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(54) Method of fabricating an organic electroluminescent display device

Herstellungsverfahren für eine organische elektrolumineszierende Anzeigevorrichtung

Méthode de fabrication d'un dispositif d'affichage électroluminescent organique

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(56) References cited:
EP-A- 0 883 190
EP-A- 0 955 791
WO-A-00/26945

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a method for fabricating an organic electroluminescence(EL) display device.

Discussion of the Related Art

[0002] A method of using a shadow mask as shown in FIG. 1 is the most efficient method to improve the luminescence efficiency among methods of forming R, G, and B pixels in fabricating a full- color organic EL display device.

[0003] Figs. 1A to 1D are diagrams showing a related art shadow mask and a full-color organic EL display device according to a pixel array method.

[0004] As shown in Fig. 1A, a first electrode 2 is formed on a transparent substrate 1 and barriers 7 are additionally formed on the same to separate between an insulating film 3 and a second electrode

[0005] Also, using a shadow mask 6, a common luminescence layer 5 of R, G, and B, and each of organic luminescence layers 5-1 to 5-3 of R, G, and B is formed at a corresponding pixel on the insulating film 3.

[0006] Then, the second elecrode is formed on the entire surface.

[0007] There are three different types(i.e. a strip type as shown in FIG. 1B, a delta type as shown in FIG. 1C, and an array type as shown in FIG. 1D) in forming an organic luminescence layer using a shadow mask depending on the array method of a pixel. In the array type, the size of R pixel is designed to be larger than G or B pixel to supplement the luminescence efficiency of the R pixel.

[0008] The strip type is best among the above three pixel array types in terms of the aperture ratio and first electrode resistance. In other words, because first electrodes are formed in the form of strips, the device can be driven with low driving voltage.

[0009] On the other hand, in the strip type, the shadow mask 6 should also be made in a strip form as shown in FIG. 1. In this instance, problems such as the transformation or droop of the shadow mask 6 are caused in a large degree because of an external pulling strength. Accordingly, in the process of deposition, colors spread not only on the intended pixel region but also on other areas because of shadow effect.

[0010] To obviate the above-mentioned problems, as shown in FIG. 2, a shadow mask on which mask holes are made in turns while having the same pixel array structure as that of the strip type of FIG. 1B is applied.

[0011] FIGs. 2A to 2D are deposition process diagrams of an organic luminescence layer of a full-color organic EL display device using the related art shadow mask structure.

[0012] In this method, however, each organic luminescence layer displaying one of R,G,and B colors should be formed by carrying out alignment and deposition twice respectively. That is, to form three layers of R,G,and B, the deposition should be carried out six times in all after the alignment being carried out six times as well.

[0013] In other words, to form organic luminescence layers of R,G,and B, in case of using the shadow mask 6 of FIGs. 1B to 1D, the shadow mask is aligned and deposited three times respectively. In case of using a shadow mask shown in FIG. 2, however, the shadow mask should be deposited 6 times.

[0014] EP 0 955 791 A1 is concerned with a process for manufacturing organic electroluminescence devices and discloses a shadow mask as according to the preamble of claim 1. The bridges or reinforcing lines formed across the apertures or holes of this known shadow mask are provided with a thickness that is equal to or less than the thickness of the shadow mask itself. In addition, the thickness of the reinforcing lines is selected in dependance on the width thereof.

[0015] WO 00/26945 A1 is concerned with a method for patterning devices and discloses a shadow mask having a plurality of triangular or rectangular apertures or holes which are arranged in a matrix like array. Depending on the size of the mask, and on whether a standoff on the substrate is used, the mask may include reinforcing ribs thereon to increase mask stiffness. Also, where the mask has large apertures, it may be preferable to provide small bridges across the large apertures to increase mask stiffness.

SUMMARY OF THE INVENTION

[0016] An object of the present invention is to provide a method for fabricating a full-color organic EL display device in which an improved shadow mask structure is provided to prevent a mask pattern from being transformed, thereby obtaining high luminescence efficiency of the display device.

[0017] This object is achieved by the present invention as defined in the appendent claims.

[0018] According to the present invention it is possible to fabricate a full-color organic EL display device using a shadow mask structure that provides a predetermined number of bridges, the thickness of which is greater than that of the mask and which are formed over long stripe-shaped holes so as to prevent transformation and droop caused by the pulling strength from occurring, thereby obtaining high aperture ratio and low driving voltage.

[0019] A full-color organic EL display device fabricated according to the present invention includes organic luminescence layers of R,G,and B formed in a strip shape at a plurality of pixels, which are defined by a crossing region of first and second electrodes, on a transparent substrate using a mask which has a plurality of strip-shaped holes and a plurality of bridges crossing the holes.

[0020] In the preferred embodiment of the present invention, thin metal that act as bridges is formed over long strip-shaped holes of a shadow mask so as to prevent the shadow mask from being transformed or drooped because of the pulling strength. The organic luminescence layers of R,G,and B are alternately arranged in rows by three times' alignments of the shadow mask.

[0021] It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, serve together with the description to explain the principle of the invention. In the drawings:

[0023] FIGs. 1A to 1D illustrate diagrams showing full-color organic EL display devices in accordance with pixel array types and related art shadow masks;

[0024] FIGs. 2A to 2D illustrate deposition process diagrams of an organic luminescence layer of a full-color organic EL display device using a shadow mask structure of a related art;

[0025] FIGs. 3A to 3D illustrate deposition process diagrams of an organic luminescence layer of a full-color organic EL display device using a shadow mask structure;

[0026] FIG. 4 illustrates a plane view of a shadow mask; and

[0027] FIGs. 5A to 5C are detailed diagrams showing a part 'A' of the shadow mask of FIG. 4.

