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(54) **ORGANIC LIGHT EMITTING DISPLAY DEVICE**

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(51) **Int. Cl.**
H01L 51/00 (2006.01)
H01L 51/50 (2006.01)
H01L 51/52 (2006.01)

(52) **U.S. Cl.** **313/506**; 313/509; 315/169.3

(58) **Field of Classification Search** 313/498–512; 315/169.1, 169.3

See application file for complete search history.

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(57) **ABSTRACT**

Provided is an organic light emitting display device. The organic light emitting display device comprises a first substrate, a second substrate facing the first substrate, a transistor on the first substrate, a first contact electrode disposed on the transistor and connected to a source or a drain of the transistor, a subpixel on the second substrate, and a first spacer projected to make an upper electrode included in the subpixel to be in contact with the first contact electrode. An upper surface area of the first spacer is about 0.5% to 20% of an upper surface area of the subpixel.

13 Claims, 3 Drawing Sheets

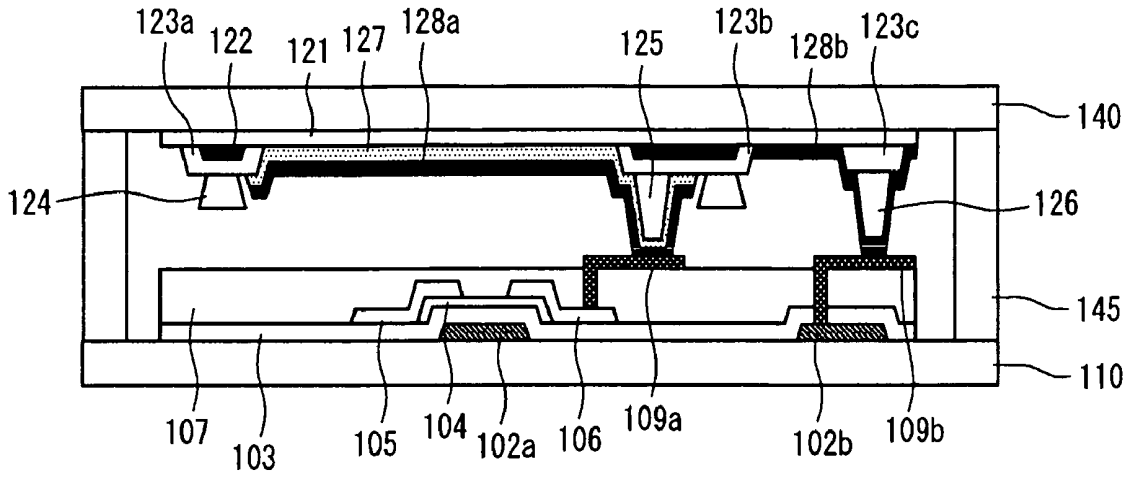


Fig. 1

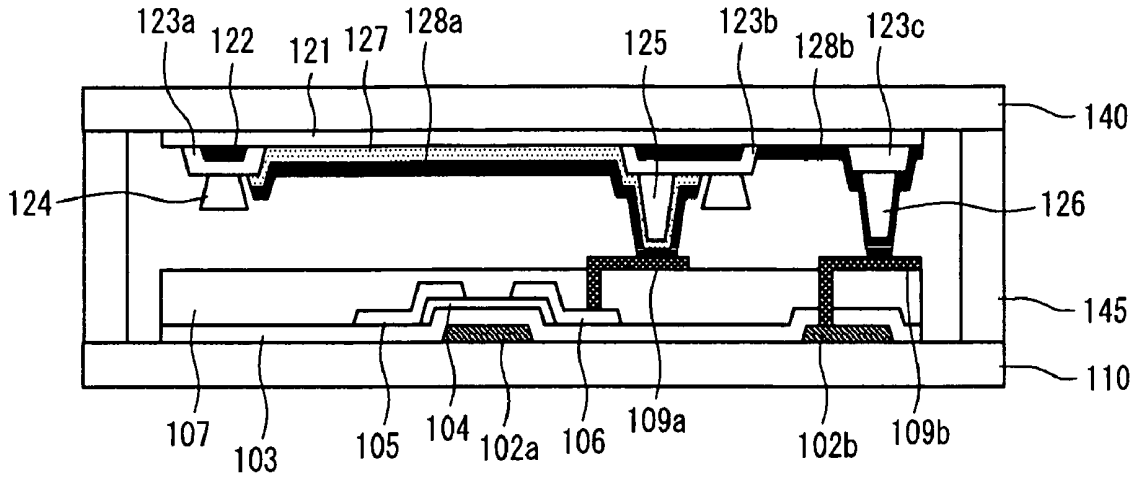

123a
122
121
127
128a
125
123b
128b
123c
140
124
126
145
110
107
103
105
104
102a
106
109a
102b
109b

