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Park

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(54) **ORGANIC ELECTRO-LUMINESCENCE DISPLAY HAVING FIRST AND SECOND BARRIER RIBS AND METHOD OF FABRICATING THE SAME**

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H05B 33/22 (2006.01)
H01J 1/62 (2006.01)

(52) **U.S. Cl.** **313/504**; 313/506; 313/505; 445/24; 445/25; 257/40

(58) **Field of Classification Search** ..... None
See application file for complete search history.

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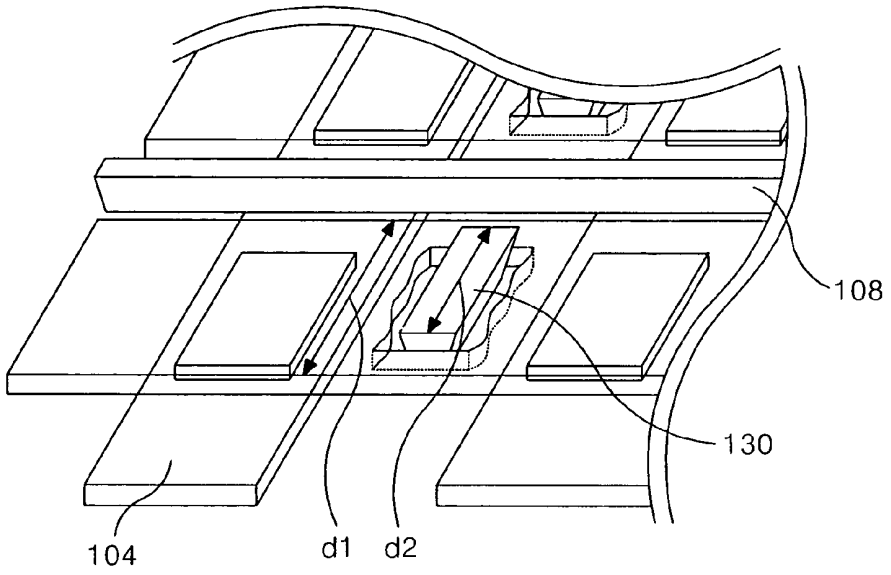
(57) **ABSTRACT**

An organic electro-luminescence device and a fabricating method thereof wherein an organic light-emitting layer can be provided at an accurate location to prevent a deterioration of picture quality. In the organic electro-luminescence device, a first barrier rib is provided between adjacent organic electro-luminescence cells along a first direction. A second barrier rib is provided between said adjacent organic electro-luminescence cells along a second direction and is positioned between the first barrier ribs.

