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(54) **Organic electroluminescent display device**

Organische elektrolumineszente Anzeigevorrichtung

Dispositif d'affichage électroluminescent organique

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Description

[0001] The present invention relates to an organic electroluminescent (EL) display device, and more particularly, to an organic electroluminescent display device having improved structures of electrodes and an encapsulation layer and an external light reflection prevention structure.

[0002] Recently, much attention has been paid to electroluminescent display devices because they have advantageous features suitable for next generation display devices, such as a wide viewing angle, a high contrast ratio and a high response speed. Electroluminescent display devices are classified into inorganic electroluminescent display devices and organic electroluminescent display devices according to materials to form emitter layers.

[0003] At the beginning of the development of inorganic electroluminescent display devices, they were put into commercial use as green-emitting display devices. However, inorganic electroluminescent display devices, like plasma display devices, are driven under an AC bias condition and require drive of several hundreds of volts. Also, since light-emitting materials for the inorganic electroluminescent display devices are inorganic matter, it is difficult to control light emission wavelength characteristics through molecular design, so that full-color display of a picture is not easily achieved.

[0004] On the other hand, organic electroluminescent display devices are spontaneous emission display devices that emit light by electrically exciting fluorescent organic compounds. Thus, it is expected that organic electroluminescent display devices can be applied to next generation display devices that can overcome shortcomings of liquid crystal display devices, with characteristics including low driving voltage, enabling the production of thin, small display panels, wide viewing angle, high response speed and so on. Organic electroluminescent display devices using a layered structure have been developed by Eastman Kodak Company and have been commercialized as green-emitting display devices having improved lifetime by Pioneer Electronic Corporation.

[0005] Recently, many kinds of new materials having various molecular structures that are advantageous in organic materials, and organic electroluminescent display devices (to be abbreviated as organic EL devices, hereinafter) as color display devices having excellent characteristics including lower DC drive voltage, small and thin structure, spontaneous emission and so on, have been the subjects of active research.

[0006] An example of an organic EL device is disclosed in Japanese Patent Publication No. Hei 10-335060 and is shown in FIG. 1.

[0007] Referring to FIG. 1, an organic EL device 10 is configured such that an organic layered structure 11 is disposed between an anode 12 and a cathode 13, and the cathode 13 is protected by an encapsulation layer 14 containing aluminum and at least one material having a work function greater than that of aluminum.

[0008] In the conventional organic EL device having the above-described configuration, external light is reflected by the cathode 13 and the encapsulation layer 14, degrading readability of an image. In particular, in an outdoor environment in which the organic EL device is exposed to sunlight, relative luminance and contrast are sharply degraded by external light reflected by the cathode 13.

[0009] U.S. Patent No. 5,059,861 discloses an organic EL device having a cathode formed of various kinds of metals, excluding alkaline metals.

[0010] U.S. Patent No. 5,047,687 discloses an organic EL device having a cathode formed of various kinds of metals including at least one metal having a low work function, excluding alkaline metals. Here, the metals include aluminum, vanadium and cobalt.

[0011] Japanese Patent Publication No. Hei 9-274990 discloses an organic EL device having an encapsulation layer that encapsulates an anode, an organic layered structure and a cathode, the encapsulation layer having at least one dehydrating agent selected from the group consisting of silica gel, zeolite, calcium chloride, activated carbon, nylon and polyvinyl alcohol.

[0012] U.S. Patent No. 5,073,446, Japanese Patent Publication Nos. Hei 5-36475, Hei 8-222368 and Hei 7-161474 disclose organic EL devices having an anode, an organic layered structure, a cathode, an encapsulation layer to protect the cathode, and a sealing layer.

[0013] PCT Patent publication No. WO 99/43028 discloses an organic light-emitting device comprising a transparent cover sheet, a region of organic light-emitting material behind the cover sheet, a region of circuitry behind the cover sheet for regulating the flow of current to the organic light-emitting material and a non-light-transmissive layer which lies between the cover sheet and the circuitry.

[0014] Japanese Patent Publication No. 08-008065 discloses a thin film electroluminescent element which has an emitter layer that is made to emit light by application of a current and located between a translucent electrode and a back electrode which are opposite to each other. The back electrode comprises a light-absorbing electrode layer and a conductive auxiliary electrode layer. The absorbing electrode layer is disposed on the side of the emitter layer.

[0015] European Patent Publication No. 1 111 438 A2 discloses a black matrix surrounding the pixels of a display device. The black matrix comprises SiO and at least one metal selected from the group of Fe, Co, V and Ti.

[0016] Most conventional EL devices use a polarizing film on the surface of a substrate in order to prevent reduction in the luminance of an image due to reflection of external light by electrodes and an organic layered structure. However,

the use of a polarizing film results in shielding of some light generated from the organic layered structure, causing a substantial decrease in luminance.

[0017] Accordingly, it is an object of the present invention to provide an organic EL device which can enhance the contrast and luminance of an image and can remove the necessity of using a polarizing film to reduce the reflection of external light.

[0018] The foregoing and other objects of the present invention are achieved by providing an organic EL device comprising: a transparent substrate ; a buffer layer formed on the transparent substrate ; a thin film transistor (TFT) layer formed on the buffer layer ; an intermediate insulator layer to cover the TFT layer ; a transparent electrode layer formed on the intermediate insulator layer in a predetermined pattern and to which voltages are selectively applied by TFTs ; an insulating protective layer having an opening to open the transparent electrode layer ; an organic EL unit having organic layers stacked on the transparent electrode layer ; and a cathode layer formed on the organic EL unit and the insulating protective layer in a predetermined pattern, wherein the cathode layer includes a first component which is a dielectric material and a second component made of one or more metals selected from the group consisting of iron (Fe), cobalt (Co), vanadium (V), titanium (Ti), aluminium (Al), silver (Ag) and platinum (Pt).

[0019] These and other objects and advantages of the present invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

FIG. 1 is a cross-sectional view of a conventional organic EL device;

FIG. 2 is a cross-sectional view of an organic EL device according to an embodiment of the present invention;

FIG. 3 is a graph illustrating a component concentration gradient according to the thickness direction of an encapsulation layer shown in FIG. 2;

FIGS. 4 and 5 illustrate component concentration gradients;

FIGS. 6 and 7 are cross-sectional views of organic EL devices according to two additional embodiments of the present invention;

FIG. 8 is a graph illustrating a component concentration gradient according to the thickness direction of a second electrode unit illustrated in FIG. 6;

FIG. 9 is a cross-sectional view of an organic EL device according to still another embodiment of the present invention;

FIG. 10 is a cross-sectional views of an organic EL device according to still another embodiment of the present invention;

FIG. 11 illustrates an arrangement of the organic EL device illustrated in FIG. 10; and

FIGS. 12 through 15 are cross-sectional views of organic EL devices according to still four additional embodiments of the present invention.

[0020] Reference will now be made in detail to the embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to the like elements throughout. The embodiments are described below in order to explain the present invention by referring to the figures.

[0021] An organic EL device according to the present invention is adapted to enhance the luminance of an image by allowing external light to be absorbed by the cathode.

[0022] Referring to FIG. 2, an organic EL device according to an example not forming part of the present invention comprises a first electrode unit 60 formed on a transparent substrate 50 in a predetermined pattern, an organic EL unit 70 including organic layers formed on the first electrode unit 60, a second electrode unit 80 formed on the organic EL unit 70 in a predetermined pattern, and an encapsulation layer 90 formed on the transparent substrate 50 to encapsulate the first electrode unit, the organic EL unit 70 and the second electrode unit 80, the encapsulation layer 90 including a first component which is a dielectric material and a second component made of one or more metals.

[0023] The first electrode unit 60 is an anode formed on the transparent substrate 50 and is made of ITO, which is a transparent conductive material. Although not shown in the figure, an embodiment of the present invention provides that the first electrode unit 60 consists of striped electrodes installed in parallel with one another.