DETAILED DESCRIPTION OF THE INVENTION

[0028] Reference will now be made in detail to the preferred embodiment of the present invention, which is illustrated in Fig. 5C. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[0029] FIGs. 3A to 3D illustrate deposition process diagrams of an organic luminescence layer of a full-color organic EL display device using a shadow mask structure of the present invention.

[0030] Referring to FIG. 3A, a first electrode 20 of a transparent electrode material is formed on a transparent substrate 10. A supplementary electrode may be applied to reduce the resistance of the first electrode 20. The substrate includes at least thin film transistors.

[0031] Metals which have relatively lower resistance than the resistance of the first electrode 20, such as Cr, Al, Cu, W, Au, Ni, and Ag, can be used as the supplementary electrode.

[0032] An insulating film 30 is formed on the first electrode 20. Any insulators, regardless of inorganic materials or organic materials, can be used as the insulating film 30.

[0033] A barrier 70 is formed on the insulating film 30 to insulate intervals of each second electrode(not shown).

[0034] As shown in FIG. 4, a shadow mask 60 is used to form each organic luminescence layer of R,G,and B and a common organic luminescence layer of the same at a plurality of pixels on the transparent substrate 10. The pixels are defined by a region crossed by the first and second electrodes.

[0035] FIG. 4 is a plane view of the shadow mask 60. The shadow mask 60 has a plurality of strip-shaped holes and a plurality of bridges 60-1 which connect the holes.

[0036] The transformation of the shadow mask 60 is prevented by the bridges 60-1 which connect the holes.

[0037] Referring to FIG. 3A, which is usefull for the understanding of the present invention one bridge 60-1 for each pixel is formed, but the bridge 60-1 is not necessarily formed at every pixel. In consideration of the transformation of the shadow mask 60, the bridge is formed between every two or three pixels.

[0038] Preferably, the bridge 60-1 has its width 'a' and thickness 'b' in the range of 1~1000 μm.

[0039] FIGs. 5A to 5C illustrate a detailed view of the part 'A' of a shadow mask usefull for the understanding of the present invention of FIG. 4. The bridge 60-1 can be formed either on the same plane and at the same thickness as the shadow mask 60 as shown in FIG. 5A, or on a different plane and at a different thickness from the shadow mask 60 as shown in FIG. 5B. According to the present invention the bridge 60-1 is formed according to claim 1 as shown in FIG. 5C.

[0040] A common luminescence layer of R, G, and B (not shown) is deposited on the transparent substrate 10 at a time using a blank mask which can deposit all the entire luminescence region.

[0041] Subsequently, each organic luminescence layer of R, G, and B is alternately arranged in rows at the pixel by three times aligning the shadow mask 60.

[0042] The common luminescence layer of R, G, and B may also be formed at each pixel of R, G, and B using the shadow mask 60, not being deposited on the entire luminescence region.

[0043] Subsequently, the second electrode (not shown) is formed by forming a second electrode (Mg-Ag alloy, or Al, or other conductive materials) using the blank shadow mask.

[0044] Then, passivation layers(oxygen adsorption layer, moisture adsorption layer, and moisture-proof layer) are formed on the second electrode and encapsulation is carried out.

[0045] The full-color organic EL display device in accordance with the present invention has the following advantages.

[0046] By forming mask holes in the form of a bridge, the transformation and droop of the shadow mask caused by the pulling strength is prevented. Thus, efficiency of

the full-color organic EL display device is maximized.

Claims

1. A method for fabricating a display device comprising the steps of:

   - forming a first column electrode pattern (20) in the form of strips on a substrate (10);
   - depositing at least one organic luminescence layer over the first electrode pattern (20) at a plurality of pixels which are defined by a crossing region of the first column and second row electrodes, through an aligned shadow mask (60) having a plurality of stripe-shaped holes and a plurality of bridges (60-1) formed in each of the holes and crossing these holes, and
   - forming the second row electrode pattern in the form of strips on the organic luminescence layer in a perpendicular direction to the first electrode pattern (20);

   characterized in that the bridges (60-1) are formed thicker than the shadow mask (60) and one surface of the bridges being coplanar with one surface of the mask and the bridges are located between every two or three pixels in a column on the substrate (10), when the substrate and the mask are aligned.

2. The method of claim 1, wherein the shadow mask (60) is aligned three times so that each organic luminescence layer of R, G, and B is alternately arranged in a row direction.

3. The method of claim 1 or 2, wherein the substrate (10) includes at least thin film transistors.

4. The method of any one of the preceding claims, wherein the bridges (60-1) have a width in the range of 1-1000 μm and a thickness in the range of 1- 1000 μm.

5. The method of any one of the preceding claims, wherein the bridges (60-1) are formed of thin metal.

Patentansprüche

1. Verfahren zum Herstellen einer Anzeigevorrichtung, das die folgenden Schritte umfasst:

   - Bilden eines ersten Spaltenelektrodenmusters (20) in Form von Streifen auf einem Substrat (10);
   - Aufbringen wenigstens einer organischen Lumineszenzschicht auf dem ersten Elektrodenmuster (20) an mehreren Pixeln, die durch einen Kreuzungsbereich der ersten Spalte und zweiten Zeilenelektroden definiert sind, durch eine ausgerichtete Lochmaske (60), die mehrere streifenförmige Löcher und mehrere Brücken (60-1), die in jedem der Löcher ausgebildet sind und diese Löcher überqueren, besitzt, und
   - Bilden des zweiten Zeilenelektrodenmusters in Form von Streifen auf der organischen Lumineszenzschicht in einer zu dem ersten Elektrodenmuster (20) senkrechten Richtung;

   dadurch gekennzeichnet, dass die Brücken (60-1) dikker als die Lochmaske (60) ausgebildet sind und eine Oberfläche der Brücken zu einer Oberfläche der Maske koplanar ist und die Brücken sich zwischen jeweils zwei oder drei Pixeln in einer Spalte auf dem Substrat (10) befinden, wenn das Substrat und die Maske aufeinander ausgerichtet sind.