16 Claims, 14 Drawing Sheets



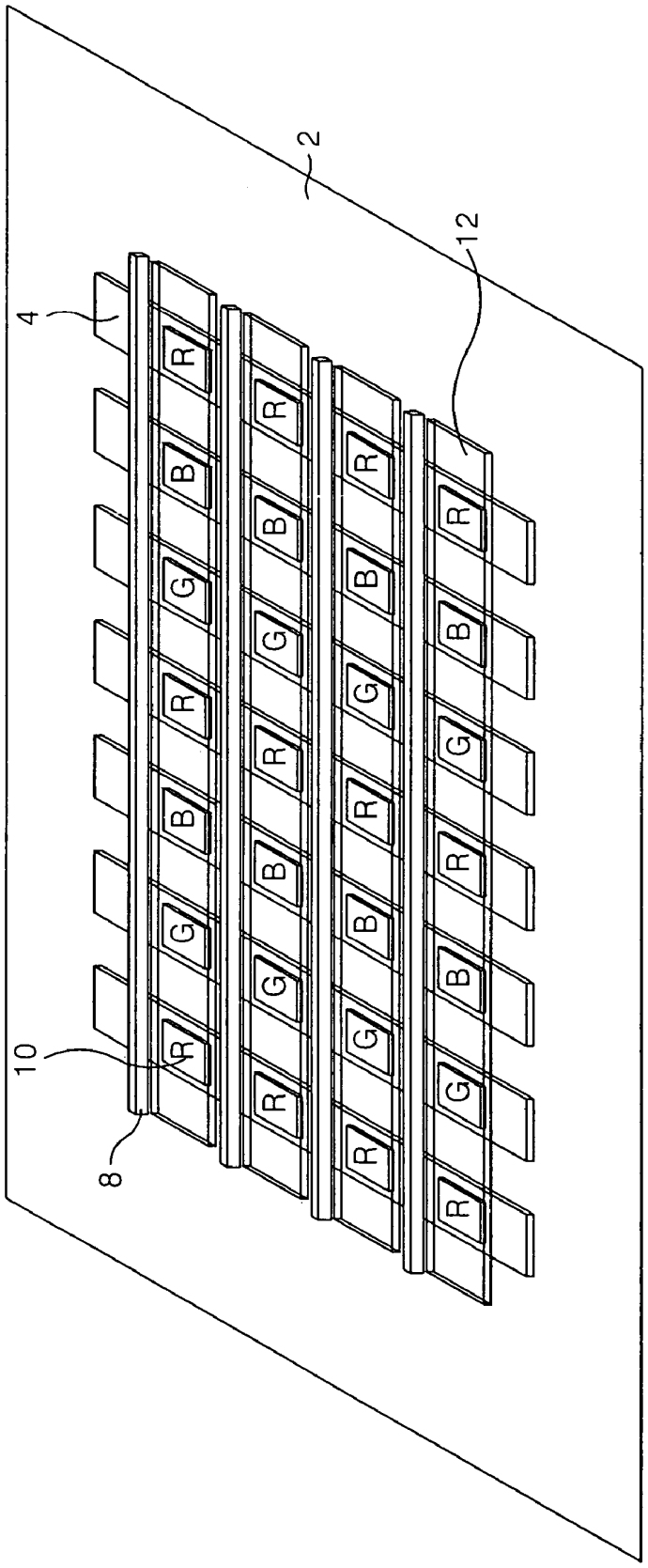


FIG. 1
RELATED ART

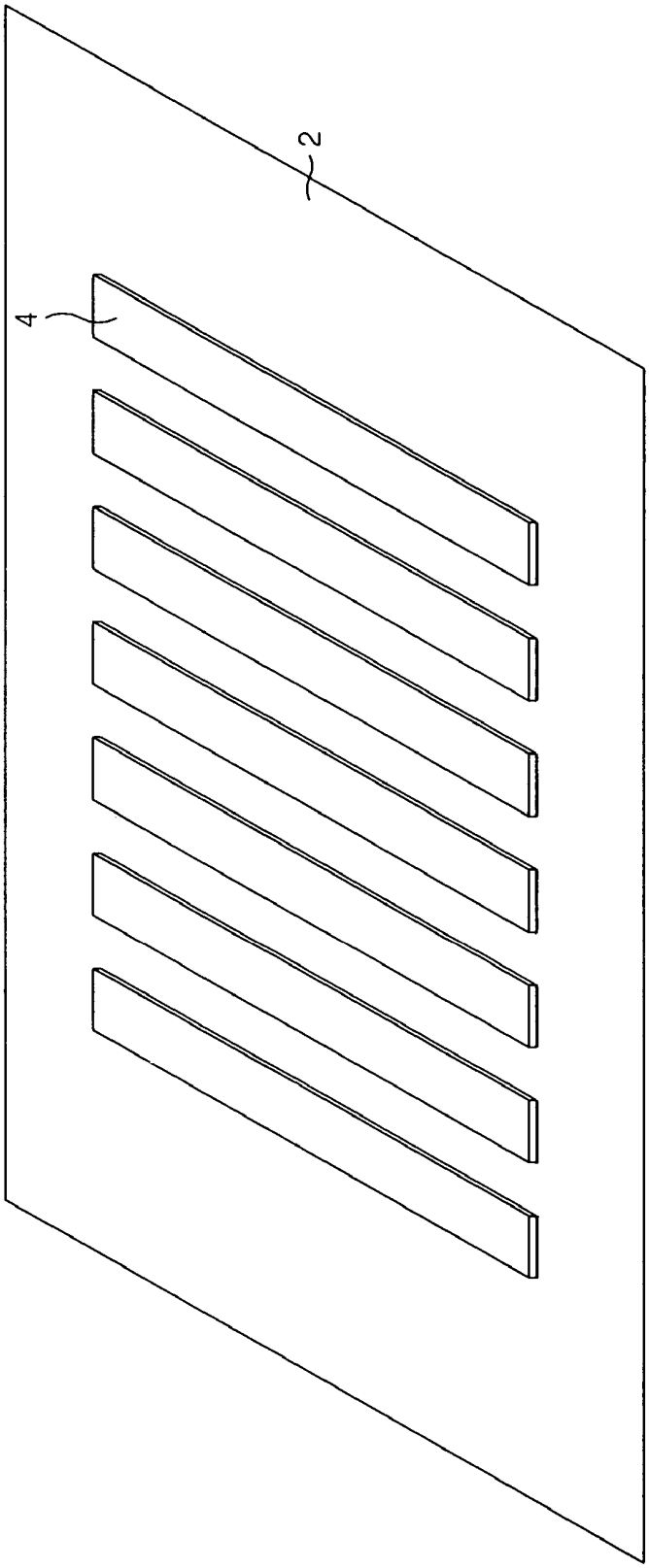


FIG.2A
RELATED ART

