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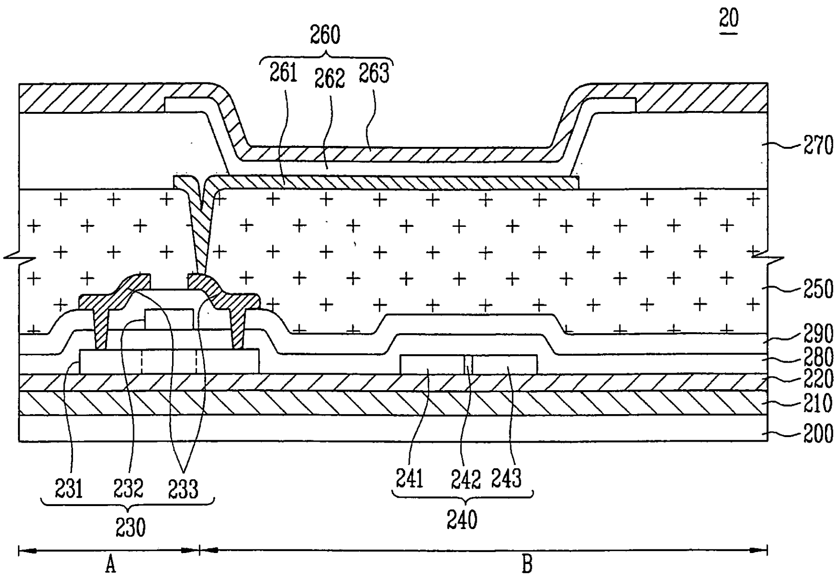
(54) **Organic light-emitting display device**

(57) An organic light-emitting display device (20) includes a substrate (200), a first buffer layer (210) and a second buffer layer (220) on the substrate (200), a thin film transistor (230) on the second buffer layer (220), an organic light-emitting diode (260) electrically connected with the thin film transistor (230), and a photo sensor (240) with an intrinsic region (242) on the second buffer layer (220), wherein the photo sensor (240) is capable of absorbing red light from the organic light-emitting diode (260) and of exhibiting quantum efficiency of from about 50% to about 90%.

FIG. 1



EP 1 865 560 A1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to organic light-emitting display devices. In particular, the present invention relates to an organic light-emitting display device with a photo sensor capable of controlling brightness thereof, while exhibiting an overall quantum efficiency of 50% to 90%.

2. Description of the Related Art

[0002] In general, an organic light-emitting display device is a flat display device where voltage may be applied to a plurality of layers interposed between two electrodes, i.e., an anode electrode and a cathode electrode, to combine electrons and holes to form images. In particular, the conventional organic light-emitting display device may include a hole injecting layer, a hole transporting layer, at least one organic light emitting layer, an electron injecting layer and an electron transporting layer between the electrodes. Accordingly, holes may be injected into the hole injecting layer from the anode electrode, so the injected holes may be transported to the organic light emitting layer through the hole transporting layer. Similarly, electrons may be injected into the electron injecting layer from the cathode electrode, so the injected electrons may be transported to the organic light emitting layer through the electron transporting layer. The transported holes and the electrons may combine with one another in the organic light emitting layer to form excitons, and, thereby, emit visible light and form images.

[0003] The conventional organic light emitting layer of the organic light-emitting display device may deteriorate over time and, thereby, reduce brightness of light emitted therefrom and/or modify color coordinates thereof. Reduced brightness of light emitted from the organic light emitting layer may decrease the image quality of the organic light emitting display device and its overall lifespan. Attempts have been made to improve the brightness of the organic light-emitting display device by incorporating a photo sensor therein. However, the conventional photo sensor may have quantum efficiency below 50%, thereby providing a limited brightness enhancement to the organic light-emitting display device.

[0004] Accordingly, there exists a need for an organic light-emitting display device with a photo sensor capable of controlling brightness thereof, while exhibiting improved quantum efficiency.

SUMMARY OF THE INVENTION

[0005] The present invention is directed to an organic-light emitting display device, which substantially overcomes one or more of the disadvantages of the related art.

[0006] It is therefore a feature of the present invention to provide an organic light-emitting display device having a photo sensor capable of controlling color brightness, while exhibiting enhanced quantum efficiency.

[0007] At least one of the above and other features and advantages of the present invention may be realized by providing an organic light-emitting display device, including a substrate, a first buffer layer and a second buffer layer on the substrate, a thin film transistor on the second buffer layer, an organic light-emitting diode electrically connected with the thin film transistor, and a photo sensor with an intrinsic region on the second buffer layer, wherein the photo sensor is capable of absorbing red light from the organic light-emitting diode and of exhibiting quantum efficiency of from about 50% to about 90%. The absorbed red light may have a wavelength of from about 645 nm to about 700 nm.

[0008] The first buffer layer may have a thickness of from about 2900 angstroms to about 3100 angstroms, the second buffer layer may have a thickness of from about 200 angstroms to about 400 angstroms, and the intrinsic region may have a width of from about 3 μm to about 10 μm. Alternatively, the first buffer layer may have a thickness of from about 700 angstroms to about 900 angstroms, the second buffer layer may have a thickness of from about 100 angstroms to about 300 angstroms, and the intrinsic region may have a width of from about 4 μm to about 10 μm. In yet another alternative, the first buffer layer may have a thickness of from about 700 angstroms to about 900 angstroms, the second buffer layer may have a thickness of from about 300 angstroms to about 500 angstroms, and the intrinsic region may have a width of from about 5 μm to about 10 μm.

[0009] The first buffer layer may include silicon oxide. The second buffer layer may include silicon nitride. The photo sensor may include amorphous silicon.

[0010] The intrinsic region of the photo sensor may be between a N-type doping region and a P-type doping region, wherein the intrinsic region, the N-type doping region and the P-type doping region may be on a same plane. The photo sensor may be capable of converting the absorbed red light into electrical signals. The electrical signals may be capable of controlling brightness of the light light-emitted from the organic light-emitting diode.