2. Verfahren nach Anspruch 1, wobei die Lochmaske (60) dreimal ausgerichtet wird, so dass jede organische Lumineszenzschicht aus R, G und B abwechselnd in einer Zeilenrichtung angeordnet wird.

3. Verfahren nach Anspruch 1 oder 2, wobei das Substrat (10) wenigstens Dünnschichttransistoren enthält.

4. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Brücken (60-1) eine Breite im Bereich von 1-1000 μm und eine Dicke im Bereich von 1-1000 μm haben.

5. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Brücken (60-1) aus dünnem Metall gebildet sind.

Revendications

1. Procédé de fabrication d'un dispositif d'affichage comprenant les étapes consistant à :

   - former un premier motif d'électrodes de colonne (20) sous forme de bandes sur un substrat (10) ;
   - déposer au moins une couche organique luminescente par-dessus le premier motif d'électrodes (20) au niveau d'une pluralité de pixels qui sont définis par une zone de croisement des premières électrodes de colonne et de deuxièmes électrodes de rangée au moyen d'un masque perforé aligné (60) présentant une pluralité de perforations sous forme de bande et une pluralité de ponts (60-1) formés dans chacune des perforations et qui croisent les perforations, et
   - former le motif des deuxièmes électrodes de rangée sous forme de bandes sur la couche or-

ganique luminescente selon une direction perpendiculaire au premier motif d'électrodes (20) ;

caractérisé en ce que les ponts (60-1) sont formés afin d'être plus épais que le masque perforé (60) et une surface des ponts étant coplanaire avec une surface du masque et les ponts sont situés entre tous les deux ou trois pixels dans une colonne sur le substrat (10), lorsque le substrat et le masque sont alignés.

2. Le procédé selon la revendication 1, dans lequel le masque perforé (60) est aligné trois fois de sorte que chaque couche organique luminescente des couleurs R, V et B soit agencée en alternance selon une direction de rangée.

3. Le procédé selon la revendication 1 ou 2, dans lequel le substrat (10) comprend au moins des transistors en couche mince.

4. Le procédé selon l'une quelconque des revendications précédentes, dans lequel les ponts (60-1) présentent une largeur dans la plage de 1 à 1000 μm et une épaisseur dans la plage de 1 à 1000 μm.

5. Le procédé selon l'une quelconque des revendications précédentes, dans lequel les ponts (60-1) sont formés en métal mince.