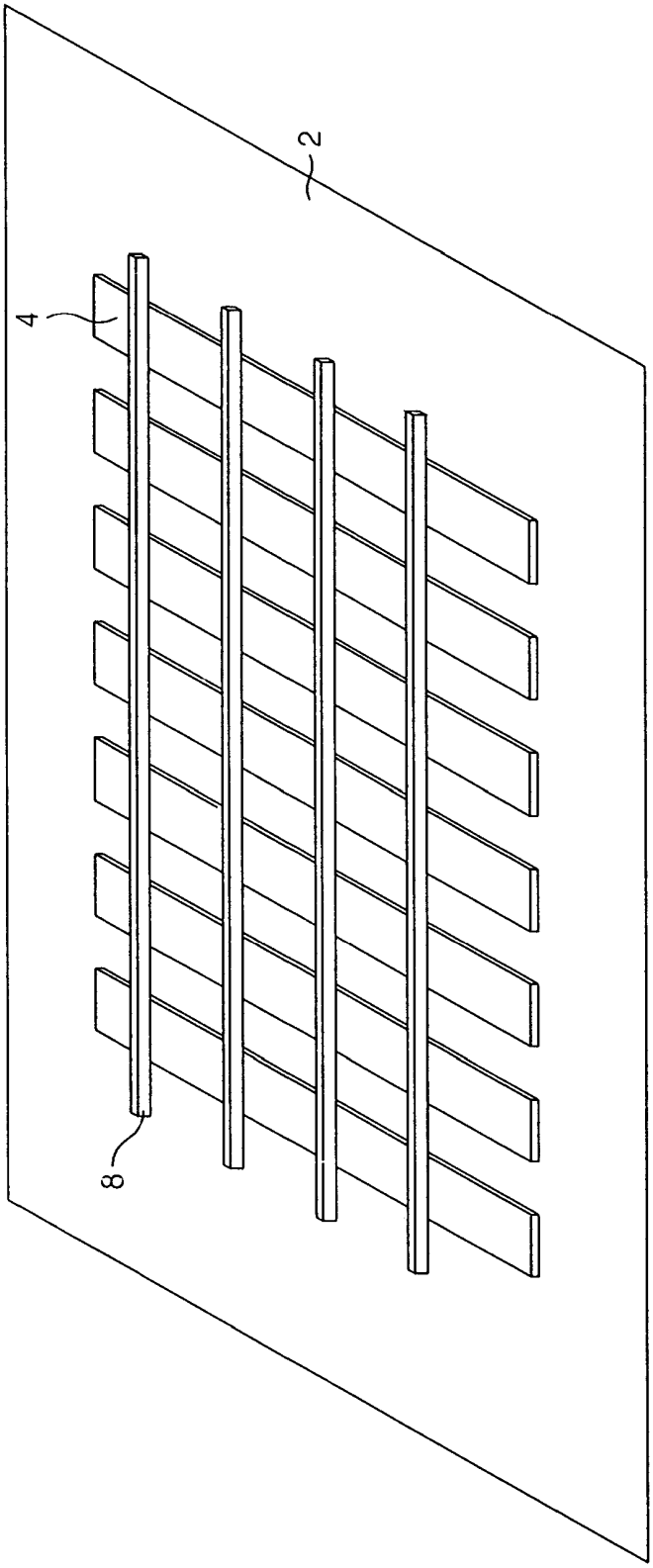


FIG.2B
RELATED ART

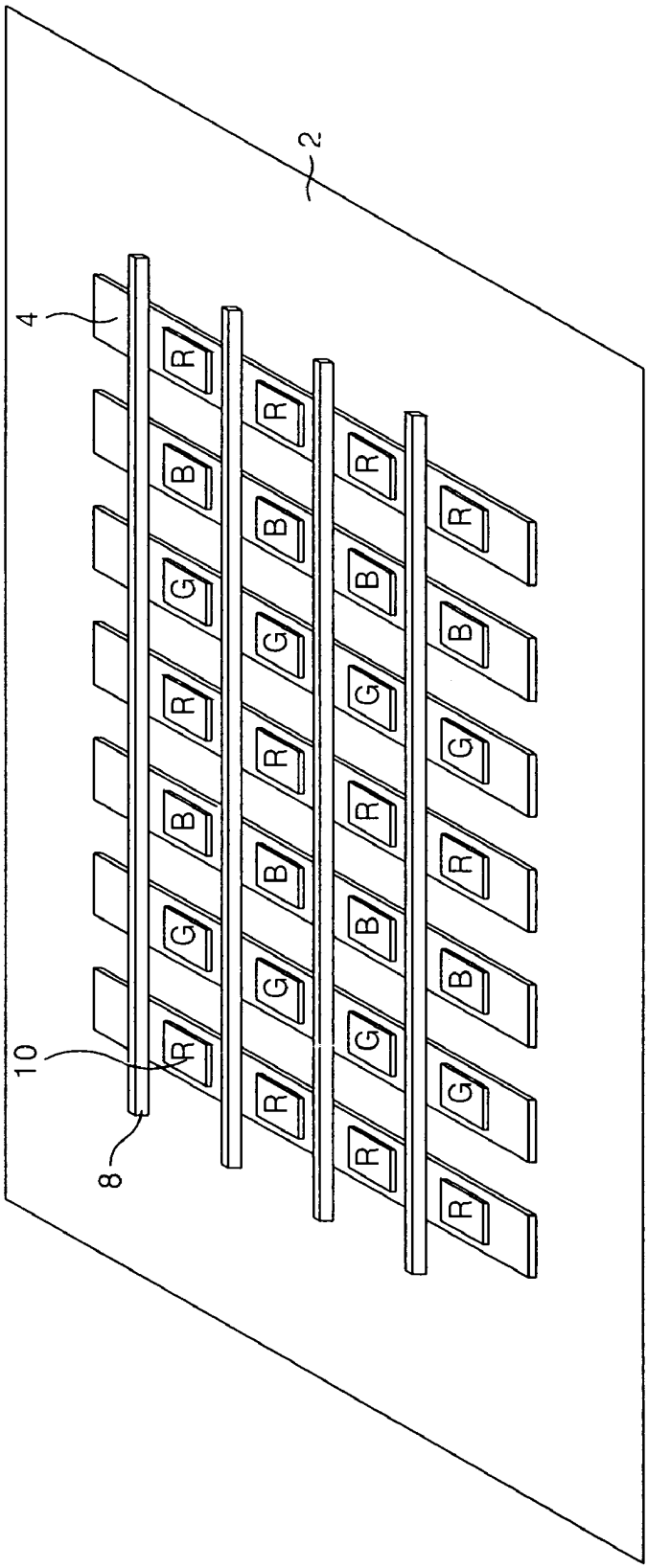


FIG.2C
RELATED ART

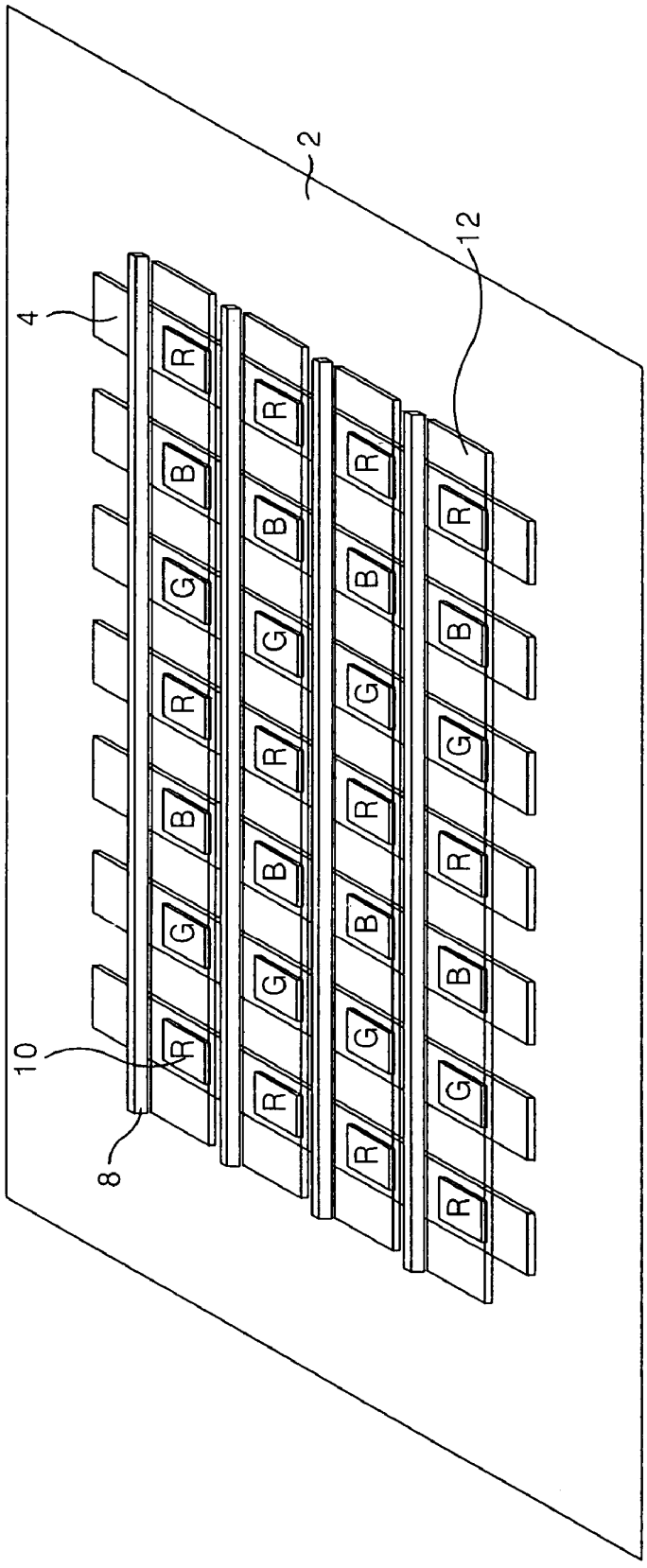


FIG.2D
