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(54) **Organic electro-luminescent display device and method of 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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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to an organic electroluminescence display device and a method of manufacturing the same, and more particularly, to an organic electroluminescence display device that can be formed with a large size screen and can prevent non-uniform brightness of a panel using an auxiliary power line to prevent a voltage drop of a power line and an upper electrode and a method of manufacturing the same.

2. Description of the Related Art

[0002] Since organic electroluminescence display (OELD) devices are emissive display devices that emit light by electrically exciting an organic fluorescent compound, can be driven at a low driving voltage, are slim and lightweight, and have a wide viewing angle and a quick response time, they are expected to solve the problems of and replace liquid crystal display devices.

[0003] An OELD device generally includes an organic film (or layer) formed in a predetermined pattern and placed on a transparent insulating substrate formed of glass or other material and electrodes formed on and under the organic film. The organic film is formed of an organic compound. In the above structure of the OELD device, when a positive voltage and a negative voltage are applied to the electrodes, holes migrate to a light emitting layer via a hole transport layer (HTL) from the electrode to which the positive voltage is applied, electrons migrate to the light emitting layer via an electron transport layer (ETL) from the electrode to which the negative voltage is applied. Excitons are generated by combining the holes and electrons in the light emitting layer and the excitons change to a ground state while being excited. Thus, an image is formed by light emitted from fluorescent molecules of the light emitting layer.

[0004] An active matrix (AM) organic electroluminescence display device includes at least two thin film transistors (TFTs) in each pixel. The TFTs are used as a switching device that controls the operation of the pixel and a driving device that drives the pixel. The TFTs have a semiconductor active layer having source and drain regions doped with a high concentration of dopant and a channel region formed between the source and drain regions. The TFT is composed of a gate insulating layer formed on the semiconductor active layer, a gate electrode formed on the gate insulating layer on the channel region of the semiconductor active layer, and, on the gate electrode, drain and source electrodes which are connected to the source and drain regions via contact holes through an inter-insulator.

[0005] FIG. 1 is a plan view of a pixel of an AM OELD device, and FIG. 2 is a cross-sectional view of the pixel of FIG. 1.

[0006] Referring to FIG. 1, the AM OELD device includes a plurality of sub-pixels. Each sub-pixel is arranged in a pixel region defined by a scan line (Scan), a data line (Data), and a driving line (VDD), and each of the sub-pixels can be simply formed of at least two TFTs, such as a switching TFT (TFTsw) and a driving TFT (TFTdr), one capacitor (Cst), and one organic light emitting diode (OLED). The numbers of TFTs and capacitor are not limited to two and one, respectively, and more than two TFTs and more than one capacitor can be included.

[0007] The switching TFT (TFTsw) transmits data signals applied to the data line Data by being driven by scanning signals applied to the scan line (Scan). The driving TFT (TFTdr) determines the amount of current inputted to the OLED through the power line VDD according to the data signals transmitted from the switching TFT (TFTsw), that is, a voltage difference Vgs between the gate and the source. The capacitor (Cst) stores data signals transmitted through the switching TFT (TFTsw) during one image frame.

[0008] FIG. 2 is a cross-sectional view of the pixel of FIG. 1. In FIG. 2, only an OELD and a TFT driving the OLED are illustrated.

[0009] Referring to FIG. 2, a buffer layer 110 is formed on a glass substrate 100, and a TFT and an OLED are formed on the buffer layer 110.

[0010] A semiconductor active layer 121 is formed in a predetermined pattern on the buffer layer 110 on the substrate 100. A gate insulating layer 130 formed of SiO_2 is formed on the semiconductor active layer 121, and a gate electrode 141 as a conductive film formed of MoW or Al/Cu is formed on the gate insulating layer 130. As depicted in FIG. 1, the gate electrode 141 is connected to one of an upper or a lower electrode of the capacitor (Cst).

[0011] An inter-insulator 150 is formed on the gate electrode 141, and the source and drain electrodes 161 are respectively connected to source and drain regions (not shown) in the semiconductor active layer 121 via contact holes. The power line VDD is also formed on the inter-insulator 150 when the source and drain electrodes 161 are formed. A passivation film 170 formed of SiO_2 or SiNx is formed on the source and drain electrodes 161 and a planarizing film 175 formed of an organic material such as acryl, polyimide, or BCB is formed on the passivation film 170.

[0012] Via-holes 175a and 170a connected to the source and drain electrodes 161 are formed in the passivation film 170 and the planarizing film 175 by photolithography or perforation. A lower electrode layer 180 that acts as an anode is formed on the planarizing film 175 and is connected to the source and drain electrodes 161. A pixel defining layer 185 formed of an organic material covering the lower electrode layer 180 is formed. After forming a predetermined opening in the pixel defining layer 185, an organic layer 190 is formed in a region defined by the opening. The organic layer 190 includes a light emitting layer. Next, an upper electrode layer 195, which acts as a cathode is formed to cover the organic layer 190. A portion of the organic layer 190 where the lower electrode layer 180 faces the upper electrode layer 195 emits light by receiving holes and electrons.

[0013] Conventionally, in the AM OELD device, a transparent cathode is used for emitting light toward a direction of a sealed substrate. Generally, the transparent cathode is formed of a transparent conductive material such as ITO or IZO. However, to function as a cathode, after thinly depositing a semitransparent metal film using a metal having low work function, such as MgAg, on a side that contacts the organic film, a thick transparent conductive film formed of ITO or IZO is deposited on the semitransparent metal film.

[0014] In a conventional method of manufacturing the OELD device, the transparent conductive film is formed after forming the organic film 190. At this time, the transparent conductive film is formed using a low temperature deposition process to minimize the damage of the organic film by heat or plasma. Therefore, the transparent conductive film has poor film quality and has a high specific resistance.

[0015] When the specific resistance of a cathode is high, a non-uniform cathode voltage can be applied to the pixels and can generate a voltage difference between a location close to the power supply point and a location remote from the power supply point due to a voltage drop. The voltage difference can cause non-uniform brightness and image characteristics, and increases power consumption. The voltage drop is also a reason that makes it difficult to manufacture a large size AM OELD device.

[0016] To solve this problem, Shoji Terada et al. have introduced a method of forming an auxiliary electrode for preventing a voltage drop of the upper electrode on a pixel defining layer 285 in 54.5L, SID2003 (Society for Information Display International Symposium, Seminar & Exhibition, Session 54, May 18-23, 2003, Baltimore, MD). The OELD device depicted in FIG. 1 has a structure in which an auxiliary electrode line 193 for preventing a voltage drop of the upper electrode is formed on the pixel defining layer 185 and the upper electrode 195 that acts as a cathode and is formed on an entire surface of the insulating substrate 100 contacts the auxiliary electrode line 193.

[0017] However, the OELD device can solve the problem of non-uniform brightness caused by the voltage drop by forming the auxiliary electrode line 193 but has drawbacks in that the organic film 190 can be damaged when forming the auxiliary electrode line 193 by patterning after forming the semitransparent metal film on the pixel defining layer 185. Also, this process is complicated since a mask process for forming the auxiliary electrode line 193 is added.

[0018] On the other hand, the power line (VDD) that inputs a current to the source and drain electrodes 161 is simultaneously formed and connected to the source and drain electrodes 161 when forming the source and drain electrodes 161. However, in the TFT structure, the wiring resistance is high due to a small cross-sectional area of the wiring since the wiring of the power line (VDD) is supplied from a side of the substrate. Therefore, the amount of current supplied to the driving TFT (TFTdr) is non-uniform due to an RC delay and voltage drop resulting in the non-uniform brightness of the OELD device.

[0019] US 2002/0158835 A1 discloses an active matrix type planar display device, which includes display elements arranged in a matrix and auxiliary wiring elements. The auxiliary wiring elements are formed in the same layer or on the same surface as the first electrode, electrically insulated from the first electrode, and electrically connected to the second electrode. JP 2002 318556 A discloses a display, wherein auxiliary wirings are provided formed on the same layer as a first electrode. EP 1 109 224 A2 discloses a light emitting device with low resistant copper foils as side wirings. US 2003/0151355 A1 discloses an active-driving OLED display device wherein light emitted from the OLED element is taken out from the side of an upper electrode, and the upper electrode comprises a main electrode formed of transparent conductive material, and an auxiliary electrode formed of a low-resistance material.

[0020] As described above, due to the voltage drops in the power line (VDD) and cathode, the manufacturing of a large size AM OELD device is difficult.

SUMMARY OF THE INVENTION

[0021] It is therefore an object of the present invention to provide an improved OELD device.

[0022] It is also an object of the present invention to provide a method of manufacturing the OELD device.

[0023] It is still an object of the present invention to provide an OELD device that prevents voltage drops of a power line (VDD) and a cathode using an auxiliary power line and a method of manufacturing the same.

[0024] It is further an object of the present invention to provide an OELD device that can be formed in a large size by improving image characteristics and brightness thereof by preventing voltage drops of a power line (VDD) and a cathode and a method of manufacturing the same.

[0025] The above and other objects can be achieved by the present invention which is defined in the appended claims.

[0026] According to an aspect of the present invention, there is provided an OELD device comprising: a power line formed on the same layer as source and drain electrodes of a TFT and formed on a substrate on which the TFT is formed; a first insulating layer formed on the TFT; a lower electrode of an OLED that is electrically connected to one of the source and drain electrodes of the TFT and disposed on the first insulating layer; a first auxiliary power line and a second auxiliary power line formed on the same layer as the lower electrode; a second insulating layer formed on an edge portion of the lower electrode and not formed on the second auxiliary power line, wherein an opening that exposes a portion of the lower electrode is formed in the second insulating layer; an organic film which includes a light emitting layer formed on a substrate and the lower electrode; and an upper electrode formed on the substrate. The first auxiliary power line is electrically connected to the power line. The second auxiliary power line is electrically connected to the upper electrode.

[0027] The first insulating layer is interposed between the first auxiliary power line and the power line and the first auxiliary power line is electrically connected to the power line through a via-hole formed in the first insulating layer.

[0028] The second auxiliary power line is preferably electrically connected through a side surface to the upper electrode.

[0029] Preferably, the lower electrodes, the first auxiliary power line, and the second auxiliary power line can be formed of the same material. They can be formed of a conductive material having a greater work function than a conductive material for forming the upper electrode.

[0030] The lower electrode, the first auxiliary power line, and the second auxiliary power line can be formed as a single layer or a multiple layer and can be formed of Al-ITO, Mo-ITO, Ti-ITO, or Ag-ITO.

[0031] The lower electrode, the first auxiliary power line, and the second auxiliary power line can have a greater thickness than the organic film.

[0032] The OELD device can include a plurality of sub-pixels having the TFTs and power lines, and one portion of the sub-pixels includes the first auxiliary power line and the other portion of the sub-pixels includes the second auxiliary power line.

[0033] Each of the first auxiliary power lines can be formed to cross the power line of the sub-pixel which includes the first auxiliary power line. Also, each of the second auxiliary power lines can be formed to cross the power line of the sub-pixel which includes the second auxiliary power line. The first auxiliary power lines and the second auxiliary power lines of the sub-pixels can be alternately formed.

[0034] According to another aspect of the present invention, an organic film is formed either on the entire substrate or on the lower electrode in the opening. The second auxiliary power line is electrically connected to the upper electrode through a side surface and an upper surface of the second auxiliary power line.

[0035] According to another aspect of the present invention, there is provided a method of manufacturing an OELD device comprising: providing a substrate; forming a thin film transistor on the substrate, said thin film transistor including source and drain electrodes; forming a power line on the same layer as the source and drain electrodes of the thin film transistor on the substrate: forming a first insulating layer on the thin film transistor; forming a lower electrode of an OLED electrically connected to one of source and drain electrodes of the TFT on the substrate that includes the TFT and a power line formed on the same layer as the source and drain electrodes of the TFT and forming an auxiliary power line having a first auxiliary power line electrically connected to a power line and a second auxiliary power line electrically connected to an upper electrode formed on the same layer as the lower electrode; forming a pixel defining film that includes an opening for exposing a portion of the lower electrode and is formed on an edge portion of the lower electrode and not on the second auxiliary power line; forming an organic film which includes a light emitting layer on the lower electrode in the opening; and forming an upper electrode on the substrate and the organic thin film.