Fig. 2

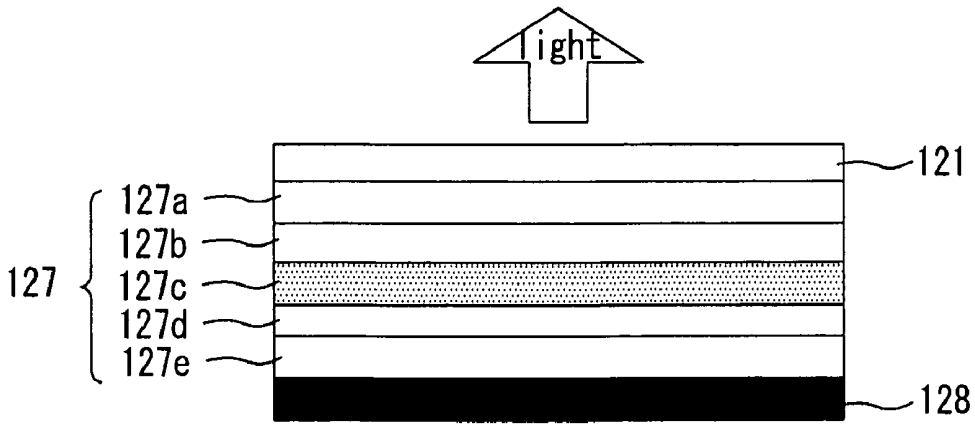

light
121
127
127a
127b
127c
127d
127e
128

Fig. 3