[0011] The organic light-emitting diode may be a rear-type organic light-emitting diode. The organic light-emitting display device may include a gate insulating layer disposed on the second buffer layer, wherein a portion of the gate insulating layer may be positioned between the thin film transistor and the photo sensor. The organic light-emitting display device may also include a transparent anode in the organic light-emitting diode. The organic light emitting display device may be incorporated into a portable electronic apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The above and other features and advantages of the present invention will become more apparent to those of ordinary skill in the art from the following description of embodiments thereof which is given with reference to the attached drawings, in which:

[0013] FIG. 1 is a cross-sectional view of an organic light-emitting display device having a photo sensor according to an embodiment of the present invention;

[0014] FIG. 2 is a graph of quantum efficiency of the photo sensor illustrated in FIG. 1 ;

[0015] FIG. 3 is a cross-sectional view of an organic light-emitting display device having a photo sensor according to another embodiment of the present invention;

[0016] FIG. 4 is a graph of quantum efficiency of the photo sensor illustrated in FIG. 3 ;

[0017] FIG. 5 is a cross-sectional view of an organic light-emitting display device having a photo sensor according to another embodiment of the present invention;

[0018] FIG. 6 is a graph of quantum efficiency of the photo sensor illustrated in FIG. 5 ; and

[0019] FIG. 7 and FIG. 8 illustrate views of portable electronic devices having an organic light-emitting display device according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0020] The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which embodiments of the invention are illustrated by way of example. The invention may, however, be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art.

[0021] In the figures, the dimensions of layers and regions may be exaggerated for clarity of illustration. It will also be understood that when a layer or an element is referred to as being "on" another layer, element or substrate, it can be directly on the other layer, element or substrate, or intervening layers or elements may also be present. Further, it will be understood that when a layer or an element is referred to as being "under" another layer or element, it can be directly under, or one or more intervening layers or elements may also be present. In addition, it will also be understood that when a layer or an element is referred to as being "between" two layers or elements, it can be the only layer or element between the two layers or elements, or one or more intervening layers or elements may also be present. Like reference numerals refer to like elements throughout.

[0022] Hereinafter, an embodiment of an organic light-emitting display device according to the present invention will be described in more detail below with reference to FIG. 1. As illustrated in FIGS. 1-2, an organic light-emitting display device 20 according to an embodiment of the present inventionincludes a substrate 200, a first buffer layer 210 and a second buffer layer 220 on the substrate 200, a thin film transistor 230 on the second buffer layer 220, an organic light-emitting diode 260 electrically connected to the thin film transistor 230, and a photo sensor 240.

[0023] The substrate 200 of the organic light-emitting display device 20 may be made of any insulating material, e.g., glass, plastic, silicon, synthetic resin, and so forth, as determined by one of ordinary skill in the art. Preferably, the substrate 200 is transparent, e.g., a glass substrate.

[0024] The substrate 200 is formed to have a non-pixel region A and a pixel region B therein, such that the pixel region B includes a region of the substrate 200 that is capable of displaying images, e.g., an area including the organic light emitting diode 260, and the non-pixel region A includes all the regions of the substrate 200 that are not capable of displaying images, i.e., regions other than the pixel region B. For example, the thin film transistor may be formed in the non-pixel region A.

[0025] The first buffer layer 210 of the organic light-emitting display device 20 is made of silicon oxide (SiO_2) to a thickness of from about 2900 angstroms to about 3100 angstroms on the substrate 200. The second buffer layer 220 is made by depositing silicon nitride (SiNx) on the first buffer layer 210 to a thickness of from about 200 angstroms to about 400 angstroms. Without intending to be bound by theory, it is believed that such thickness of the first buffer layer 210 and the second buffer layer 220 is advantageous in the present invention to facilitate enhanced quantum efficiency of the photo sensor 240 as will be discussed in more detail below. It should further be noted that the first buffer layer 210 and the second buffer layer 220 according to the present invention minimize diffusion of impurities into the thin film transistor 230 and the photo sensor 240 during post-processing thereof.

[0026] The thin film transistor 230 of the organic light-emitting display device 20 is formed on the second buffer layer 220 by crystallizing an amorphous silicon layer into a low temperature polysilicon (LTPS) via, for example, laser irradiation. The thin film transistor 230 includes a semiconductor layer 231, a gate electrode 232, and a source/drain electrode 233, wherein a gate insulating layer 280 is disposed between the semiconductor layer 231 and the gate electrode 232 and an inter-insulating layer 290 is disposed between the gate electrode 232 and the source/drain electrode 233. The gate insulating layer 280 is deposited on the second buffer layer 220 and over the semiconductor layer 231 and the photo sensor 240, as illustrated in FIG. 1, such that a portion of the gate insulating layer 280 is positioned on the second buffer layer 220 between the semiconductor layer 231 of the thin film transistor 230 and the photo sensor 240 to separate therebetween. The source/drain electrode 233 of the thin film transistor 230 is disposed over the inter-insulating layer

290 and electrically connected with both sides of the semiconductor layer 231 via a contact hole formed through the gate insulating layer 280 and the inter-insulating layer 290.

[0027] The organic light-emitting diode 260 of the light-emitting display device 20 is formed on the substrate 200 and includes a first electrode layer 261, a second electrode layer 263, and a light emitting layer 262 therebetween. The organic light-emitting diode 260 is electrically connected to the thin film transistor 230, i.e., any one of the source and drain electrodes 233, via a hole.

[0028] The first electrode layer 261 of the organic light-emitting diode 260 is made of any suitable transparent conductor, e.g., indium-tin-oxide (ITO), indiumzinc-oxide (IZO), zinc oxide (ZnO), and so forth. The second electrode layer 263 of the organic light-emitting diode 260 is formed on the first electrode layer 261. At least one layer of the second electrode layer 263 is made of a reflective metal film. The light emitting layer 262 of the organic light-emitting diode 260 is formed between the first and second electrode layers 261 and 263, respectively. In particular, the light emitting layer 262 is formed to partially expose the first electrode layer 261. Further, the light emitting layer 262 includes a hole injecting layer, a hole transporting layer, an electron transporting layer and an electron injecting layer. Accordingly, the light emitting layer 262 generates light when holes and electron injected from the first and second electrode layers 261 and 263, respectively, are coupled therein. Further, the light emitted from the light emitting layer 262 is emitted to the substrate 200 through the first electrode layer 261 due to the reflective metal film employed in the second electrode layer 263.