[0036] The forming of the auxiliary power line includes: forming a planarizing film on the substrate that includes the TFT; forming a first via-hole that exposes the one of the source and drain electrodes of the TFT and a second via-hole that exposes the power line in the planarizing film; and forming the lower electrodes electrically connected to the one of the source and drain electrodes through the first via-hole and a first auxiliary power line electrically connected to the power line through the second via-hole and a second auxiliary power line one the planarizing film.

[0037] The first via-hole and a second auxiliary power line can be formed at the same time. The lower electrode, the first auxiliary power line, and the second auxiliary power line formed on the planarizing film may be formed of the same material.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] A more complete appreciation of the present invention, and many of the above and other features and advantages of the present invention, will be readily apparent as the same becomes better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings in which like reference symbols indicate the same or similar components, wherein

[0039] FIG. 1 is a plan view of a conventional front face emitting active matrix organic electroluminescence display (AM OELD) device;

[0040] FIG. 2 is a cross-sectional view of a pixel of FIG. 1;

[0041] FIG. 3 is a cross-sectional view showing structures of pixels arranged in an nth column and (n+1)th column of an OELD device according to a first embodiment of the present invention;

[0042] FIGS. 4A and 4B are cross-sectional views illustrating a method of manufacturing an OELD device according to an embodiment of the present invention;

[0043] FIGS. 5A and 5B are cross-sectional views illustrating a method of manufacturing an OELD device according to an embodiment of the present invention;

[0044] FIGS. 6A and 6B are cross-sectional views illustrating a method of manufacturing an OELD device according to an embodiment of the present invention;

[0045] FIGS. 7A and 7B are cross-sectional views illustrating a method of manufacturing an OELD device according to an embodiment of the present invention;

[0046] FIG. 8 is a cross-sectional view showing structures of pixels arranged in an nth column and (n+1)th column of an OELD device according to a second embodiment of the present invention; and

[0047] FIG. 9 is a plan view of an OELD device according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0048] The present invention will now be described more fully with reference to the accompanying drawings in which exemplary embodiments of the invention are shown.

[0049] In the drawings and the specification, when a layer is shown or described as placed on another layer or on a substrate in order to indicate that a layer is either directly formed upon the other layer or on the substrate, or, alternatively, that a layer is formed on a third layer which, in turn, rests upon either the other layer or the substrate.

[0050] FIG. 3 is a cross-sectional view showing structures of pixels arranged in an nth column and (n+1)th column of an OELD device according to a first embodiment of the present invention.

[0051] Referring to FIG. 3, the OELD device according to a first embodiment of the present invention includes a buffer layer 210 formed on a substrate 200, a thin film transistor (TFT) (hereinafter a first TFT) of a pixel arranged in an nth column and a TFT (hereinafter a second TFT) of a pixel arranged in an (n+1)th column. The first and second TFTs are disposed on the buffer layer 210. The substrate can be an insulating substrate that includes glass or plastic or a metal substrate.

[0052] The first TFT includes a semiconductor active layer 221, a gate electrode 241, source and drain electrodes 261, and the second TFT includes a semiconductor active layer 222, a gate electrode 242, and source and drain electrodes 262.

[0053] A gate insulating layer 230 is formed between the semiconductor active layers 221 and 222 and the gate electrodes 241 and 242, and the source and drain electrodes 261 and 262 are formed on the inter-insulator 250 and respectively connected to the semiconductor active layer 221 and 222 through each contact hole. Also, power lines (VDD (n) and VDD (n+1)) are formed on the inter-insulator 250 at the same level as the source and drain electrodes 261 and 262.

[0054] Each of the nth power line (VDD(n)) and the (n+1)th power line (VDD(n+1)) is connected in common to a plurality of pixels arranged in a same column, that is, the same data line. That is, as depicted in FIG. 3, the nth power line (VDD(n)) is extended to connect in common to a plurality of pixels arranged in the nth column, and the (n+1)th power line (VDD(n+1)) is extended to connect in common to a plurality of pixels arranged in the (n+1)th column.

[0055] A passivation film 270 formed of SiO_2 or SiNx and a planarizing film 275 formed of an organic film of acryl, polyimide, or BCB are formed on the substrate 200 on which the first and second TFTs are formed. A lower electrode 281 that acts as an anode of an OLED (a first OLED) of a pixel arranged in the nth column and a lower electrode 282 that acts as an anode of an OLED (a second OLED) of a pixel arranged in the (n+1)th column are formed on the planarizing film 275. The lower electrode 281 is electrically connected to one of the source and drain electrodes 261 of the first TFT through via-holes 270a and 275a, and the lower electrode 282 is electrically connected to one of the source and drain electrodes 262 of the second TFT through via-holes 270c and 275c.

[0056] Also, a first auxiliary power line (VDDa(n)) and a second auxiliary power line (VSS(n+1)) are formed on the planarizing film 275 at the same level as the lower electrodes 281 and 282 of the first and second OLEDs.

[0057] The first auxiliary power line (VDDa(n)) is formed on the same layer as the lower electrodes 281 and 282, and reduces the resistance of the nth power line (VDD(n)) by electrically connecting to the nth power line (VDD(n)) through the via-holes 270b and 275b. In FIG. 3, for a better understanding, the first auxiliary power line (VDDa(n)) is shown rotated by 90 degrees. In fact, the first auxiliary power line (VDDa(n)) has a structure that extends along a scan line.

[0058] The second auxiliary power line (VSS(n+1)) is formed on the same level as the lower electrodes 281 and 282, and reduces the resistance of the upper electrode 295 by electrically connecting to the upper electrode 295. In FIG. 3, for a better understanding, the second auxiliary power line (VSS(n+1)) is shown rotated by 90 degrees. In fact, the second auxiliary power line (VSS (n+1)) has a structure that extends along the first auxiliary power line (VDD(n)).

[0059] A pixel defining film 285 is formed on a predetermined region including an edge portion of the lower electrodes 281 and 282. The pixel defining film 285 is formed not to be disposed on the second auxiliary power line (VSS(n+1)). When patterning the pixel defining film 285, openings are formed by exposing portions of the lower electrodes 281 and 282. The organic film 290 is formed on the entire substrate or on the openings. As depicted in FIG. 3, in the present embodiment, the organic film 290 is formed on the entire region on the substrate, but an organic film 290 can be formed only on the openings as depicted in FIG. 8.

[0060] The organic film 290 is not formed on a side surface of the second auxiliary power line (VSS(n+1)) but exposes the side surface of the second auxiliary power line (VSS(n+1)). An upper electrode 295 that acts as a cathode of the first and second OLEDs is formed on the organic film 290. The organic film 290 is electrically connected to the side surface of the second auxiliary power line (VSS(n+1)) since the side surface of the second auxiliary power line (VSS(n+1)) is not covered by the organic film 290.

[0061] At this time, not to form the organic film 290 on side surfaces of the second auxiliary power line (VSS (n+1)), the organic film 290 is coated after forming the second auxiliary power line (VSS(n+1)) with a thickness of greater than 3000 Å. The organic film 290 can be coated on the pixel defining film 285 since the pixel defining film 285 is formed with a certain taper angle. However, the side surfaces of the second auxiliary power line (VSS (n+1)) are not completely covered by the organic film 290 since the side surfaces of the second auxiliary power line (VSS(n+1)) are formed almost vertically and much thicker than the organic film 290.

[0062] The lower electrodes 281 and 282 that act as anodes, the first auxiliary power line (VDDa(n)), the second auxiliary power line (VSS(n+1)) can be formed of the same material. Also, they can be formed of a conductive material having greater work function than a material for forming the upper electrode 295 that acts as a cathode, for example, after forming a reflection film using Ag, Mg, Al, Pt, Pd, Au, Ni, Nd, Ir, Cr, or a compound of these metals, a transparent conductive film can be formed on the reflection film using ITO, IZO, or In_2O_3. Preferably, the lower electrodes 281 and 282, the first auxiliary power line (VDDa(n)), and the second auxiliary power line (VSS (n+1)) can be formed of a material having a low specific resistance of 1-20$\mu\Omega\cdot$cm for reducing the voltage drop of the power line (VDD) and the cathode, and a material having high reflectance of 70-99.9% for increasing the reflectance of the organic film 290 which will be formed in a subsequent process, such as Al-ITO, Mo-ITO, Ti-ITO, or Ag-ITO or a material that can be used for forming a reflection film or an anode.

[0063] Also, the lower electrodes 281 and 282, the first auxiliary power line (VDDa(n)), and the second auxiliary power line (VSS(n+1)) can be formed as a single layer or a multiple layer.

[0064] The organic film 290 formed on the opening can be a low molecular weight organic layer or a polymer layer. When the organic film 290 is a low molecular weight organic layer, the organic film 290 may be a hole injection layer (HIL), a hole transport layer (HTL), an emission layer (EML), an electron transport layer (ETL), an electron injection layer (EIL) or a combination of these layers and can be composed of copper phthalocyanine (CuPc), N,N'-Di(naphthalene-1-yl)-N,N'-diphenyl-benzidine (NPB), or tris-8-hydroxyquinoline aluminum (Alq3). The low molecular weight organic layer can be formed using an evaporation method.

[0065] If the organic film 290 is a polymer organic layer, the organic film 290 can be an HTL and an EML. The HTL can be formed of poly-(2,4)-ethylene-dihydroxy thiophene (PEDOT) and the EML can be formed of a polymer such as Poly-Phenylenevinylene (PPV), or Polyfluorene and can be formed using a screen printing or an inkjet printing.

[0066] The organic film is not limited thereto, but a variety of embodiments can be applied.

[0067] The upper electrode 295 formed on the organic film 290 can be used as a transparent electrode or a reflection electrode. When the upper electrode 295 is used as the transparent electrode since the upper electrode 295 acts as a cathode, after depositing a metal layer using a metal having a low work function, such as Li, Ca, LiF/Ca, LiF/Al, Al, Mg, or a compound of these metals, a transparent electrode material can be formed on the metal layer using ITO, IZO, ZnO or In_2O_3. When the upper electrode 295 is used as the reflection electrode, the upper electrode 295 can be formed entirely depositing a metal layer using a metal having low work function, such as Li, Ca, LiF/Ca, LiF/Al, Al, Mg, or a compound of these metals. In the present embodiment, the upper electrode 295 in the front face emitting OELD device can be formed by forming an IZO film on an MgAg metal layer having low work function and low electrical resistance.

[0068] The upper electrode 295 is electrically connected to the side surfaces of the second auxiliary power line (VSS(n+1)) since the side surfaces of the second auxiliary power line (VSS(n+1)) are exposed, thereby preventing the voltage drop of the cathode.

[0069] FIG. 8 is a cross-sectional view showing structures of pixels disposed in an nth column and an (n+1) th column of an OELD device according to a second embodiment of the present invention.

[0070] The AM OELD device depicted in FIG. 8 has a similar structure with the AM OELD device of the first embodiment. The difference between them is that the organic film 290 in the first embodiment is formed on the entire surface of the substrate, and the upper electrode 295 is electrically connected to the side surfaces of the second auxiliary power line (VSS(n+1)), but an upper electrode 395 in the second embodiment is electrically connected to the side surfaces and the upper surface of the second auxiliary power line (VSS(n+1)) since an organic film 390 in the second embodiment is formed only on lower electrodes 381 and 382 not on the second auxiliary power line (VSS(n+1)).

[0071] At this time, the organic film 390 can be formed only on the opening of a pixel defining film 385 formed on an edge portion of the lower electrodes 381 and 382 by a method such as laser induced thermal imaging (LITI) transferring or patterning. That is, unlike in the first embodiment, the organic film 390 is not formed on the second auxiliary power line (VSS(n+1)).

[0072] Therefore, the voltage drop of the upper electrode 395 can be prevented by electrically connecting the upper electrode 395 to both side surfaces and the upper surface of the second auxiliary power line (VSS (n+1)) that prevents the voltage drop of the upper electrode 395.

