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(54) Organic electro-luminescent display and method for manufacturing the same

Organische elektrolumineszente Anzeigevorrichtung und Verfahren zu deren Herstellung

Dispositif d'affichage électroluminescent organique et son procédé de fabrication

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(73) Proprietor: **LG Display Co., Ltd.**
Yeongdeungpo-gu
Seoul
150-721 (KR)

(72) Inventor: **Kim, Hong Gyu**
Uiwang-si
Gyeonggi-do (KR)

(74) Representative: **Ter Meer Steinmeister & Partner**
Patentanwälte mbB
Postfach 86 07 69
81634 München (DE)

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EP-A- 1 220 191
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US-A1- 2002 195 961
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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to an organic electro-luminescent (EL) display, and more particularly, to a dual-panel type organic EL display and a method for manufacturing the same.

Discussion of the Related Art

[0002] Generally, dual-panel type organic EL displays include a lower substrate, on which pixel switching elements and pixel driving elements are formed, and an upper substrate, on which an organic material is laminated. The upper and lower substrates are bonded to be electrically connected, for implementation of a display.

[0003] Hereinafter, a conventional method for manufacturing such a dual-panel type organic EL display will be described.

[0004] The lower substrate of a dual-panel type organic EL display mainly includes, for each pixel region thereof, a switching thin film transistor (typically, a polysilicon thin film transistor) for switching of a pixel corresponding to the pixel region, a driving thin film transistor for driving of the pixel, a storage capacitor, and a pixel electrode.

[0005] FIG. 1A is a sectional view illustrating a conventional process for manufacturing a lower substrate of a dual-panel type organic EL display. The following description will be given only in conjunction with one thin film transistor included in one pixel of the dual-panel type organic EL display.

[0006] In accordance with the conventional process, first, a semiconductor layer 2 made of, for example, polysilicon, is formed over a transparent substrate 1, as shown in FIG. 1A. The semiconductor 2 is then patterned such that the semiconductor 2 remains only in a region where a thin film transistor is to be formed.

[0007] Thereafter, a gate insulating film 3 and a conductive film for formation of a gate electrode are sequentially formed over the entire surface of the resulting structure. The conductive film is then patterned to form a gate electrode 4.

[0008] Using the gate electrode 4 as a mask, impurity ions such as phosphorous (P) ions are then implanted into the semiconductor layer 2 which is, in turn, annealed to form source and drain regions 2a and 2c of the thin film transistor. Thus, an NMOS thin film transistor is completely formed.

[0009] The portion of the semiconductor layer 2, into which the impurity ions are not implanted, forms a channel region 2b of the NMOS thin film transistor.

[0010] Next, an interlayer insulating film 5 is formed over the entire surface of the resulting structure. Subsequently, the interlayer insulating film 5 and gate insulating film 3 are selectively removed such that the source and drain regions 2a and 2c of the NMOS thin film transistor are exposed.

[0011] An electrode line 6 and a pixel electrode 6' are then formed on the exposed source and drain regions 2a and 2c such that the electrode line 6 and pixel electrode 6' are electrically connected to the source and drain regions 2a and 2c, respectively. Thus, the lower substrate is completely formed.

[0012] FIG. 2 is a plan view illustrating an upper substrate of the dual-panel type organic EL display manufactured in accordance with a conventional process. FIG. 1B is a cross-sectional view taken along the line I - I of FIG. 2.

[0013] In accordance with the conventional process, as shown in FIGs. 1B and 2, an anode 8 is formed on a transparent substrate 7. The anode 8 is made of a transparent conductive material having a high work function, such as indium tin oxide (ITO) or indium zinc oxide (IZO).

[0014] Thereafter, an insulating film 9 is formed on a portion of the anode 8, using an insulating material such as polyimide. A barrier 10 is then formed on the insulating film 9.

[0015] Next, an island-shaped spacer 11 is formed on the anode 8 at a pixel region, using another insulating material.

[0016] Subsequently, organic materials for a hole injection layer 12, a hole transfer layer 13, a light-emitting layer 14, an electron transfer layer 15, and an electron injection layer 16 are sequentially deposited over the entire surface of the resulting structure including the spacer 11.

[0017] A cathode 17, which is made of a conductive material having a low work function, such as aluminum, is then deposited over the electron injection layer 16. Thus, the upper substrate is completely formed.

[0018] FIG. 1C is a sectional view illustrating a process for bonding the lower substrate of FIG. 1A and the upper substrate of FIG. 1B.

[0019] As shown in FIG. 1C, the lower substrate of FIG. 1A and the upper substrate of FIG. 1B are bonded such that the cathode 17 formed on the spacer 11 in the upper substrate comes into contact with the pixel electrode 6' to be electrically connected.

[0020] FIG. 1D is a sectional view illustrating a process for sealing the organic EL display in which the upper and lower substrates are bonded. As shown in FIG. 1D, vacuum is formed in a space defined between the bonded upper and lower substrates. Thereafter, the space between the upper and lower substrates is sealed, using a sealant 18.

[0021] In the conventional organic EL display manufactured in the above-mentioned manner, NMOS thin film transistors must be used because each cathode in the upper substrate and the drain region of the corresponding driving thin film transistor in the lower substrate are electrically connected.

[0022] However, the above-mentioned conventional EL display has a problem in that it is difficult to use a low-temperature polysilicon thin film transistor manufacturing process using a laser annealing method. This is because the low-temperature polysilicon thin film transistor is of a PMOS type.

[0023] For this reason, the conventional organic EL display cannot use PMOS thin film transistors, which are more stable than NMOS thin film transistors.

[0024] US 2002/0195961 A1 is concerned with organic light emitting devices and discloses an organic electroluminescent display comprising a first substrate and a second substrate, both formed of light-transmissive material such as glass or plastics. The first substrate comprises an active matrix TFT driver array. An anode is formed on the light emitting region of the second substrate. On the anode an organic layer is disposed, which comprises active components, which are emissive of light when electrically stimulated. Further, an electrically conductive spacer is formed on the anode so as to electrically contact the anode to the thin film transistor and spacing the first and second substrate from each other by a predetermined distance. At last, a cathode is formed on the organic layer.