[0024] The organic EL unit 70 includes a hole transport layer 71, an emitter layer 72 and an electron transport layer 73, sequentially stacked from the top surface of the first electrode unit 60. The organic EL unit 70 includes organic thin layers made of organic compounds. In particular, representative materials of the emitter layer 72 include small-molecule materials such as tris(8-hydroxyquinoline) aluminium (Alq₃), and polymers such as poly(para-phenylenevinylenes) or poly(2-methoxy-5(2'-ethylhexyloxy)-1,4-phenylenevinylenes).

[0025] The second electrode unit 80 is formed of a conductive metal, and an embodiment of the present invention provides that this second electrode unit 80 has a plurality of striped electrodes formed in a direction orthogonal with the first electrode unit 60.

[0026] The encapsulation layer 90, formed on the transparent substrate 50, encapsulates the first electrode unit 60, the organic EL unit 70 and the second electrode unit 80 and is configured to absorb incident external light.

[0027] In more detail, the encapsulation layer 90 includes of the first component, which is a dielectric material, and the second component made of one or more metals selected from the group consisting of iron (Fe), cobalt (Co), vanadium (V), titanium (Ti), aluminium (Al), silver (Ag) and platinum (Pt). As illustrated in FIG. 3, the encapsulation layer 90 has a gradual component concentration gradient along a thickness direction. The first component includes one or more dielectric materials selected from the group consisting of SiO_x ($x>1$), SiN_x ($x>1$), MgF_2 , CaF_2 , Al_2O_3 , In_2O_3 , and ITO (Indium Tin Oxide).

[0028] According to the gradual content grade of the encapsulation layer 90 along a thickness direction, as the distance from the surface upon which external light is incident increases, a light absorption efficiency of the encapsulation layer 90 gradually increases or decreases, as illustrated in FIGS. 4 and 5. Also, as the distance of the encapsulation layer 90 having the component concentration gradient from the surface upon which external light is incident increases, the content of the dielectric material, i.e., the first component, gradually decreases and the content of the metal, that is, the second component, gradually increases.

[0029] An embodiment of the present invention provides that the second electrode unit 80 has a first electrode 81 made of Ca and a second electrode 82 made of ITO, which is a conductive transparent material, stacked on the first electrode 80, to have a sheet resistance of $1 \Omega/\square$ or less, as illustrated in FIG. 6. In the case where the second electrode unit 80 includes ITO, the ITO content gradually decreases and the metal content gradually increases as the distance of the second electrode unit 80 from the surface upon which external light is incident increases. Also, an embodiment of the present invention provides that the encapsulation layer 90 further includes a protective layer 100 that encapsulates the first electrode unit 60, the organic EL unit 70 and the second electrode unit 80.

[0030] FIG. 7 is a cross-sectional view of an organic EL device according to an embodiment of the present invention. In this embodiment, the same reference numerals denote the same elements as in the embodiment shown in FIG. 6.

[0031] Referring to FIG. 7, a transparent substrate 50, a first electrode unit 60 made of a conductive material and having a predetermined pattern, and an organic EL unit 70 made of a plurality of organic layers, are stacked in sequence. A second electrode unit 110 is formed on the organic EL unit 70. The second electrode unit 110 includes a first component, which is a dielectric material, and a second component made of one or more metals selected from the group consisting of iron (Fe), cobalt (Co), vanadium (V), titanium (Ti), aluminium (Al), silver (Ag) and platinum (Pt). The second electrode unit 110 has a gradual component concentration gradient along a thickness direction. According to the gradual content grade of the second electrode unit 110 along a thickness direction, as the distance from the surface upon which external light is incident increases, a light absorption efficiency of the second electrode unit 110 gradually increases. As shown in FIG. 8, as the second electrode unit 110 having the content grade from the surface upon which external light is incident increases, the content of the dielectric material, i.e., the first component, gradually increases and the content of the metal, that is, the second component, gradually decreases.

[0032] Also, the first electrode unit 60, the organic EL unit 70 and the second electrode unit 110 are encapsulated by an encapsulation layer 120. The encapsulation layer 120 is made of aluminum or an aluminum alloy, and the first electrode unit 60 is insulated by the insulation layer 21 and the encapsulation layer 120.

[0033] FIG. 9 is a cross-sectional view of an organic EL device according to another example not forming part of the present invention.

[0034] Referring to FIG. 9, the organic EL device according to this example comprises an external light absorbing layer 132 formed on a transparent substrate 131 to absorb external light, a second electrode unit 133 formed on the external light absorbing layer 132, an organic EL unit 134 formed of organic layers having a predetermined pattern, the organic layers being stacked on the second electrode unit 133, and a transparent first electrode unit 135 formed on the organic EL unit 134 in a predetermined pattern.

[0035] The external light absorbing layer 132 includes a first component including one or more dielectric materials selected from the group consisting of SiO_x ($x>1$), SiN_x ($x>1$), MgF_2 , CaF_2 , Al_2O_3 , In_2O_3 , and ITO (Indium Tin Oxide), and a second component including one or more metals selected from the group consisting of iron (Fe), cobalt (Co), vanadium (V), titanium (Ti), aluminium (Al), silver (Ag) and platinum (Pt). Also, the external light absorbing layer 132 has a gradual component concentration gradient. As the distance of the external light absorbing layer 132 from the surface upon which external light is incident increases, the content of the dielectric material, i.e., the first component, gradually decreases and the content of the metal, that is, the second component, gradually increases.

[0036] FIGS. 10 and 11 show an exemplary active matrix organic light emitting display (AMOLED) device.

[0037] As shown, the AMOLED device comprises a buffer layer 201 formed on a transparent substrate 200, a pixel area 300 having pixels and a transparent electrode 210 for pixel formation, the pixel area 300 formed on the buffer layer 201, and a drive area 400 having a thin film transistor (TFT) and a capacitor 250.

[0038] In the drive area 400, the TFT includes a p- or n-type semiconductor layer 202 arranged on the buffer layer 201 in a predetermined pattern, and covered by a gate insulation layer 203, a gate electrode layer 204 corresponding to the semiconductor layer 202, an intermediate insulator layer 205 to cover the gate electrode layer 204, and drain and source electrodes 206 and 207 connected to both sides of the semiconductor layer 202 via contact holes 206a and 207a formed through the intermediate insulator layer 205 and the gate insulation layer 203 and formed on the intermediate

insulator layer 205. Also, the capacitor 250 includes a first electrode 251 connected with the source electrode 207 and formed on the intermediate insulator layer 205, and a second electrode 252 opposed to the first electrode 251 and covered by the intermediate insulator layer 205.

[0039] A protective layer 208 to protect the intermediate insulator layer 205, and a planarization layer 209 having an opening 209a formed in the pixel area 300, are provided. A transparent electrode 210 electrically connected to the drain electrode 206 is formed on the bottom of the opening 209a of the planarization layer 209. An organic layer 220 is formed on the transparent electrode 210, and a cathode layer 230 is formed on the organic layer 220 and planarization layer 209.

[0040] An external light absorbing layer 240 is formed between the substrate 200 and the buffer layer 201 corresponding to the pixel area 300, that is, under the TFT and the capacitor 250 constituting the drive area 400. The external light absorbing layer 240 includes a first component made of one or more dielectric materials selected from the group consisting of SiO_x ($x>1$), SiN_x ($x>1$), MgF_2 , CaF_2 , Al_2O_3 , In_2O_3 , and ITO (Indium Tin Oxide) and a second component made of one or more metals selected from the group consisting of iron (Fe), cobalt (Co), vanadium (V), titanium (Ti), aluminium (Al), silver (Ag) and platinum (Pt), and has a gradual component concentration gradient along a thickness direction. Preferably, as the distance of the external light absorbing layer 240 from the surface upon which external light is incident increases, the content of the dielectric material, i.e., the first component, gradually decreases and the content of the metal, that is, the second component, gradually increases.