[0073] FIG. 9 is a plan view of an OELD device according to an embodiment of the present invention.

[0074] Referring to FIG. 9, an OELD device has a matrix shape of rows and columns having a plurality of sub-pixels, in which TFTs, lower electrodes, an organic layer, and an upper electrode are included. Conventionally, each pixel is composed of R, G, B sub-pixels, but is not necessarily limited thereto. The sub-pixels in the same column are connected to the same power line (VDD) and data line (Data). The sub-pixels in the same row are connected to the same scan line (Scan). The sub-pixels in the same row are connected to a first auxiliary power line (VDDa) or a second auxiliary power line (VSS), which is formed to cross the power line (VDD). The first auxiliary power line (VDDa) is electrically connected to the power line (VDD) by the via-holes 270b and 275b.

[0075] One portion of the sub-pixels are connected to the first auxiliary power line (VDDa), and the other portion of the sub-pixels are connected to the second auxiliary power line (VSS). In this manner, the sub-pixels form a mesh shape.

[0076] In the embodiment depicted in FIG. 9, the first auxiliary power line (VDDa) and the second auxiliary power line (VSS) are alternately formed in each row. However, the number of the first auxiliary power lines (VDDa) can be increased if the voltage drop (IR drop) of the power line (VDD) is needed to be taken into consideration, and the number of the second auxiliary power lines (VSS) can be increased if the voltage drop of the cathode is needed to be taken into consideration.

[0077] A method of manufacturing an OELD device according to an embodiment of the present invention will now be described with reference to the FIGS. 4A through 7B.

[0078] FIGS. 4A and 4B are cross-sectional views illustrating a method of manufacturing an OELD device, in which first and second TFTs and a power line are formed on a substrate, according to an embodiment of the present invention.

[0079] A buffer layer 210 is formed on an insulating substrate formed of glass or plastic or a metal substrate. When the buffer layer 210 is formed, the penetration of impurity elements is prevented and a surface is planarized. The buffer layer 210 can be formed of SiO_2 or SiN using p (PECVD), a (APCVD), low pressure (LPCVD), or electron cyclotron resonance (ECR) in a thickness of approximately 3000Å. After forming semiconductor active layers 221 and 222 on the buffer layer 210, ions are doped to the semiconductor active layers 221 and 222. Afterward, a gate insulating layer 230 is formed on the semiconductor active layers 221 and 222 and gate electrodes 241 and 242 are formed on the gate insulating layer 230. Next, source and drain electrodes 261 and 262 that contact the semiconductor active layers 221 and 222 through via-holes are formed. This completes the manufacturing of the first and second TFTs.

[0080] More specifically, the semiconductor active layers 221 and 222 can be formed of an inorganic semiconductor or an organic semiconductor in a thickness of approximately 500Å. When the semiconductor active layers 221 and 222 are formed of poly silicon of an inorganic semiconductor, after forming amorphous silicon, the amorphous silicon can be crystallized to a poly crystal by various crystallization methods. The active layer has source and drain regions highly doped with an N type or a P type dopant and a channel region is formed therebetween. The inorganic semiconductor can be a silicon material including CdS, GaS, ZnS, CdSe, CaSe, ZnSe, CdTe, SiC, a-Si(amorphous silicon), or poly-Si(poly silicon), and the organic semiconductor can be a semiconductor organic material having a band gap in a range of 1-4 eV and can include a poly organic material such as polythiopene or a low molecular weight organic material such as pentacene.

[0081] The gate insulating layer 230 formed of SiO2 is formed on the semiconductor active layers 221 and 222, and the gate electrodes 241 and 242 formed of a conductive metal, such as MoW, Al, Cr, or Al/Cu, are formed on a predetermined region on the gate insulating layer 230. The material for forming the gate electrodes 241 and 242 are not limited thereto, and they can be formed of various conductive materials such as conductive polymer. The region where the gate electrodes 241 and 242 are formed is a region corresponding to a channel region of the semiconductor active layers 221 and 222.

[0082] An inter-insulator 250 formed of SiO_2 or SiNx is formed on the gate electrodes 241 and 242, and the source and drain electrodes 261 and 262 are formed on the inter-insulator 250 after forming a contact hole in the inter-insulator 250 and the gate insulating layer 230. The source and drain electrodes 261 and 262 can be formed of a conductive metal film such as MoW, Al, Cr, or Al/Cu or a conductive polymer. The power lines (VDD(n) and VDD(n+1)) are formed on the inter-insulator 250 at the time the source and drain electrodes 261 and 262 are formed. The power line (VDD) can be formed of the same material or a different material for forming the source and drain electrodes 261 and 262.

[0083] The structure of the TFT is not limited to the above descriptions. The conventional TFTs can also be employed.

[0084] Next, referring to FIGS. 5A and 5B, the lower electrodes 281 and 282 electrically connected to one of the source and drain electrodes 261 and 262 of the TFTs are formed on the substrate 200 that includes TFTs and the power line (VDD) formed on the same layer as the source and drain electrodes 261 and 262 of the TFTs. The first and second auxiliary power lines (VDDa and VSS) are formed on the same layer as the lower electrodes 281 and 282.

[0085] The first auxiliary power line (VDDa) is formed on the same layer as the lower electrodes 281 and 282, but it is electrically connected to the power line (VDD(n)) through via-holes 270b and 275b. In FIG. 5A, for a better understanding, the first auxiliary power line (VDDa(n)) is shown rotated by 90 degrees. In fact, the first auxiliary power line (VDDa(n)) has a structure that extends along the scan line (Scan).

[0086] Also, in FIG. 5B, for a better understanding, the second auxiliary power line (VSS(n+1)) is shown rotated by 90 degrees. In fact, the second auxiliary power line (VSS(n+1)) has a structure that extends along the scan line (Scan).

[0087] The lower electrodes 281 and 282, the first auxiliary power line (VDDa(n)), and the second auxiliary power line (VSS(n+1)) are formed on a passivation film 270 and a planarizing film 275 coated on the TFT.

[0088] The passivation film 270 is formed of SiNx on the source and drain electrodes 261 and 262, and the planarizing film 275 is formed of acryl, BCB, or polyimide on the passivation film 270. In a sub-pixel of the nth column, via-holes 270a and 275a are formed in the passivation film 270 and the planarizing film 275 to expose the source and drain electrodes 261 and 262. Next, the lower electrode 281 of the first OLED is formed on the passivation film 270 and the lower electrode 281 is connected to one of the source and drain electrodes 261 through the via-holes 270a and 275a.

[0089] In a sub-pixel of the nth column, other via-holes 270b and 275b for exposing the power line (VDD(n)) are formed at the time when the via-holes 270a and 275a are formed. The first auxiliary power line (VDDa(n)) is formed to be connected to the power line (VDD(n)) through the via-holes 270b and 275b at the same time when the lower electrode 281 is formed on the planarizing film 275.

[0090] Also, via-holes 270c and 275c for exposing the source and drain electrodes 262 are formed in a pixel of the (n+1)th column on the passivation film 270 and the planarizing film 275 at the same time when the via-holes 270a and 275a are formed in a pixel of the nth column. Also, in the pixel of an (n+1)th column, the lower electrode 282 of the second OLED is formed in the pixel of an (n+1) th column, and the lower electrode 282 is connected to one of the source and drain electrodes 262 through the via-holes 270c and 275c at the same time when the lower electrode 281 of the first OLED is formed on the planarizing film 275 in a pixel of the nth column. Also, the second auxiliary power line (VSS(n+1)) is formed on the power line (VDD(n+1)) in a sub-pixel of the n+1th column at the same time when the lower electrodes 281 and 282 are formed on the planarizing film 275.

[0091] The lower electrodes 281 and 282 used as anodes, the first auxiliary power line (VDDa), and the second auxiliary power line (VSS) can be formed of the same material, and can be formed of a conductive material having a greater work function than a material for forming the upper electrode 295 that acts as a cathode. For example, after forming a reflection film using a metal such as Ag, Mg, Al, Pt, Pd, Au, Ni, Nd, Ir, Cr, or a compound of these metals, the lower electrodes 281 and 282, the first auxiliary power line (VDDa), and the second auxiliary power line (VSS) can be formed by forming a layer using ITO, IZO, ZnO, or In2O3 on the reflection film.

[0092] More preferably, the lower electrodes 281 and 282, the first auxiliary power line (VDDa), and the second auxiliary power line (VSS) can be formed of a material having a low specific resistance for reducing the voltage drop of the power line (VDD) and the upper electrode 295 which acts as the cathode, and having high reflectance for increasing the reflectance of the organic film 290 which will be formed in a subsequent process, such as Al-ITO, Mo-ITO, Ti-ITO, or Ag-ITO or a material that can be used for forming a reflection film or an anode.

[0093] Also, the lower electrodes 281 and 282, the first auxiliary power line (VDDa), and the second auxiliary power line (VSS) can be formed as a single layer or a multiple layer. The manufacturing process can be reduced by forming the lower electrodes 281 and 282, the first auxiliary power line (VDDa(n)), and the second auxiliary power line (VSS(n+1)) at the same time. The lower electrodes 281 and 282, the first auxiliary power line (VDDa(n)), and the second auxiliary power line (VSS (n+1)) are formed as thick as possible so that the organic film 290, which will be coated on the second auxiliary power line (VSS(n+1)) in a subsequent process, can not cover side surfaces of the second auxiliary power line (VSS(n+1)). An upper electrode 295, which will be formed on the organic film 290 in a subsequent process, is electrically connected to the second auxiliary power line (VSS (n+1)) through the side surfaces of the second auxiliary power line (VSS(n+1)).

[0094] After forming the lower electrodes 281 and 282, the first auxiliary power line (VDDa(n)), and the second auxiliary power line (VSS(n+1)), a pixel defining film 285 is formed on edge portions of the lower electrodes 281 and 282 on the substrate 200. As depicted in FIGS. 6A and 6B, the pixel defining film 285 is not formed on the second auxiliary power line (VSS(n+1)). Openings that expose portions of the lower electrodes 281 and 282 are formed by forming the pixel defining film 285 on edge portions of the lower electrodes 281 and 282.

[0095] Afterward, an organic film 290 that includes a light emitting layer is coated on an entire surface of the insulating substrate 200. The organic film 290 is not formed on side surfaces of the second auxiliary power line (VSS(n+1)). On the other hand, an upper electrode 295 that acts as a cathode of an OLED is formed on the organic film 290. The upper electrode 295 is electrically connected to the second auxiliary power line (VSS(n+1)) through the side surfaces of the second auxiliary power line (VSS(n+1)) since the side surfaces of the second auxiliary power line (VSS(n+1)) are not covered by the organic film 290.

[0096] At this time, the forming of the organic film 290 on the side surfaces of the second auxiliary power line (VSS(n+1)) can be avoided such that the organic film 290 is coated on the second auxiliary power line (VSS (n+1)) after forming the second auxiliary power line (VSS (n+1)) to a thick thickness of greater than 3000Å. The pixel defining film 285 is formed with a certain taper angle so that the organic film 290 can be coated, but the organic film 290 can not be formed on the side surfaces of the second auxiliary power line (VSS(n+1)) since the second auxiliary power line (VSS(n+1)) is formed to a much greater thickness than the thickness of the organic film

290 and the side surfaces of the second auxiliary power line (VSS(n+1)) is almost vertical.

[0097] Next, referring to FIGS. 7A and 7B, the upper electrode 295 that acts as a cathode is formed on an entire surface of the substrate 200. The upper electrode 295 can be formed such that, after depositing a metal layer using a metal having a low work function, such as Li, Ca, LiF/Ca, LiF/Al, Al, Mg, or a compound of these metals, toward the organic film 290, a transparent electrode material, such as ITO, IZO, ZnO, or In_2O_3 can be formed on the metal layer. In the present embodiment, the upper electrode 295 can be formed by forming an IZO film on an MgAg metal layer having low work function and low electrical resistance.