RELATED ART

FIG. 3
RELATED ART

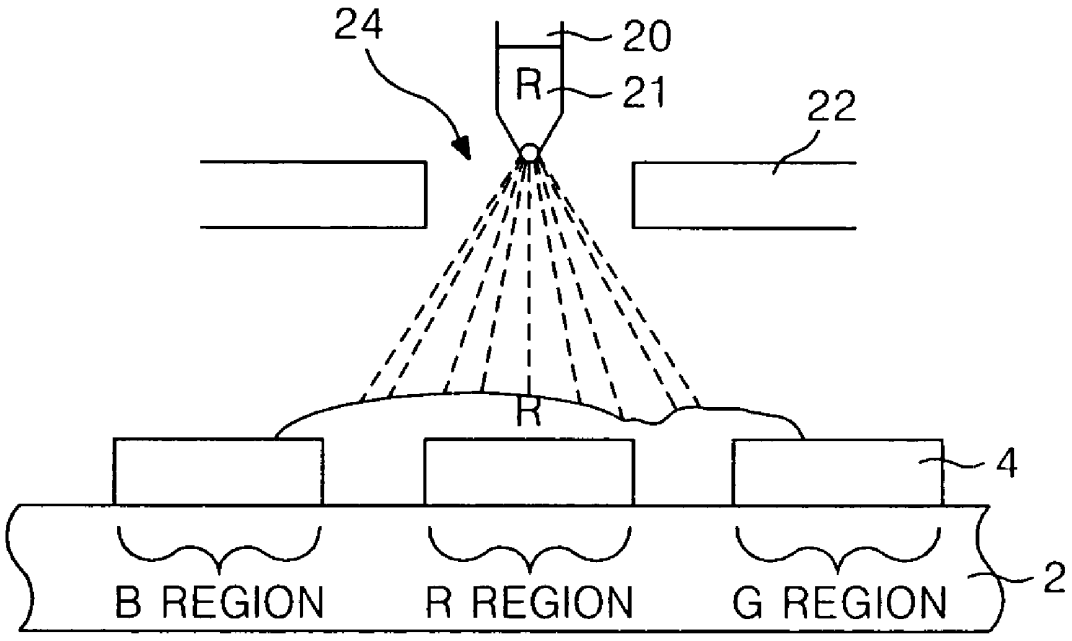


FIG. 4

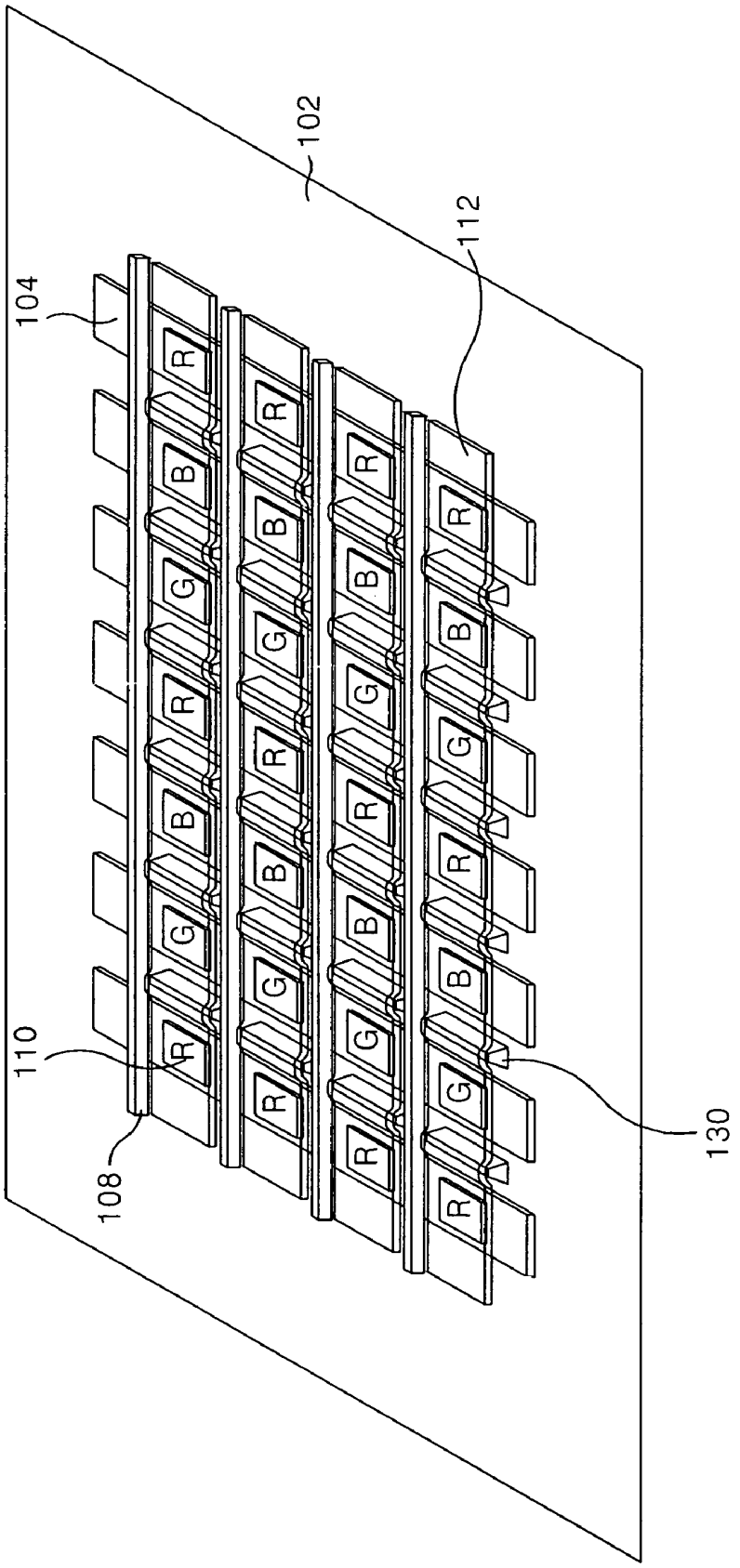
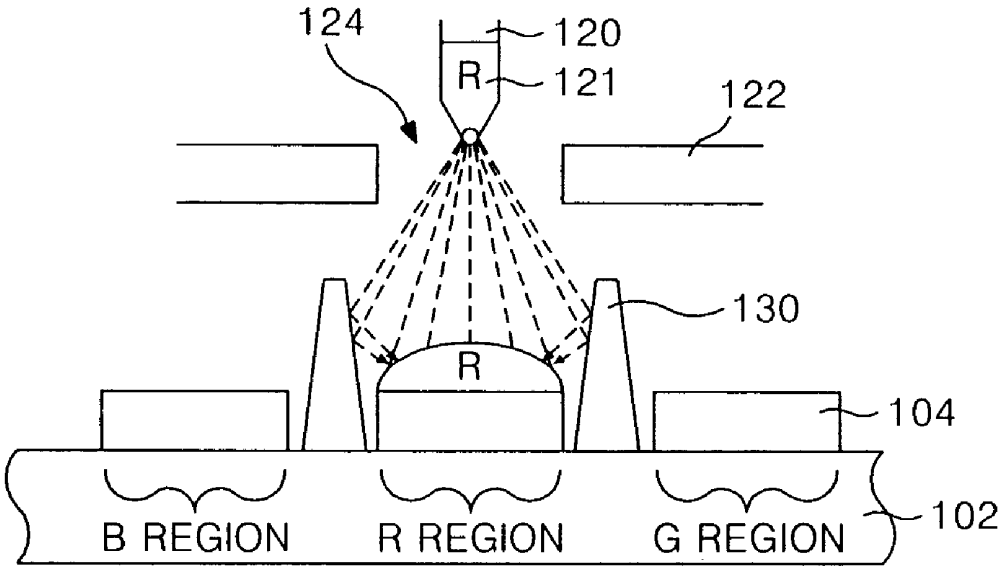