FIG.1A
Prior Art

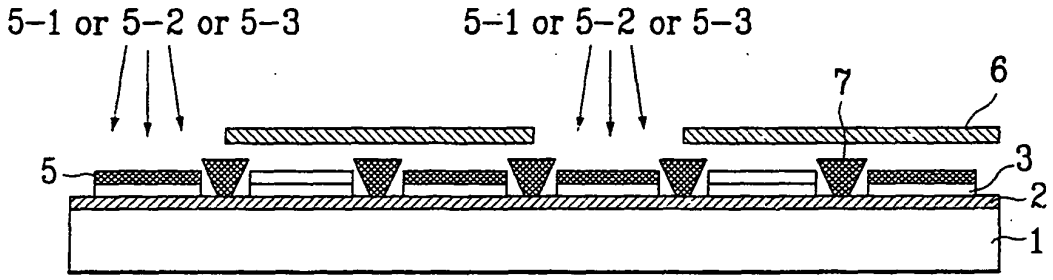


FIG.1B
Prior Art

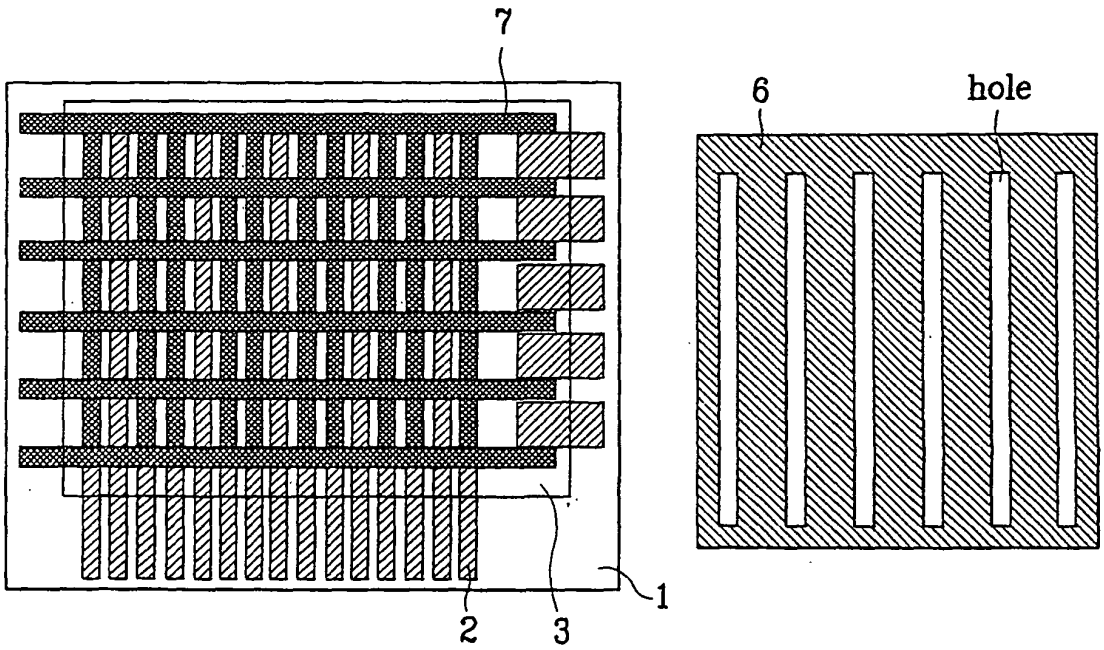


FIG.1C
Prior Art

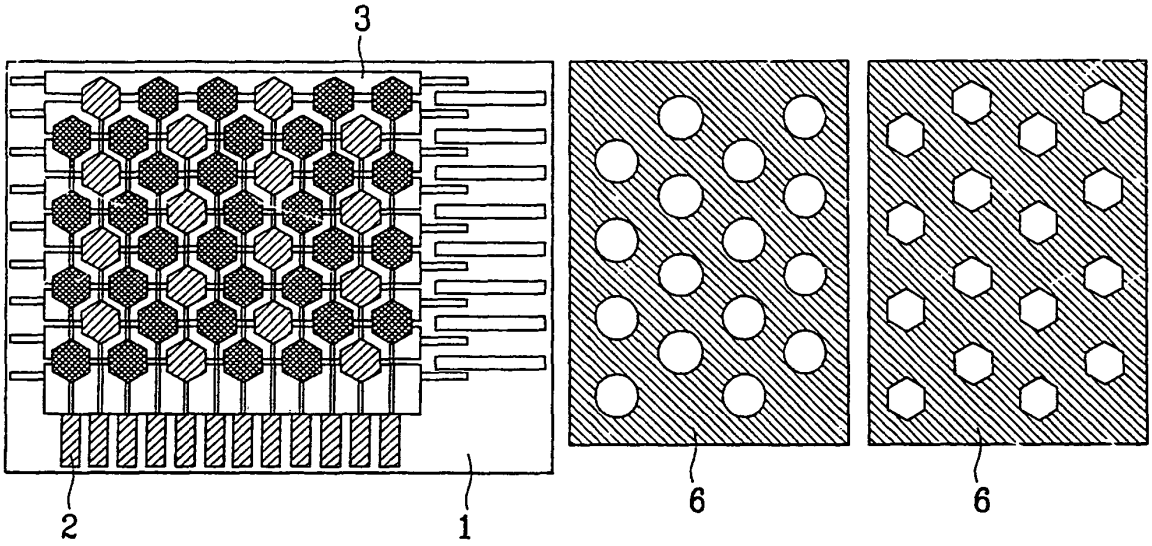


FIG.1D