[0041] As illustrated in FIG. 11, the external light absorbing layer 240 may be formed on an area other than the pixel area 300. That is to say, the external light absorbing layer 240 may be formed between the protective layer 208 and the planarization layer 209, that is, in an area corresponding to the pixel area 300, as illustrated in FIG. 12, in a front-surface emission type organic EL device. Also, as illustrated in FIG. 13, a front-surface emission type organic EL device may be formed over the entire surface between the substrate 200 and the buffer layer 201.

[0042] FIG. 14 illustrates another example of a front-surface emission type organic EL device according to the present invention.

[0043] Referring to FIG. 14, a transparent electrode 210, which is an anode layer of an area for pixel formation, includes a first component made of ITO, and a second component. Here, the transparent electrode 210 is configured such that the content of the second component is relatively higher at a substrate side and the content of the first component is relatively higher at an organic emission layer side.

[0044] According to an embodiment of the present invention, as illustrated in FIG. 15, in the case of a rear-surface emission type organic EL device, the cathode layer 230 includes a first component and a second component and has a component concentration gradient.

[0045] Referring back to FIG. 2, in the organic EL device having the above-described configuration, if a predetermined voltage is applied to the first electrode unit 60 and the second electrode unit 80, holes injected from the first electrode 60, that is, the anode, move to the emitter layer 72 via the hole transport layer 71, and electrons from the second electrode unit 80 are injected into the emitter layer 72 via the electron transport layer 73. The electrons and holes are recombined at the emitter layer 72 to generate excitons, and the generated excitons de-excite from an excited state to a base state so that fluorescent molecules of the emitter layer 72 emit light, thereby forming an image.

[0046] Since the organic EL device driven as described above is configured such that the encapsulation layer 90 or the second electrode unit 80 includes a dielectric material and a metal to absorb incident external light, the luminance and contrast of the image formed by the organic EL unit 70 can be prevented from decreasing by reducing the reflection of incident external light.

[0047] These operations and effects will become more apparent by considering experiments to evaluate the luminance of the organic EL device according to Examples and a Comparative Example.

Example 1

[0048] A first electrode unit made of ITO was formed on a transparent substrate, a hole injection layer made of copper phthalocyanine (CuPc) was deposited on the first electrode unit at 400°C to a thickness of 200 Å, and a hole transport layer made of N,N'-di(naphthalene-1-yl)-N,N'-diphenyl-benzidine (NPB) was deposited on the hole injection layer at 300°C to a thickness of 500 Å. Then, tris-8-hydroxyquinoline aluminum (Alq_3), lithium fluoride (LiF) and calcium (Ca) were deposited on the hole transport layer to thicknesses of 400 Å, 10 Å and 2000 Å, respectively, and an encapsulation layer was formed thereon to a thickness of 1000 Å such that a first component, e.g., SiO_2 , and a second component, e.g., Ti, have a component concentration gradient.

[0049] The reflectivity of the organic EL device fabricated in the above-described manner, was less than 10%, as shown in Table 1. Even when the light intensity is 50 cd/m^2 , the contrast of a formed image is 100:1, ensuring good optical characteristics.

Example 2

[0050] A patterned black matrix was fabricated in the same manner as in Example 1, except that a transparent conductive material, e.g., ITO, was deposited on a Ca electrode to form a second electrode unit having a sheet resistance of $1 \Omega/\square$ or less.

[0051] The reflectivity of the thus-fabricated organic EL device could be reduced to less than 10%, as illustrated in Table 1.

Example 3

[0052] A patterned black matrix was fabricated in the same manner as in Example 1, except that a second electrode unit was formed using ITO and an encapsulation layer was formed using ITO-metal (e.g., Ti).

[0053] The reflectivity of the thus-fabricated organic EL device could be reduced to less than 20%, as illustrated in Table 1.

Example 4

[0054] A patterned black matrix was fabricated in the same manner as in Example 1, except that a second electrode unit was formed using ITO and a protective layer to protect a first electrode unit, an organic EL unit and the second electrode unit from moisture, was formed on the inner surface of an encapsulation layer.

[0055] The reflectivity of the thus-fabricated organic EL device was reduced to less than 10% and the luminance thereof was enhanced by over 50% compared to an organic EL device according to a Comparative Example to be described later, as illustrated in Table 1.

Example 5

[0056] A light absorbing layer including a first component, SiO, which is a dielectric layer, and a second component, Ti, which is a metal, was formed to a thickness of 1000 Å to have a component concentration gradient, a first electrode unit made of ITO was formed on the transparent substrate, a hole injection layer made of CuPc was deposited on the first electrode unit at 400°C to a thickness of 200 Å, and a hole transport layer made of NPB was deposited on the hole injection layer at 300°C to a thickness of 500 Å. Then, Alq₃, LiF and Ca were deposited on the hole transport layer to thicknesses of 400 Å, 10 Å and 2000 Å, respectively.

[0057] The reflectivity of the organic EL device fabricated in the above-described manner, was less than 10%, and the luminance thereof was enhanced by over 70% compared to an organic EL device according to the Comparative Example to be described later, as illustrated in Table 1.

Example 6

[0058] In a rear-surface emission type AMOLED device using a TFT, an external light absorbing layer including a first component, e.g., SiO, which is a dielectric material, and a second component, e.g., Ti, was formed between a substrate and a buffer layer, corresponding to the pixel area 300 having a TFT and a capacitor, to have a component concentration gradient.

[0059] The reflectivity of the thus-fabricated organic EL device could be reduced to less than 10%, and the luminance thereof was enhanced by over 200% compared to an organic EL device according to the Comparative Example to be described next, as illustrated in Table 1.

Comparative Example

[0060] A first electrode unit made of ITO was formed on a transparent substrate, a hole injection layer made of CuPc was deposited on the first electrode unit at 400°C to a thickness of 200 Å, and a hole transport layer made of NPB was deposited on the hole injection layer at 300°C to a thickness of 500 Å. Then, Alq₃, LiF and Ca were deposited on the hole transport layer to thicknesses of 400 Å, 10 Å and 2000 Å, respectively, followed by hermetically sealing using an encapsulating material.

[0061] The reflectivity of the organic EL device fabricated in the above-described manner, was greater than 90%. Also, when the fabricated organic EL device was driven with a light intensity of 100 cd/m² and the intensity of external light was 50 cd/m², the contrast was noticeably reduced, that is, approximately 2:1, resulting in a considerable reduction in readability.

[0062] The experimental results of Examples 1-6 and the Comparative Example are illustrated in Table 1.

Table 1

	Composition (wt%)	Luminance	Reflected light	Cathode resistance	Lifetime	Components of encapsulation layer or electrode
Comparative Example	With polarizing film	100	10%	Less than 100 Ω/\square	100%	
	Without polarizing film	200	100%	Less than 100 Ω/\square	100%	
Example 1		150	10%	Less than 100 Ω/\square	150%	SiO-Ti
Example 2		150	10%	Less than 100 Ω/\square	150%	SiO-Ti
Example 3		150	20%	Less than 100 Ω/\square	120%	ITO-Ti
Example 4		150	10%	Less than 100 Ω/\square	200%	SiO _x -SiN _x -Ti
Example 5		170	10%	Less than 100 Ω/\square		SiO-Ti
Example 6		200	10%	Less than 100 Ω/\square		SiO-Ti

[0063] The encapsulation layer, third electrode layer or external light absorbing layer of the above-described organic EL device which absorbs external light can be fabricated by the following process.

[0064] First, a first electrode unit, an organic EL unit and a second electrode unit are sequentially formed on a substrate and the substrate is then fixed to be disposed opposite to a deposition boat in a vacuum deposition device. A mixture of a metal and a dielectric material having different melting points, that is, a mixture containing a first and a second component, is injected into the deposition boat. Here, the mixture of a metal and a dielectric material comprises 50-97 wt% of the second component, that is, at least one metal selected from the group consisting of Fe, Co, V, Ti, Al, Ag, Cu and Pt, and 3-50 wt% of the first component, that is, at least one dielectric material selected from the group consisting of SiO_x (x>1), SiN_x (x>1), MgF₂, CaF₂, Al₂O₃, In₂O₃, and ITO (Indium Tin Oxide).