[0029] The photo sensor 240 of the light-emitting display device 20 may be any suitable optical sensor capable of receiving a light signal and converting the light signal into an electrical signal, e.g., current or voltage. For example, the photo sensor 240 may be a semiconductor device having a light detecting function, such as a diode with a light detecting function at a junction thereof, i.e., a photo diode. In other words, because electrons or holes are generated by means of absorption of photons, and, therefore, the conductivity of a diode is modulated with respect to a light signal detected therein, a diode functioning as the photo sensor 240 converts light signals into electrical signals with respect to changes of current flow therein as related to optical changes.

[0030] The photo sensor 240 is formed on the second buffer layer 220. In particular, the photo sensor 240 is formed of amorphous silicon in the pixel region B of the substrate 200, as illustrated in FIG. 1, and crystallized as polycrystalline silicon through a predetermined heat treatment, i.e., any appropriate heat treatment of amorphous silicon material as determined by a person skilled in the art. More specifically, the photo sensor 240 is formed to be able to absorb light in a red wavelength-range, e.g., from about 645 nm to about 700 nm, emitted from the organic light-emitting diode 260. In other words, the photo sensor 240 is positioned on the second buffer layer 220, such that vertical rays of light emitted from the organic light-emitting diode 260 reach the photo sensor 240.

[0031] The photo sensor 240 has a structure of a P-i (intrinsic)-N and, therefore, have a N-type doping region 241 for applying a positive voltage, a P-type doping region 243 for applying a negative voltage, and an intrinsic region 242 therebetween. The N-type doping region 241, the P-type doping region 243, and the intrinsic region 242 are positioned on the same plane, e.g., positioned in direct communication with the second buffer layer 220. In particular, the N-type doping region 241 is formed by injecting a high concentration of N-type impurity ions into a first region of the polycrystalline silicon, i.e., photo sensor 240. Similarly, the P-type doping region 243 is formed by injecting a high concentration of P-type impurity ions into a second region of the polycrystalline silicon. In this respect, it should be noted that the first region of the polycrystalline silicon is horizontally separated from the second region thereof, such that the intrinsic region 242 is formed therebetween.

[0032] The intrinsic region 242 of the photo sensor 240 is formed of polycrystalline silicon between the N-type doping region 241 and the P-type doping region 243, such that no impurities may be injected therein. The intrinsic region 242 generates charges according to the incident light through its surface in order to convert the charges into electric energy. Without intending to be bound by theory, it is believed that the intrinsic region 242 of the photo sensor 240 increases the thickness of a depletion layer thereof, thereby decreasing the capacity of the photo sensor 240. Such a decrease in the electrostatic capacity of the photo sensor 240 increases the operation speed and decrease the power consumption thereof as compared to a conventional diode. Additionally, the photo sensor 240 has a lower dark current, i.e., current flow when a photo sensor is not exposed to light, as compared to the conventional diode.

[0033] The intrinsic region 242 is formed to have a width of from about 3 μm to about 10 μm. Such a width of the intrinsic region 242 provides the photo sensor 240 with a quantum efficiency of from about 50% to about 90%. In particular and without intending to be bound by theory, it is believed that formation of the photo sensor 240 with an intrinsic region 242 having a width of about 3 μm to about 10 μm on the first and second buffer layers 210 and 220 having specific thicknesses as described above is advantageous in improving the quantum efficiency of the photo sensor 240 due to improved pixel aperture ratio and reduced junction areas of the N-type and P-type doping regions 241 and 243. On the other hand, if the intrinsic region 242 is formed to have a width other than from about 3 μm to about 10 μm, the quantum efficiency of the red wavelength-range is below about 50%, thereby reducing a capability of controlling the photo sensor 240 for the purpose of brightness enhancement.

[0034] For example, as illustrated in FIG. 2, a photo sensor formed on two buffer layers, i.e., a first buffer layer having a thickness of 3000 angstroms and a second buffer layer having a thickness of 300 angstroms, and having an intrinsic layer with a width of 3 μm, exhibits quantum efficiency of about 50%. Further, an increase in the width of the intrinsic region to 10 μm provides a quantum efficiency of over 80%. On the other hand, when the intrinsic region has a width below 3 μm, the quantum efficiency of the photo sensor is in the range of 20% to 40%.

[0035] In this respect, it should be noted that the X and Y axes of the graph illustrated in FIG. 2 refer to a wavelength-range and quantum efficiency of the photo sensor in the red wavelength range, respectively. "Quantum efficiency" refers to a rate at which red light incident from the organic light-emitting diode is absorbed by the photo sensor, while the actual quantum efficiency values are produced as a ratio between (1240 X Current leaving the device in amperes) and (wavelength X power used in watts).

[0036] Accordingly, if an anode voltage is applied to the P-type doping region 243 and a cathode voltage is applied to the N-type doping region 241, the intrinsic region 242 becomes fully depleted, thereby generating charges by absorbing light signals, from the organic light-emitting diode 260 and converting them into electrical signals. The electrical signals generated by the photo sensor 240 in response to the absorbed light signals may represent actual brightness values of the organic light-emitting diode 260 and be compared to a predetermined brightness reference value. Any deviation of the actual brightness values from the predetermined brightness reference value may be controlled by the photo sensor 240, thereby facilitating constant brightness output from the organic light-emitting diode 260, i.e., light generated by the light emitting layer 262.

[0037] More specifically, for example, electric signals generated by the photo sensor 240, i.e., signals representing actual brightness values, can be supplied to a signal processing part and, subsequently, to a gamma compensating part in order to perform a predetermined gamma revision and to generate a standard voltage corresponding to each gradation level. The standard voltage corresponding to each gradation level can be applied to a data signal generator to generate a data signal to be applied to respective data lines. Alternatively, electric signals generated by the photo sensor 240 can be supplied to a controller, so that the controller may output a respective control signal for controlling the brightness of the light emitting layer 262 with respect to the internal red light thereof.

[0038] The illustrated embodiment of a light-emitting display device 20 according to the present invention also includes a planarization layer 250. The planarization layer 250 is formed on the thin film transistor 230 by depositing a layer of an oxide, e.g., silicon oxide (SiO_2) or a nitride, e.g., silicon nitride (SiNx). In particular, the planarization layer 250 is positioned between the thin film transistor 230 and the organic light emitting diode 260, and a portion of the planarization layer 250 is etched to expose one of the source and drain electrodes 233 in order to provide a connection between the thin film transistor 230 and the organic light emitting diode 260.