Prior Art

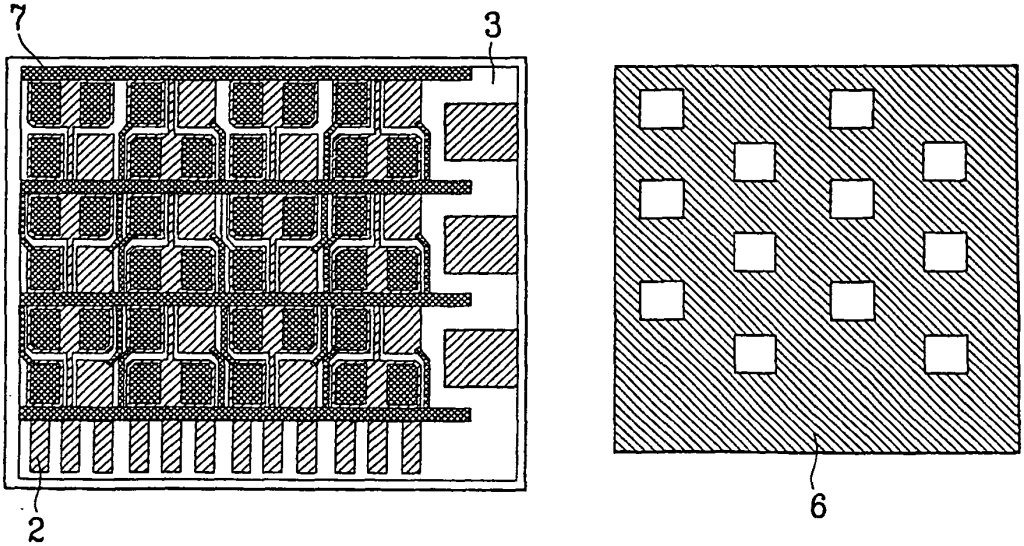


FIG.2A
Prior Art

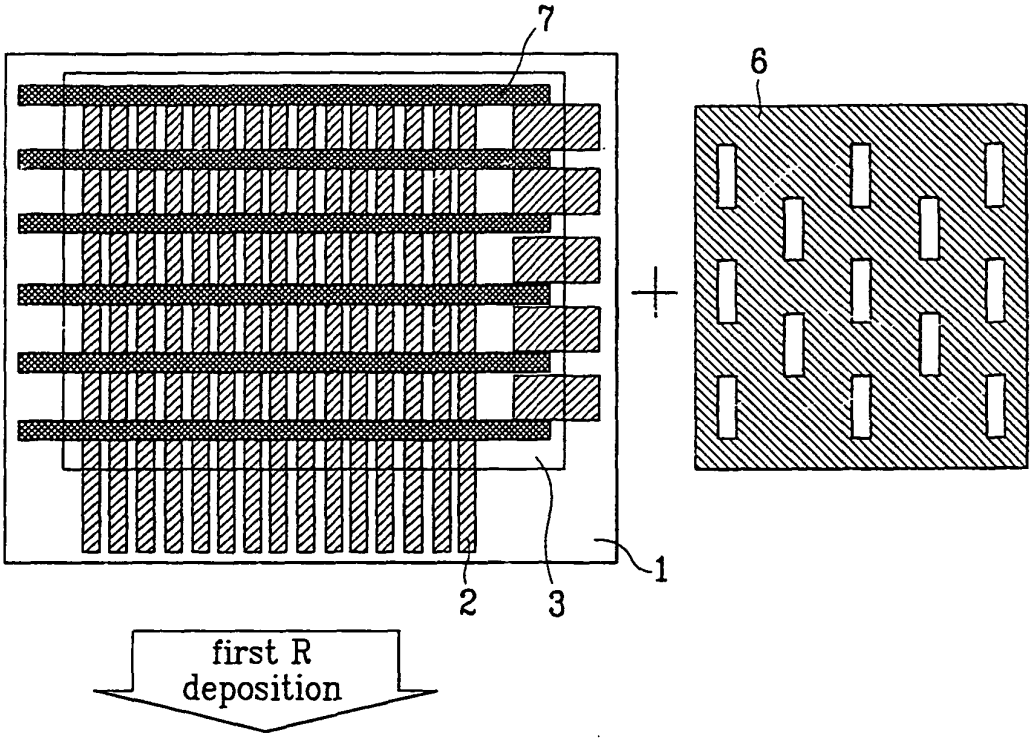


FIG.2B
Prior Art

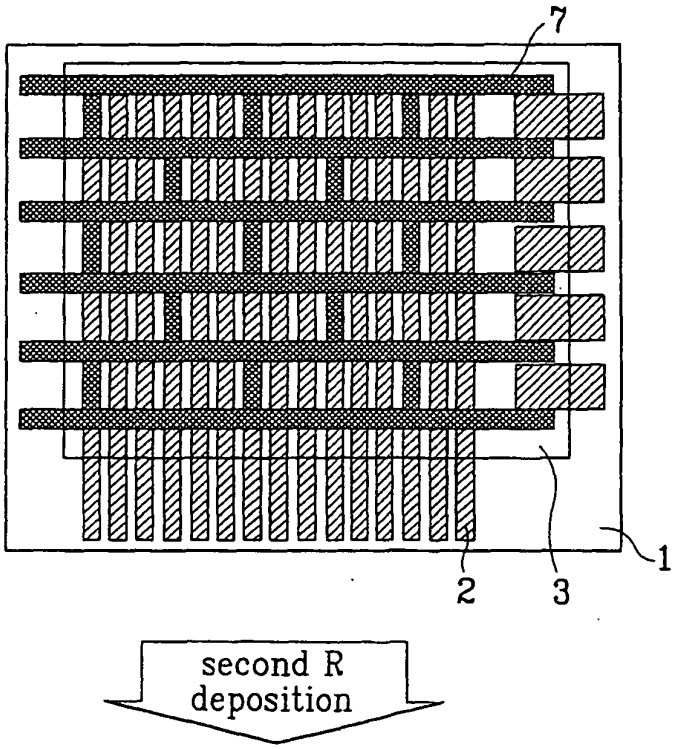


FIG.2C
Prior Art