[0025] EP 1 220 191 A2 is concerned with another organic electroluminescent display and discloses a pixel circuit for supplying current to an organic electroluminescent diode of the display. The pixel circuit comprises thin film transistors, which can be configured as PMOS type TFTs or as NMOS type TFTs.

SUMMARY OF THE INVENTION

[0026] An object of the present invention is to provide an organic EL display which can use PMOS thin film transistors so as to enhance reliability and a prolong life thereof.

This object is achieved by the organic electro-luminescent display according to claim 1.

Refinements and advantageous developments are described in the dependent claims.

[0027] According to the present invention, an organic electro-luminescent display comprises: a first transparent substrate and a second transparent substrate which are arranged to face each other while being spaced apart from each other by a predetermined distance by means of a spacer formed on the second transparent substrate around a light emitting region; a transistor formed on the first transparent substrate; an anode formed on the light emitting region of the second transparent substrate and the spacer such that the anode has a portion formed on the light emitting region, and a portion formed on the spacer, the anode portion formed on the spacer being electrically connected to the transistor; a barrier formed around the spacer; an organic electro-luminescent layer formed on the anode portion formed on the light emitting region of the second transparent substrate, except for the spacer; and a cathode formed on the organic electro-luminescent layer.

[0028] The barrier may comprise a first barrier formed in a stripe on the anode at one side of the spacer, and a second barrier formed in a stripe on the second transparent substrate at the other side of the spacer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] 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, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In the drawings:

FIGs. 1A to 1D are sectional views illustrating a conventional method for manufacturing an organic EL display having a conventional structure;
FIG. 2 is a plan view illustrating an upper substrate of the conventional organic EL display.
FIGs. 3A to 3D are sectional views illustrating a method for manufacturing a dual-panel type organic EL display in accordance with the present invention; and
FIGs. 4A and 4B are plan views illustrating upper substrates having different structures, which are used in the organic EL display according to the present invention, respectively.

DETAILED DESCRIPTION OF THE INVENTION

[0030] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[0031] The present invention proposes a dual-panel type organic EL display having a structure capable of using PMOS thin film transistors.

[0032] That is, in accordance with the present invention, a PMOS thin film transistor is formed on one substrate of the dual-panel type organic EL display, as a device for driving of a pixel. Also, an organic EL element is formed on the other substrate. The substrates are then bonded such that an anode of the organic EL element and a pixel electrode of the PMOS thin film transistor are electrically connected.

[0033] FIGs. 3A to 3E are sectional views illustrating sequential processing steps of a method for manufacturing the dual-panel type EL display of the present invention. The following description will be given only in conjunction with one thin film transistor included in one pixel of the organic EL display.

[0034] FIG. 3A is a sectional view illustrating a process for manufacturing a lower substrate of the dual-panel type EL display. This process may be carried out in a conventional manner. In accordance with this process, first, a semiconductor layer 22 made of, for example, polysilicon, is formed over a first transparent substrate 21, as shown in FIG. 3A. The semiconductor layer 22 is then patterned to remain only in a region where a thin film transistor is to be formed.

[0035] Thereafter, a gate insulating film 23 and a conductive film for formation of a gate electrode are sequentially formed over the entire surface of the resulting structure. The conductive film is then patterned to form a gate electrode 24.

[0036] Using the gate electrode 24 as a mask, impurity ions such as boron (B) ions are then implanted into the semiconductor layer 22 which is, in turn, annealed to form source and drain regions 22a and 22c of the thin film transistor. Thus, a PMOS thin film transistor is completely formed.

[0037] The portion of the semiconductor layer 22, into which the impurity ions are not implanted, forms a channel region 22b of the PMOS thin film transistor.

[0038] Next, an interlayer insulating film 25 is formed over the entire surface of the resulting structure. The interlayer insulating film 25 and gate insulating film 23 are then selectively removed to expose the source and drain regions 22a and 22c of the PMOS thin film transistor.

[0039] Thereafter, an electrode line 26 and a pixel electrode 26' are formed on the resulting structure such that the electrode line 26 and pixel electrode 26' are electrically connected to the source and drain regions 22a and 22c, respectively. Thus, a lower substrate is completely formed.

[0040] FIGs. 4A and 4B are plan views illustrating an upper substrate of the dual-panel type organic EL display in accordance with the present invention. FIG. 3B is a cross-sectional view taken along the line II - II of FIG. 4A and the line III - III of FIG. 4B, illustrating an upper substrate manufacturing process according to the present invention.

[0041] In accordance with the upper substrate manufacturing process, an island-shaped spacer 28 is first formed on a second transparent substrate 27, using an insulating material, as shown in FIG. 3B.

[0042] The spacer 28 is arranged around a light emitting region. The spacer 28 is also shaped such that the lower portion of the spacer 28 is wider than the upper portion of the spacer 28.

[0043] Thereafter, an anode 29 is formed on the second transparent substrate 27 including the spacer 28. The anode 29 is made of a transparent conductive material having a high work function, such as indium tin oxide (ITO) or indium zinc oxide (IZO).

[0044] The anode 29 is formed only on the spacer 28 and the light emitting region of the second transparent substrate 27.

[0045] Subsequently, an insulating film 30 is formed on a peripheral portion of the anode 29 and a region around the spacer 28, using an insulating material such as polyimide. A barrier 31 is then formed on the insulating film 30.

[0046] The insulating film 30 and barrier 31 may be formed using one of two methods.

[0047] In accordance with the first method, the insulating film 30 is first formed over the entire surface of the structure including the anode 29, is then patterned such that the insulating film 30 remains only around the spacer 28 to surround the spacer 28. The barrier 31 is then formed on the remaining insulating film 30 such that the barrier 31 surrounds the spacer 28.