[0039] The light-emitting display device 20 also includes a pixel defining film 270. The pixel defining film 270 is formed on the planarization layer 250, such that the pixel defining film 270 includes an opening part (not shown) to at least partially expose the first electrode layer 261 of the organic light emitting diode 260. In particular, portions of the pixel defining film 270 are positioned between the first and second electrode layers 261 and 263 of the organic light emitting diode 260. The pixel defining film 270 is made of an organic insulation material, e.g., acrylic organic compounds, polyamides, polyimides, and so forth.

[0040] In another embodiment of the present invention, illustrated in FIG. 3, an organic light-emitting display device 30 includes a substrate 300 having a non-pixel region D and a pixel region E, a first buffer layer 310 and a second buffer layer 320 on the substrate 300, a thin film transistor 330 on the second buffer layer 320, an organic light-emitting diode 360 electrically connected to the thin film transistor 330, and a photo sensor 340. The structures of the substrate 300, the thin film transistor 330, and the organic light-emitting diode 360 are similar to the structures of the substrate 200, the thin film transistor 230, and the organic light-emitting diode 260 described previously with respect to FIG. 1 and, therefore, their detailed description will not be repeated hereinafter.

[0041] The first buffer layer 310 of the light-emitting display device 30 is formed on the substrate 300. The first buffer layer 310 is made of silicon oxide (SiO_2) to a thickness of from about 700 angstroms to about 900 angstroms. The second buffer layer 320 is made by depositing silicon nitride (SiNx) on the first buffer layer 310 to a thickness of from about 100 angstroms to about 300 angstroms. Without intending to be bound by theory, it is believed the control of the thickness of the first buffer layer 310 and the second buffer layer 320 facilitates control of the red light emitted from the organic light-emitting diode 360 and absorbed by the photo sensor 340, thereby achieving a quantum efficiency rate of from about 50% to about 90%. Similarly to the first and second buffer layers 210 and 220, the first buffer layer 310 and the second buffer layer 320 minimize diffusion of impurities into the thin film transistor 330 and the photo sensor 340 during post-processing.

[0042] The photo sensor 340 of the light-emitting display device 30 according to the present invention is similar to the photo sensor 240 described previously with respect to FIG. 1 with the exception that the intrinsic region 342 of the photo sensor 340 has a width of from about 4 μm to about 10 μm. Similarly to the embodiment described previously with respect to FIGS. 1-2, such a width of the intrinsic region 342 provides the photo sensor 340 with a quantum efficiency of from about 50% to about

90%, when it is formed on buffer layers having specific thicknesses as described above.

[0043] For example, as illustrated in FIG. 4, a photo sensor formed on two buffer layers, i.e., a first buffer layer having a thickness of 800 angstroms and a second buffer layer having a thickness of 200 angstroms, and having an intrinsic layer with a width of 4 μm, exhibits quantum efficiency of about 50%. Further, an increase in the width of the intrinsic region to 10 μm may provide quantum efficiency of about 60% to about 80%. On the other hand, when the intrinsic region had a width below 4 μm, the quantum efficiency of the photo sensor is in the range of 10% to 40%.

[0044] In yet another embodiment of the present invention, illustrated in FIG. 5, an organic light-emitting display device 40 includes a substrate 400 having a non-pixel region H and a pixel region G, a first buffer layer 410 and a second buffer layer 420 on the substrate 400, a thin film transistor 430 on the second buffer layer 420, an organic light-emitting diode 460 electrically connected to the thin film transistor 430, and a photo sensor 440. The structures of the substrate 400, the thin film transistor 430, and the organic light-emitting diode 460 are similar to the structures of the substrate 200, the thin film transistor 230, and the organic light-emitting diode 260 described previously with respect to FIG. 1, and therefore, their detailed description will not be repeated hereinafter.

[0045] The first and second buffer layers 410 and 420 of the light-emitting display device 40 are similar to the first and second buffer layers 210 and 220 described previously with respect to FIG. 1 with the exception that a thickness of the first buffer layer 410 is be from about 700 angstroms to about 900 angstroms, and a thickness of the second buffer layer 420 is from about 300 angstroms to about 500 angstroms.

[0046] The photo sensor 440 of the light-emitting display device 40 according to the present invention is similar to the photo sensor 240 described previously with respect to FIG. 1 with the exception that the intrinsic region 442 of the photo sensor 440 has a width of from about 5 μm to about 10 μm. Similarly to the embodiment described previously with respect to FIGS. 1-2, such a width of the intrinsic region 442 may provide the photo sensor 440 with a quantum efficiency of from about 50% to about 90%, when it is formed on buffer layers having specific thicknesses as described above.

[0047] For example, as illustrated in FIG. 6, a photo sensor formed on two buffer layers, i.e., a first buffer layer having a thickness of 800 angstroms and a second buffer layer having a thickness of 400 angstroms, and having an intrinsic layer with a width of 5 μm, exhibits quantum efficiency of almost 60%. Further, an increase in the width of the intrinsic region to 10 μm may provide quantum efficiency of almost 80%. On the other hand, when the intrinsic region had a width below 4 μm, the quantum efficiency of the photo sensor is in the range of 15% to 40%.

[0048] As illustrated in FIGS. 7-8, the organic light-emitting display devices previously described with respect to FIGS. 1-6 may be employed in any portable electronic apparatus, e.g., a cellular phone, a lap-top type computer, a digital camera, a personal multimedia player (PMP), and so forth.

[0049] As described above, the present invention is advantageous in providing an organic light-emitting display device having a photo sensor capable of absorbing light in the red wavelength range at an enhanced quantum efficiency of from about 50% to about 95% and controlling the brightness of the organic light-emitting display device accordingly. Such enhanced quantum efficiency may be achieved by controlling the thickness of the buffer layers formed between the photo sensor and the substrate and the width of the intrinsic region of the photo sensor. As such, the present invention may advantageously minimize brightness and image quality wear due to organic layer deterioration, thereby enhancing current flow into pixels and improving overall quality of the organic light-emitting display.

[0050] Embodiments of the present invention have been disclosed herein, and although specific terms are employed, they are used and are to be interpreted in a generic and descriptive sense only and not for purpose of limitation. Accordingly, it will be understood by those of ordinary skill in the art that various changes in form and details may be made without departing from the scope of the present invention as set forth in the following claims.