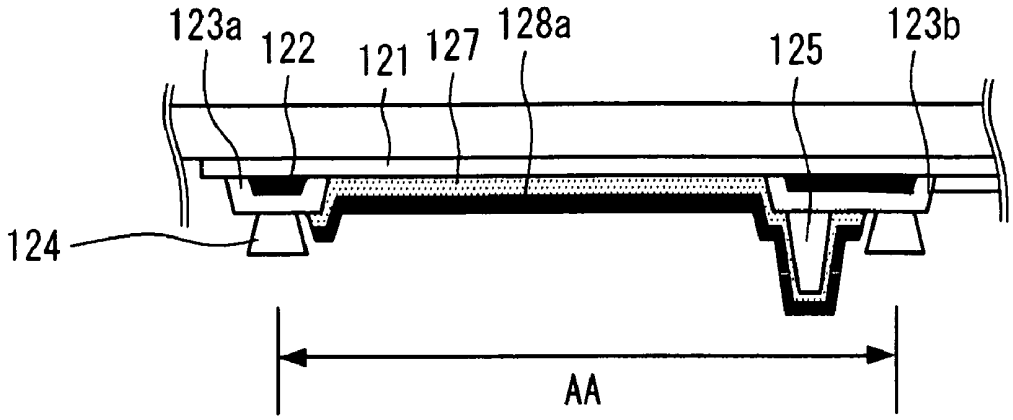


Fig. 4

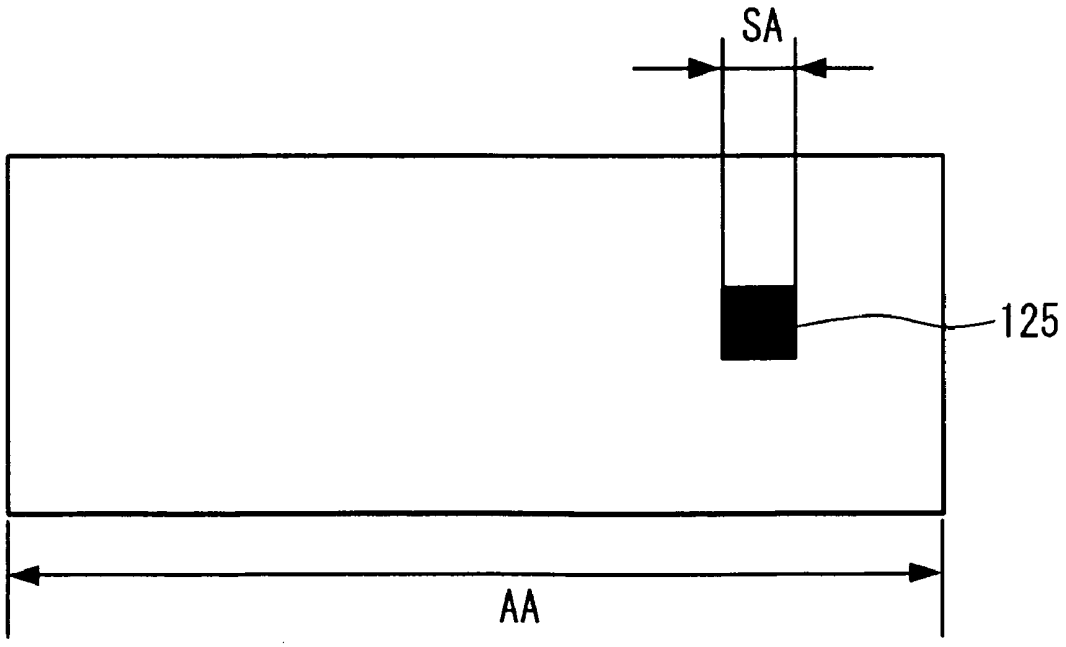
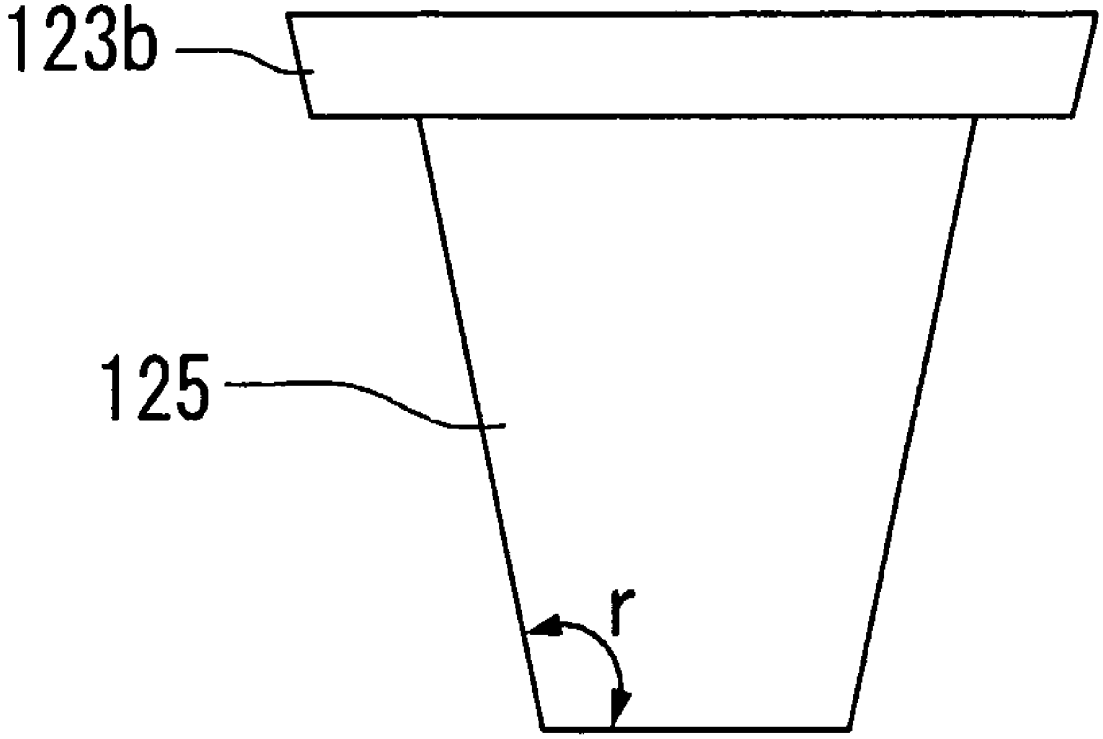