FIG.5



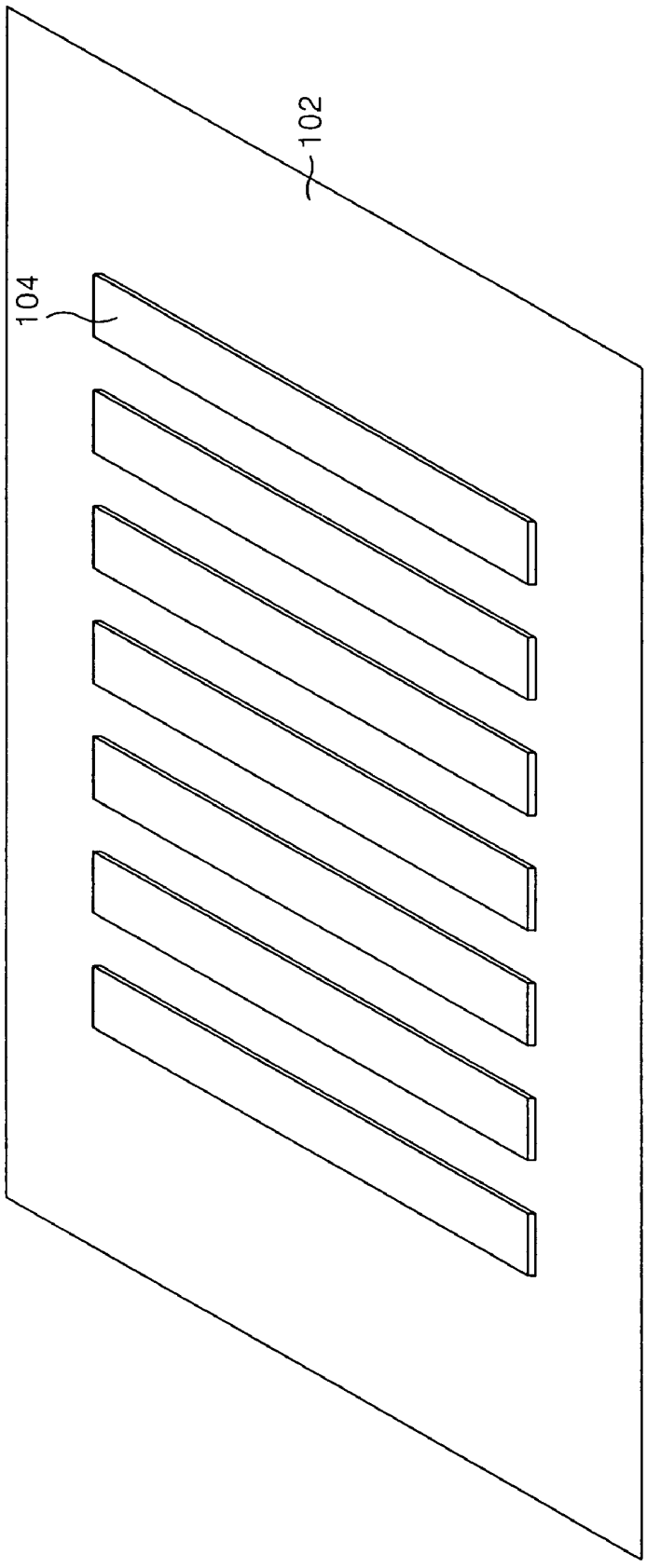


FIG. 6A

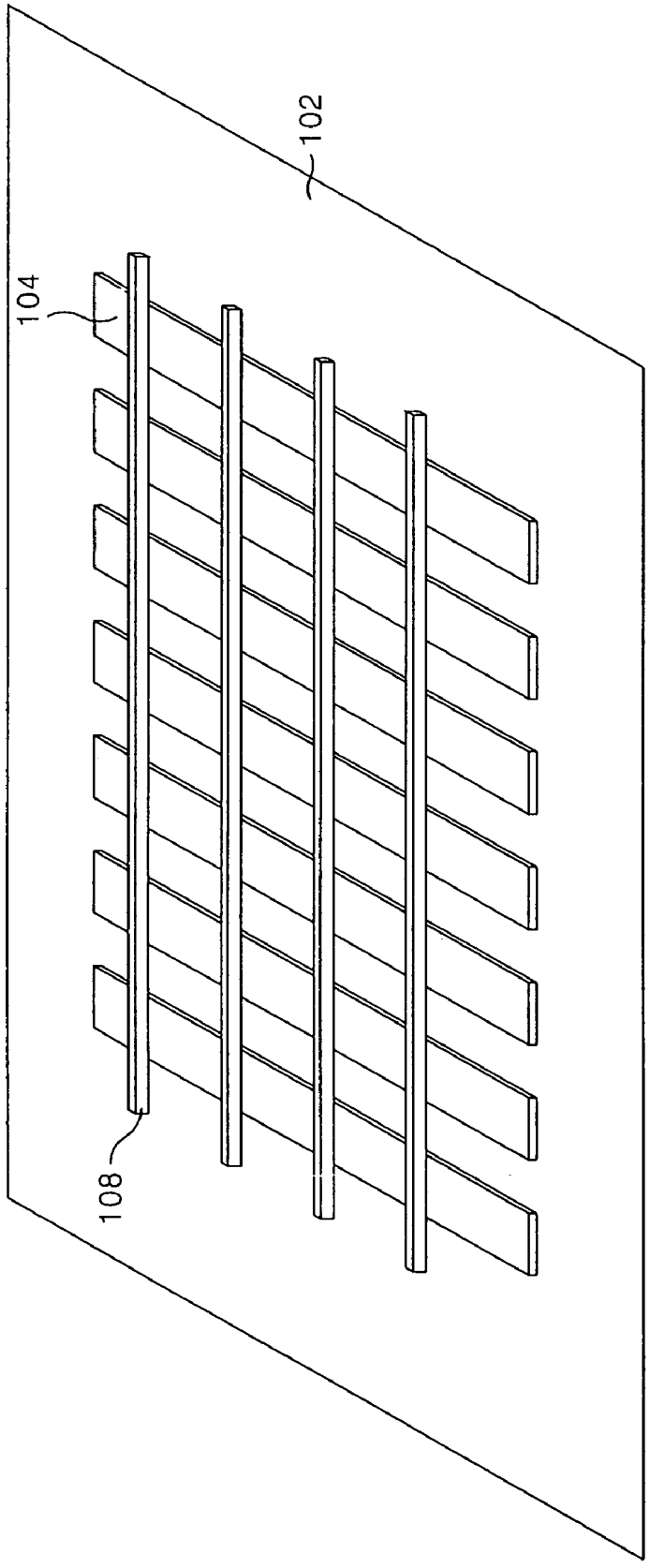


FIG.6B

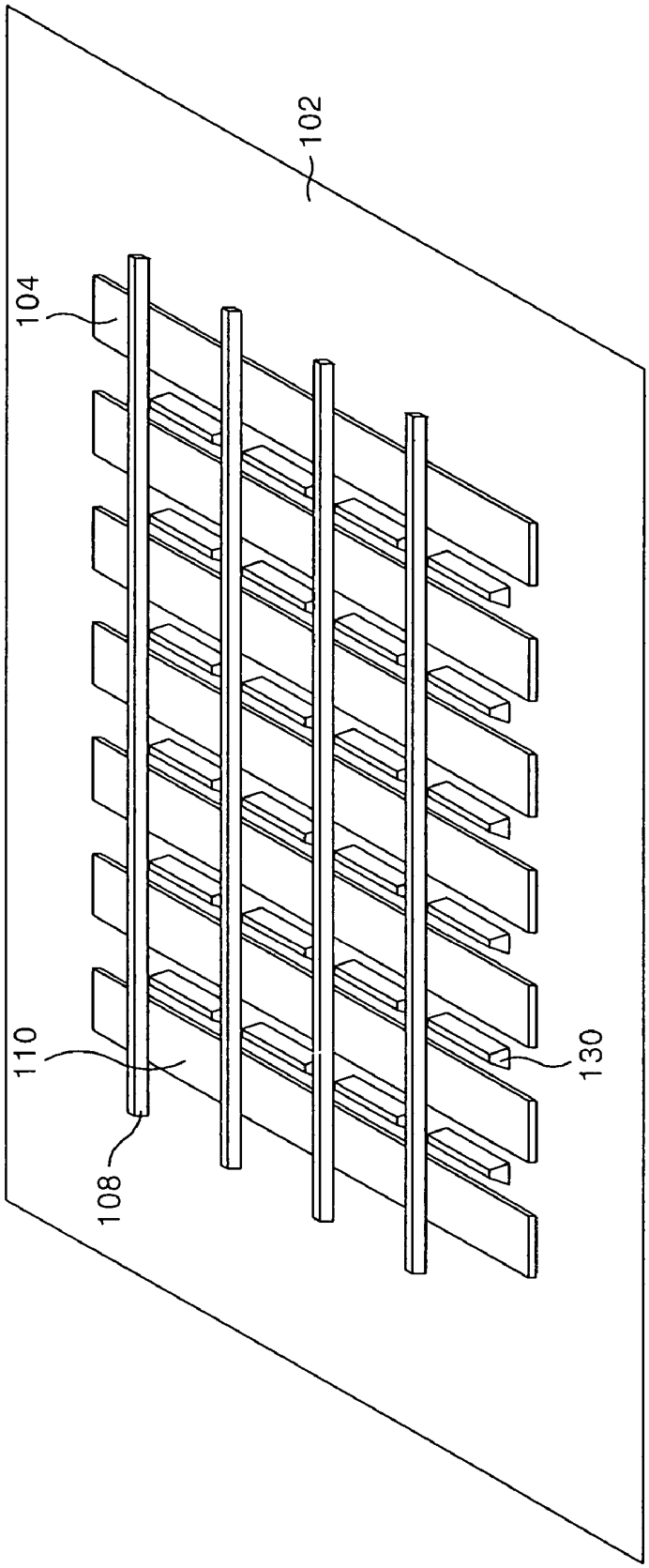


FIG. 6C

FIG.6D

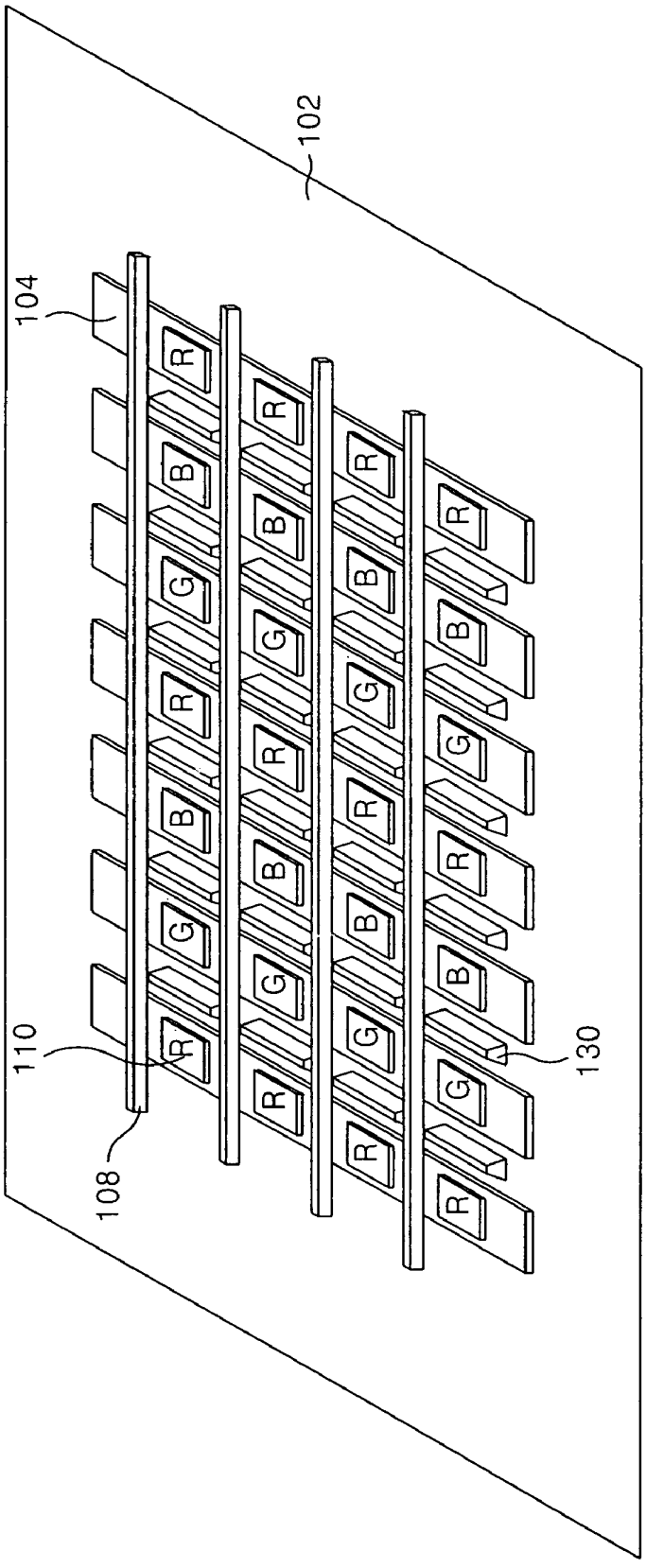


FIG.6E

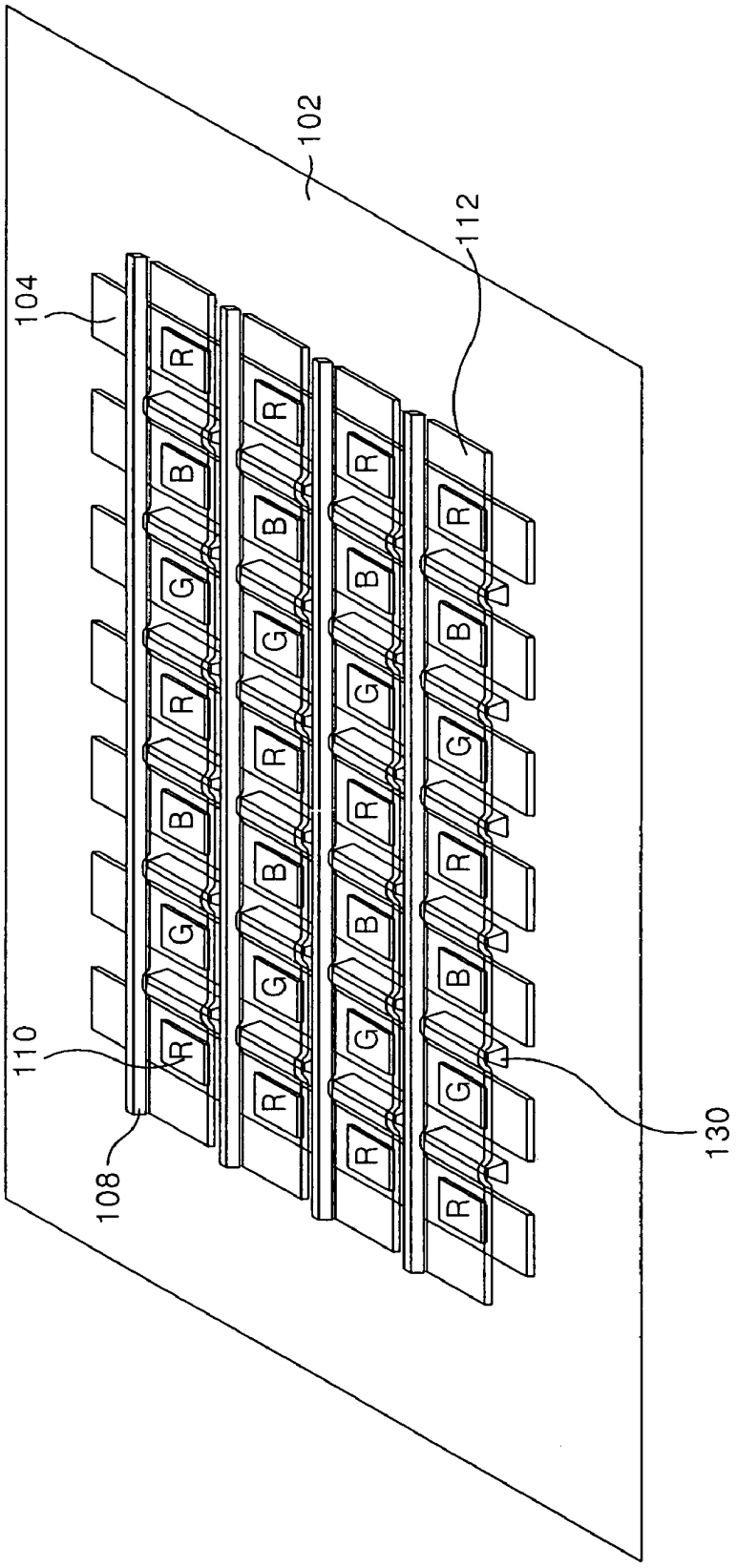
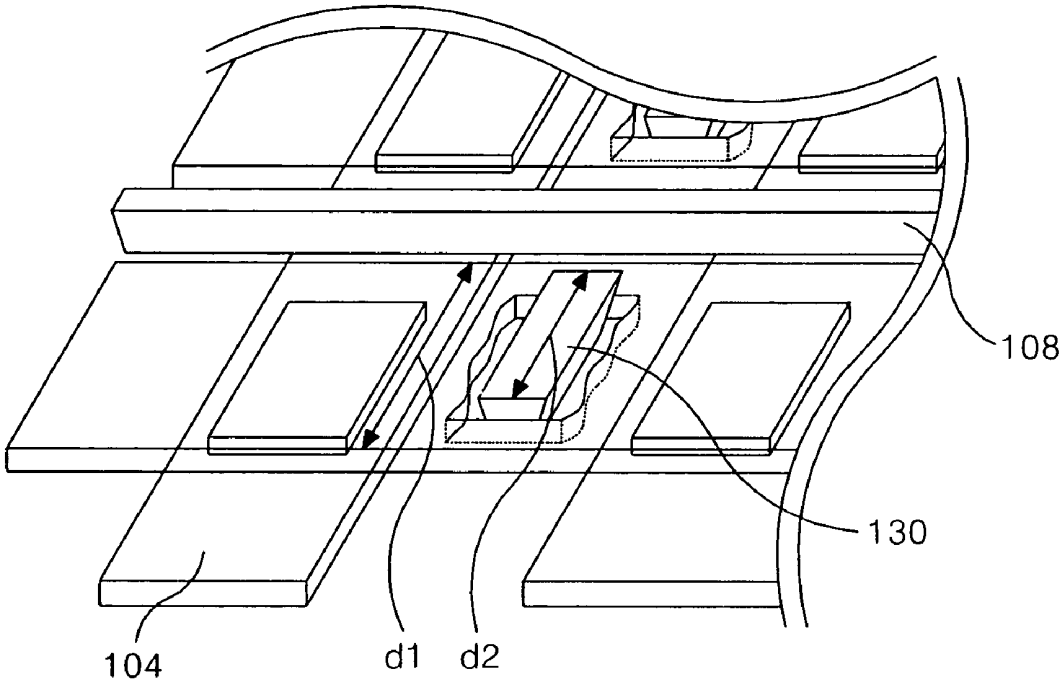


FIG. 7



ORGANIC ELECTRO-LUMINESCENCE DISPLAY HAVING FIRST AND SECOND BARRIER RIBS AND METHOD OF FABRICATING THE SAME

This application claims the benefit of Korean Patent Application No. P2004-19293 filed in Korea on Mar. 22, 2004, which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an electro-luminescence display (ELD), and more particularly to an organic electro-luminescence device and a fabricating method thereof wherein an organic light-emitting layer can be provided at an accurate location to prevent a deterioration of picture quality.

2. Description of the Related Art

Recently, there have been developed various flat panel display devices reduced in weight and bulk that is capable of eliminating disadvantages of a cathode ray tube (CRT). Such flat panel display devices include a liquid crystal display (LCD), a field emission display (FED), a plasma display panel (PDP) and an electro-luminescence display device (ELD), etc. Particularly, the ELD has a structure in which electrodes are attached onto each side of an organic light-emitting layer basically consisting of a hole carrier layer, a light-emitting layer and an electron carrier layer. The ELD has been highlighted to be a post-generation flat panel display device owing to characteristics of a wide viewing angle, a high aperture ration and a high chromaticity, etc.

Such an ELD is largely classified into an inorganic ELD and an organic ELD depending upon its used material. The organic ELD has an advantage in that it can be driven with a lower voltage than the inorganic ELD because electrons and holes emit a light while being extinguished after making a pair when electric charges are injected into an organic EL layer provided between a hole injection electrode and an electron injection electrode. Further, the organic ELD has advantages in that it can be formed on a flexible transparent substrate such as plastic and can be driven with a lower voltage (i.e., less than 10V) than the PDP or the inorganic ELD; and it has a relatively small power consumption and an excellent color sense.