[0048] In accordance with the second method, the insulating film 30 is first formed over the entire surface of the structure including the anode 29, is then patterned such that the insulating film 30 remains to have stripe-shaped portions respectively arranged in parallel at opposite sides of the spacer 28. The barrier 31 is then formed on the remaining insulating film 30.

[0049] In the latter case, the barrier 31 includes a first barrier formed in a stripe at one side of the spacer 28, and a second barrier formed in a stripe at the other side of the spacer 28. The first and second barriers are arranged in parallel in the form of parallel stripes at the opposite sides of the spacer 28, respectively, such that the spacer 28 is interposed between the first and second barriers.

[0050] Thereafter, organic materials for a hole injection layer 32, a hole transfer layer 33, a light-emitting layer 34, an electron transfer layer 35, and an electron injection layer 36 are sequentially deposited over a portion of the anode 29 corresponding to the light emitting region of the second transparent substrate 27, except for the spacer 28. Thus, an organic EL layer is formed.

[0051] In the organic EL layer forming process, a shadow mask is used in order to prevent the organic EL layer from being formed on the spacer 28.

[0052] A cathode 37, which is made of a conductive material having a low work function, such as aluminum, is then deposited over the electron injection layer 36. Thus, an upper substrate is completely formed.

[0053] Where the barrier 31 has the structure of FIG. 4A, the cathode 37 can be formed without using a shadow mask. However, where the barrier 31 has the structure of FIG. 4B, a shadow mask is used in the process of forming the cathode 37, so as to prevent the cathode 37 from being formed on a region where no organic EL layer is formed between the stripe-shaped barriers.

[0054] That is, in the latter case, it is necessary to expose the anode 29 formed on the spacer 28, so as to enable the anode 29 to come into electrical contact with the pixel electrode 26' of the first transparent substrate 21.

[0055] FIG. 3C is a sectional view illustrating a process for bonding the lower substrate of FIG. 3A and the upper substrate of FIG. 3B.

[0056] As shown in FIG. 3C, the lower substrate of FIG. 3A and the upper substrate of FIG. 3B are bonded such that the anode 29 formed on the spacer 28 in the upper substrate comes into contact with the pixel electrode 26' of the lower substrate to be electrically connected.

[0057] FIG. 3D is a sectional view illustrating a process for sealing the organic EL display in which the upper and lower substrates are bonded. As shown in FIG. 3D, a vacuum is formed in a space defined between the bonded upper and lower substrates. Thereafter, the space between the upper and lower substrates is sealed, using a sealant 38.

[0058] As apparent from the above description, the organic EL display of the present invention can use PMOS thin film transistors because the drain region of each driving thin film transistor formed on the lower substrate is electrically connected with the corresponding anode formed on the upper substrate.

[0059] That is, in accordance with the present invention, it is possible to manufacture a dual-panel type organic EL display having an enhanced reliability and a prolonged life, by virtue of use of PMOS thin film transistors which are more stable than NMOS thin film transistors.

[0060] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope of the invention defined in the appended claims. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims.

Claims

1. An organic electro-luminescent display comprising:

a first transparent substrate (21) and a second transparent substrate (27) which are arranged to face each other while being spaced apart from each other by a predetermined distance by means of a spacer (28) formed on the second transparent substrate (27);
a transistor formed on the first transparent substrate (21);
an anode (29) formed on the light emitting region of the second transparent substrate (27);
an organic electro-luminescent layer (32 - 36) formed on the anode portion formed on the light emitting region of the second transparent substrate (27), except for the spacer (28); and
a cathode (37) formed on the organic electro-luminescent layer (32 - 36);
characterized in that
the spacer (28) is formed around a light emitting region;
the anode (29) is also formed on the spacer (28) such that the anode (29) has a portion formed on the light emitting region, and a portion covering the spacer (28), the anode portion covering the spacer (28) being electrically connected to the transistor; and
a barrier (31) formed around the spacer (28).

2. The organic electro-luminescent display according to claim 1, wherein the transistor is a PMOS thin film transistor.

3. The organic electro-luminescent display according to claim 1, wherein the barrier (31) surrounds the spacer (28).

4. The organic electro-luminescent display according to claim 1, wherein the barrier comprises:

a first barrier (31) formed in a stripe on the anode at one side of the spacer (28) ; and
a second barrier (31) formed in a stripe on the second transparent substrate (27) at the other side of the spacer (28).

5. The organic electro-luminescent display according to claim 4, further comprising:

an insulating film (30) formed beneath the first and second barriers (31).

6. The organic electro-luminescent display according to claim 4, wherein the first and second barriers (31) are arranged in parallel at the opposite sides of the spacer (28) such that the spacer (28) is interposed between the first and second barriers (31).

7. The organic electro-luminescent display according to claim 1, wherein the spacer (28) is protruded to a level higher than the barrier (31).

Patentansprüche

1. Organische Elektrolumineszenzanzeige, die umfasst:

ein erstes lichtdurchlässiges Substrat (21) und ein zweites Substrat (27), die so angeordnet sind, dass sie einander gegenüberliegen, während sie mittels eines auf dem zweiten lichtdurchlässigen Substrat (27) gebildeten Abstandshalters (28) durch eine vorgegebene Entfernung voneinander beabstandet sind;
einen Transistor, der auf dem ersten lichtdurchlässigen Substrat (21) gebildet ist;
eine Anode (29), die auf dem Lichtemissionsgebiet des zweiten lichtdurchlässigen Substrats (27) gebildet ist;
eine organische Elektrolumineszenzschicht (32-36), die auf dem auf dem Lichtemissionsgebiet des zweiten lichtdurchlässigen Substrats (27) gebildeten Anodenabschnitt mit Ausnahme des Abstandshalters (28) gebildet ist; und
eine Katode (37), die auf der organischen Elektrolumineszenzschicht (32-36) gebildet ist;
dadurch gekennzeichnet, dass
der Abstandshalter (28) um ein Lichtemissions-

gebiet gebildet ist;
die Anode (29) außerdem in der Weise auf dem Abstandshalter (28) gebildet ist, dass die Anode (29) einen auf dem Lichtemissionsgebiet gebildeten Abschnitt und einen Abschnitt, der den Abstandshalter (28) bedeckt, aufweist, wobei der Anodenabschnitt, der den Abstandshalter (28) bedeckt, mit dem Transistor elektrisch verbunden ist; und
um den Abstandshalter (28) eine Sperre (31) gebildet ist.