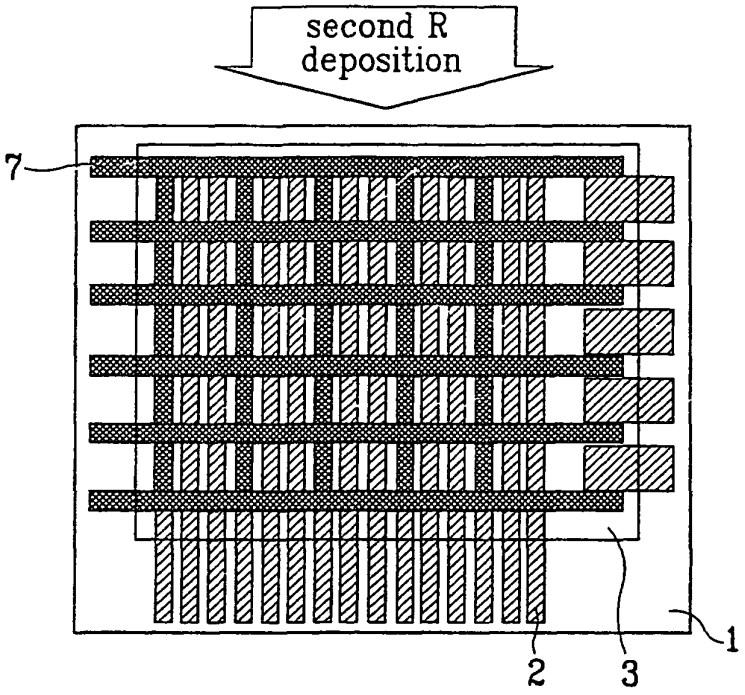


FIG.2D
Prior Art

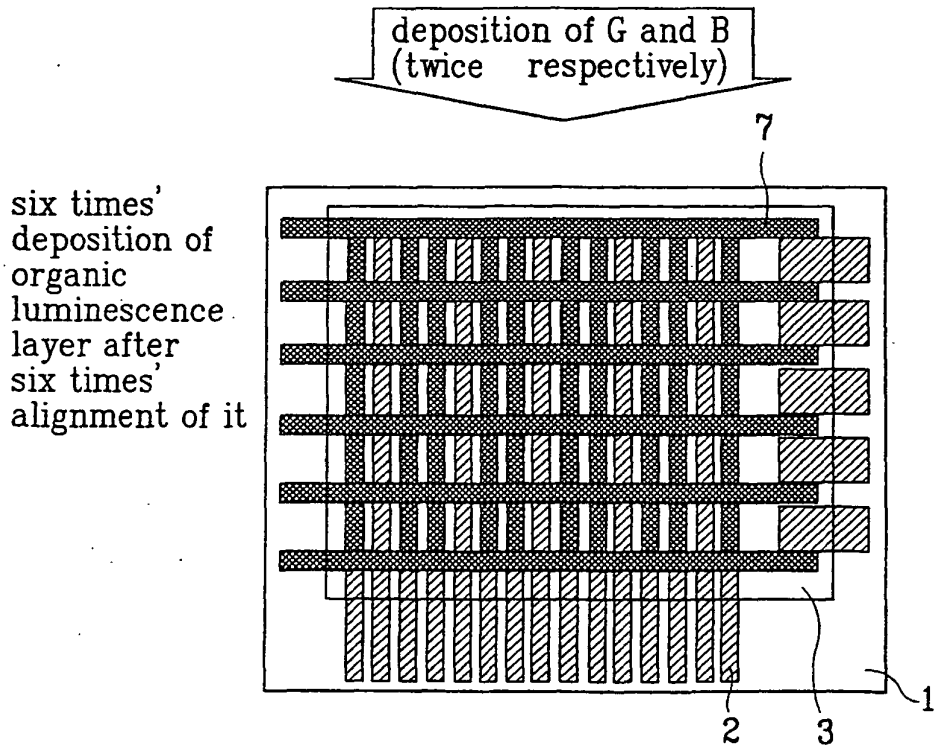


FIG.3A

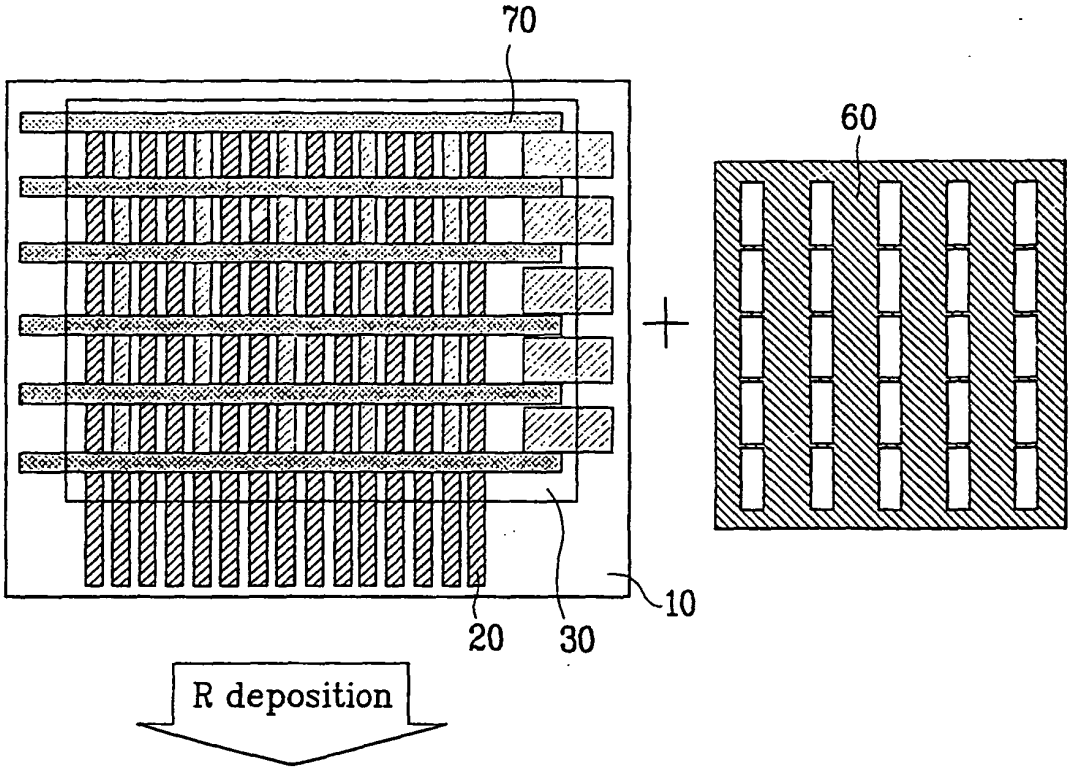


FIG.3B

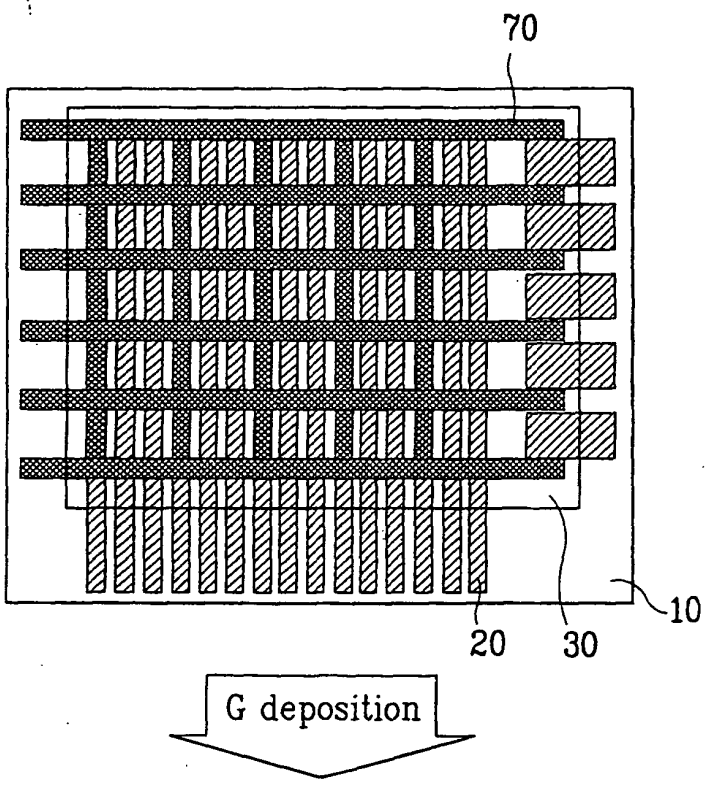