[0098] The upper electrode 295 is electrically connected to the side surface of the second auxiliary power line (VSS(n+1)) by coating the upper electrode 295. As described above, the upper electrode 295 can be electrically connected to the second auxiliary power line (VSS (n+1)) since the side surfaces of the second auxiliary power line (VSS(n+1)) is formed thick enough not to be covered by the organic film 290.

[0099] The embodiment depicted in FIG. 8 shows that the organic film 390 is coated only on lower electrodes 381 and 382 and openings. Therefore, the side surfaces and an upper surface of the second auxiliary power line (VSS(n+1)) can contact the upper electrode 395. The rest of elements are identical to the first embodiment.

[0100] FIG. 9 is a plan view of an OELD device according to an embodiment of the present invention. Referring to FIG. 9, an OELD device has a matrix shape of rows and columns having a plurality of sub-pixels in which TFTs, the lower electrodes 281 and 282, the organic film 290, the upper electrode 295 are included. The sub-pixels in the same column are connected to the same power line (VDD) and data line (Data). The sub-pixels in the same row are connected to the same scan line (Scan). The sub-pixels in the same row are connected to a first auxiliary power line (VDDa) or a second auxiliary power line (VSS), which is formed to cross the power line (VDD). At this time, the first auxiliary power line (VDDa) is electrically connected to the power line (VDD) by the via-holes 270b and 275b.

[0101] One portion of the sub-pixels are connected to the first auxiliary power line (VDDa), and the other portions of the sub-pixels are connected to the second auxiliary power line (VSS). In this manner, the sub-pixels form a mesh shape on a plane.

[0102] In the present embodiment depicted in FIG. 9, the first auxiliary power line (VDDa) and the second auxiliary power line (VSS) are alternately formed in each row. However, the number of the first auxiliary power lines (VDDa) can be increased if the voltage drop (IR drop) of the power line (VDD) is needed to be taken into consideration and the number of the second auxiliary power lines (VSS) can be increased if the voltage drop of the cathode is needed to be taken into consideration.

[0103] As described above, according to the OELD device according to the present invention and the method of manufacturing the OELD device, the voltage drop of the power line (VDD) and the voltage drop of the cathode can be reduced at the same time by using a first auxiliary power line and a second auxiliary power line. The non-uniform brightness and image characteristics of the OELD device can be prevented by preventing the voltage drop of the power line (VDD) and the voltage drop of the cathode.

[0104] A bus line for preventing the voltage drop can be formed, without an additional masking process, by forming the first and second auxiliary power lines at the time the anode is formed.

[0105] The present invention can provide an OELD device that has low power consumption and a large screen size by preventing the voltage drop of the power lines and the cathode, and can provide an improved lifetime and reliable OELD device.

[0106] While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes may be made therein without departing from the scope of the present invention as defined by the following claims.

[0107] For example, although one TFT is depicted in the drawings, a plurality of TFTs can be disposed on a practical plane according to a circuit design, the lower electrode can be used as an anode, the upper electrode can be used as a cathode, the location of electrodes can be easily changed, and therefore, all these modifications should considered with in the scope of the present invention.

Claims

1. An organic electroluminescence display device, comprising:

    a substrate (200);
    a thin film transistor formed on the substrate, said thin film transistor including source and drain electrodes (261);
    a power line (VDD) formed on the same layer as the source and drain electrodes (261) of the thin film transistor and formed on the substrate (200);
    a first insulating layer (275) formed on the thin film transistor;
    a lower electrode (281) electrically connected to one of the source and drain electrodes (261) of the thin film transistor and disposed on the first insulating layer (275) ;
    a first auxiliary power line (VDDa) and a second auxiliary power line (VSS) formed on the same layer as the lower electrode (281);
    a second insulating layer (285) formed on an edge portion of the lower electrode (281) and

not formed on the second auxiliary power line (VSS) to form an opening that exposes a portion of the lower electrode (281);
an organic film (290) which includes a light emitting layer formed on the substrate (200) and the lower electrode; and
an upper electrode (295) formed on the substrate (200) and the organic thin film (290) wherein
the first auxiliary power line (VDDa) is electrically connected to the power line (VDD), and
the second auxiliary power line (VSS) is electrically connected to the upper electrode (295).

2. The organic electroluminescence display device of claim 1, wherein the first insulating layer (275) is interposed between the first auxiliary power line (VDDa) and the power line (VDD), and the first auxiliary power (VDDa) line is electrically connected to the power line (VDD) through a via-hole (275b) formed in the first insulating layer (275).

3. The organic electroluminescence display device of claim 1, wherein the second auxiliary power line (VSS) is electrically connected to the upper electrode (295) through a side surface of the second auxiliary power line (VSS).

4. The organic electroluminescence display device of claim 1, wherein the lower electrode (281), the first auxiliary power line (VDDa), and the second auxiliary power line (VSS) are formed of the same material.

5. The organic electroluminescence display device of claim 4, wherein the lower electrode (281), the first auxiliary power line (VDDa), and the second auxiliary power line (VSSa) are formed of a conductive material having a greater work function than a conductive material for forming the upper electrode (295).

6. The organic electroluminescence display device of claim 4, wherein the lower electrode (281), the first auxiliary power line (VDDa), and the second auxiliary power line (VSSI) are formed as a single layer or a multiple layer.

7. The organic electroluminescence display device of claim 4, wherein the lower electrode (281), the first auxiliary power line (VDDa), and the second auxiliary power line (VSS) are formed of one selected from the group consisting of Al-ITO, Mo-ITO, Ti-ITO, and Ag-ITO.

8. The organic electroluminescence display device of claim 4, wherein the lower electrode (281), the first auxiliary power line (VDDA), and the second auxiliary power line (VSS) has a greater thickness than the organic film.

9. The organic electroluminescence display device of claim 1, wherein the organic electroluminescence display device includes a plurality of sub-pixels having the thin film transistor and the power lines, and one portion of the sub-pixels includes the first auxiliary power line (VDDa) and the other portion of the sub-pixels includes the second auxiliary power line (VSSa).

10. The organic electroluminescence display device of claim 9, wherein each of the first auxiliary power lines (VDDa) is formed to cross the power line of the sub-pixel which includes the first auxiliary power line (VDDa).

11. The organic electroluminescence display device of claim 9, wherein each of the second auxiliary power lines (VSS) is formed to cross the power line of the sub-pixel which includes the second auxiliary power line (VSS).

12. The organic electroluminescence display device of claim 9, wherein the first auxiliary power lines (VDDa) and the second auxiliary power lines (VSS) of the sub-pixels are alternately formed.

13. The organic electroluminescence display device of claim 1, wherein
the organic film (290) is formed on the entire substrate (200); or
the organic film (390) is only formed on the lower electrode (381) in the opening and
the second auxiliary power line (VSS) is electrically connected to the upper electrode (295) through a side surface and an upper surface of the second auxiliary power line (VSS).

14. A method of manufacturing an organic electroluminescence display device, comprising:

providing a substrate (200);
forming a thin film transistor on the substrate (200), said thin film transistor including source and drain electrodes (261);
forming a power line (VDD) on the same layer as the source and drain electrodes (261) of the thin film transistor on the substrate (200);
forming a first insulating layer (275) on the thin film transistor;
forming a lower electrode (281) / connected to one of source and drain electrodes (261) of the thin film transistor on the substrate (200) that includes the thin film transistor and a power line (VDD) formed on the same layer as the thin film transistor and the source and drain electrodes (261) of the thin film transistor;
forming on the same layer as the lower electrode (281) an auxiliary power line comprising a first

auxiliary power line (VDDa) electrically connected to a power line (VDD) and a second auxiliary power line (VSS) electrically connected to an upper electrode (295);
forming a pixel defining film (284) on an edge portion of the lower electrode (281) and not on the second auxiliary power line (VSS) to form an opening for exposing a portion of the lower electrode (281);
forming an organic film (290) which includes a light emitting layer on the lower electrode in the opening; and
forming the upper electrode (295) on the substrate (200) and the organic thin film (290).

15. The method of claim 14, wherein the forming of the auxiliary power line includes:

forming a planarizing film (275) on the substrate (200);
forming a first via-hole (275a) that exposes the one of the source and drain electrodes (261) and a second via-hole (275b) that exposes the power line in the planarizing film (275); and
forming the lower electrode (281) electrically connected to one of the source and drain electrodes (261) through the first via-hole (275a) and the first auxiliary power line (VDDA) and the second auxiliary power line (VSS) electrically connected to the power line (VDD) through the second via-hole (275b) on the planarizing film (275).

16. The method of claim 15, wherein the first via-hole (275a) and a second via-hole (275b) are formed at the same time.

17. The method of claim 15, wherein the lower electrode (281), the first auxiliary power line (VDDa), and the second auxiliary power (VSS) line formed on the planarizing film (275) are formed of the same material.

18. The method of claim 15, wherein the lower electrode (281), the first auxiliary power line (VDDa), and the second auxiliary power line (VSS) formed on the planarizing film (275) are formed of a conductive material having a greater work function than a conductive material for forming the upper electrode (295).

19. The method of claim 15, wherein the lower electrode (281), the first auxiliary power line (VDDa), and the second auxiliary power line (VSS) are formed as a single layer or a multiple layer.

20. The method of claim 15, wherein the lower electrode (281), the first auxiliary power line (VDDa), and the second auxiliary power line (VSS) are formed of one selected from the group consisting of Al-ITO, Mo-ITO, Ti-ITO, and Ag-ITO.

21. The method of claim 15, wherein the lower electrodes (281), the first auxiliary power line (VSS), and the second auxiliary power line (VSS) has a greater thickness than the organic film.

22. The method of claim 14, wherein the organic film (290) is not formed on the side surfaces of the second auxiliary power line (VSS), and the second auxiliary power line (VSS) is electrically connected to the upper electrode (295) through said side surface of the second auxiliary power line (VSS).

23. The method of claim 14, wherein the organic film (290) is not formed on the side surfaces and the upper surface of the second auxiliary power line (VSS), and the second auxiliary power line (VSS) is electrically connected through the side surface and the upper surface of the second auxiliary power line (VSS).

24. The method of claim 14, wherein a plurality of subpixels having the first and second auxiliary power lines (VDDa, VSS) are formed at the same time with the formation of the auxiliary power line (VDDa), and the first auxiliary power line is formed on one portion of the sub-pixels and the second auxiliary power line (VSS) is formed on the other portion of the sub-pixels.

25. The method of claim 14, wherein each of the first auxiliary power lines (VDDa) is formed to cross the power line of the sub-pixel which includes the first auxiliary power line (VDDa).

26. The method of claim 14, wherein each of the second auxiliary power lines (VSS) is formed to cross the power line of the sub-pixel which includes the second auxiliary power line (VSS).

27. The method of claim 14, wherein the first auxiliary power lines (VDDa) and the second auxiliary power lines (VSS) of the sub-pixels are alternately formed.

Patentansprüche

1. Organische Elektrolumineszenz-Anzeigevorrichtung, umfassend:

ein Substrat (200);
einen auf dem Substrat ausgebildeten Dünnschichttransistor, wobei der Dünnschichttransistor Source- und Drainelektroden (261) umfasst;
eine Stromleitung (VDD), die auf derselben Schicht ausgebildet ist wie die Source- und Drainelektroden (261) des auf dem Substrat (200)

ausgebildeten Dünnschichttransistors;
eine auf dem Dünnschichttransistor ausgebildete erste Isolierschicht (275);
eine untere Elektrode (281), die elektrisch mit einer der Source- und Drainelektroden (261) des Dünnschichttransistors verbunden und auf der ersten Isolierschicht (275) angeordnet ist;
eine erste Hilfsstromleitung (VDDa) und eine zweite Hilfsstromleitung (VSS), die auf derselben Schicht ausgebildet sind, wie die untere Elektrode (281);
eine zweite Isolierschicht (285), die an einem Randabschnitt der unteren Elektrode (281) ausgebildet ist und nicht auf der zweiten Hilfsstromleitung (VSS) ausgebildet ist, zur Ausbildung einer Öffnung, die einen Teil der unteren Elektrode (281) freigibt;
einen auf dem Substrat (200) und der unteren Elektrode ausgebildeten organischen Film (290), der eine lichtemittierende Schicht aufweist; und
eine auf dem Substrat (200) und dem organischen dünnen Film (290) ausgebildete obere Elektrode (295),
wobei
die erste Hilfsstromleitung (VDDa) elektrisch mit der Stromleitung (VDD) verbunden ist, und
die zweite Hilfsstromleitung (VSS) elektrisch mit der oberen Elektrode (295) verbunden ist.