Claims

1. An organic light-emitting display device, comprising:

a substrate;
a first buffer layer and a second buffer layer on the substrate ;
a thin film transistor on the second buffer layer;
an organic light-emitting diode electrically connected with the thin film transistor; and
a photo sensor with an intrinsic region on the second buffer layer, wherein the photo sensor is capable of absorbing red light from the organic light-emitting diode and of exhibiting quantum efficiency of from 50% to 90%.

2. An organic light-emitting display device as claimed in claim 1, wherein the first buffer layer has a thickness of from 2900 angstroms to 3100 angstroms, the second buffer layer has a thickness of from 200 angstroms to 400 angstroms, and the intrinsic region has a width of from 3 μm to 10 μm.

3. An organic light-emitting display device as claimed in claim 2, wherein the first buffer layer has a thickness of about 3000 angstroms and the second buffer layer has a thickness of about 300 angstroms.

4. An organic light-emitting display device as claimed in claim 1, wherein the first buffer layer has a thickness of from about 700 angstroms to about 900 angstroms, the second buffer layer has a thickness of from about 100 angstroms to about 300 angstroms, and the intrinsic region has a width of from about 4 μm to about 10 μm

5. Ane organic light-emitting display device as claimed in claim 4, wherein the first buffer layer has a thickness of about 800 angstroms and the second buffer layer has a thickness of about 200 angstroms.

6. An organic light-emitting display device as claimed in claim 1, wherein the first buffer layer has a thickness of from about 700 angstroms to about 900 angstroms, the second buffer layer has a thickness of from about 300 angstroms to about 500 angstroms, and the intrinsic region has a width of from about 5 μm to about 10 μm.

7. An organic light-emitting display device as claimed in claim 6, wherein the first buffer layer has a thickness of about 800 angstroms and the second buffer layer has a thickness of about 400 angstroms.

8. An organic light-emitting display device as claimed in any preceding claim, wherein a gate insulating layer is disposed on the second buffer layer, a portion of the gate insulating layer being positioned between the thin film transistor and the photo sensor .

9. An organic light-emitting display device as claimed in any preceding claim, wherein the first buffer layer includes silicon oxide.

10. An organic light-emitting display device as claimed in any preceding claim, wherein the second buffer layer includes silicon nitride.

11. An organic light-emitting display device as claimed in any preceding claim, wherein the intrinsic region of the photo sensor is between a N-type doping region and a P-type doping region, and wherein the intrinsic region, the N-type doping region and the P-type doping region are on a same plane second buffer layer.

12. An organic light-emitting display device as claimed in any preceding claim, wherein the photo sensor is capable of converting the absorbed red light into electrical signals.

13. An organic light-emitting display device as claimed in claim 12, wherein the electrical signals are capable of controlling brightness of the light-emitted from the organic light-emitting diode.

14. An organic light-emitting display device as claimed in any preceding claim, wherein the absorbed red light has a wavelength of from about 645 nm to about 700.

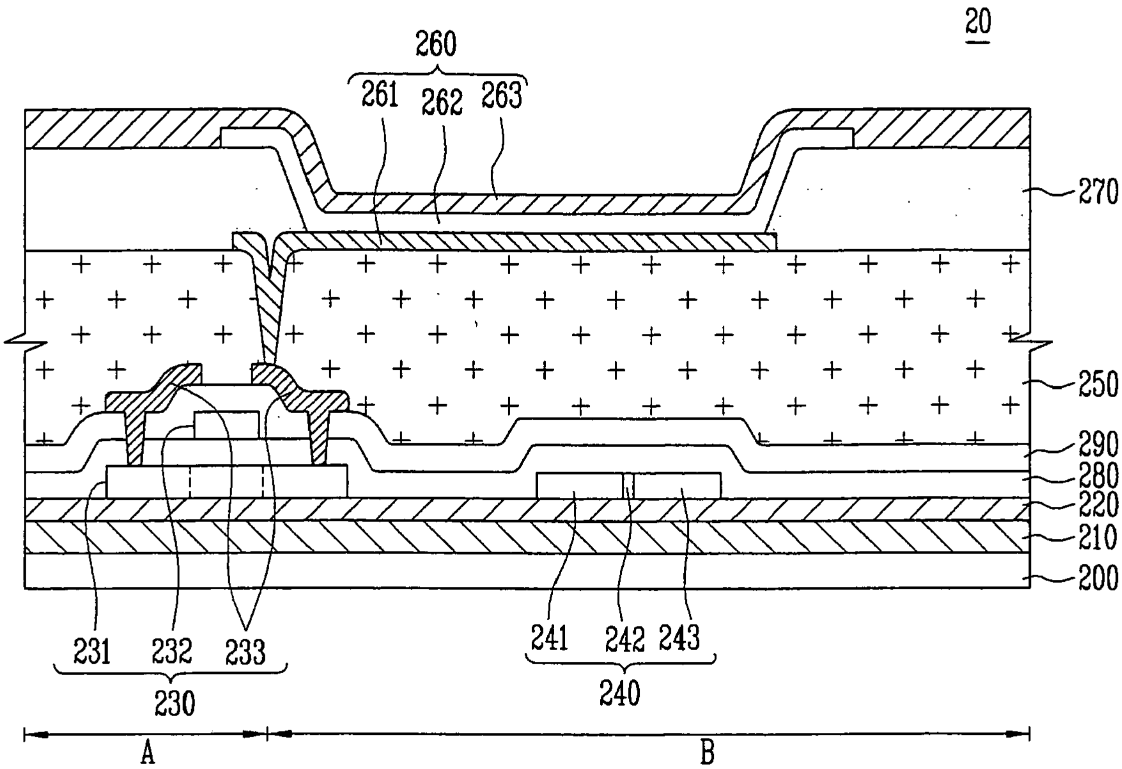
15. An organic light-emitting display device as claimed in any preceding claim, wherein the photo sensor includes amorphous silicon.

16. An organic light-emitting display device as claimed in any preceding claim, wherein the organic light-emitting diode includes a transparent anode.

17. An organic light-emitting display device as claimed in any preceding claim, wherein the organic light-emitting diode is a rear-type organic light-emitting diode.

18. A portable electronic apparatus, comprising an organic light-emitting display device as set out in any preceding claim.