[0065] Then, while varying the temperature of the deposition boat containing the mixture of a metal and a dielectric material, vacuum thermal deposition is performed. In order to vary the temperature of the deposition boat, a voltage applied to the deposition boat is slowly increased.

[0066] If the deposition temperature is slowly raised over time, the dielectric material SiO first begins to be deposited, both the dielectric component and the metal component are simultaneously deposited at higher deposition temperature, and only the metal component is finally deposited, without any of the dielectric component remaining in the mixture, at a highest deposition temperature. As the result, as illustrated in FIG. 3, it is possible to form the encapsulation layer having the dielectric component, e.g., SiO, distributed such that its content gradually decreases and the metal component distributed such that its content gradually increases, as they are farther from the surface upon which external light is incident.

[0067] Alternatively, the encapsulation layer or electrode layer can be formed as follows.

[0068] First, a first electrode unit, an organic EL device and a second electrode unit are sequentially formed on a substrate, and the substrate is then fixed to be disposed opposite to a deposition boat in a vacuum deposition device. Sputtering is performed using a dielectric material target and a target having at least one metal selected from the group consisting of Fe, Co, V, Ti, Al, Ag, Cu and Pt, thereby forming the encapsulation layer.

[0069] As described above, according to the organic EL device of the present invention and the preparation method thereof, the contrast and luminance of an image can be enhanced by greatly reducing the reflection of external light. In particular, a polarizing film to shield external light can be removed, thereby promoting manufacturability.

Claims

1. An organic EL device comprising:

- 5 a transparent substrate (200);
 a buffer layer (201) formed on the transparent substrate;
 a thin film transistor (TFT) layer formed on the buffer layer;
 an intermediate insulator layer (205) to cover the TFT layer;
 10 a transparent electrode layer (210) formed on the intermediate insulator layer in a predetermined pattern and
 to which voltages are selectively applied by TFTs;
 an insulating protective layer (208) having an opening to expose the transparent electrode layer;
 an organic EL unit (220) having organic layers stacked on the transparent electrode layer; and
 a cathode layer (230) formed on the organic EL unit and the insulating protective layer in a predetermined pattern;
 15 **characterized in that** the cathode layer includes a mixture of a first component which is a dielectric material
 and of a second component made of one or more metals selected from the group consisting of iron (Fe), cobalt
 (Co), vanadium (V), titanium (Ti), aluminium (Al), silver (Ag) and platinum (Pt).
2. The organic EL device according to claim 1, wherein the first component is at least one dielectric material selected
 20 from the group consisting of SiO_x ($x > 1$), SiN_x ($x > 1$), MgF_2 , CaF_2 , Al_2O_3 , In_2O_3 , and ITO (Indium Tin Oxide).
3. The organic EL device according to claim 1 or 2, wherein the cathode layer (230) has a gradual component con-
 25 centration gradient in the direction of its thickness.

Patentansprüche

1. Organisches Elektrolumineszenz(EL)-Bauelement, umfassend:

- 30 ein transparentes Substrat (200),
 eine Pufferschicht (201), die auf dem transparenten Substrat ausgebildet ist,
 eine Dünnschichttransistor(TFT)-Schicht, die auf der Pufferschicht ausgebildet ist,
 eine Zwischenisolierschicht (205), die die TFT-Schicht bedeckt,
 eine transparente Elektrodenschicht (210), die auf der Zwischenisolierschicht in einem vorgegebenen Muster
 35 ausgebildet ist und an die durch TFTs selektiv Spannungen angelegt werden,
 eine isolierende Schutzschicht (208) mit einer Öffnung, so dass die transparente Elektrodenschicht freigelegt ist,
 eine organische EL-Einheit (220) mit organischen Schichten, die auf der transparenten Elektrodenschicht auf-
 gestapelt sind, und
 eine Kathodenschicht (230), die auf der organischen EL-Einheit und der isolierenden Schutzschicht in einem
 40 vorgegebenen Muster ausgebildet ist,
dadurch gekennzeichnet, dass die Kathodenschicht eine Mischung aus einer ersten Komponente, die ein
 dielektrisches Material ist, und aus einer zweiten Komponente, die aus einem oder mehreren Metallen gebildet
 ist, die ausgewählt sind aus der Gruppe bestehend aus Eisen (Fe), Cobalt (Co), Vanadium (V), Titan (Ti),
 Aluminium (Al), Silber (Ag) und Platin (Pt), beinhaltet.
- 45 2. Organisches EL-Bauelement nach Anspruch 1, wobei die erste Komponente mindestens ein dielektrisches Material
 ist, das ausgewählt ist aus der Gruppe bestehend aus SiO_x ($x > 1$), SiN_x ($x > 1$), MgF_2 , CaF_2 , Al_2O_3 , In_2O_3 und ITO
 (Indiumzinnoxid).
3. Organisches EL-Bauelement nach Anspruch 1 oder 2, wobei die Kathodenschicht (230) in Schichtdickenrichtung
 50 einen graduellen Komponenten-Konzentrationsgradienten aufweist.

Revendications

1. Dispositif EL organique comprenant :

- 55 un substrat transparent (200) ;
 une couche tampon (201) formée sur le substrat transparent ;

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une couche de transistor en couche mince (TFT) formée sur la couche tampon ;
une couche isolante intermédiaire (205) pour couvrir la couche TFT ;
une couche d'électrode transparente (210) formée sur la couche isolante intermédiaire selon un motif prédéterminé et à laquelle des tensions sont sélectivement appliquées par les TFT ;
5 une couche protectrice isolante (208) ayant une ouverture pour exposer la couche d'électrode transparente ;
une unité EL organique (220) ayant des couches organiques empilées sur la couche d'électrode transparente ; et
une couche cathodique (230) formée sur l'unité EL organique et la couche protectrice isolante selon un motif prédéterminé ;

10 **caractérisé en ce que** la couche cathodique comprend un mélange d'un premier composant qui est un matériau diélectrique et d'un second composant constitué d'un ou plusieurs métaux choisis dans le groupe constitué par le fer (Fe), le cobalt (Co), le vanadium (V), le titane (Ti), l'aluminium (Al), l'argent (Ag) et le platine (Pt).

2. Dispositif EL organique selon la revendication 1, dans lequel le premier composant est au moins un matériau diélectrique choisi dans le groupe constitué par SiO_x ($x > 1$), SiN_x ($x > 1$), MgF_2 , CaF_2 , Al_2O_3 , In_2O_3 et ITO (oxyde d'indium-étain).
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3. Dispositif EL organique selon la revendication 1 ou 2, dans lequel la couche cathodique (230) a un gradient de concentration de composant progressif dans la direction de son épaisseur.
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FIG. 1 (PRIOR ART)