2. Organische Elektrolumineszenzanzeige nach Anspruch 1, wobei der Transistor ein PMOS-Dünnschichttransistor ist.

3. Organische Elektrolumineszenzanzeige nach Anspruch 1, wobei die Sperre (31) den Abstandshalter (28) umgibt.

4. Organische Elektrolumineszenzanzeige nach Anspruch 1, wobei die Sperre umfasst:

eine erste Sperre (31), die in einem Streifen auf der Anode auf einer Seite des Abstandshalters (28) gebildet ist; und
eine zweite Sperre (31), die in einem Streifen auf dem zweiten lichtdurchlässigen Substrat (27) auf der anderen Seite des Abstandshalters (28) gebildet ist.

5. Organische Elektrolumineszenzanzeige nach Anspruch 4, die ferner umfasst:

eine Isolierschicht (30), die unter der ersten und der zweiten Sperre (31) gebildet ist.

6. Organische Elektrolumineszenzanzeige nach Anspruch 4, wobei die erste und die zweite Sperre (31) in der Weise auf den gegenüberliegenden Seiten des Abstandshalters (28) parallel angeordnet sind, dass der Abstandshalter (28) zwischen der ersten und der zweiten Sperre (31) liegt.

7. Organische Elektrolumineszenzanzeige nach Anspruch 1, wobei der Abstandshalter (28) auf ein höheres Niveau als die Sperre (31) vorsteht.

Revendications

1. Affichage électroluminescent organique, comprenant :

un premier substrat transparent (21) et un second substrat transparent (27) qui sont agencés face à face tout en étant espacés l'un de l'autre d'une distance prédéterminée au moyen d'un élément d'espacement (28) formé sur le second substrat transparent (27) ;
un transistor formé sur le premier substrat transparent (21) ;
une anode (29) formée sur la région émettrice de lumière du second substrat transparent (27) ;
une couche électroluminescente organique (32-36) formée sur la portion d'anode formée sur la région émettrice de lumière du second substrat transparent (27), à l'exception de l'élément d'espacement (28) ; et
une cathode (37) formée sur la couche électroluminescente organique (32-36) ;
caractérisé en ce que
l'élément d'espacement (28) est formé autour d'une région émettrice de lumière ;
l'anode (29) est aussi formée sur l'élément d'espacement (28) de telle façon que l'anode (29) possède une portion formée sur la région émettrice de lumière, et une portion couvrant l'élément d'espacement (28), la portion d'anode couvrant l'élément d'espacement (28) étant électriquement connectée au transistor ; et
une barrière (31) formée autour de l'élément d'espacement (28).

2. Affichage électroluminescent organique selon la revendication 1, dans lequel le transistor est un transistor en film mince PMOS.

3. Affichage électroluminescent organique selon la revendication 1, dans lequel la barrière (31) entoure l'élément d'espacement (28).

4. Affichage électroluminescent organique selon la revendication 1, dans lequel la barrière comprend :

une première barrière (31) formée dans une bande sur l'anode d'un côté de l'élément d'espacement (28) ; et
une seconde barrière (31) formée dans une bande sur le second substrat transparent (27) de l'autre côté de l'élément d'espacement (28).

5. Affichage électroluminescent organique selon la revendication 4, comprenant en outre un film isolant (30) formé au-dessous de la première et de la seconde barrière (31).

6. Affichage électroluminescent organique selon la revendication 4, dans lequel la première et la seconde barrière (31) sont agencées en parallèle sur les côtés opposés de l'élément d'espacement (28) de telle façon que l'élément d'espacement (28) est interposé entre la première et la seconde barrière (31).

7. Affichage électroluminescent organique selon la revendication 1, dans lequel l'élément d'espacement

(28) se projette à un niveau plus élevé que la barrière (31).