FIG. 1


20
260
261
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263
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240
A
B

FIG. 2

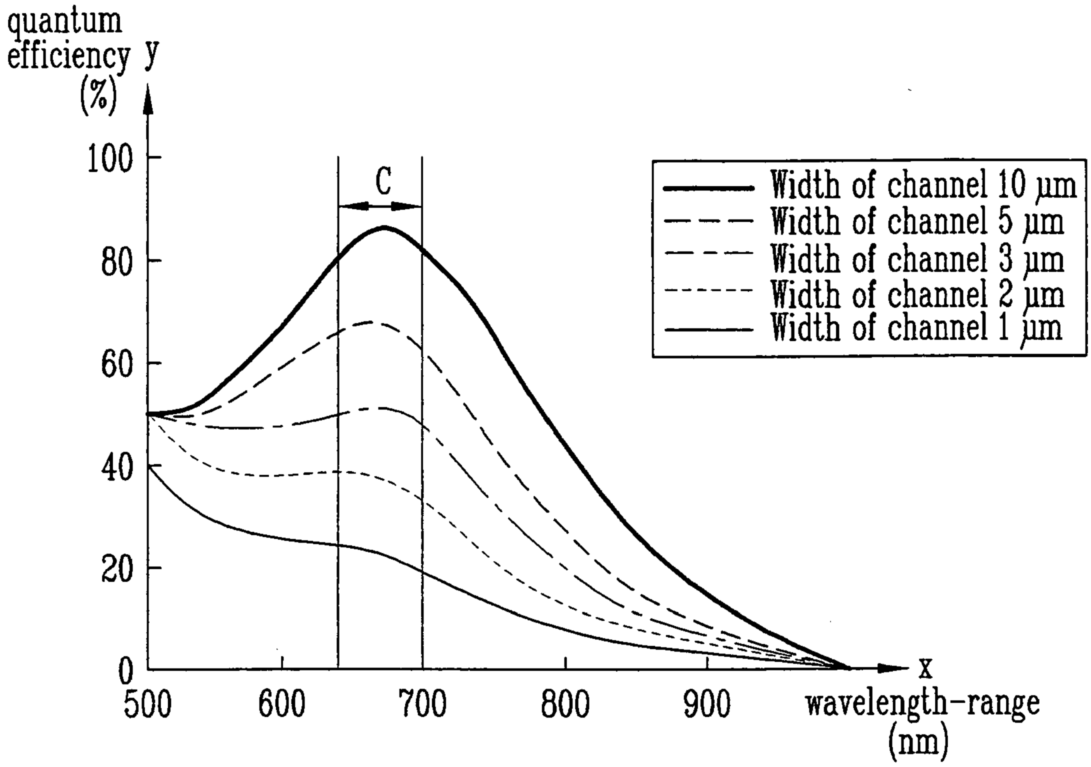
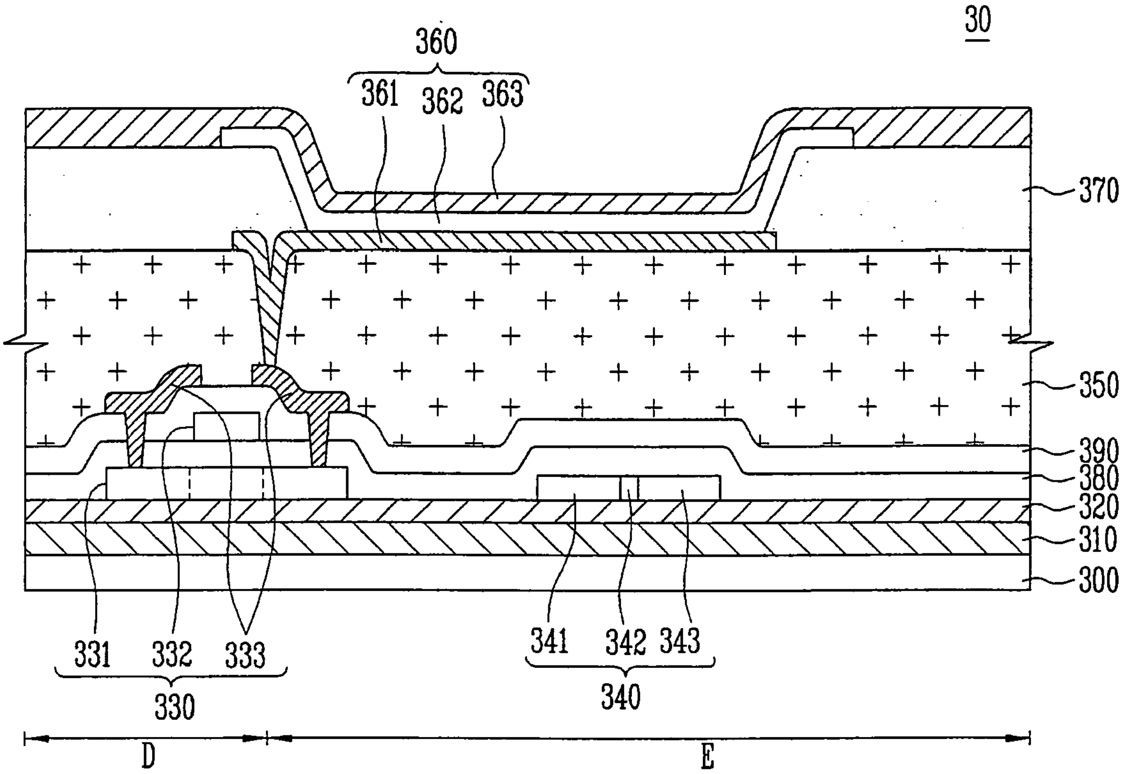

quantum
efficiency y
(%)
100
80
60
40
20
0
500
600
700
800
900
x
wavelength-range
(nm)
C
Width of channel 10 μm
Width of channel 5 μm
Width of channel 3 μm
Width of channel 2 μm
Width of channel 1 μm