FIG. **1** is a perspective view showing a structure of a conventional organic ELD.

Referring to FIG. **1**, the organic ELD has an anode electrode **4** and a cathode electrode **12** provided on a substrate **2** in a direction crossing each other.

A plurality of anode electrodes **4** are provided on the substrate **2** in such a manner to be spaced at a desired distance. An insulating film (not shown) having an aperture for each EL cell area is formed on the substrate **2** provided with the anode electrodes **4**. On the insulating film, barrier ribs **8** for separating an organic light-emitting layer **10** and the cathode electrode **12** to be provided thereon are positioned. The barrier rib **8** is provided in a direction crossing the anode electrode **4**, and has a backward taper structure in which its upper portion has a larger width than its lower portion. The organic light-emitting layer **10** made from an organic compound and the cathode electrode **12** are entirely deposited onto the insulating film provided with the barrier rib **8**. The organic light-emitting layer **10** has a hole carrier layer, a light-emitting layer and an electron carrier layer deposited onto the insulating film. Such a passive ELD emits electrons and holes when a driving signal is applied to the anode electrode **4** and the cathode electrode **12**. The electrons and holes emitted from the anode electrode **4** and the cathode electrode **12** are recombined within the organic light-emitting layer **10** to generate a visible light. The generated visible light outputs to the exterior via the anode electrode **4** to thereby display a desired picture or image.

Hereinafter, a method of fabricating the conventional organic ELD will be described with reference to FIG. **2**A to FIG. **2**D.

Firstly, as shown in FIG. **2**A, the anode electrode **4** is provided by depositing a metal transparent conductive material onto the substrate **2** made from a soda lime or a vulcanized glass and then patterning it by the photolithography and the etching process. Herein, indium-tin-oxide (ITO) or SnO_2 is used as the metal material.

The insulating film (not shown) is formed in such a manner to expose a light-emitting area by coating a photosensitive insulating material onto the substrate **2** provided with the anode electrode **4** by the spin coating technique and then patterning it by the photolithography and the etching process.