2. Organische Elektrolumineszenz-Anzeigevorrichtung nach Anspruch 1, wobei die erste Isolierschicht (275) zwischen die erste Hilfsstromleitung (VDDa) und die Stromleitung (VDD) geschaltet ist, und die erste Hilfsstromleitung (VDDa) elektrisch mit der Stromleitung (VDD) über ein in der ersten Isolierschicht (275) ausgebildetes Kontaktloch (275b) verbunden ist.

3. Organische Elektrolumineszenz-Anzeigevorrichtung nach Anspruch 1, wobei die zweite Hilfsstromleitung (VSS) elektrisch mit der oberen Elektrode (295) über eine Seitenfläche der zweiten Hilfsstromleitung (VSS) verbunden ist.

4. Organische Elektrolumineszenz-Anzeigevorrichtung nach Anspruch 1, wobei die untere Elektrode (281), die erste Hilfsstromleitung (VDDa) und die zweite Hilfsstromleitung (VSS) aus demselben Material gebildet sind.

5. Organische Elektrolumineszenz-Anzeigevorrichtung nach Anspruch 4, wobei die untere Elektrode (281), die erste Hilfsstromleitung (VDDa) und die zweite Hilfsstromleitung (VSSa) aus einem leitfähigen Material gebildet sind, das eine größere Austrittsarbeit besitzt als ein leitfähiges Material zur Ausbildung der oberen Elektrode (295).

6. Organische Elektrolumineszenz-Anzeigevorrichtung nach Anspruch 4, wobei die untere Elektrode (281), die erste Hilfsstromleitung (VDDa) und die zweite Hilfsstromleitung (VSSI) als eine Einzelschicht oder eine Mehrfachschicht ausgebildet sind.

7. Organische Elektrolumineszenz-Anzeigevorrichtung nach Anspruch 4, wobei die untere Elektrode (281), die erste Hilfsstromleitung (VDDa) und die zweite Hilfsstromleitung aus einem ausgewählt aus der Gruppe bestehend aus Al-ITO, Mo-ITO, Ti-ITO und Ag-ITO ausgebildet sind.

8. Organische Elektrolumineszenz-Anzeigevorrichtung nach Anspruch 4, wobei die untere Elektrode (281), die erste Hilfsstromleitung (VDDA) und die zweite Hilfsstromleitung (VSS) eine größere Dicke als der organische Film aufweisen.

9. Organische Elektrolumineszenz-Anzeigevorrichtung nach Anspruch 1, wobei die organische Elektrolumineszenz-Anzeigevorrichtung eine Vielzahl von Sub-Pixeln mit dem Dünnschichttransistor und den Stromleitungen aufweist und ein Teil der Sub-Pixel die erste Hilfsstromleitung (VDDa) und der andere Teil der Sub-Pixel die zweite Hilfsstromleitung (VSSa) aufweist.

10. Organische Elektrolumineszenz-Anzeigevorrichtung nach Anspruch 9, wobei jede der ersten Hilfsstromleitungen (VDDa) ausgebildet ist, die Stromleitung des Sub-Pixels, welches die erste Hilfsstromleitung (VDDa) aufweist, zu kreuzen.

11. Organische Elektrolumineszenz-Anzeigevorrichtung nach Anspruch 9, wobei jede der zweiten Hilfsstromleitungen (VSS) ausgebildet ist, die Stromleitung des Sub-Pixels, welches die zweite Hilfsstromleitung (VSS) aufweist, zu kreuzen.

12. Organische Elektrolumineszenz-Anzeigevorrichtung nach Anspruch 9, wobei die ersten Hilfsstromleitungen (VDDa) und die zweiten Hilfsstromleitungen (VSS) der Sub-Pixel abwechselnd ausgebildet sind.

13. Organische Elektrolumineszenz-Anzeigevorrichtung nach Anspruch 1, wobei
der organische Film (290) auf dem gesamten Substrat (200) ausgebildet ist; oder der organische Film (390) nur auf der unteren Elektrode (381) in der Öffnung ausgebildet ist, und
die zweite Hilfsstromleitung (VSS) elektrisch mit der oberen Elektrode (295) über eine Seitenfläche und eine obere Fläche der zweiten Hilfsstromleitung (VSS) verbunden ist.

14. Verfahren zum Herstellen einer organischen Elektrolumineszenz-Anzeigevorrichtung, umfassend:

Vorsehen eines Substrats (200);
Ausbilden eines Dünnschichttransistors auf dem Substrat (200), wobei der Dünnschichttransistor Source- und Drainelektroden (261) umfasst;
Ausbilden einer Stromleitung (VDD) auf derselben Schicht wie die Source- und Drainelektroden (261) des Dünnschichttransistors auf dem Substrat (200);
Ausbilden einer ersten Isolierschicht (275) auf dem Dünnschichttransistor;
Ausbilden einer unteren Elektrode (281), die mit einer der Source- und Drainelektroden (261) des Dünnschichttransistors auf dem Substrat (200), das den Dünnschichttransistor und eine Stromleitung (VDD) aufweist, die auf derselben Schicht ausgebildet ist wie der Dünnschichttransistor und die Source- und Drainelektroden (261) des Dünnschichttransistors, verbunden ist,
Ausbilden auf derselben Schicht wie die untere Elektrode (281) einer Hilfsstromleitung umfassend eine erste Hilfsstromleitung (VDDa), die elektrisch mit einer Stromleitung (VDD) verbunden ist, und eine zweite Hilfsstromleitung (VSS), die elektrisch mit einer oberen Elektrode (295) verbunden ist,
Ausbilden eines pixeldefinierenden Films (284) an einem Randabschnitt der unteren Elektrode (281) und nicht auf der zweiten Hilfsstromleitung (VSS), zur Ausbildung einer Öffnung zum Freigeben eines Teils der unteren Elektrode (281);
Ausbilden eines organischen Films (290), der eine lichtemittierende Schicht aufweist, auf der unteren Elektrode in der Öffnung; und
Ausbilden der oberen Elektrode (295) auf dem Substrat (200) und dem organischen dünnen Film (290).

15. Verfahren nach Anspruch 14, wobei das Ausbilden der Hilfsstromleitung umfasst:

Ausbilden eines Planarisierungsfilms (275) auf dem Substrat (200);
Ausbilden eines ersten Kontaktlochs (275a), das die eine der Source- und Drainelektroden (261) freigibt, und eines zweiten Kontaktlochs (275b), das die Stromleitung in dem Planarisierungsfilm (275) freigibt; und
Ausbilden der unteren Elektrode (281), die elektrisch mit einer der Source- und Drainelektroden (261) über das erste Kontaktloch (275a) verbunden ist, und der ersten Hilfsstromleitung (VDDA) und der zweiten Hilfsstromleitung (VSS), die elektrisch mit der Stromleitung (VDD) über das zweite Kontaktloch (275b) auf dem Planarisierungsfilm (275) verbunden sind.

16. Verfahren nach Anspruch 15, wobei das erste Kontaktloch (275a) und ein zweites Kontaktloch (275b) gleichzeitig ausgebildet werden.

17. Verfahren nach Anspruch 15, wobei die untere Elektrode (281), die erste Hilfsstromleitung (VDDa) und die zweite Hilfsstromleitung (VSS), die auf dem Planarisierungsfilm (275) ausgebildet sind, aus demselben Material gebildet sind.

18. Verfahren nach Anspruch 15, wobei die untere Elektrode (281), die erste Hilfsstromleitung (VDDa) und die zweite Hilfsstromleitung (VSS), die auf dem Planarisierungsfilm (275) ausgebildet sind, aus einem leitfähigen Material gebildet sind, das eine größere Austrittsarbeit besitzt als ein leitfähiges Material zur Ausbildung der oberen Elektrode (295).

19. Verfahren nach Anspruch 15, wobei die untere Elektrode (281), die erste Hilfsstromleitung (VDDa) und die zweite Hilfsstromleitung (VSS) als eine Einzelschicht oder eine Mehrfachschicht ausgebildet sind.

20. Verfahren nach Anspruch 15, wobei die untere Elektrode (281), die erste Hilfsstromleitung (VDDa) und die zweite Hilfsstromleitung (VSS) aus einem ausgewählt aus der Gruppe bestehend aus Al-ITO, Mo-ITO, Ti-ITO und Ag-ITO ausgebildet sind.

21. Verfahren nach Anspruch 15, wobei die untere Elektroden (281), die erste Hilfsstromleitung (VSS) und die zweite Hilfsstromleitung (VSS) eine größere Dicke als der organische Film aufweisen.

22. Verfahren nach Anspruch 14, wobei der organische Film (290) nicht auf den Seitenflächen der zweiten Hilfsstromleitung (VSS) ausgebildet ist, und die zweite Hilfsstromleitung (VSS) elektrisch mit der oberen Elektrode (295) über die Seitenfläche der zweiten Hilfsstromleitung (VSS) verbunden ist.

23. Verfahren nach Anspruch 14, wobei der organische Film (290) nicht auf den Seitenflächen und der oberen Fläche der zweiten Hilfsstromleitung (VSS) ausgebildet ist, und die zweite Hilfsstromleitung (VSS) elektrisch über die Seitenfläche und die obere Fläche der zweiten Hilfsstromleitung (VSS) verbunden ist.

24. Verfahren nach Anspruch 14, wobei eine Vielzahl von Sub-Pixeln mit den ersten und zweiten Hilfsstromleitungen (VDDa, VSS) gleichzeitig mit der Ausbildung der Hilfsstromleitung (VDDa) ausgebildet werden, und die erste Hilfsstromleitung auf einem Teil der Sub-Pixel ausgebildet wird und die zweite Hilfsstromleitung (VSS) auf dem anderen Teil der Sub-Pixel ausgebildet wird.

25. Verfahren nach Anspruch 14, wobei jede der ersten Hilfsstromleitungen (VDDa) ausgebildet ist, die Stromleitung des Sub-Pixels, welches die erste Hilfsstromleitung (VDDa) aufweist, zu kreuzen.

26. Verfahren nach Anspruch 14, wobei jede der zweiten Hilfsstromleitungen (VSS) ausgebildet ist, die Stromleitung des Sub-Pixels, welches die zweite Hilfsstromleitung (VSS) aufweist, zu kreuzen.

27. Verfahren nach Anspruch 14, wobei die ersten Hilfsstromleitungen (VDDa) und die zweiten Hilfsstromleitungen (VSS) der Sub-Pixel abwechselnd ausgebildet sind.

Revendications

1. Dispositif d'affichage à électroluminescence organique, comprenant :

un substrat (200) ;
un transistor à film mince formé sur le substrat, ledit transistor à film mince comprenant des électrodes de source et de drain (261) ;
une ligne d'alimentation (VDD) formée sur la même couche que les électrodes de source et de drain (261) du transistor à film mince et formée sur le substrat (200) ;
une première couche isolante (275) formée sur le transistor à film mince ;
une électrode inférieure (281) électriquement connectée à l'une des électrodes de source et de drain (261) du transistor à film mince et disposée sur la première couche isolante (275) ;
une première ligne d'alimentation auxiliaire (VDDa) et une deuxième ligne d'alimentation auxiliaire (VSS) formées sur la même couche que l'électrode inférieure (281) ;
une deuxième couche isolante (285) formée sur une partie de bord de l'électrode inférieure (281), et non formée sur la deuxième ligne d'alimentation auxiliaire (VSS), de façon à former une ouverture qui expose une partie de l'électrode inférieure (281) ;
un film organique (290) qui comprend une couche émettrice de lumière, formé sur le substrat (200) et l'électrode inférieure ; et
une électrode supérieure (295) formée sur le substrat (200) et le film mince organique (290), dans lequel :

la première ligne d'alimentation auxiliaire (VDDa) est électriquement connectée à la ligne d'alimentation (VDD), et
la deuxième ligne d'alimentation auxiliaire (VSS) est électriquement connectée à l'électrode supérieure (295).