Fig. 5



ORGANIC LIGHT EMITTING DISPLAY DEVICE

This application claims the benefit of Korean Patent Application No. 10-2008-0075096 filed on Jul. 31, 2008 which is hereby incorporated by reference in its entirety.

BACKGROUND

1. Field of the Invention

This document relates to an organic light emitting display device.

2. Related Art

An organic light emitting element used in an organic light emitting display device was a self emissive element comprising an emission layer disposed between two electrodes formed on a substrate.

The organic light emitting display device is classified into a top-emission type, a bottom-emission type, and a dual-emission type according to a light emission direction. The organic light emitting display device is also classified into a passive matrix type and an active matrix type according to a driving method.

The organic light emitting display device selects one from a plurality of subpixels arranged in matrix and controls the selected pixel to emit light by applying a scan signal, a data signal, and power to the plurality of subpixels arranged in matrix, thereby displaying images.

Meanwhile, some of organic light emitting display devices according to the related art comprise a first substrate and a second substrate. Each of the first and second substrates includes a transistor and an organic light emitting diode, and the first substrate and the second substrate are sealed together through adhesive member. Such an organic light emitting display device according to the related art also includes a spacer that is protruded for helping electric connection between the transistor on the first substrate and the organic light emitting diode on the second substrate.

However, a contact electrode connected to a source or a drain of the transistor may be poorly contacted with an upper electrode on the spacer of an organic light emitting diode when the first substrate and the second substrate are sealed together in the organic light emitting display device according to the related art. Such poor contact causes a black dot detect on a subpixel or abnormal operation of an element. Therefore, such a problem needs to be solved.

SUMMARY

An aspect of this document is to provide an organic light emitting display device. In an aspect, the organic light emitting display device comprising a first substrate, a second substrate facing the first substrate, a transistor on the first substrate, a first contact electrode disposed on the transistor and connected to a source or a drain of the transistor, a subpixel on the second substrate, and a first spacer projected to make an upper electrode included in the subpixel to be in contact with the first contact electrode, wherein an upper surface area of the first spacer is about 0.5% to 20% of an upper surface area of the subpixel.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompany drawings, which are included to provide a further understanding of the invention and are incorporated on and constitute a part of this specification illustrate embodiments of the invention and together with the description serve to explain the principles of the invention.

FIG. **1** is a cross-sectional view of an organic light emitting display device according to an exemplary embodiment of the invention.

FIG. **2** is a diagram illustrating a structure of an organic light emitting diode.

FIG. **3** is a cross-sectional view of a part of FIG. **1**.

FIG. **4** is a plan view illustrating an area of a first spacer compared with an area of a subpixel.

FIG. **5** is a diagram for describing a slop of a first spacer.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail embodiments of the invention examples of which are illustrated in the accompanying drawings.

As shown in FIG. **1** and FIG. **3**, the organic light emitting display device according to the present embodiment comprises a first substrate **110** and a second substrate **140** facing the first substrate **110**. The first substrate **110** and the second substrate **140** may be sealed together through an adhesive member **145**.

The first substrate **110** and the second substrate **140** may be made of material that has high strength and excellent dimensional stability for forming elements.