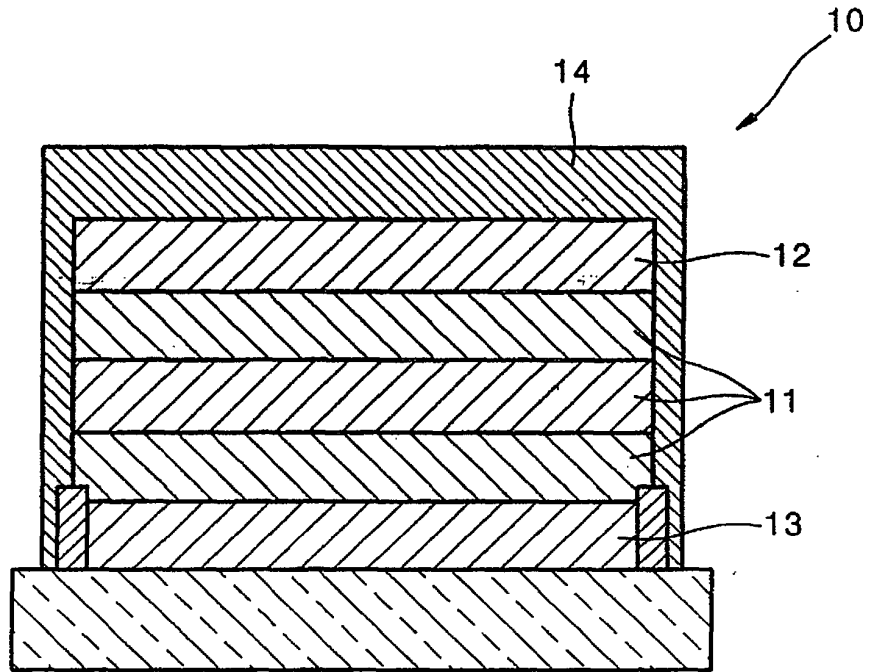


FIG. 2

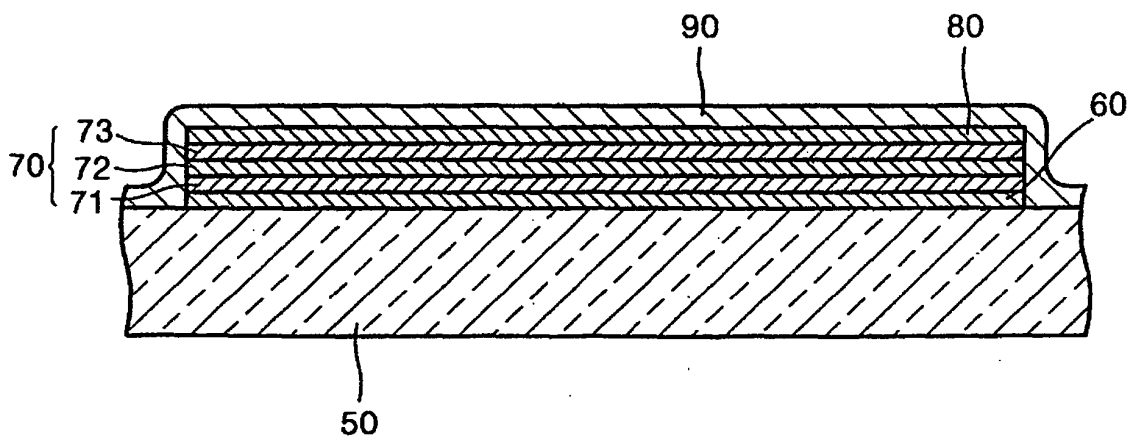


FIG. 3

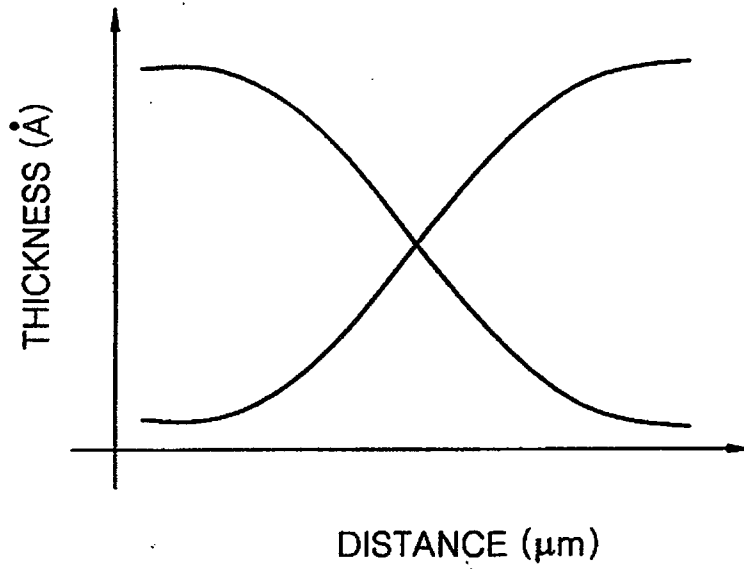


FIG. 4

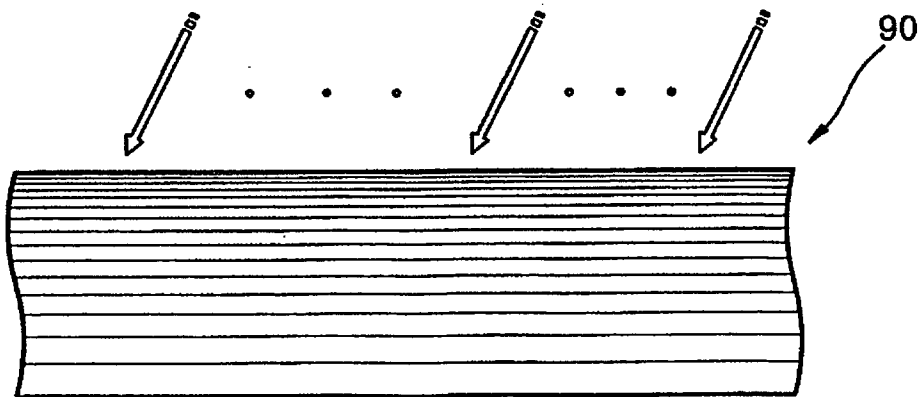


FIG. 5

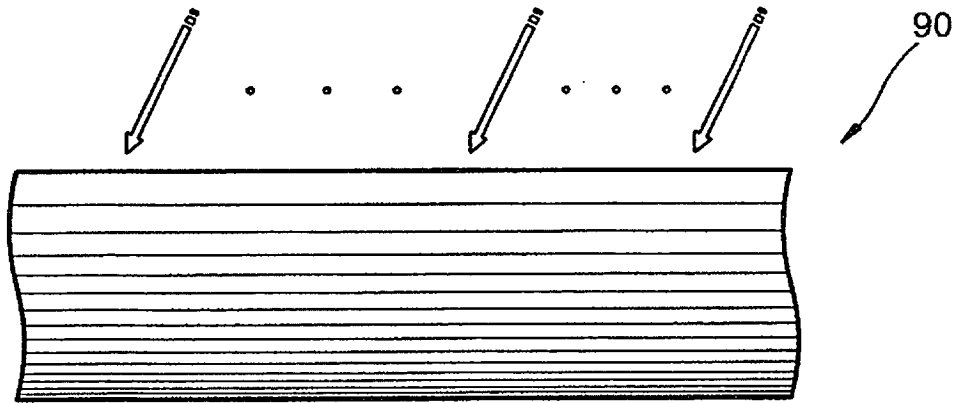


FIG. 6

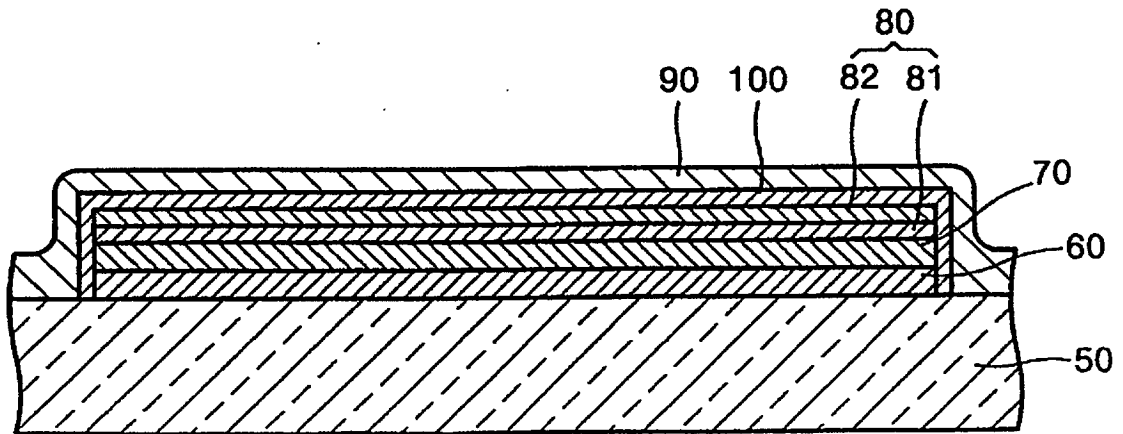


FIG. 7