2. Dispositif d'affichage à électroluminescence organique selon la revendication 1, dans lequel la première couche isolante (275) est interposée entre la première ligne d'alimentation auxiliaire (VDDa) et la ligne d'alimentation (VDD), et la première ligne d'alimentation auxiliaire (VDDa) est électriquement connectée à la ligne d'alimentation (VDD) par l'intermédiaire d'un trou traversant (275b) formé dans la première couche isolante (275).

3. Dispositif d'affichage à électroluminescence organique selon la revendication 1, dans lequel la deuxième ligne d'alimentation auxiliaire (VSS) est électriquement connectée à l'électrode supérieure (295) par l'intermédiaire d'une surface latérale de la deuxième ligne d'alimentation auxiliaire (VSS).

4. Dispositif d'affichage à électroluminescence organique selon la revendication 1, dans lequel l'électrode inférieure (281), la première ligne d'alimentation auxiliaire (VDDa) et la deuxième ligne d'alimentation auxiliaire (VSS) sont constituées par le même matériau.

5. Dispositif d'affichage à électroluminescence organique selon la revendication 4, dans lequel l'électrode inférieure (281), la première ligne d'alimentation auxiliaire (VDDa) et la deuxième ligne d'alimentation auxiliaire (VSSa) sont constituées par un matériau conducteur ayant un travail d'extraction supérieur à celui d'un matériau conducteur pour former l'électrode supérieure (295).

6. Dispositif d'affichage à électroluminescence organique selon la revendication 4, dans lequel l'électrode inférieure (281), la première ligne d'alimentation auxiliaire (VDDa) et la deuxième ligne d'alimentation auxiliaire (VSSI) sont formées sous la forme d'une couche unique ou d'une couche multiple.

7. Dispositif d'affichage à électroluminescence organique selon la revendication 4, dans lequel l'électrode inférieure (281), la première ligne d'alimentation auxiliaire (VDDa) et la deuxième ligne d'alimentation auxiliaire (VSS) sont constituées par un matériau sélectionné parmi le groupe comprenant AI-ITO, Mo-ITO, Ti-ITO et Ag-ITO.

8. Dispositif d'affichage à électroluminescence organique selon la revendication 4, dans lequel l'électrode inférieure (281), la première ligne d'alimentation auxiliaire (VDDa) et la deuxième ligne d'alimentation auxiliaire (VSS) ont une épaisseur supérieure à celle du film organique.

9. Dispositif d'affichage à électroluminescence organique selon la revendication 1, ledit dispositif d'affichage à électroluminescence organique comprenant une pluralité de sous-pixels comportant le transistor à film mince et les lignes d'alimentation, et une partie des sous-pixels comprenant la première ligne d'alimentation auxiliaire (VDDa) et l'autre partie des sous-pixels comprenant la deuxième ligne d'alimentation auxiliaire (VSSa).

10. Dispositif d'affichage à électroluminescence organique selon la revendication 9, dans lequel chacune des premières lignes d'alimentation auxiliaires (VDDa) est formée de façon à croiser la ligne d'alimentation du sous-pixel qui comprend la première ligne d'alimentation auxiliaire (VDDa).

11. Dispositif d'affichage à électroluminescence organique selon la revendication 9, dans lequel chacune des deuxièmes lignes d'alimentation auxiliaires (VSS) est formée de façon à croiser la ligne d'alimentation du sous-pixel qui comprend la deuxième ligne d'alimentation auxiliaire (VSS).

12. Dispositif d'affichage à électroluminescence organique selon la revendication 9, dans lequel les premières lignes d'alimentation auxiliaires (VDDa) et les deuxièmes lignes d'alimentation auxiliaires (VSS) des sous-pixels sont formées en alternance.

13. Dispositif d'affichage à électroluminescence organique selon la revendication 1, dans lequel :

le film organique (290) est formé sur la totalité du substrat (200) ; ou
le film organique (390) n'est formé que sur l'électrode inférieure (381) dans l'ouverture ; et
la deuxième ligne d'alimentation auxiliaire (VSS) est électroniquement connectée à l'électrode supérieure (295) par l'intermédiaire d'une surface latérale et d'une surface supérieure de la deuxième ligne d'alimentation auxiliaire (VSS).

14. Procédé de fabrication d'un dispositif d'affichage à électroluminescence organique, comprenant :

la disposition d'un substrat (200) ;
la formation d'un transistor à film mince sur le substrat (200), ledit transistor à film mince comprenant des électrodes de source et de drain (261) ;
la formation d'une ligne d'alimentation (VDD) sur la même couche que les électrodes de source et de drain (261) du transistor à film mince sur le substrat (200) ;
la formation d'une première couche isolante (275) sur le transistor à film mince ;
la formation d'une électrode inférieure (281) connectée à l'une des électrodes de source et de drain (261) du transistor à film mince sur le substrat (200) qui comprend le transistor à film mince et une ligne d'alimentation (VDD) formée sur la même couche que le transistor à film mince et les électrodes de source et de drain (261) du transistor à film mince ;
la formation, sur la même couche que l'électrode inférieure (281), d'une ligne d'alimentation auxiliaire comprenant une première ligne d'alimentation auxiliaire (VDDa) électriquement connectée à une ligne d'alimentation (VDD) et une deuxième ligne d'alimentation auxiliaire (VSS) électriquement connectée à une électrode supérieure (295) ;
la formation d'un film de définition de pixels (284) sur une partie de bord de l'électrode inférieure (281), et non sur la deuxième ligne d'alimentation auxiliaire (VSS), de façon à former une ouverture pour exposer une partie de l'électrode inférieure (281) ;
la formation d'un film organique (290) qui comprend une couche émettrice de lumière sur l'électrode inférieure dans l'ouverture ; et
la formation de l'électrode supérieure (295) sur le substrat (200) et le film mince organique (290).

15. Procédé selon la revendication 14, dans lequel la formation de la ligne d'alimentation auxiliaire comprend :

la formation d'un film de planarisation (275) sur le substrat (200) ;
la formation d'un premier trou traversant (275a) qui expose l'une des électrodes de source et de drain (261) et d'un deuxième trou traversant (275b) qui expose la ligne d'alimentation dans le film de planarisation (275) ; et
la formation de l'électrode inférieure (281) électriquement connectée à l'une des électrodes de source et de drain (261) par l'intermédiaire du premier trou traversant (275a) et de la première ligne d'alimentation auxiliaire (VDDA) et de la deuxième ligne d'alimentation auxiliaire (VSS) électriquement connectées à la ligne d'alimentation (VDD) par l'intermédiaire du deuxième trou traversant (275b) sur le film de planarisation (275).

16. Procédé selon la revendication 15, dans lequel le premier trou traversant (275a) et un deuxième trou traversant (275b) sont formés en même temps.

17. Procédé selon la revendication 15, dans lequel l'électrode inférieure (281), la première ligne d'alimentation auxiliaire (VDDa) et la deuxième ligne d'alimentation auxiliaire (VSS) formées sur le film de planarisation (275) sont constituées par le même matériau.

18. Procédé selon la revendication 15, dans lequel l'électrode inférieure (281), la première ligne d'alimentation auxiliaire (VDDa) et la deuxième ligne d'alimentation auxiliaire (VSS) formées sur le film de planarisation (275) sont constituées par un matériau conducteur ayant un travail d'extraction supérieur à celui d'un matériau conducteur pour former l'électrode supérieure (295).

19. Procédé selon la revendication 15, dans lequel l'électrode inférieure (281), la première ligne d'alimentation auxiliaire (VDDa) et la deuxième ligne d'alimentation auxiliaire (VSS) sont formées sous la forme d'une couche unique ou d'une couche multiple.

20. Procédé selon la revendication 15, dans lequel l'électrode inférieure (281), la première ligne d'alimentation auxiliaire (VDDa) et la deuxième ligne d'alimentation auxiliaire (VSS) sont constituées par un matériau sélectionné parmi le groupe comprenant Al-ITO, Mo-ITO, Ti-ITO et Ag-ITO.

21. Procédé selon la revendication 15, dans lequel l'électrode inférieure (281), la première ligne d'alimentation auxiliaire (VSS) et la deuxième ligne d'alimentation auxiliaire (VSS) ont une épaisseur supérieure à celle du film organique.

22. Procédé selon la revendication 14, dans lequel le film organique (290) n'est pas formé sur les surfaces latérales de la deuxième ligne d'alimentation auxiliaire (VSS), et la deuxième ligne d'alimentation auxiliaire (VSS) est électriquement connectée à l'électrode supérieure (295) par l'intermédiaire de ladite surface latérale de la deuxième ligne d'alimentation auxiliaire (VSS).

23. Procédé selon la revendication 14, dans lequel le film organique (290) n'est pas formé sur les surfaces latérales et la surface supérieure de la deuxième ligne d'alimentation auxiliaire (VSS), et la deuxième ligne d'alimentation auxiliaire (VSS) est électriquement connectée par l'intermédiaire de la surface latérale et de la surface supérieure de la deuxième ligne d'alimentation auxiliaire (VSS).

24. Procédé selon la revendication 14, dans lequel une pluralité de sous-pixels comportant les première et deuxième lignes d'alimentation auxiliaires (VDDa, VSS) sont formés en même temps que la formation de la ligne d'alimentation auxiliaire (VDDa), et la première ligne d'alimentation auxiliaire est formée sur une partie des sous-pixels et la deuxième ligne d'alimentation auxiliaire (VSS) est formée sur l'autre partie des sous-pixels.

25. Procédé selon la revendication 14, dans lequel chacune des premières lignes d'alimentation auxiliaires (VDDa) est formée de façon à croiser la ligne d'alimentation du sous-pixel qui comprend la première ligne d'alimentation auxiliaire (VDDa).

26. Procédé selon la revendication 14, dans lequel chacune des deuxièmes lignes d'alimentation auxiliaires (VSS) est formée de façon à croiser la ligne d'alimentation du sous-pixel qui comprend la deuxième ligne d'alimentation auxiliaire (VSS).

27. Procédé selon la revendication 14, dans lequel les premières lignes d'alimentation auxiliaires (VDDa) et les deuxièmes lignes d'alimentation auxiliaires (VSS) des sous-pixels sont formées en alternance.