For example, the first substrate **110** and the second substrate **140** may be made of a glass plate, a metal plate, a ceramic plate, or a plastic plate (polycarbonate resin, acryl resin, vinyl chloride resin, polyethylene terephthalate resin, polyimide resin, polyester resin, epoxy resin, silicon resin, and fluorine resin.

A switching transistor, a driving transistor, and a capacitor may be disposed on the first substrate **110**. The switching transistor, the driving transistor, and the capacitor are connected to a scan line a data line, and a power line, respectively. An organic light emitting diode, and a spacer connected to a source or a drain of the driving transistor may be disposed on the second substrate **140**.

Hereinafter, the organic light emitting display device according to the present embodiment will be described in more detail with reference to schematic cross-sectional views of the transistor on the first substrate **110** and the organic light emitting diode on the second substrate **140**.

A first gate **102***a* and a second gate **102***b* may be disposed on the first substrate **110**. The first gate **102***a* may be a gate metal of the transistor formed on the first substrate **110**, and the second gate **102***b* may be a gate metal connected to the power line on the first substrate **110**. In additional, a gate metal may be further disposed on the substrate **110** as a lower electrode of the capacitor.

The first and second gates **102***a* and **102***b* may be made of one selected from the group consisting of molybdenum Mo, aluminum Al, chrome Cr, gold Au, titanium Ti, nickel Ni, neodymium Nd, copper Cu, and alloy thereof. The first gate **102***a* and the second gate **102***b* may be a multilayer formed one selected from the group consisting of molybdenum Mo, aluminum Al, chrome Cr, gold Au, titanium Ti, nickel Ni, neodymium Nd, copper Cu, and alloy thereof. The first and second gates **102***a* and **102***b* may be also a dual layer of molybdenum Mo/aluminum Al-neodymium Nd or molybdenum Mo/aluminum Al.

A first insulation layer **103** may be disposed on the first and second gates **102***a* and **102***b*. The first insulation layer **103** may be made of a silicon oxide layer SiOx, a silicon nitride

layer SiNx, or may be a multilayer thereof. However, the first insulation layer **103** is not limited thereto.

An active layer **104** may be disposed on the first insulation layer **103**. The active layer **104** may comprise amorphous silicon or polycrystalline silicon which is crystallized amorphous silicon. Although it is not shown, the active layer **104** may comprise a channel area, a source area, and a drain area, and the source area and the drain area may be doped with P type or N type impurities. Also, the active layer **104** may comprise an ohmic contact layer for reducing contact resistance.

A source **105** and a drain **106** may be disposed on the active layer **104**. One of the source **105** and the drain **106** may be disposed to face a lower electrode of the capacitor formed on the substrate **110**, thereby forming the capacitor.

The source **105** and the drain **106** may be formed as a single layer or a multilayer. If the source **105** and the drain **106** are a single layer, the source **105** and the drain **106** may be made of one selected from the group consisting of molybdenum (Mo), aluminum (Al), chrome (Cr), gold (Au), titanium (Ti), nickel (Ni), neodymium (Nd), copper (Cu), and alloy thereof. If the source **105** and the drain **106** are a multilayer, the source **105** and the drain **106** may be a dual layer of Mo/Al—Nd or Mo/Al, or a triple layer of Mo/Al—Nd/Mo.

A second insulation layer **107** may be disposed on the source **105** and the drain **106**. The second insulation layer **107** may be a silicon oxide layer SiOx, a silicon nitride layer SiNx, or a multilayer thereof. However, the second insulation layer **107** is not limited thereto. The second insulating layer **116** may be a passivation layer or a planarization layer.

A first contact electrode **109***a* may be disposed on the second insulation layer **107**. The first contact electrode **109***a* is connected to the source **105** or the drain **106** of the transistor. Also, a second contact electrode **109***b* may be disposed on the second insulation layer **107**. The second contact electrode **109***b* is connected to the second gate **102***b*. The second contact electrode **109***b* may be disposed on at least one of transistors or on an outline of the first substrate **110**.

Hereinbefore, a bottom gate type transistor was described as an example of the transistor disposed on the first substrate **110**. However, the transistor disposed on the first substrate **110** is not limited thereto. A top gate type transistor may be disposed on the first substrate **110**.