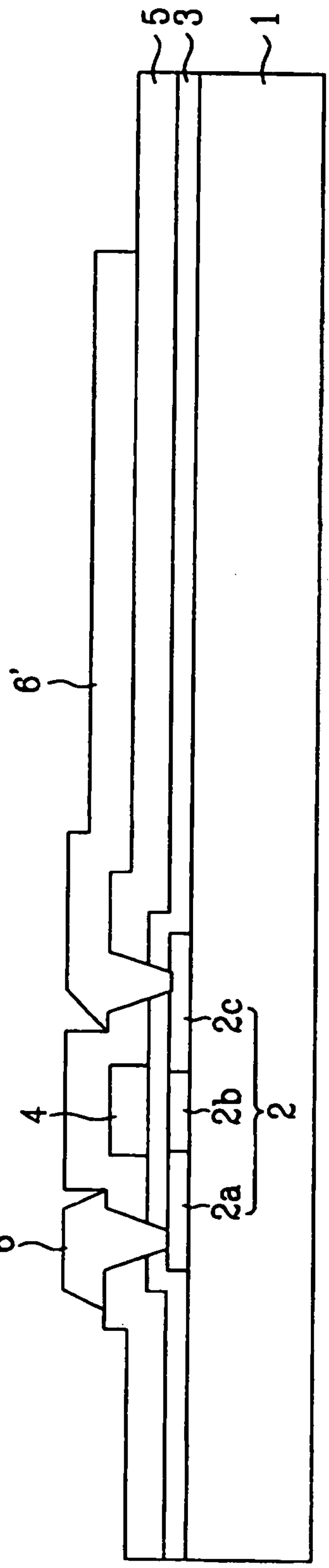


FIG. 1A
Related Art

FIG. 1B
Related Art

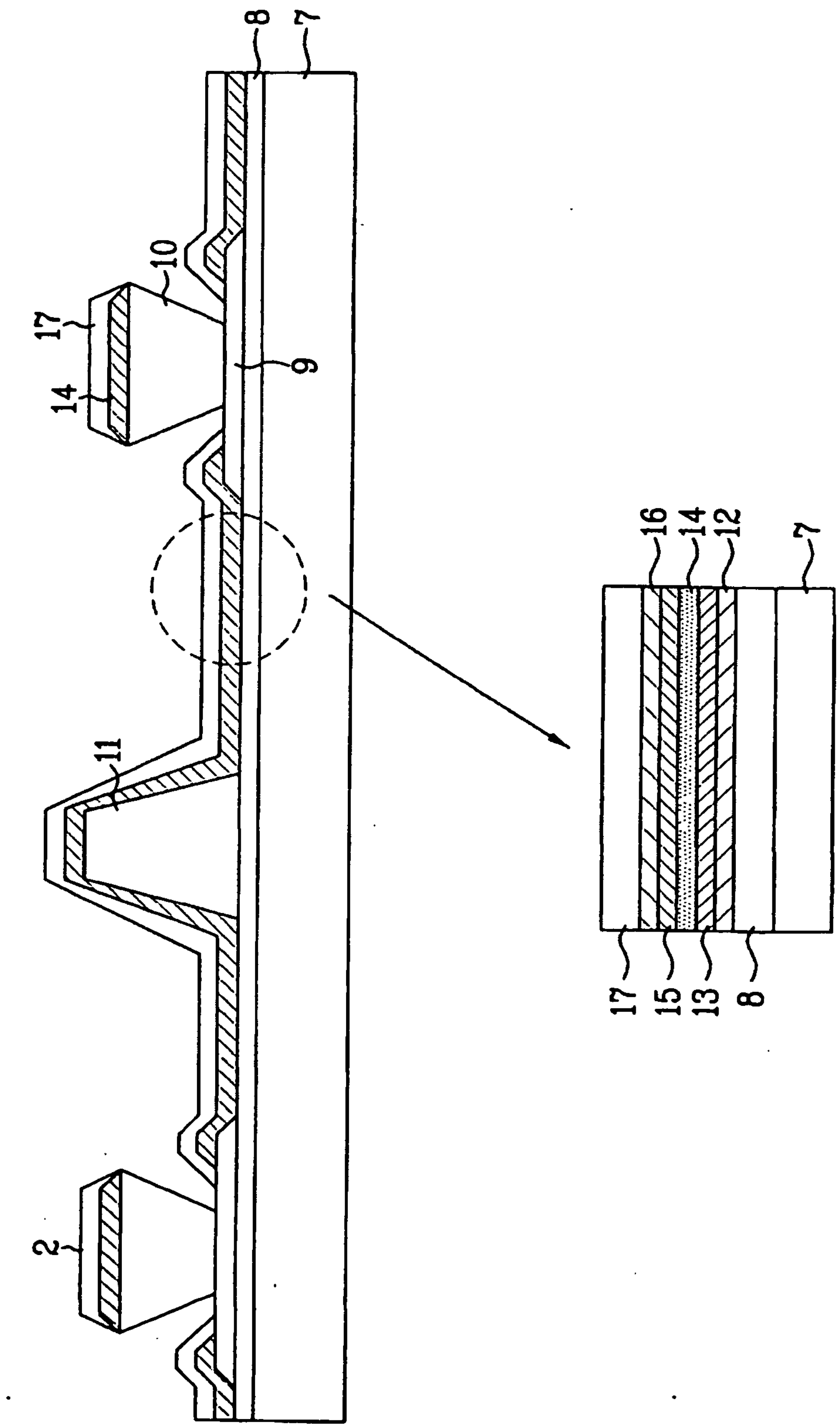


FIG. 1C
Related Art

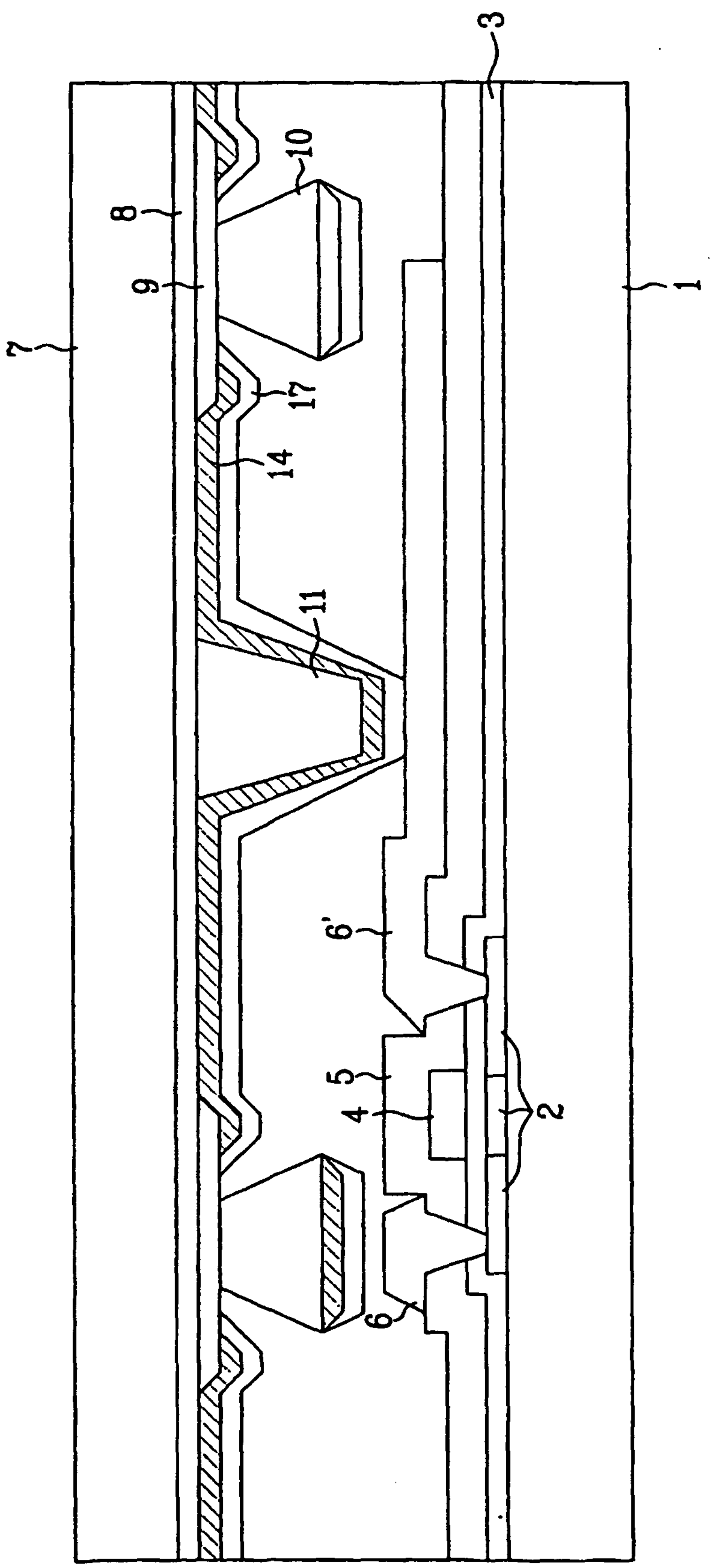


FIG. 1D
Related Art

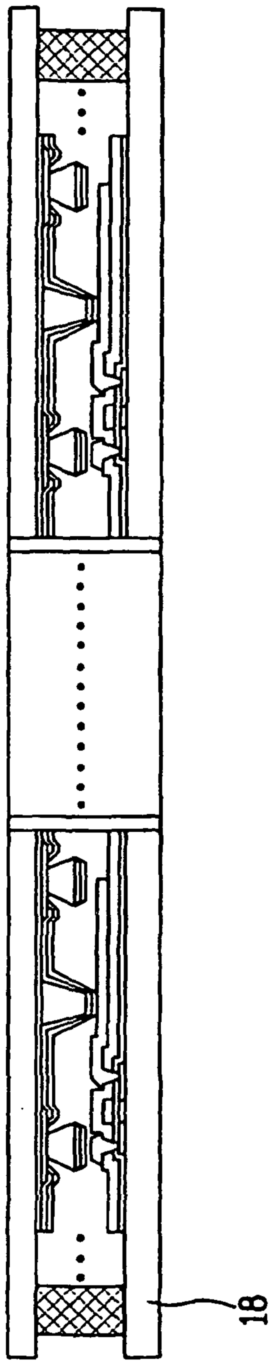


FIG. 2
Related Art

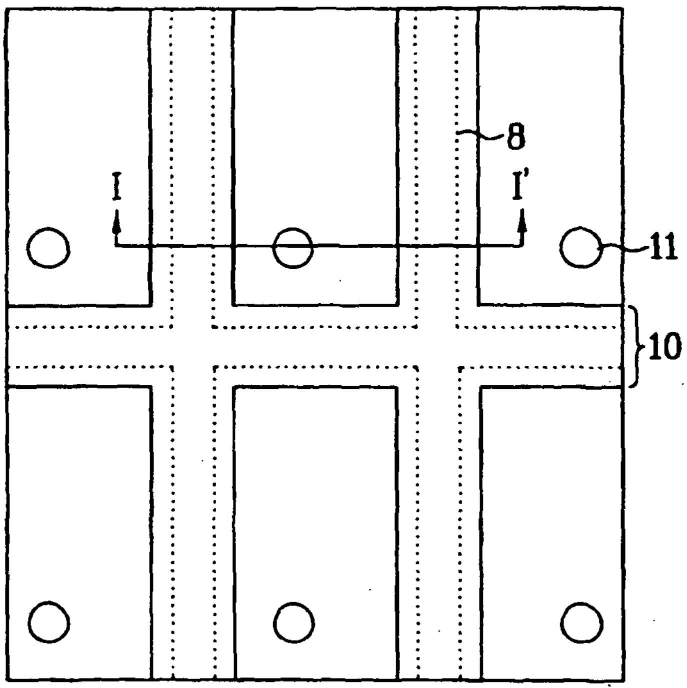


FIG. 3A

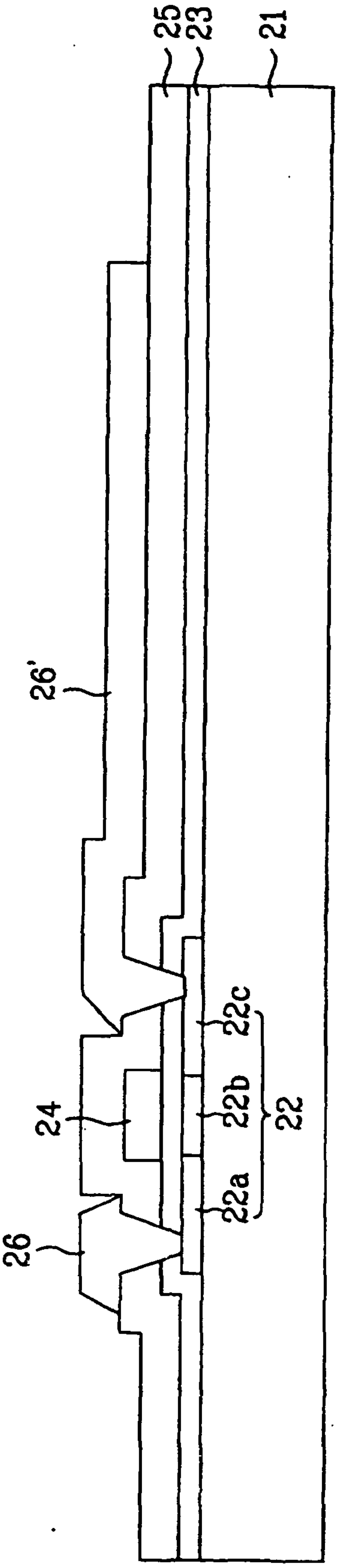