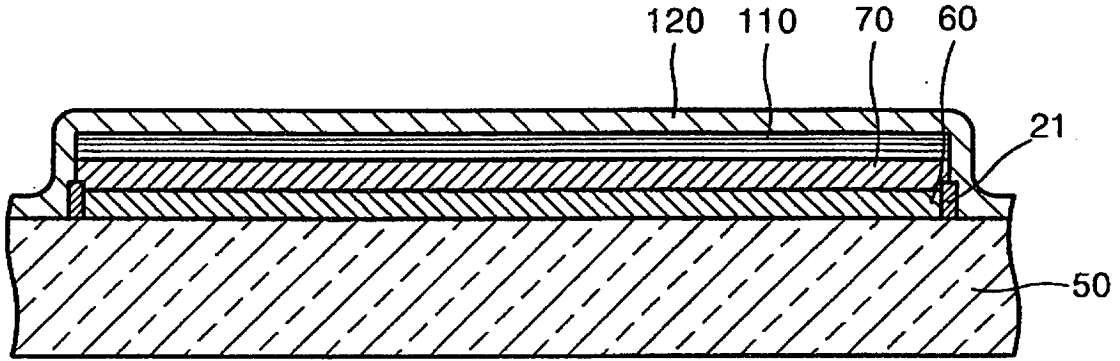


FIG. 8

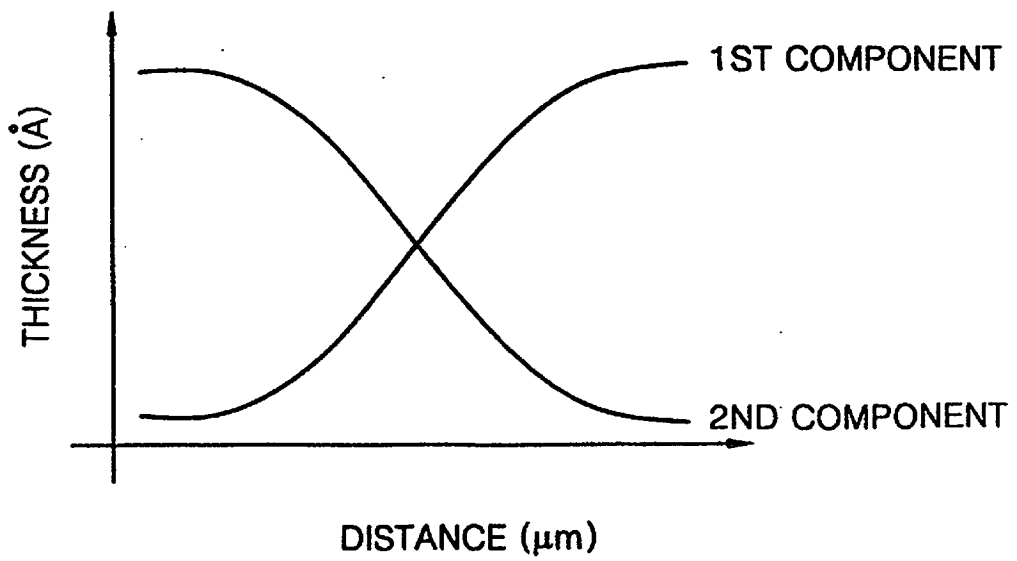


FIG. 9

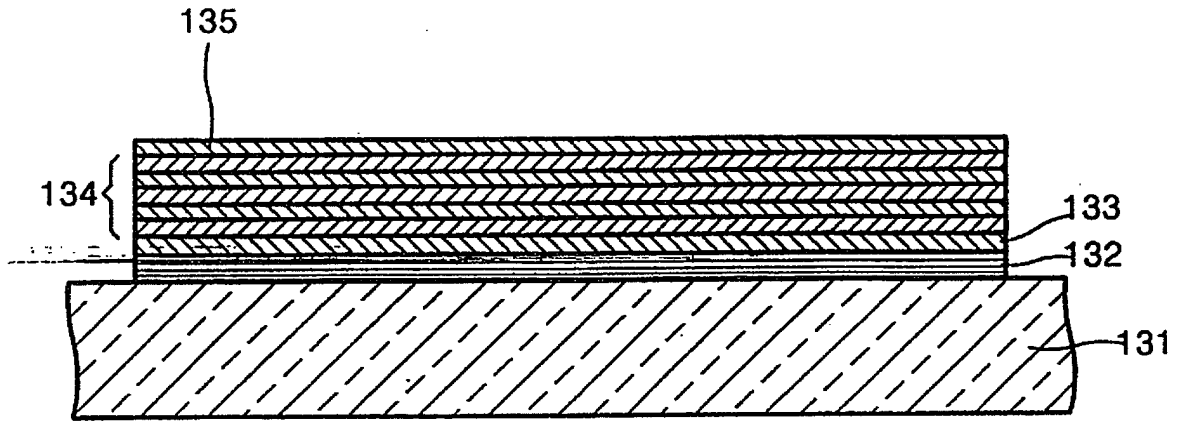


FIG. 10

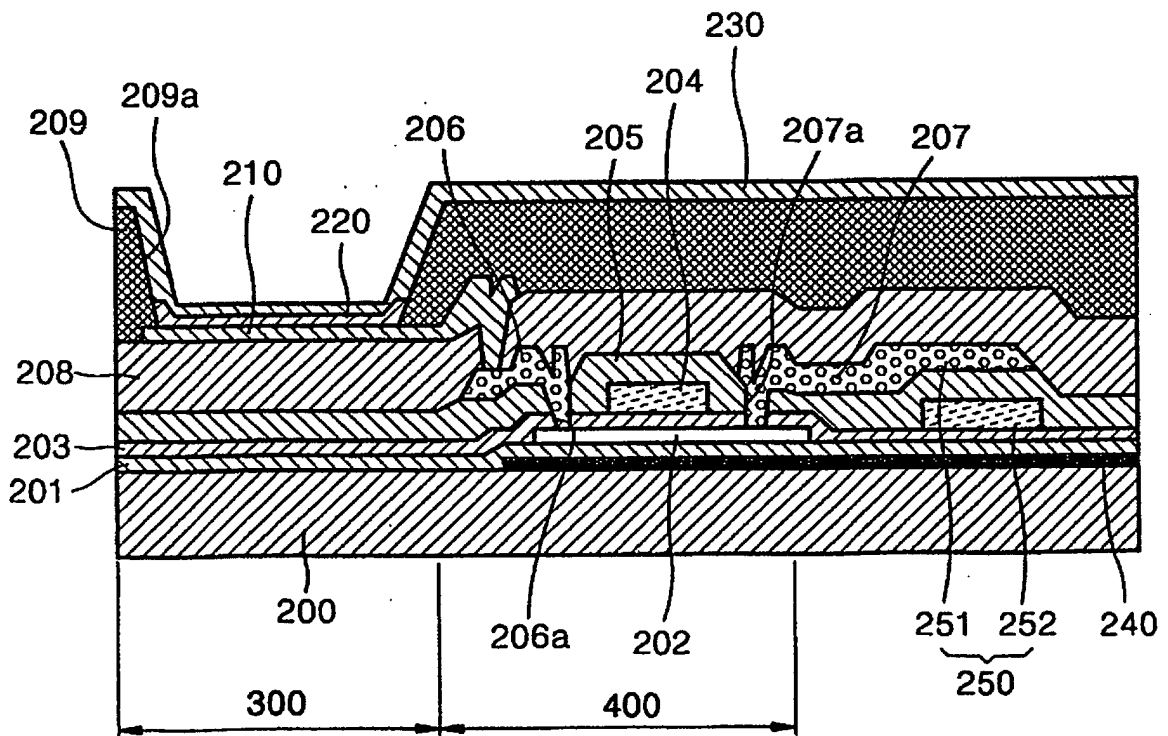


FIG. 11

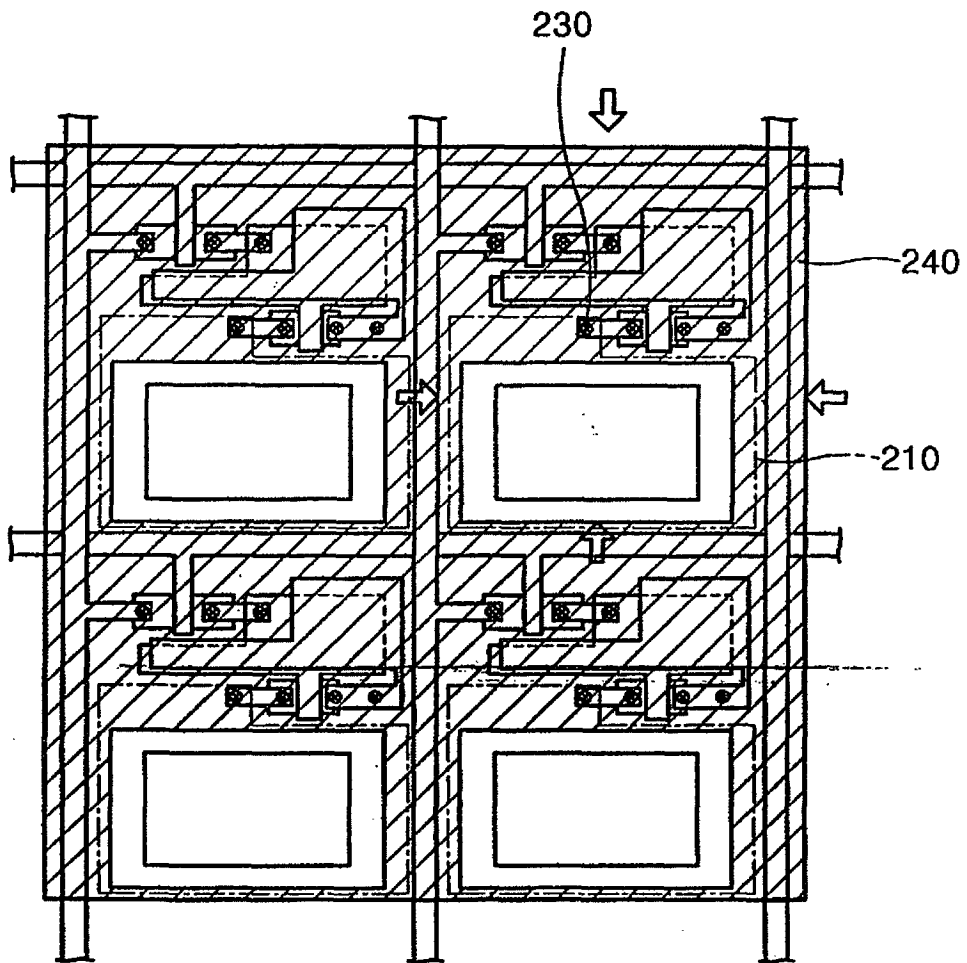


FIG. 12

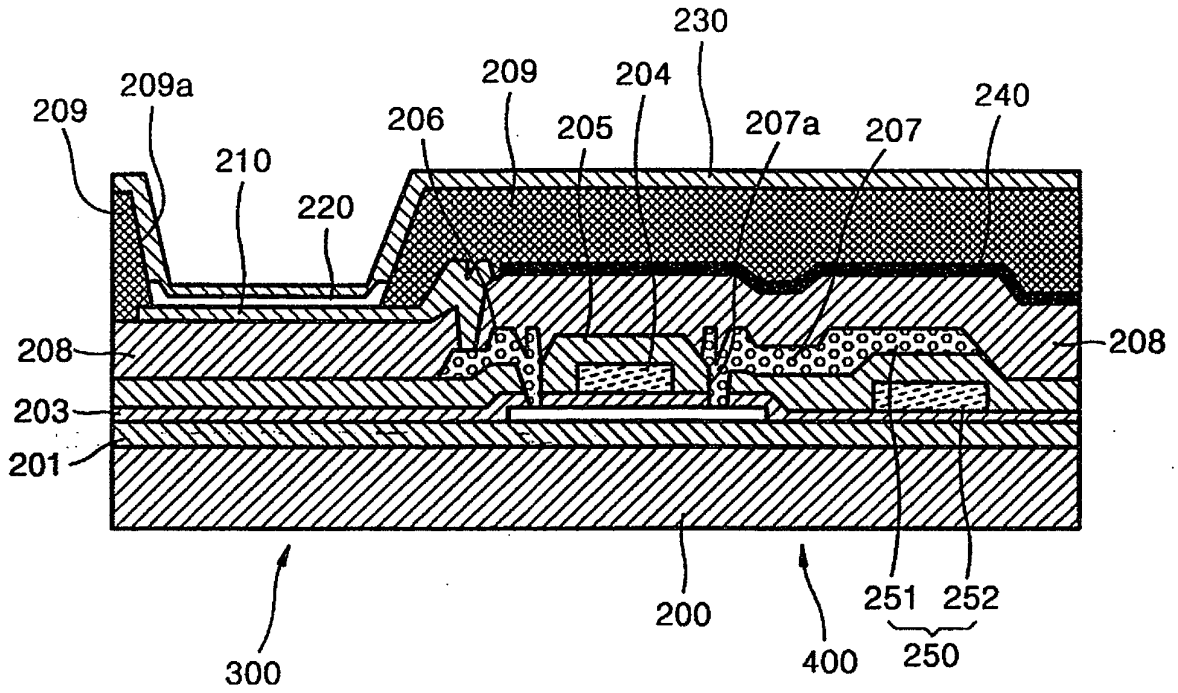


FIG. 13