Unlike the bottom gate type transistor, the top gate type transistor includes a gate formed at a layer higher than the active layer.

Meanwhile, a lower electrode **121** may be disposed on the second substrate **140**. The lower electrode **121** may be selected as an anode. The lower electrode **121** selected as the anode may be made of transparent material such as Indium Tin Oxide (ITO), Indium Zinc Oxide (IZO), Indium Tin Zinc Oxide (ITZO), and ZnO doped Al2O3 (AZO).

The lower electrode **121** may be connected to an auxiliary electrode **122**. For example, the auxiliary electrode **122** may be disposed on the lower electrode **212**. The auxiliary electrode **122** may be made of one of molybdenum (Mo), aluminum (Al), chrome (Cr), gold (Au), titanium (Ti), nickel (Ni), neodymium (Nd), and copper (Cu).

Bank layers **123***a*, **123***b*, **123***c* may be disposed on the lower electrode **121** and the auxiliary electrode **122**. The bank layer **123***a*, **123***b*, and **123***c* may include organic material such as benzocyclobutene resin, acryl resin, or polyimide region. The bank layers **123***a* and **123***b* may have openings for exposing the lower electrode **121**.

A barrier **124** may be disposed on the bank layers **123***a* and **123***b*. The barrier **124** defines a subpixel area. The barrier **124** may be formed for making a process convenient when the organic light emitting layer and the upper electrode are formed in following processes. The barrier **124** may be formed in a reverse taper type having a base area narrower than an upper area.

Meanwhile, the auxiliary electrode **122** may be disposed at a lower part of the barrier **124** that is formed on the bank layers **123***a* and **123***b* having the opening for defining a subpixel area. That is, the auxiliary electrode **122** overlaps with an area where the barrier **124** is disposed.

A first spacer **125** may be disposed on the bank layer **123***b*. The first spacer **125** may be made of an organic material or an inorganic material. However, the first spacer **135** is not limited thereto. The first spacer **125** is projected to be in contact with the first contact electrode **109***a* disposed on the substrate **110** when the first substrate **110** is sealed with the second substrate **140**. Since the first spacer **125** helps electric connection between the first contact electrode **109***a* on the first substrate **110** and the upper electrode **128***a* on the second substrate **140**, setting an area and a slop of the first spacer **125** is very important. Hereinafter, it will be described in more detail in later.

A second spacer **126** may be disposed on the bank layer **123***c*. The second spacer **126** may be disposed at an outer area of the second substrate **140**. The second spacer **126** is projected to be in contact with a second contact electrode **109***b* disposed on the first substrate when the first substrate **110** is sealed with the second substrate **140**.

An organic light emitting layer **127** may be disposed on a lower electrode **121** exposed through the openings of the bank layers **123***a* and **123***b*. The organic light emitting layer **127** may be divided into subpixel areas (AA) by the barrier **124**.

Referring to FIG. **2**, the organic light emitting layer **127** may includes a hole injection layer **127***a*, a hole transport layer **127***b*, an emission layer **127***c*, an electron transport layer **127***d*, and an electron injection layer **127***e*.

The hole injection layer **127***a* makes the injection of hole smooth. The hole injection layer **127***a* may be made of one selected from the group consisting of cupper phthalocyanine (CuPc), poly(3,4)-ethylenedioxythiophene (PEDOT), polyaniline (PANI), and N,N-dinaphthyl-N,N'-diphenyl benzidine (NPD). However, the hole injection layer **127***a* is not limited thereto.

The hole transport layer **127***d* makes the transport of holes smooth. The hole transport layer **121***d* may be made of one selected from the group consisting of N,N-dinaphthyl-N,N'-diphenyl benzidine (NPD), N,N'-bis-(3-methylphenyl)-N,N'-bis-(phenyl)-benzidine (TPD), s-TAD, and 4,4',4"-Tris(N-3-methylphenyl-N-phenyl-amino)-triphenylamine (MTDATA). However, the hole transport layer **127***d* is not limited thereto.