FIG. 3B

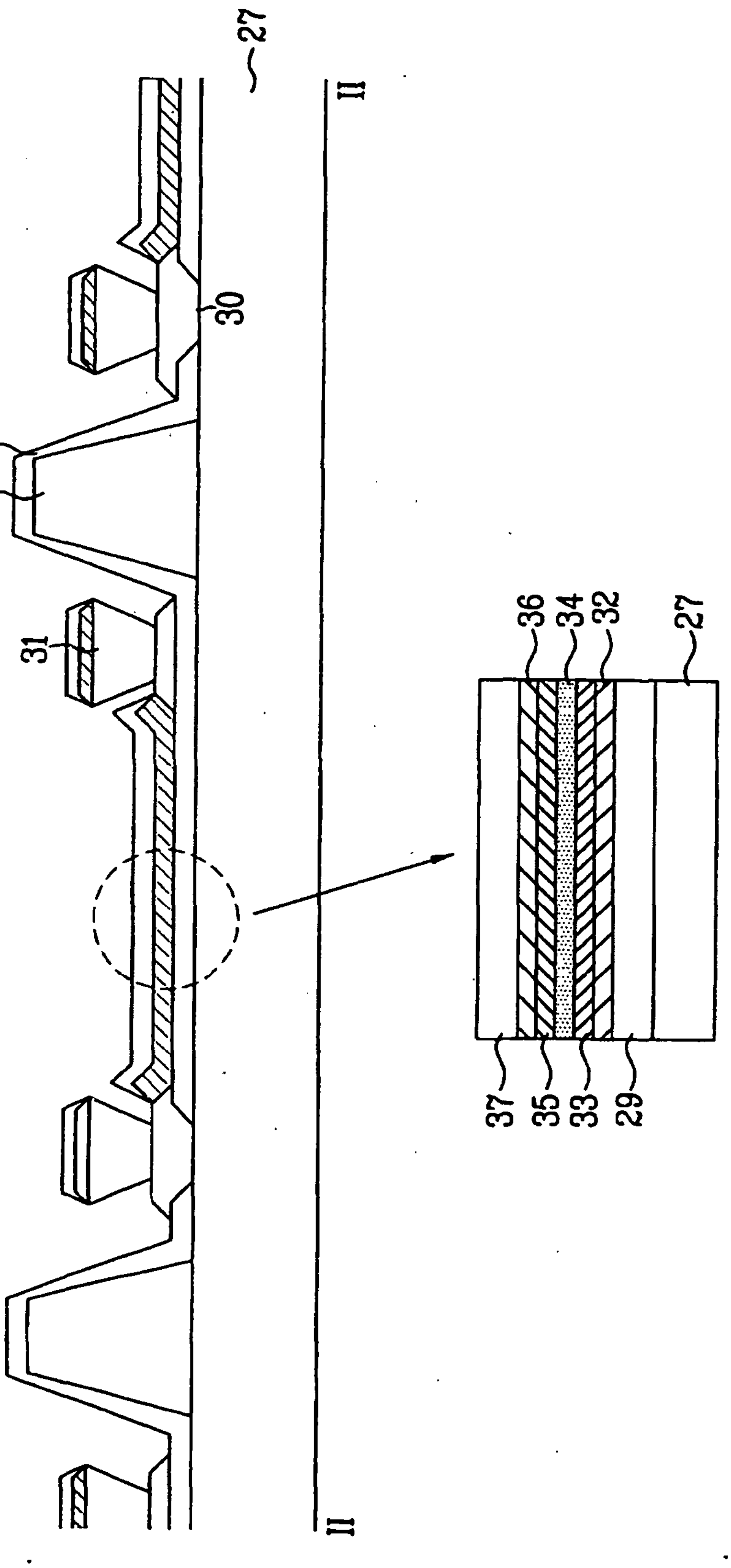


FIG. 3C

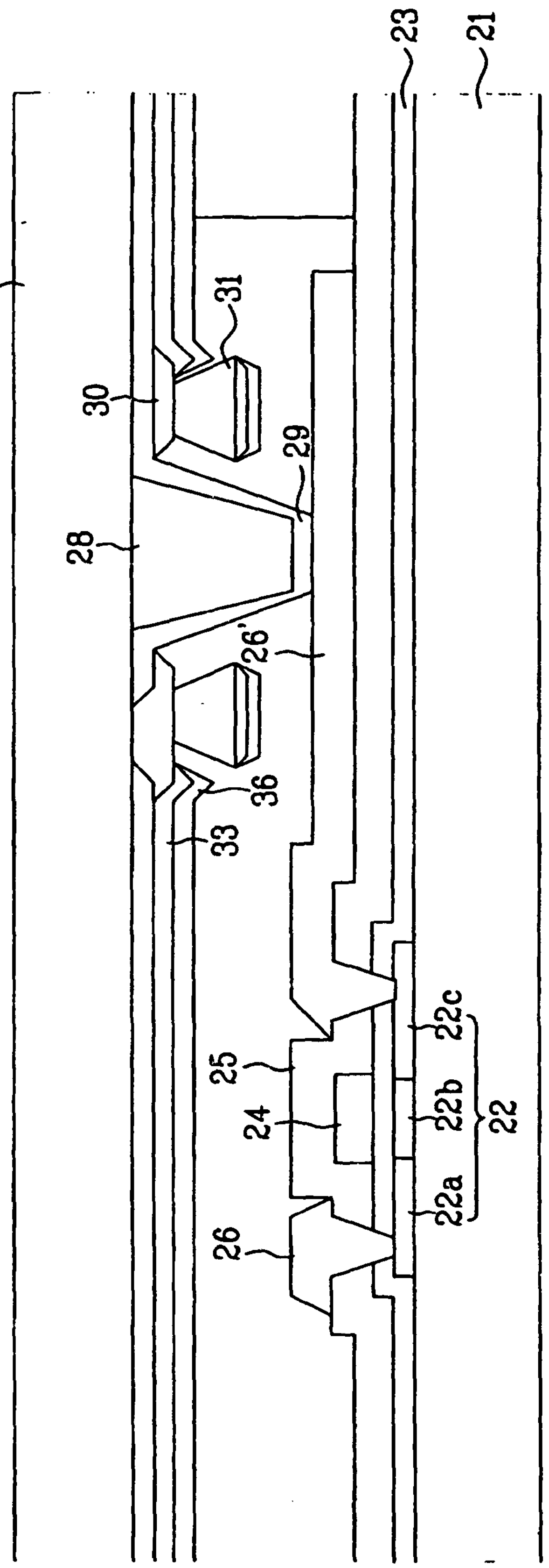


FIG. 3D

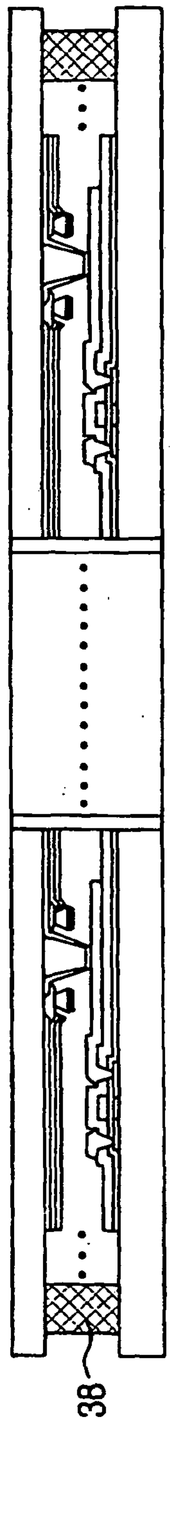


FIG. 4A

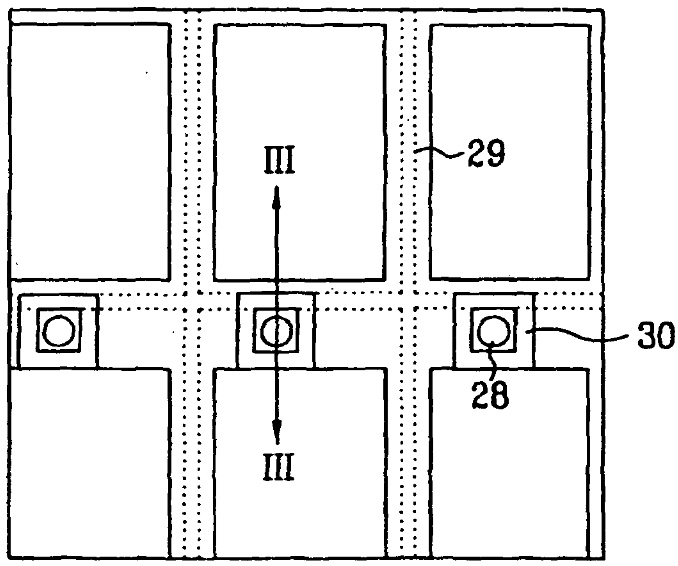
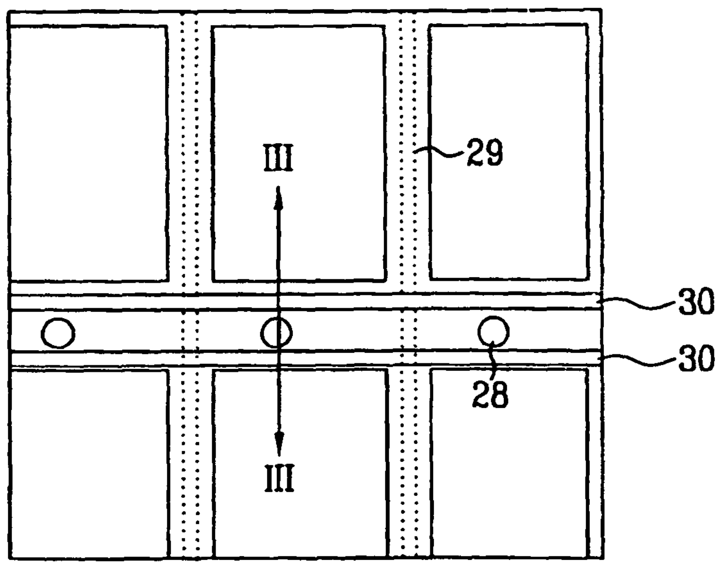


FIG. 4B



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20020195961 A1 **[0024]**