FIG. 3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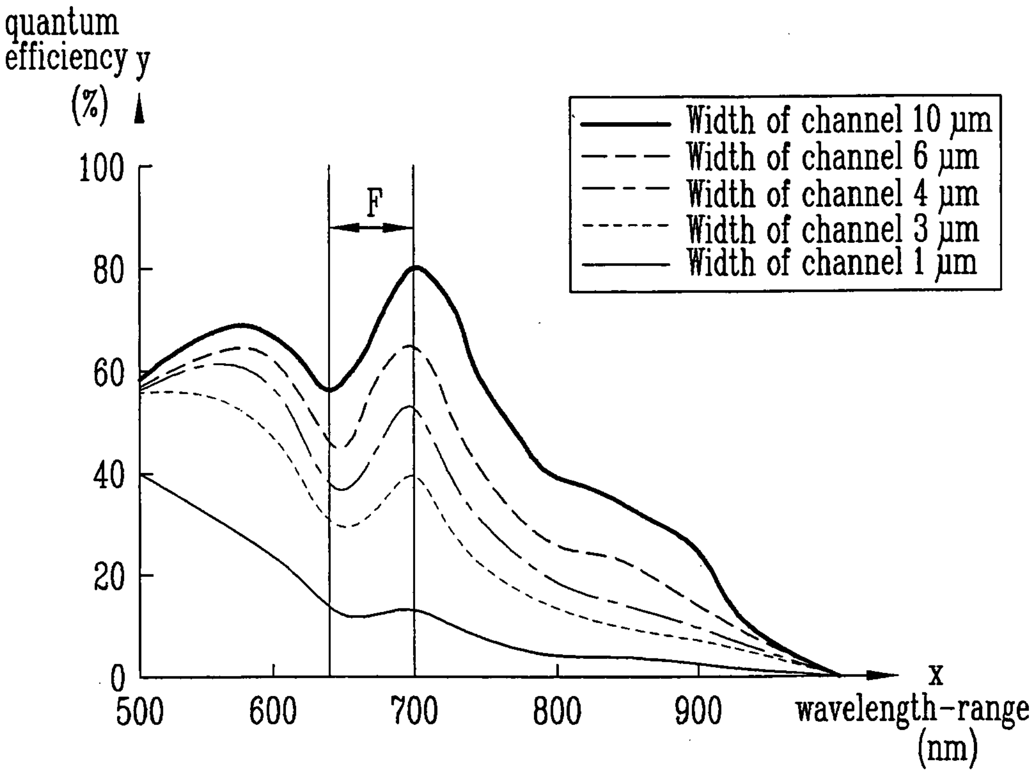
D
E

FIG. 4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(%)
100
80
60
40
20
0
500
600
700
800
900
x
wavelength-range
(nm)
F
Width of channel 10 µm
Width of channel 6 µm
Width of channel 4 µm
Width of channel 3 µm
Width of channel 1 µm