The emission layer **127***c* may comprise material that emits red, green, or blue light. Also, the emission layer **127***c* may be made of phosphorescent or fluorescent material.

If the emission layer **127***c* is red, the emission layer **127***c* may be made of phosphorescent material including host material having carbazole biphenyl (CBP) or 1,3-bis(carbazol-9-yl) mCP, and dopant having at least one of the group consisting of PIQIr(acac)(bis(1-phenylisoquinoline)acetylacetonate iridium), PQIr(acac)(bis(1-phenylquinoline) acetylacetonate iridium), PQIr(tris(1-phenylquinoline)iridium), and PtOEP(octaethylporphyrin platinum). Also, the emission layer **127***c* may be made of fluorescent material having PBD:Eu(DBM)3(Phen) or Perylene.

If the emission layer **127***c* is green, the emission layer **127***c* may be made of material including a phosphorescent material having host material having CBP or mCP and dopant material having Ir(ppy)3(fac tris(2-phenylpyridine)iridium).

Unlikely, the emission layer **127***c* may be made of a fluorescent material having Alq3(tris(8-hydroxyquinolino)aluminum).

If the emission layer **127***c* is blue, the emission layer **127***c* may made of phosphorescent material including host material CBP or mCP and dopant material having (4,6-F2ppy)2Irpic. Unlikely, the emission layer **127***c* may be made of fluorescent material having one selected from the group consisting of spiro-DPVBi, spiro-6P, distryrylbenzene (DSB), distyryl arylene (DSA), PFO polymer, and PPV polymer. However, the emission layer **127***c* is not limited thereto.

The electron transport layer **127***d* makes the transport of electrons smooth and may be made of Alq3(tris(8-hydroxyquinolino)aluminum), PBD, TAZ, spiro-PBD, BAlq, LiF, or SAlq. However, the electron transport layer **127***b* is not limited thereto.

The electron injection layer **127***a* makes the injection of electron smooth and may be made of tris(8-hydroxyquinolino)aluminum (Alq3), PBD, TAZ, spiro-PBD, BAlq, LiF, or SAlq. However, the electron injection layer **127***a* is not limited thereto.

Here, the present invention is not limited to FIG. **2**. At least one of the electron injection layer **127***a*, the electron transport layer **127***b*, the hole transport layer **127***d*, and the hole injection layer **127***e* may be omitted.

Upper electrodes **128***a* and **128***b* may be disposed on the organic light emitting layer **127**. One of the upper electrodes **128***a* and **128***b*, for example, the upper electrode **128***a*, may cover an upper part of the organic light emitting layer **127** and the second spacer **125** in the subpixel area (AA). The other electrode, for example, the upper electrode **128***b*, may cover the second spacer **126** which is disposed outside of the subpixel area (AA).

That is, the upper electrodes **128***a* and **128***b* may be separated into the upper electrode **128***a* disposed inside the subpixel area (AA) and the lower electrode **128***b* disposed outside the subpixel area (AA). Accordingly, the upper electrodes **128***a* and **128***b* may be divided into subpixel areas by the barrier **124**.

The upper electrode **128***a* covering the first spacer **125** and the upper electrode **128***b* covering the second spacer **126** are in contact with the first contact electrode **109***a* and the second contact electrode **109***b*, respectively, when the first substrate **110** is sealed with the second substrate **140** in vacuum.

The upper electrodes **128***a* and **128***b* may be selected as a cathode. The upper electrodes **128***a* and **128***b* selected as the cathode may be made of opaque material with high reflectivity.

Hereinafter, the first space will be described in more detail.

Referring to FIG. **1** to FIG. the first spacer **125** is formed to have a surface area (SA) equivalent to about 0.5% to 20% of the upper surface area (AA) of the subpixel.

The upper surface area (SA) of the first spacer **125** will be described in more detail with Table 1 showing data obtained from simulations.