FIG.3C

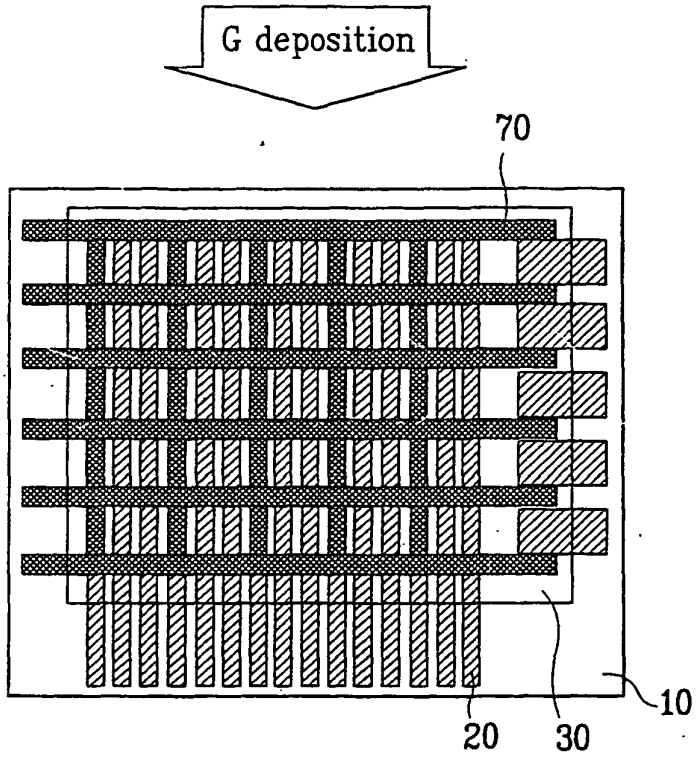
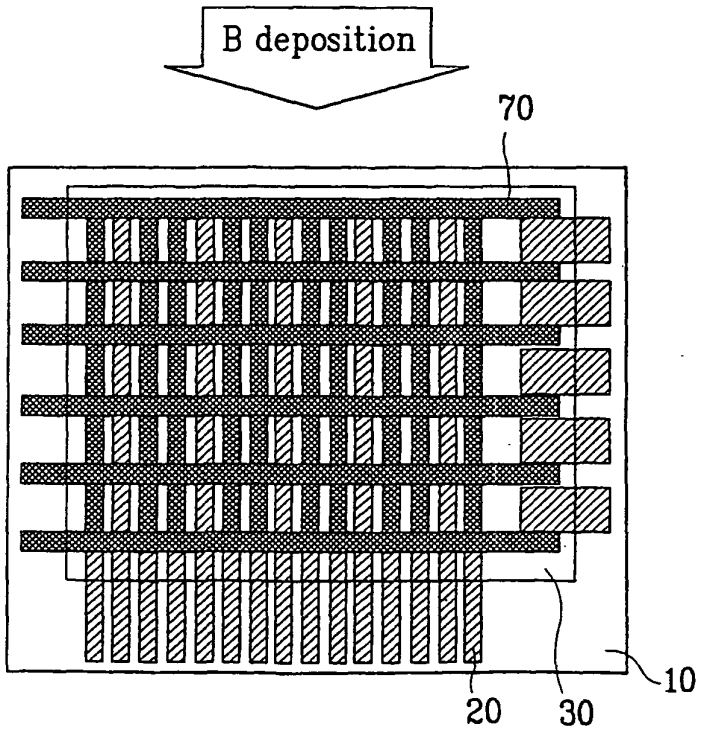


FIG.3D



three times' deposition of organic luminescence layer after three times' alignment of it