FIG. 1

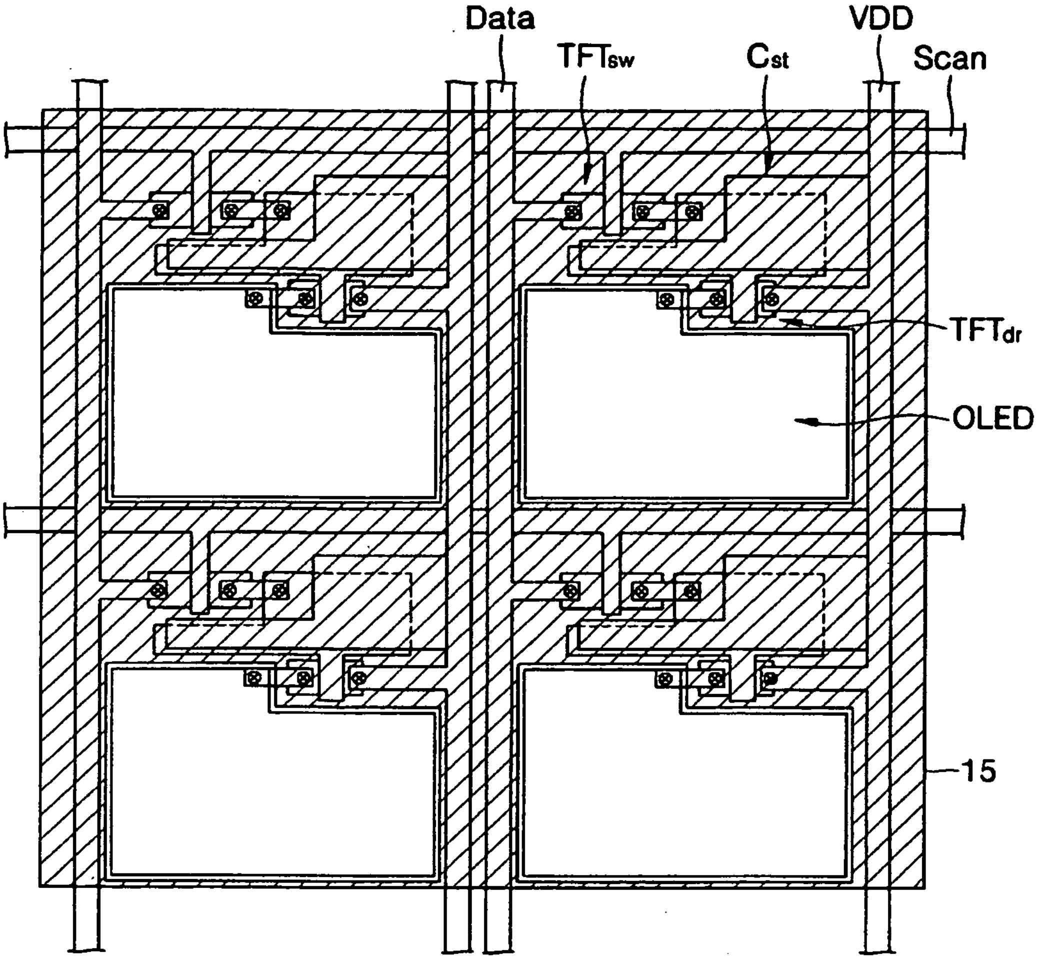

Data
TFTsw
Cst
VDD
Scan
TFTdr
OLED
15

FIG. 2

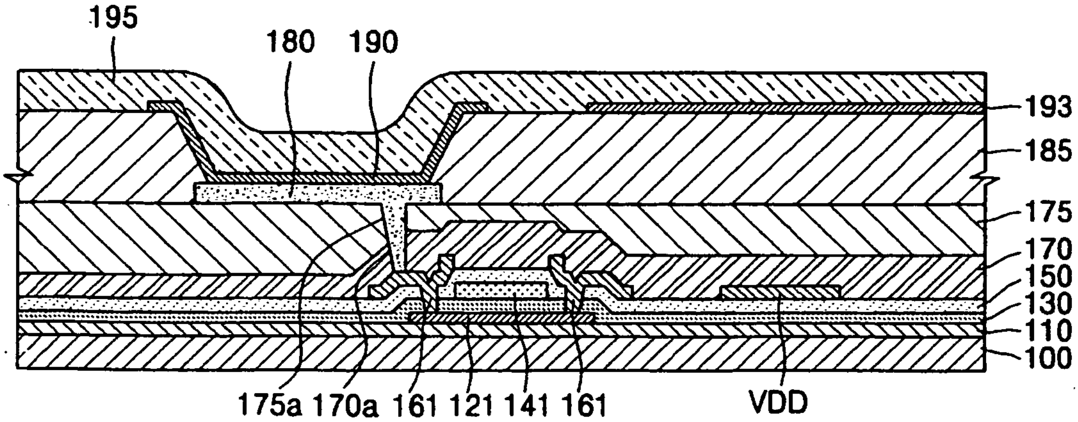

195
180
190
193
185
175
170
150
130
110
100
175a
170a
161
121
141
161
VDD

FIG. 3

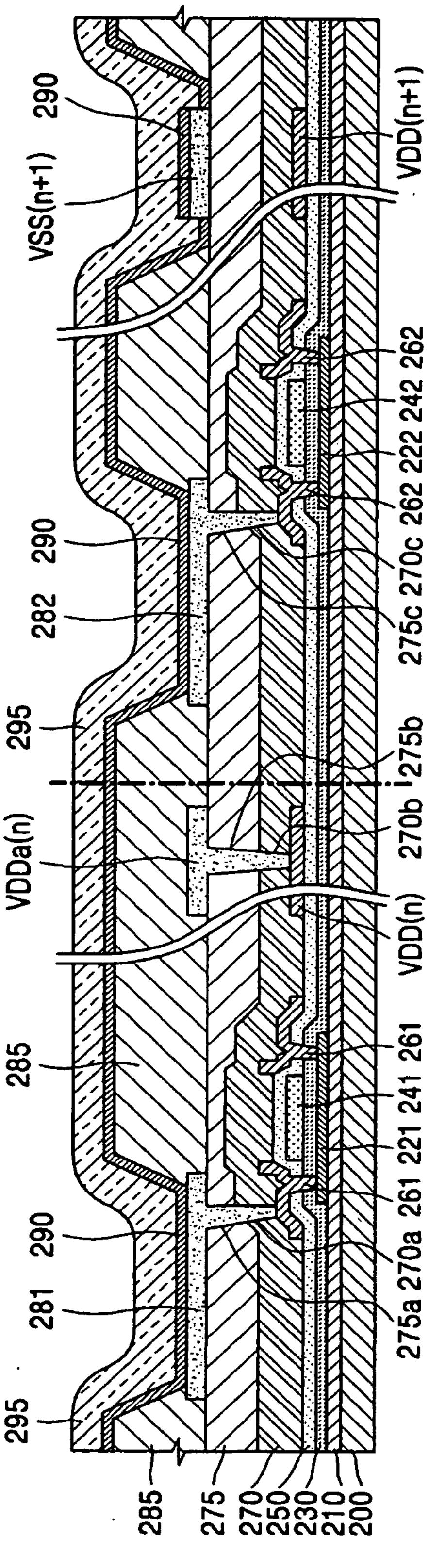

290
VSS(n+1)
290
282
295
VDDa(n)
285
290
281
295
VDD(n+1)
262 242 222 262 270c 275c
275b
270b
VDD(n)
261 241 221 261 270a 275a
285
275
270
250
230
210
200

FIG. 4A

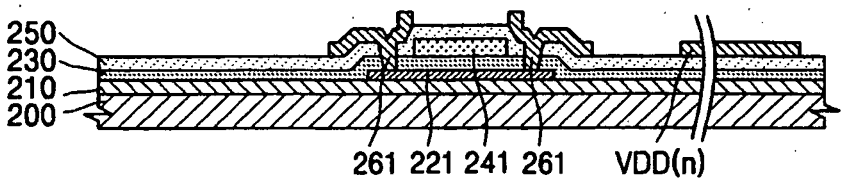

250
230
210
200
261 221 241 261
VDD(n)

FIG. 4B

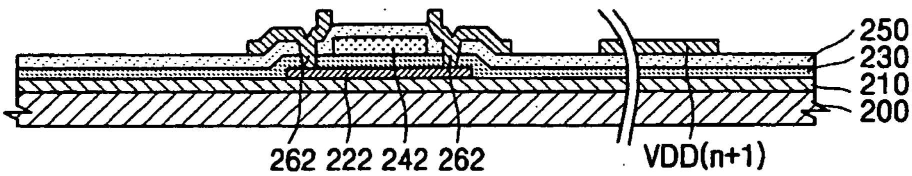

250
230
210
200
262 222 242 262
VDD(n+1)

FIG. 5A

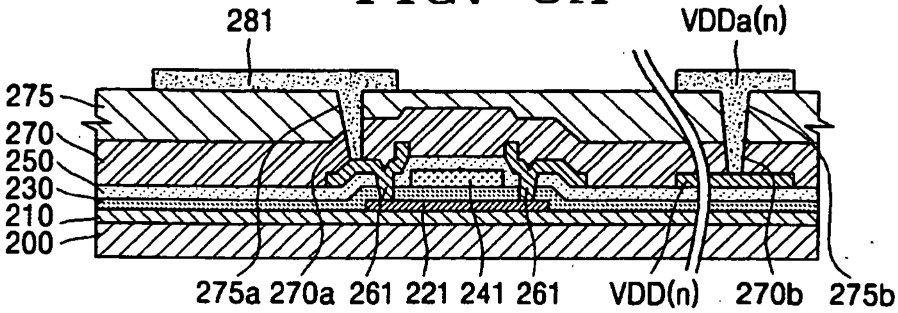

281
VDDa(n)
275
270
250
230
210
200
275a 270a 261 221 241 261 VDD(n) 270b 275b

FIG. 5B

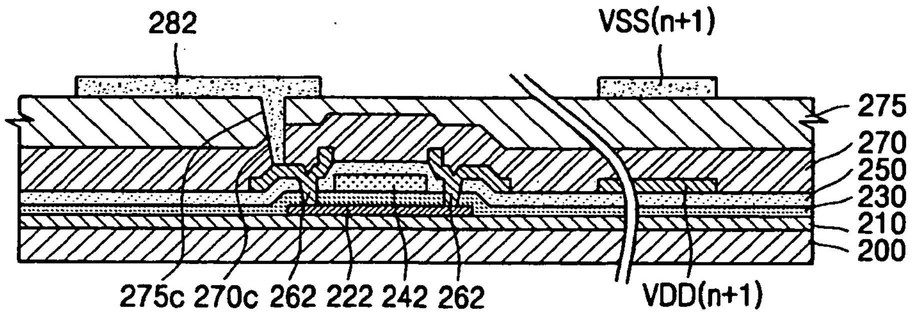

282
VSS(n+1)
275
270
250
230
210
200
275c 270c 262 222 242 262 VDD(n+1)

FIG. 6A

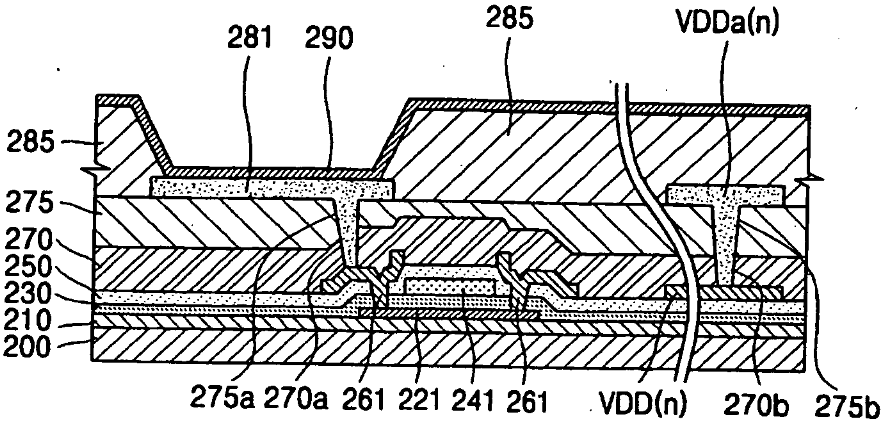

281
290
285
VDDa(n)
285
275
270
250
230
210
200
275a
270a
261
221
241
261
VDD(n)
270b
275b

FIG. 6B

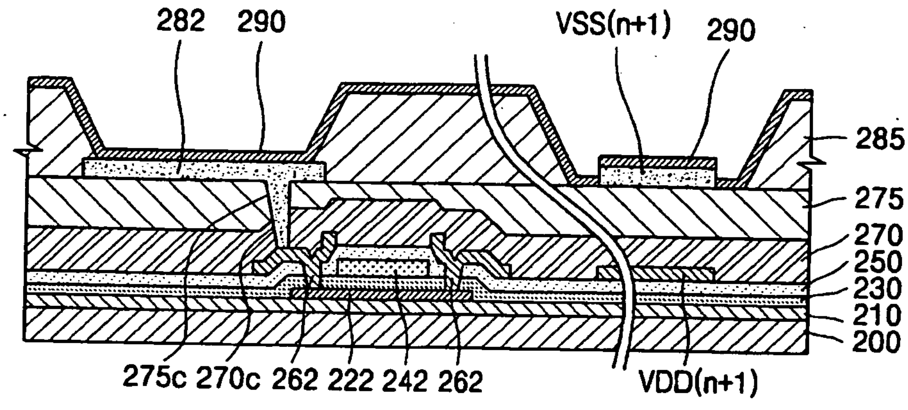

282
290
VSS(n+1)
290
285
275
270
250
230
210
200
275c
270c
262
222
242
262
VDD(n+1)