As shown in FIG. **2**B, the barrier rib **8** is formed by depositing a photosensitive organic material onto the insulating film and then patterning it by the photolithography and the etching process. The barrier rib **8** is provided to divide the pixels in such a manner to cross the plurality of anode electrodes **4**.

As shown in FIG. **2**C, the organic light-emitting layer **10** is formed on the substrate **2** provided with the barrier rib **8** by utilizing a shadow mask (not shown).

As shown in FIG. **2**D, the cathode electrode **12** is formed by depositing a metal material onto the substrate **2** provided with the organic light-emitting layer **10**.

Meanwhile, the formation of the organic light-emitting layer **10** by utilizing the conventional shadow mask raises a problem in that an organic light-emitting material passing through a slit of the shadow mask is not secured at an accurate location to generate a formation badness of the organic light-emitting layer **10**, thereby causing a deterioration of picture quality.

This will be described in detail with reference to FIG. **3** below.

When a heating vessel **20** contained with a specific organic material (e.g., a light-emitting material **21** for implementing a red (R) color) is heated, the specific organic material **21** (e.g., a light-emitting material **21** for implementing a red (R) color) within the heating vessel **20** is sublimed to be deposited onto the anode electrode **4**. Herein, a shadow mask **22** is provided in such a manner to be spaced at a desired distance from the anode electrode **4** as the barrier rib **8** is formed on the barrier rib. Further, as a process tolerance is generated upon fabricating the shadow mask **22**, the specific organic material **21** having passed through a slot **24** of the shadow mask **22** is widely spread. Thus, there is raised a problem in that a deposition of it onto the adjacent sub-pixel for implementing a different color (i.e., the sub-pixel for implementing a green (G) color or a blue (B) color) occurs frequently.

Therefore, the formation badness of the organic light-emitting layer **10**, such as a mixing of different color organic light-emitting material at each sub-pixel (i.e., R, G or B sub-pixel), or a formation of improper amount of organic light-emitting material, is generated to cause a deterioration of picture quality such as a non-uniformity of picture quality upon a light-emission of the organic ELD.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide an organic electro-luminescence device and a fabri-

cating method thereof wherein an organic light-emitting layer can be provided at an accurate location to prevent a deterioration of picture quality.

In order to achieve these and other objects of the invention, an organic electro-luminescence device according to one aspect of the present invention includes a first barrier rib provided between adjacent organic electro-luminescence cells along a first direction; and a second barrier rib provided between said adjacent organic electro-luminescence cells along a second direction and positioned between the first barrier ribs.

In the organic electro-luminescence device, the second barrier rib is formed from the same material as the first barrier rib.

In the organic electro-luminescence device, the second barrier rib has a smaller width as it goes from the lower portion thereof into the upper portion thereof.

In the organic electro-luminescence device, the second barrier rib has a larger width as it goes from the lower portion thereof into the upper portion thereof.

A method of fabricating an organic electro-luminescence device according to another aspect of the present invention includes the steps of forming a first barrier rib between adjacent organic electro-luminescence cells along a first direction; and forming a second barrier rib provided between said adjacent organic electro-luminescence cells along a second direction and positioned between the first barrier ribs.

In the method, the second barrier rib is formed from the same material as the first barrier rib.

In the method, the second barrier rib has a smaller width as it goes from the lower portion thereof into the upper portion thereof.

In the method, the second barrier rib has a larger width as it goes from the lower portion thereof into the upper portion thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects of the invention will be apparent from the following detailed description of the embodiments of the present invention with reference to the accompanying drawings, in which:

FIG. **1** is a perspective view showing a structure of a conventional organic electro-luminescence device;

FIG. **2**A to FIG. **2**D are views for explaining a method of fabricating the conventional organic electro-luminescence device;

FIG. **3** is a view for showing a bad formation of the organic light-emitting layer in the conventional organic electro-luminescence device;

FIG. **4** is a perspective plan view showing a structure of an organic electro-luminescence device according to a first embodiment of the present invention;

FIG. **5** is a view for showing a normal formation of the organic light-emitting layer shown in FIG. **4**;

FIG. **6**A to FIG. **6**E are views for explaining a method of fabricating the organic electro-luminescence device according to the first embodiment of the present invention; and

FIG. **7** is a perspective plan view showing a portion of an organic electro-luminescence device according to a second embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

Hereinafter, the preferred embodiments of the present invention will be described in detail with reference to FIGS. **4** to **7**.

FIG. **4** is a perspective plan view showing a structure of an organic electro-luminescence device (ELD) according to a first embodiment of the present invention.

Referring to FIG. **4**, the organic ELD has an anode electrode **104** and a cathode electrode **112** provided on a substrate **102** in a direction crossing each other.

A plurality of anode electrodes **104** are provided on the substrate **102** in such a manner to be spaced at a desired distance. An insulating film (not shown) having an aperture for each EL cell area is formed on the substrate **102** provided with the anode electrodes **104**. On the insulating film, first barrier ribs **108** for separating an organic light-emitting layer **110** and the cathode electrode **112** for implementing the same color to be provided thereon are positioned. The barrier rib **108** is provided in a direction crossing the anode electrode **104**, and has a backward taper structure in which its upper portion has a larger width than its lower portion (i.e., a shape having a larger width as it goes from the lower portion into the upper portion).

On the insulating film provided with the first barrier rib **108**, a second barrier rib **130** having a forward taper structure is provided in such a manner to make a direction perpendicular to the first barrier rib **108** and be positioned between it and an organic light-emitting layer **110** for implementing a different color. The second barrier rib **130** is located between organic light-emitting areas for implementing different colors to divide the EL cells implementing different colors, thereby providing the organic light-emitting layer **110** at an accurate location.

This will be described in detail with reference to FIG. **5** below.

When a heating vessel **120** contained with an organic material **121** is heated, the specific organic material **121** (e.g., a light-emitting material for implementing a red (R) color) within the heating vessel **120** is sublimed to be deposited onto the anode electrode **104**. Herein, even though the specific organic material **121** having passing through a slot **124** of the shadow mask **122** is widely spread due to a height of the first barrier rib **108** and a process tolerance upon fabrication of the shadow mask **122**, the second barrier rib **130** positioned between the light-emitting areas for implementing different colors prevents the specific organic material **121** (i.e., the light-emitting material for implementing a red (R) color) from being secured onto the adjacent light-emitting area (i.e., the light-emitting area for implementing a green (G) color or a blue (B) color).

Accordingly, the organic light-emitting layer **110** is provided at an accurate location to thereby prevent a deterioration of picture quality such as a non-uniformity of picture quality.

The organic light-emitting layer **110** made from an organic compound and the cathode electrode **112** are entirely deposited onto the insulating film provided with the second barrier rib **130**. The organic light-emitting layer **110** has a hole carrier layer, a light-emitting layer and an electron carrier layer deposited onto the insulating film. Such a passive ELD emits electrons and holes when a driving signal is applied to the anode electrode **104** and the cathode electrode **112**. The electrons and holes emitted from the anode electrode **104** and the cathode electrode **112** are re-combined within the organic light-emitting layer **110** to generate a visible light. The generated visible light outputs to the exterior via the anode electrode **104** to thereby display a desired picture or image.

Hereinafter, a method of fabricating the organic ELD according to the first embodiment of the present invention will be described with reference to FIG. **6**A to FIG. **6**E.

Firstly, as shown in FIG. **6**A, the anode electrode **104** is provided by depositing a metal transparent conductive material onto the substrate **102** made from a soda lime or a vulcanized glass and then patterning it by the photolithography and the etching process. Herein, indium-tin-oxide (ITO) or SnO_2 is used as the metal material.

The insulating film (not shown) is formed in such a manner to expose a light-emitting area by coating a photosensitive insulating material onto the substrate **102** provided with the anode electrode **104** by the spin coating technique and then patterning it by the photolithography and the etching process.

As shown in FIG. **6**B, the first barrier rib **108** is formed by depositing a photosensitive organic material onto the insulating film and then patterning it by the photolithography and the etching process. The first barrier rib **108** is provided to divide the pixels in such a manner to cross the plurality of anode electrodes **104**.

As shown in FIG. **6**C, the second barrier rib **130** having a forward taper structure (i.e., a shape having a smaller width as it goes from the lower portion into the upper portion) is provided in such a manner to make a direction perpendicular to the first barrier rib **108** (or parallel to the anode electrode **104**) and be positioned between the light-emitting areas for implementing different colors by depositing a photosensitive organic material onto the substrate **102** provided with the first barrier rib **108** and then patterning it by the photolithography and the etching process.