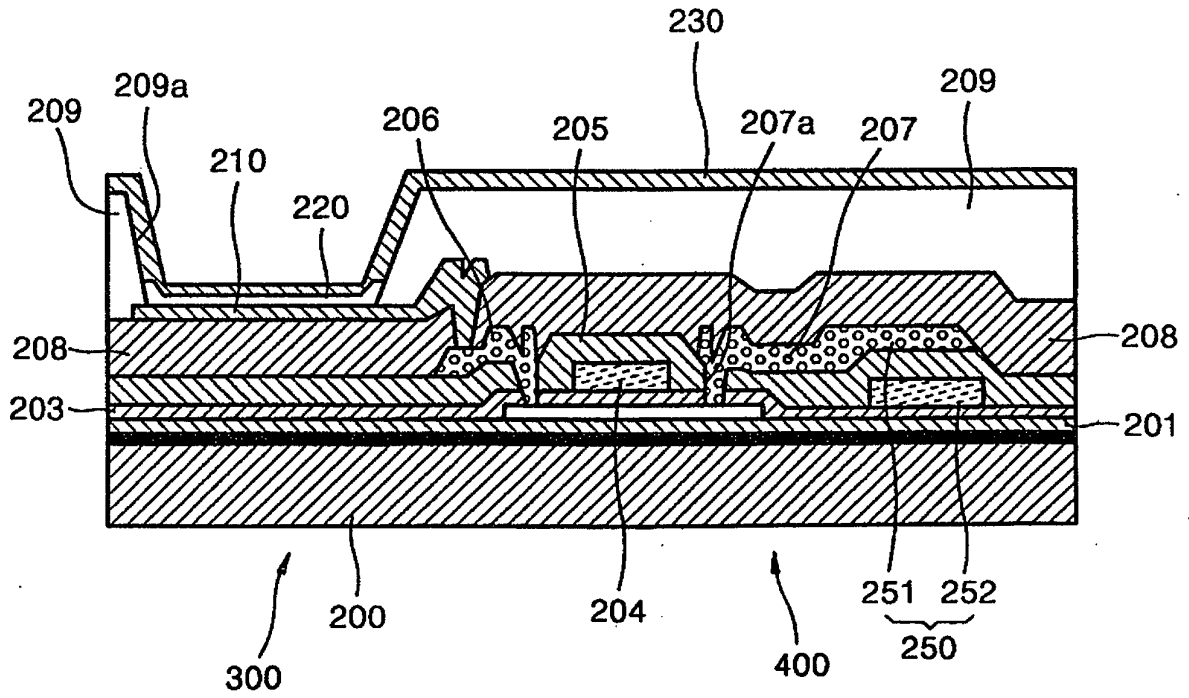


FIG. 14

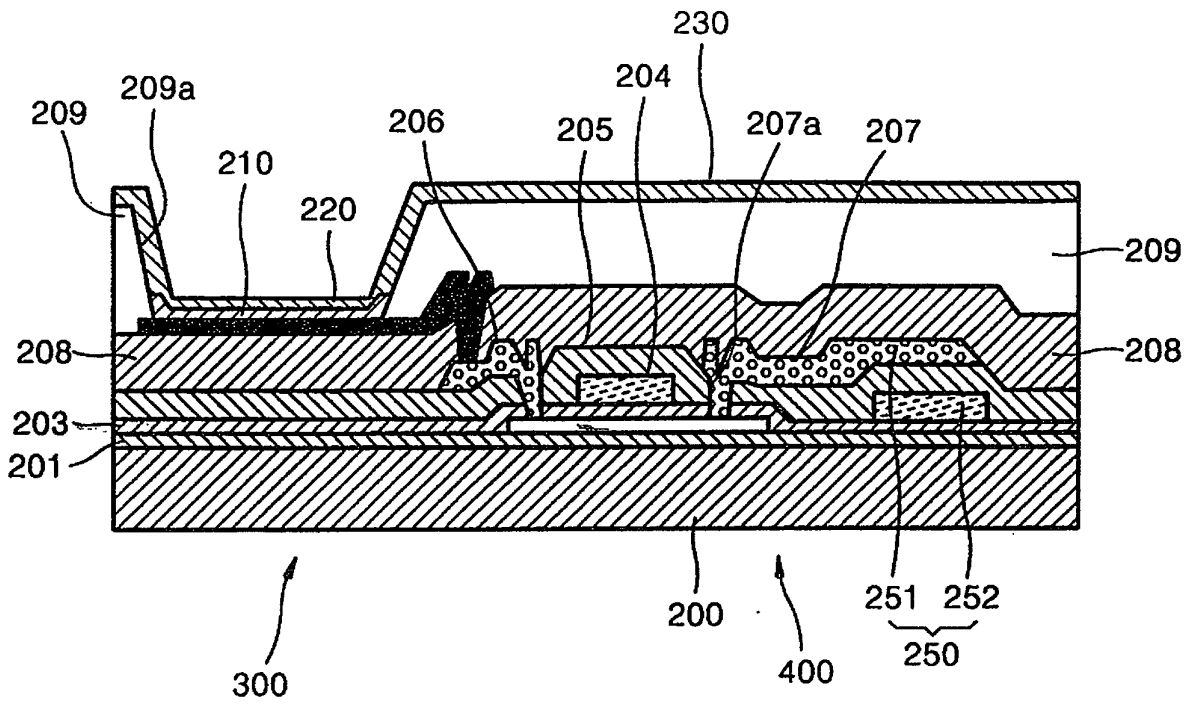
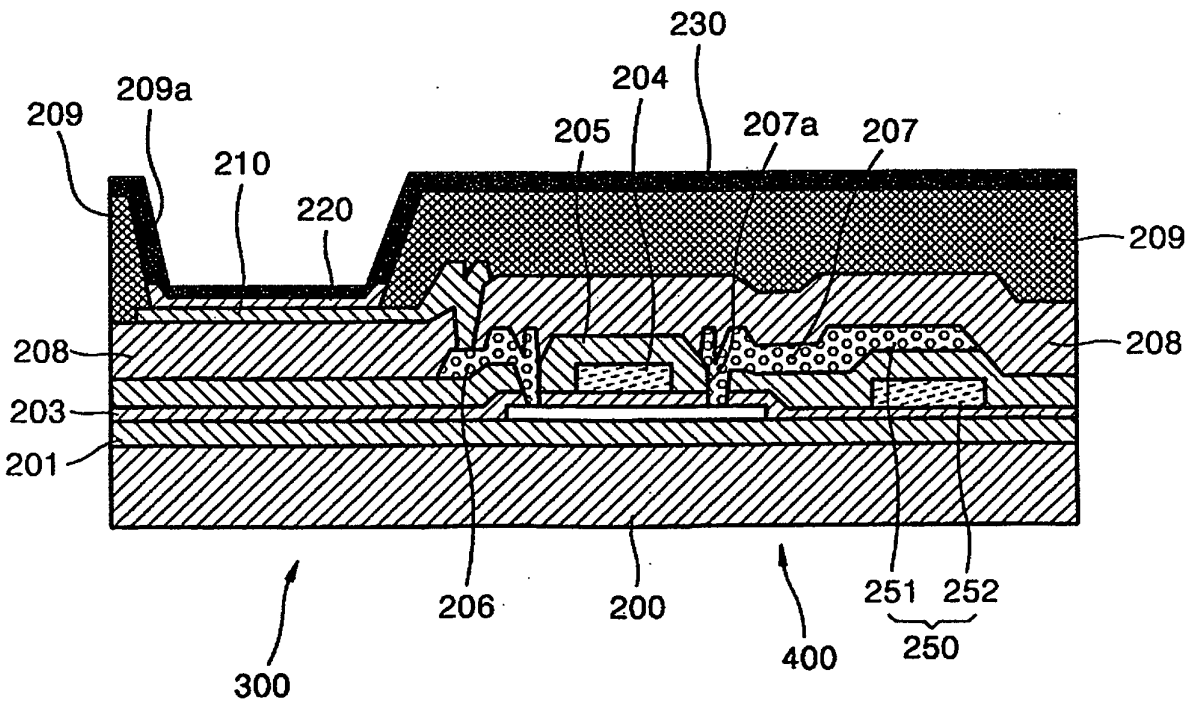


FIG. 15



REFERENCES CITED IN THE DESCRIPTION

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优先权	1020010085101 2001-12-26 KR		
其他公开文献	EP2273576A1		
外部链接	Espacenet		

摘要(译)

一种有机EL器件, 包括透明基板;形成在透明基板上的缓冲层;薄膜晶体管(TFT)层形成在缓冲层上;中间绝缘层, 覆盖TFT层;透明电极层以预定图案形成在中间绝缘层上, 并且由TFT选择性地施加电压;绝缘保护层, 具有暴露透明电极层的开口;有机EL单元, 具有堆叠在透明电极层上的有机层;阴极层以预定图案形成在有机EL单元和绝缘保护层上;其中阴极层包括作为介电材料的第一组分和由选自铁(Fe), 钴(Co), 钒(V), 钛(Ti), 铝的一种或多种金属制成的第二组分(Al), 银(Ag)和铂(Pt)。

FIG. 1 (PRIOR ART)

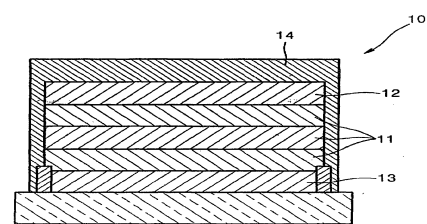


FIG. 2

