claim **1**, wherein an area of the first sub-pixel is substantially equal to an area of the second sub-pixel.

6. An OLED display, comprising:

a substrate;

a plurality of pixel units, arranged in a number of directions on the substrate, wherein each of the plurality of pixel units comprises:

a first sub-pixel;

a second sub-pixel;

a third sub-pixel; and

a fourth sub-pixel, wherein the configuration of the first, second, third and fourth sub-pixels in each of the two neighboring pixel units along a first direction of the directions are symmetrical with each other.

7. The OLED display as claimed in claim **6**, wherein the third sub-pixel and the fourth sub-pixel are the same color, and the third sub-pixel and the fourth sub-pixel are arranged parallel to the first direction.

8. The OLED display as claimed in claim **6**, wherein the third sub-pixel and the fourth sub-pixel are the same color, wherein the first direction passes through the third sub-pixel and the fourth sub-pixel.

9. The OLED display as claimed in claim **6**, wherein the light emitted from the first sub-pixel in an excited state is blue light, the light emitted from the second sub-pixel in an excited state is red light, and the light emitted from the third sub-pixel and the fourth sub-pixel in an excited state is green light.

10. The OLED display as claimed in claim **6**, wherein an area of the first sub-pixel is substantially equal to an area of the second sub-pixel.

11. The OLED display as claimed in claim **6**, wherein an area of the third sub-pixel is substantially equal to an area of the fourth sub-pixel.

* * * * *

专利名称(译)	OLED显示屏		
公开(公告)号	US20150236077A1	公开(公告)日	2015-08-20
申请号	US14/699368	申请日	2015-04-29
[标]申请(专利权)人(译)	群创光电股份有限公司		
申请(专利权)人(译)	群创光电		
当前申请(专利权)人(译)	群创光电		
[标]发明人	HUANG HAO JUNG KANG CHIA PIN LIN CHE WEI CHOU HAO YU		
发明人	HUANG, HAO-JUNG KANG, CHIA-PIN LIN, CHE-WEI CHOU, HAO-YU		
IPC分类号	H01L27/32 H01L51/50		
CPC分类号	H01L27/3218 H01L27/3209 H01L27/3216 H01L27/326 H01L51/001 H01L51/0011 H01L51/0068 H01L51/0545 H01L51/50 H01L51/504		
优先权	102107438 2013-03-04 TW		
其他公开文献	US9412795		
外部链接	Espacenet USPTO		

摘要(译)

提供OLED显示器。OLED显示器包括基板，第一发光层，第二发光层和两个第三发光层。两个第三发光层对应于第一子像素和与第一子像素相邻的第二子像素。轴穿过第一发光层和第二发光层。轴位于两个第三发光层之间。第一子像素和第二子像素的配置相对于轴对称。