FIG. 4

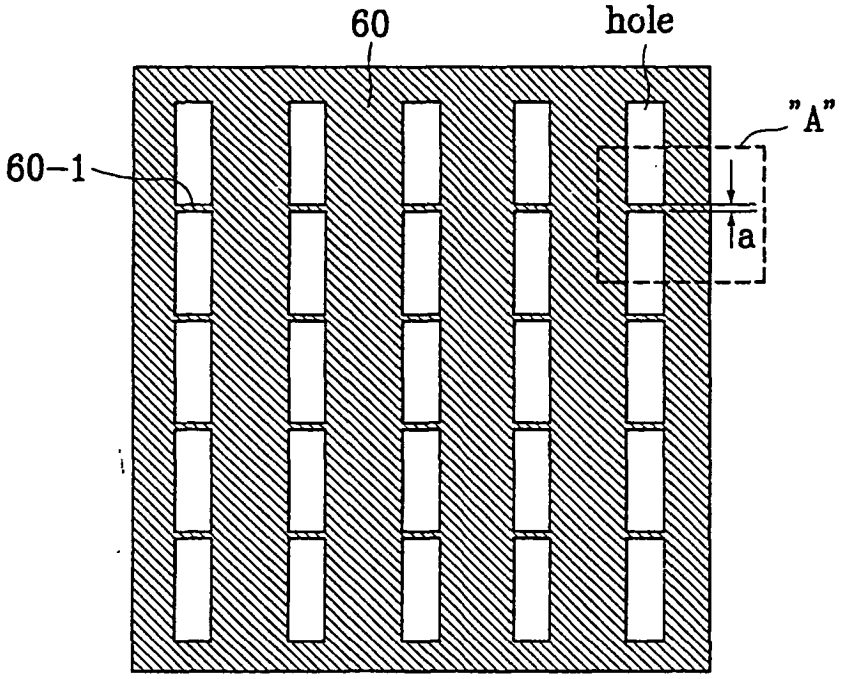


FIG.5A

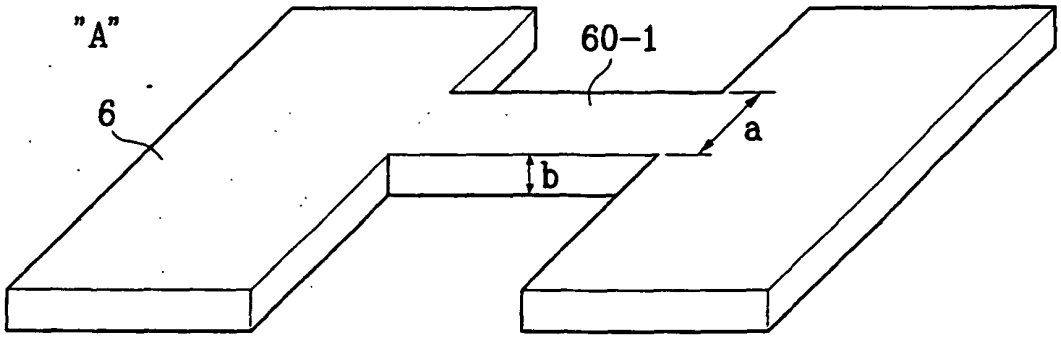


FIG.5B

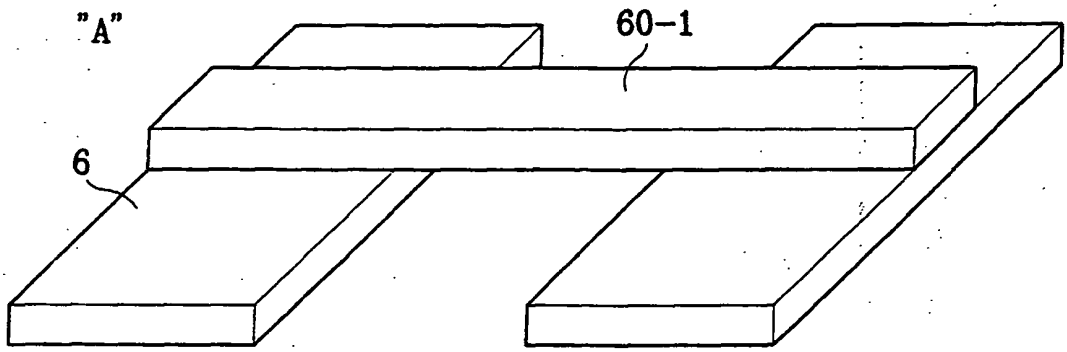
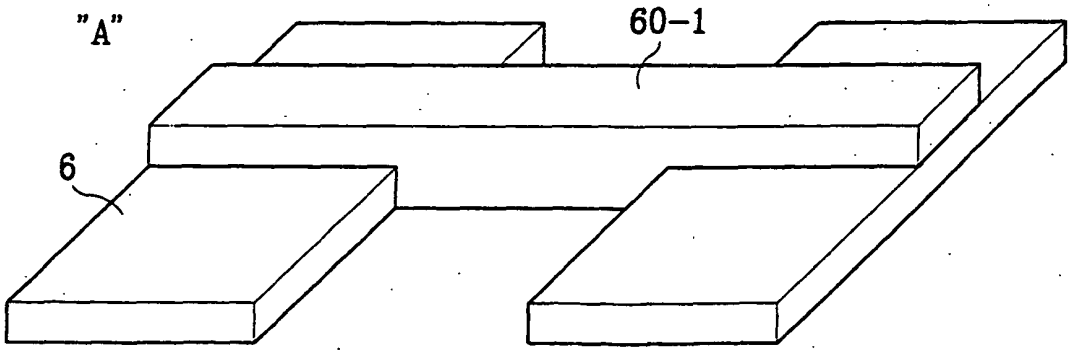


FIG.5C



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 0955791 A1 **[0014]**
- WO 0026945 A1 **[0015]**

专利名称(译)	制造有机电致发光显示装置的方法		
公开(公告)号	EP1274130B1	公开(公告)日	2009-01-21
申请号	EP2002014618	申请日	2002-07-02
申请(专利权)人(译)	LG电子株式会社.		
当前申请(专利权)人(译)	LG DISPLAY CO. , LTD.		
[标]发明人	KIM CHANG NAM		
发明人	KIM, CHANG, NAM		
IPC分类号	H01L27/00 H01L51/40 H05B33/10 C23C14/04 C23C14/06 C23C14/12 C23C14/24 H01L27/32 H01L51/50 H01L51/56		
CPC分类号	H01L51/0011 C23C14/042 H01L27/3211 H01L27/3244 H01L27/3281 H01L51/56		
优先权	1020010039542 2001-07-03 KR		
其他公开文献	EP1274130A2 EP1274130A3		
外部链接	Espacenet		

摘要(译)

公开了一种有机EL显示装置及其制造方法，其中使用其上通过桥连接有多个孔的荫罩在第一和第二电极的交叉区域处形成有机发光层。

FIG.1A
Prior Art

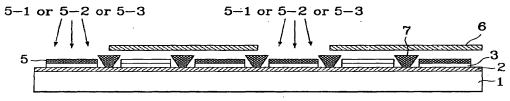

FIG.1B
Prior Art