FIG. 7A

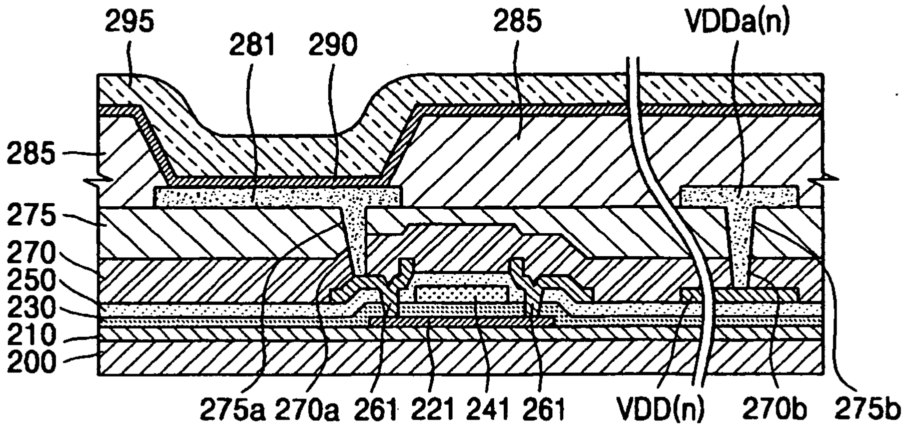

295
281
290
285
VDDa(n)
285
275
270
250
230
210
200
275a
270a
261
221
241
261
VDD(n)
270b
275b

FIG. 7B

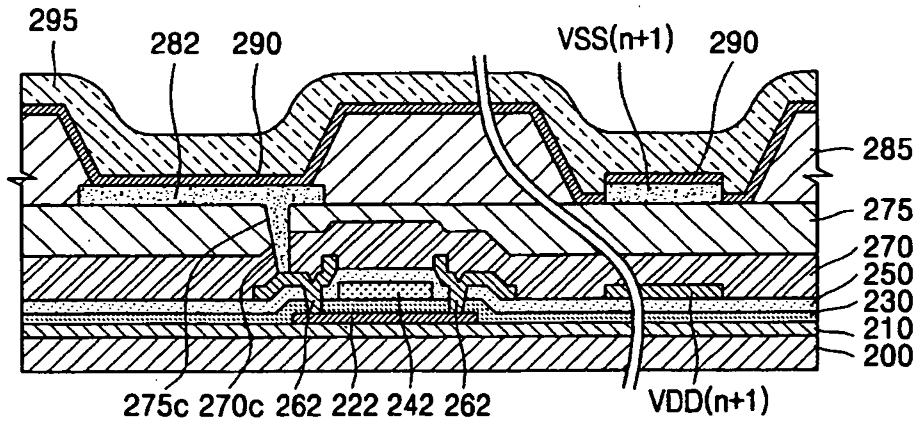

295
282
290
VSS(n+1)
290
285
275
270
250
230
210
200
275c
270c
262
222
242
262
VDD(n+1)

FIG. 8

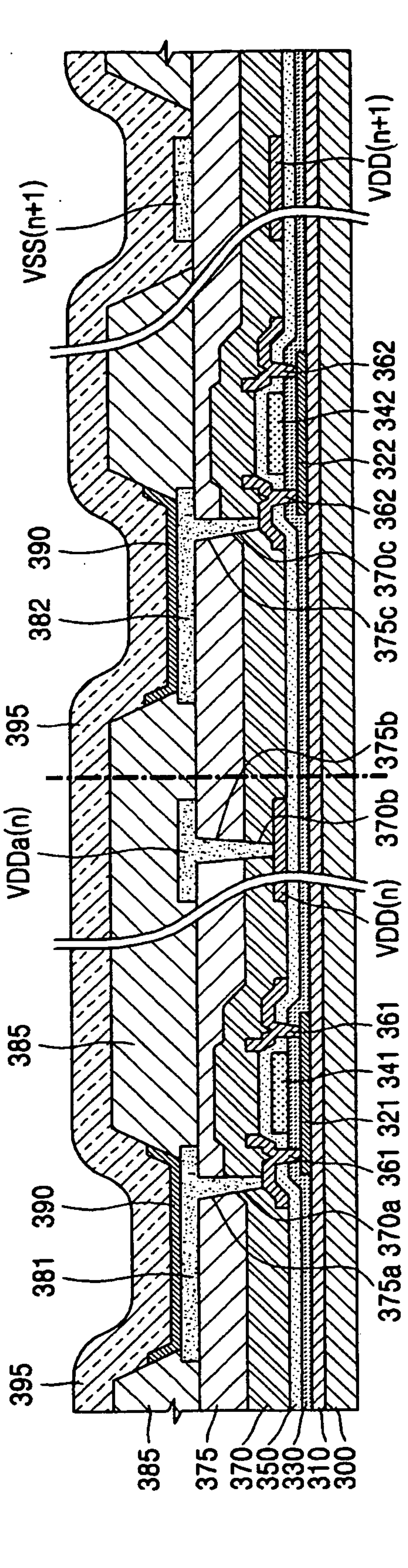
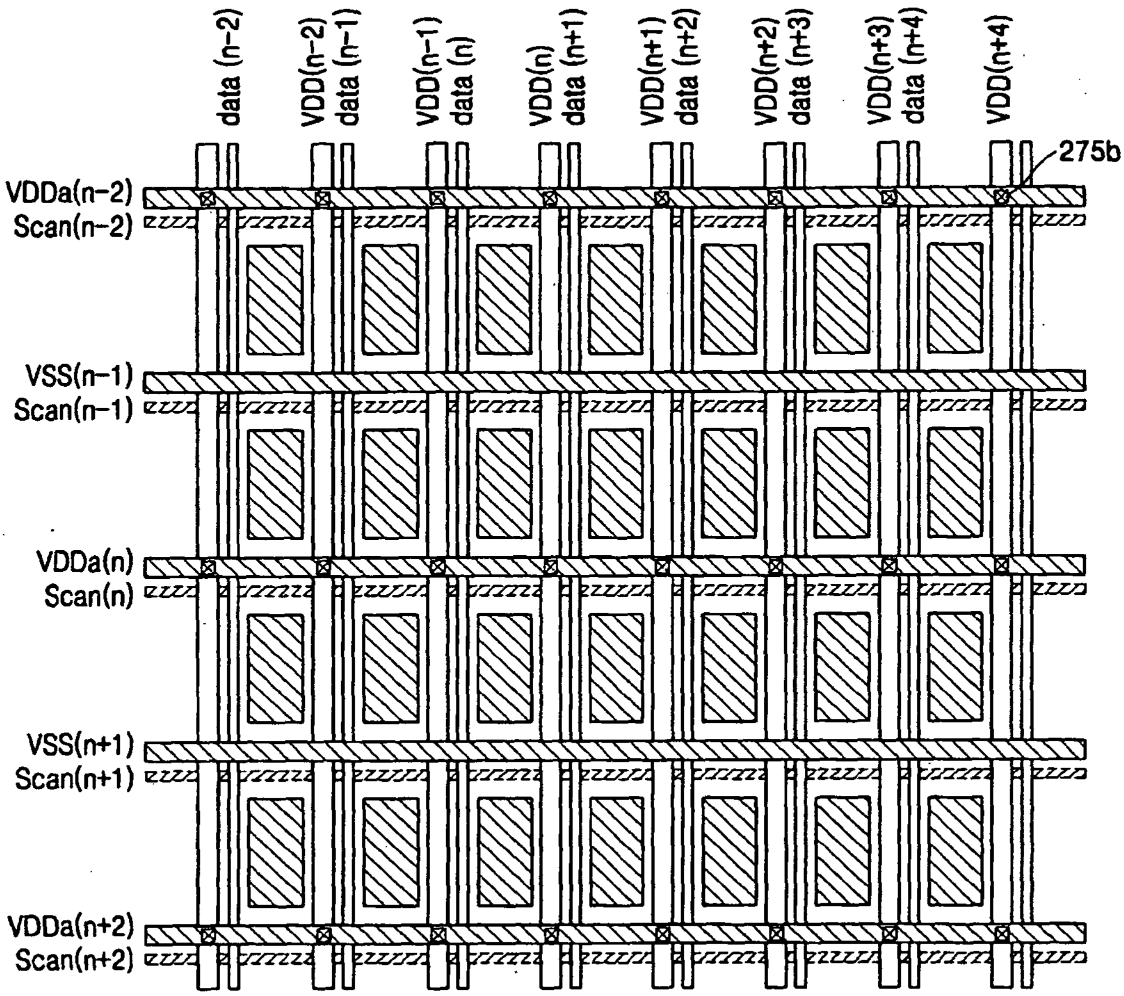

VSS(n+1)
VDD(n+1)
390
382
395
VDDa(n)
385
390
381
395
362 342 322 362 370c 375c
375b
370b
VDD(n)
361 341 321 361 370a 375a
385
375
370
350
330
310
300

FIG. 9


data (n-2)
VDD(n-2)
data (n-1)
VDD(n-1)
data (n)
VDD(n)
data (n+1)
VDD(n+1)
data (n+2)
VDD(n+2)
data (n+3)
VDD(n+3)
data (n+4)
VDD(n+4)
275b
VDDa(n-2)
Scan(n-2)
VSS(n-1)
Scan(n-1)
VDDa(n)
Scan(n)
VSS(n+1)
Scan(n+1)
VDDa(n+2)
Scan(n+2)

REFERENCES CITED IN THE DESCRIPTION

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- US 20020158835 A1 **[0019]**
- JP 2002318556 A **[0019]**
- EP 1109224 A2 **[0019]**
- US 20030151355 A1 **[0019]**

专利名称(译)	有机电致发光显示装置及其制造方法		
公开(公告)号	EP1587154B1	公开(公告)日	2013-11-27
申请号	EP2005090025	申请日	2005-02-09
[标]申请(专利权)人(译)	三星斯笛爱股份有限公司		
申请(专利权)人(译)	三星SDI CO.，LTD.		
当前申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
发明人	KWAK, WON-KYU LEGAL & IP TEAM,SAMSUNG SDI CO.,LTD.		
IPC分类号	H01L27/32 H01L51/52 H05B33/10 G09F9/30 G09G3/32 H01L51/50 H05B33/26		
CPC分类号	H01L27/3279 H01L51/5228 H01L51/5234		
代理机构(译)	hengelhaupt，Jürgen		
优先权	1020040009842 2004-02-14 KR		
其他公开文献	EP1587154A2 EP1587154A3		
外部链接	Espacenet		

摘要(译)

一种有机电致发光器件，包括形成在与薄膜晶体管（TFT）的源极和漏极相同的层上并形成在其上形成有TFT的基板上的电源线，形成在TFT上的第一绝缘层，下部电连接到TFT的源极和漏极之一并设置在第一绝缘层上的电极，第一辅助电源线和第二辅助电源线形成在与第二绝缘层中的下电极相同的层上，第二绝缘层形成在下电极的边缘部分上而不形成在第二辅助电源线上，其中形成暴露下电极的一部分的开口，形成在基板上的有机膜;以及形成在基板上的上电极。

FIG. 1

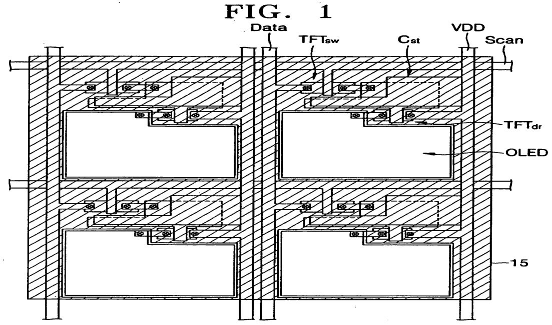

FIG. 2