As shown in FIG. **6**D, the organic light-emitting layer **110** is formed on the substrate **102** provided with the second barrier rib **130** by utilizing a shadow mask (not shown).

As shown in FIG. **6**E, the cathode electrode **112** is formed by depositing a metal material onto the substrate **102** provided with the organic light-emitting layer **110**.

As described above, the organic ELD according to the first embodiment of the present invention includes the second barrier rib **130** located between the first barrier ribs **108** for dividing the EL cells implementing the same color and positioned between the EL cells implementing different colors, thereby providing the organic light-emitting layer **110** at an accurate location.

FIG. **7** shows a portion of an organic electro-luminescence device (ELD) according to a second embodiment of the present invention.

The organic ELD shown in FIG. **7** has the same elements as the organic ELD shown in FIG. **4** except that both the first and second barrier ribs **108** and **130** have the backward taper structure. Therefore, the elements identical to those in FIG. **4** will be given by the same reference numerals, and a-detailed explanation as to the same elements will be omitted.

The first barrier rib **108** is provided in a direction crossing the anode electrode **104** to divide the EL cells implementing the same color, whereas the second barrier rib **130** makes a direction perpendicular to the first barrier rib **108** and is positioned between the EL cells implementing, thereby allowing the organic light-emitting layer **110** to be provided at an accurate location.

The cathode electrode **112** is provided in such a manner to be broken at an area corresponding to the second barrier rib **130** by the second barrier rib **130** having a backward taper structure, but is provided such that a line width d**1** thereof is larger than a length d**2** of the second barrier rib **130**, thereby allowing it to be electrically connected to the second barrier rib **130** at an area other than an area overlapping with the second barrier rib **130**.

A method of fabricating the organic ELD according to the second embodiment of the present invention has the same steps as that shown in FIG. **6**A to FIG. **6**E except that the first and second barrier ribs **108** and **130** having the backward taper structure are formed simultaneously by depositing a photosensitive organic material onto the substrate provided with the anode electrode **104** and the insulating film and then patterning it by the photolithography and the etching process. Therefore, a detailed explanation as to it will be omitted.

As described above, in the organic ELD according to the second embodiment of the present invention and the fabricating method thereof, the second barrier rib **130** having the forward taper structure is further provided in such a manner to be perpendicular to the first barrier rib **108** and parallel to the anode electrode **105** and in such a manner to be positioned between the sub-pixels for implementing different colors. Accordingly, even though the specific organic material **121** having passing through a slot **124** of the shadow mask **122** is widely spread, the second barrier rib **130** positioned between the sub-pixels prevents the specific organic material **121** from being secured onto the adjacent sub-pixel (i.e., the light-emitting area for implementing a green (G) color or a blue (B) color). As a result, the organic light-emitting layer **110** is provided at an accurate location to thereby prevent a deterioration of picture quality such as a non-uniformity of picture quality.

As described above, according to the present invention, the second barrier rib located between the first barrier ribs for dividing the EL cells implementing the same color and positioned between the EL cells implementing different colors is further provided. The second barrier rib can prevent an organic light-emitting material corresponding to a specific EL cell from being secured onto the adjacent different EL cells. Accordingly, the red, green and blue organic light-emitting layers are provided at an accurate location, so that it becomes possible to prevent a deterioration of picture quality.

Although the present invention has been explained by the embodiments shown in the drawings described above, it should be understood to the ordinary skilled person in the art that the invention is not limited to the embodiments, but rather that various changes or modifications thereof are possible without departing from the spirit of the invention. Accordingly, the scope of the invention shall be determined only by the appended claims and their equivalents.

What is claimed is:

1. An organic electro-luminescence display, comprising:

a continuous line-shaped first barrier rib provided between adjacent organic electro-luminescence cells along a first direction; and

an island-shaped second barrier rib provided between said adjacent organic electro-luminescence cells along a second direction,

wherein the first and second barrier ribs are disposed on a same plane, the second barrier rib is positioned between the first barrier ribs without touching the first barrier ribs, and the second barrier rib has a larger width as it goes from a lower portion on said plane into an upper portion.

2. The organic electro-luminescence display according to claim **1**, wherein the second barrier rib is formed from the same material as the first barrier rib.

3. The organic electro-luminescence display according to claim **1**, wherein the second barrier ribs have a substantially equal height.

4. The organic electro-luminescence display according to claim **1**, wherein the adjacent organic electro-luminescence cells include at least one of red, green and blue pixels.

5. The organic electro-luminescence display according to claim 1, wherein the adjacent organic electro-luminescence cells have an equal color in a longitudinal direction or in a transverse direction.

6. The organic electro-luminescence display according to claim 1, wherein the second barrier ribs are positioned to be spaced apart from each of the first barrier ribs.

7. A method of fabricating an organic electro-luminescence display, the method comprising:

forming a continuous line-shaped first barrier rib between adjacent organic electro-luminescence cells along a first direction; and

forming an island-shaped second barrier rib between said adjacent organic electro-luminescence cells along a second direction,

wherein the first and second barrier ribs are disposed on a same plane, the second barrier rib is positioned between the first barrier ribs without touching the first barrier ribs, and the second barrier rib has a larger width as it goes from a lower portion on said plane into an upper portion.

8. The method according to claim 7, wherein the second barrier rib is formed from the same material as the first barrier rib.

9. The method according to claim 7, wherein the second barrier ribs have a substantially equal height.

10. The method according to claim 7, wherein the adjacent organic electro-luminescence cells include at least one of red, green and blue pixels.

11. The method according to claim 7, wherein the adjacent organic electro-luminescence cells have an equal color in a longitudinal direction or in a transverse direction.

12. The method according to claim 7, wherein the second barrier ribs are positioned to be spaced apart from each of the first barrier ribs.

13. An organic electro-luminescence display, comprising:

at least one continuous line-shaped first barrier rib provided between adjacent organic electro-luminescence cells along a first direction; and

an island-shaped second barrier rib provided between said adjacent organic electro-luminescence cells along a second direction,

wherein the first and second barrier ribs are disposed on a same plane, the second barrier rib is positioned between the first barrier ribs without touching the first barrier ribs, and the second barrier rib has a larger width as it goes from a lower portion on said plane into an upper portion.

14. The organic electro-luminescence device according to claim 13, wherein the adjacent organic electro-luminescence cells include at least one of red, green and blue pixels.

15. The organic electro-luminescence device according to claim 13, wherein the adjacent organic electro-luminescence cells have an equal color in a longitudinal direction or in a transverse direction.

16. The organic electro-luminescence device according to claim 13, wherein the second barrier ribs are positioned to be spaced apart from each of the first barrier ribs.

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专利名称(译)	具有第一和第二障肋的有机电致发光显示器及其制造方法		
公开(公告)号	US7714499	公开(公告)日	2010-05-11
申请号	US11/082883	申请日	2005-03-18
申请(专利权)人(译)	LG电子株式会社.		
当前申请(专利权)人(译)	LG电子株式会社.		
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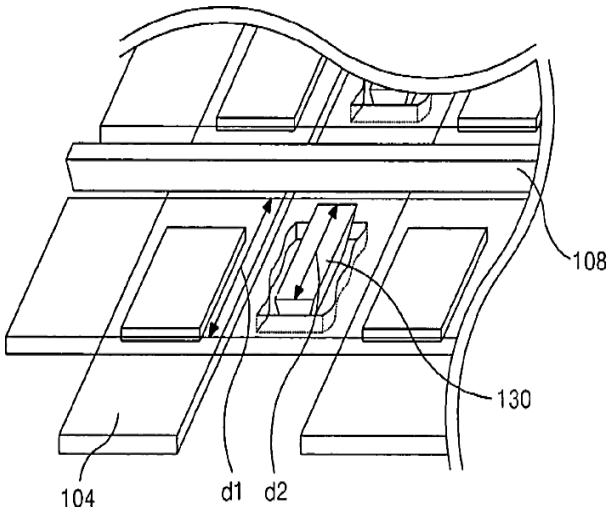
其他公开文献	US20050206307A1		
外部链接	Espacenet USPTO		

摘要(译)

一种有机电致发光器件及其制造方法，其中可以在精确的位置提供有机发光层以防止图像质量的劣化。在有机电致发光器件中，第一阻挡肋沿第一方向设置在相邻的有机电致发光单元之间。第二障肋沿第二方向设置在所述相邻的有机电致发光单元之间，并位于第一障肋之间。