FIG. 5

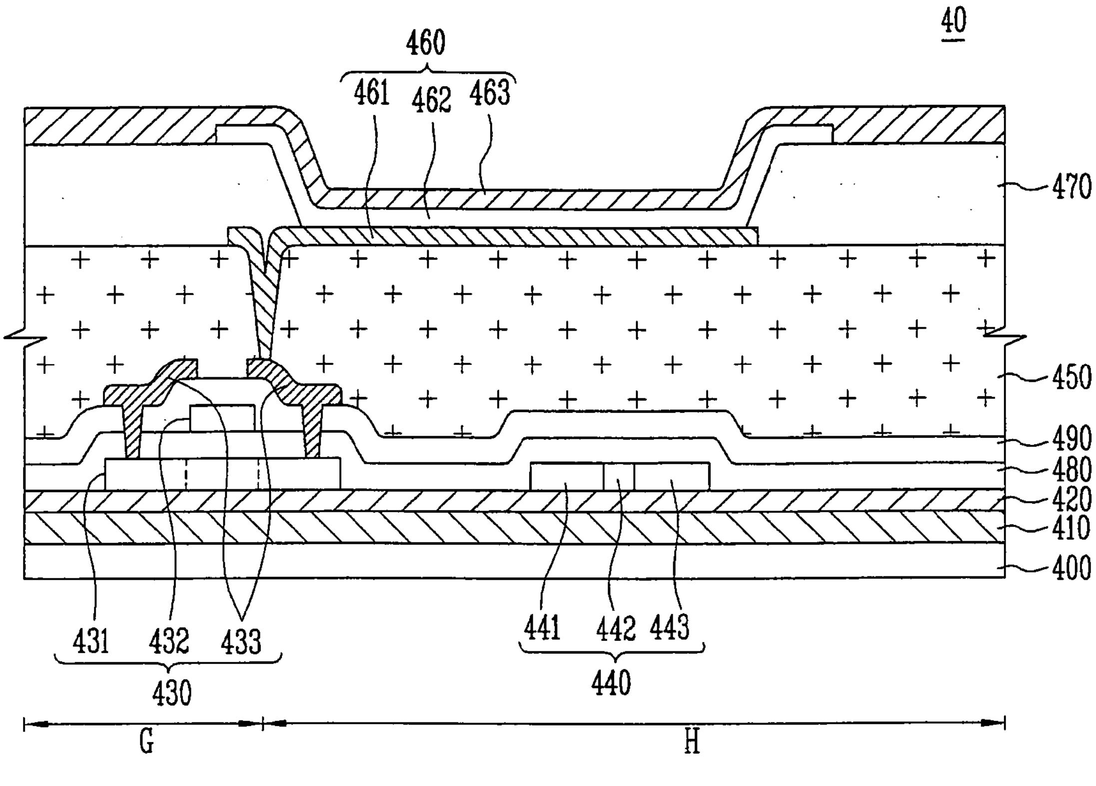

40
460
461
462
463
470
450
490
480
420
410
400
431
432
433
430
441
442
443
440
G
H

FIG. 6

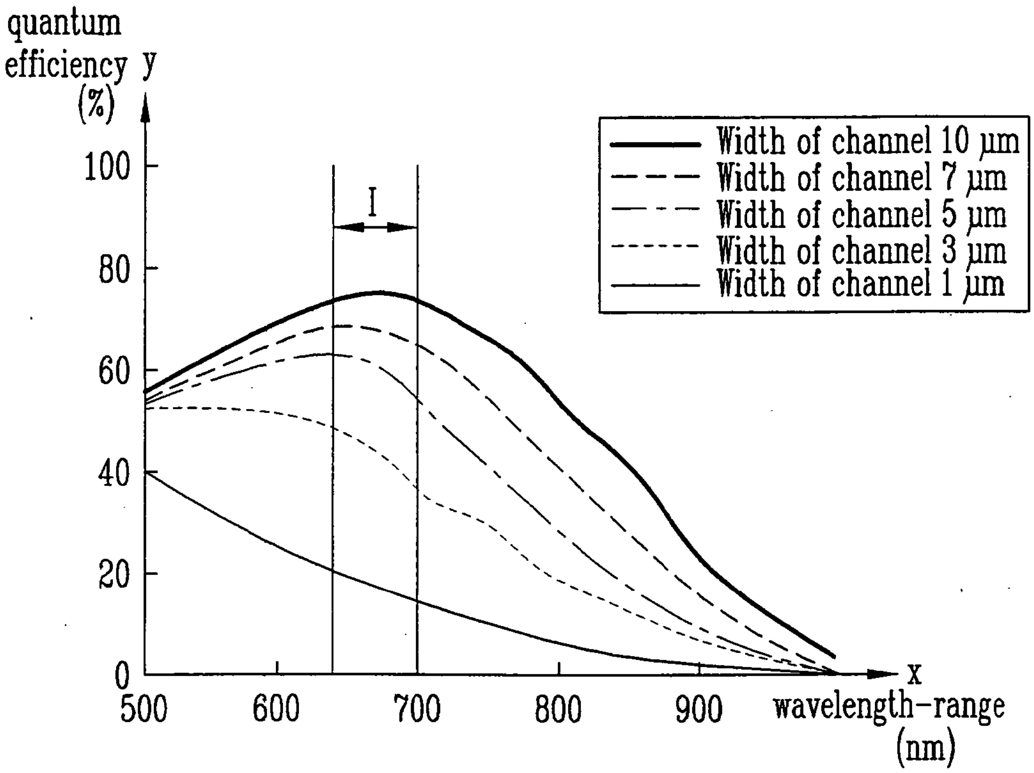

quantum
efficiency y
(%)
100
80
60
40
20
0
500
600
700
800
900
x
wavelength-range
(nm)
I
Width of channel 10 μm
Width of channel 7 μm
Width of channel 5 μm
Width of channel 3 μm
Width of channel 1 μm

FIG. 7

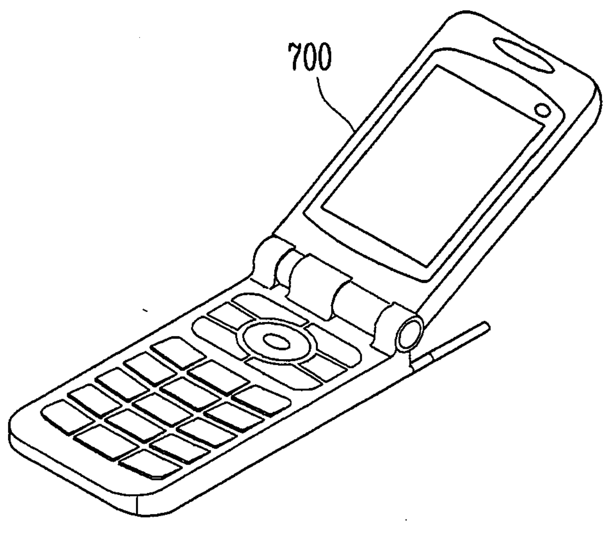
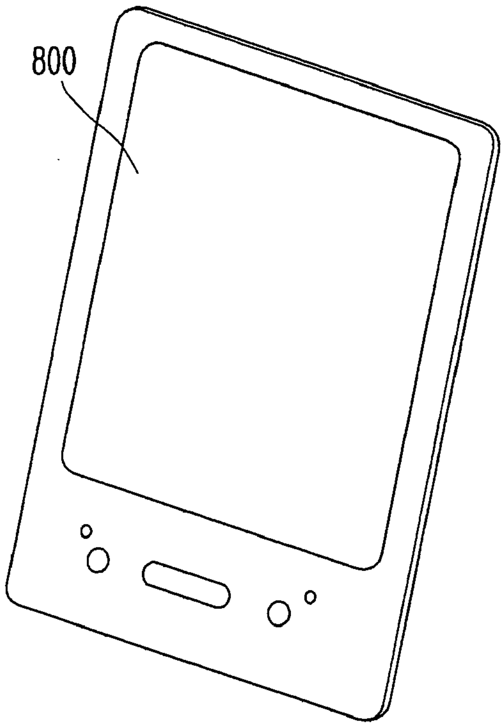


FIG. 8



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EUROPEAN SEARCH REPORT

Application Number
EP 07 25 1703

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2002/044208 A1 (YAMAZAKI SHUNPEI [JP] ET AL) 18 April 2002 (2002-04-18) * paragraphs [0024], [0421] - [0430], [0440]; figure 19a *	1,8,9, 11-18	INV. H01L27/32
Y	US 2005/056841 A1 (YAMAZAKI SHUNPEI [JP] ET AL) 17 March 2005 (2005-03-17) * paragraphs [0370] - [0381]; figure 25 *	1,8-18	
Y	EP 1 139 454 A (SEMICONDUCTOR ENERGY LAB [JP]) 4 October 2001 (2001-10-04) * paragraph [0059]; figure 8a *	1,8-18	
A	US 6 380 531 B1 (SUGIHWO FRED [US] ET AL) 30 April 2002 (2002-04-30) * column 3, line 29 - column 5, line 36; figures 1,2 *	1-7	

TECHNICAL FIELDS SEARCHED (IPC)

H01L
G09G
H05B

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	20 September 2007	Bakos, Tamás

CATEGORY OF CITED DOCUMENTS

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20-09-2007

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

专利名称(译)	有机发光显示装置		
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[标]申请(专利权)人(译)	三星斯笛爱股份有限公司		
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其他公开文献	EP1865560B1		
外部链接	Espacenet		

摘要(译)

有机发光显示装置（20）包括基板（200），基板（200）上的第一缓冲层（210）和第二缓冲层（220），第二缓冲层上的薄膜晶体管（230）层（220），与薄膜晶体管（230）电连接的有机发光二极管（260），以及在第二缓冲层（220）上具有本征区（242）的光传感器（240），其中光传感器（240）能够吸收来自有机发光二极管（260）的红光，并且具有约50％至约90％的量子效率。

FIG. 1