- EP 1220191 A2 **[0025]**

专利名称(译)	有机电致发光显示器及其制造方法		
公开(公告)号	EP1605516B1	公开(公告)日	2015-02-18
申请号	EP2005012275	申请日	2005-06-08
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 HONG GYU		
发明人	KIM, HONG GYU		
IPC分类号	H01L27/32 H01L51/56 H05B33/12 G09F9/30 H01L51/50 H05B33/00 H05B33/04 H05B33/10 H05B33/22 H05B33/26		
CPC分类号	H01L27/3246 H01L27/3251 H01L51/56		
优先权	1020040042635 2004-06-10 KR		
其他公开文献	EP1605516A2 EP1605516A3		
外部链接	Espacenet		

摘要(译)

公开了一种有机电致发光显示器及其制造方法。有机电致发光显示器包括第一透明基板和第二透明基板，第一透明基板和第二透明基板布置成彼此面对，同时彼此隔开预定距离，形成在第一透明基板上的晶体管，形成在第二透明基板上的阳极透明基板，电连接到晶体管，形成在阳极上的有机电致发光层，以及形成在有机电致发光层上的阴极，阳极，阴极和有机电致发光层设置在相邻的阴影库之间，阴影库在相邻的校正部分之间提供这些部分，该部分用电子校正形成在第一透明基板上的晶体管，阳极在第二透明基板上。

FIG. 1A Related Art