TABLE 1

Surface area (SA) of first spacer	Area (AA) of subpixel	Contact defect ratio	Decrement of opening ratio	Abnormal operation ratio
0.2	100	□	X	□
0.3	100	○	X	○
0.5	100	X	X	X
1	100	X	X	X
5	100	X	X	X
10	100	X	X	X
15	100	X	X	X
20	100	X	X	X
25	100	X	○	X
30	100	X	□	X

X: No,
○: Average,
□: High

Table 1 clearly shows that the contact defect, the decrement of opening ratio, the abnormal operation are not generated if the first spacer **125** is formed to have an upper surface area (SA) equivalent to about 0.5% or 20% of the upper surface area (AA) of the subpixel.

Therefore, if the first spacer **125** is formed to have an upper surface area (SA) equivalent to about 0.5% or 20% of the upper surface area (AA) of the subpixel, a contact area can be secured between the upper electrode **128***a* on the first spacer **125** and the first contact electrode **109***a*, and the contact defect ratio can be reduced, thereby preventing block dot defect from generating at a subpixel. Also, it is possible to prevent the opening rate of the subpixel from decreasing, and to lower an abnormal operation rate of the subpixel, thereby improving reliability thereof.

Accordingly, when the organic light emitting display device according to the present embodiment is tested for analyzing reliability in a high temperature and high humidity atmosphere, the testing results clearly show that the black dot defect problem and the abnormal operation problem are improved.

In addition, when a push test is performed, a problem that a black dot defect is appeared at a subpixel by deformation of the first spacer **125** is improved. Here, the push test is a test that forcedly pushes a panel from the outside. In consideration of a general process margin, it is preferable to form the upper surface area (SA) of the first spacer **125** in a form above top 1% of Table.

Referring to FIG. **1** to FIG. **5**, the first spacer **125** may be formed in a trapezium having an upper area having a narrower slop (r) than a base area. The slop (r) of the first spacer **125** may be about 30° to 70°. If the slop (r) of the first spacer **125** is greater than 30°, a proper contact area between the upper electrode **128***a* and the first contact electrode **109***a* is sustained, thereby preventing exfoliation of the upper electrode **128***a* due to concentration of current applied when a signal is transferred between the upper electrode **128***a* and the first contact electrode **109***a*. It is also possible to prevent the upper electrode **128***a* on the first spacer **125** from damage by pressure when the first substrate **110** is sealed with the second substrate **140**. When a push test for forcedly pushing a panel from the outside is performed after manufacturing the panel, it may have a high resisting power against an external pressure. If the slop (r) of the first spacer **125** is smaller than 70°, it is possible to prevent a corner area of the upper electrode **128***a* on the first spacer **125** from damaging. It is also possible to prevent the upper electrode **128***a* from opening (cutting). Furthermore, it is possible to prevent the upper electrode **128***a* from exfoliation after analyzing the reliability of the panel.

Meanwhile, although the second spacer **126** may be formed in a trapezium shape like the first spacer **125**, the second spacer **126** is not limited thereto. Like the first spacer **125**, the second spacer **126** also has the same slop of the first spacer **125**. However, the second spacer **126** is not limited thereto.

The organic light emitting display device according to the present embodiment can display images by controlling the emission layer to emit lights using electrons and holes that are transported through the lower electrode **121** connected to the power line and the upper electrode **128***a* connected to the source **105** or the drain **106** of the transistor when the scan signal and the data signal are applied through the scan line and the data line.

The foregoing embodiments and advantages are merely exemplary and are not to be construed as limiting the present invention. The present teaching can be readily applied to other types of apparatuses. The description of the foregoing embodiments is intended to be illustrative, and not to limit the scope of the claims. Many alternatives, modifications, and variations will be apparent to those skilled in the art. In the claims, means-plus-function clauses are intended to cover the structures described herein as performing the recited function and not only structural equivalents but also equivalent structures. Moreover, unless the term "means" is explicitly recited in a limitation of the claims, such limitation is not intended to be interpreted under 35 USC 112(6).

What is claimed is:

1. An organic light emitting display device comprising:

a first substrate;

a second substrate facing the first substrate;

a plurality of transistors on the first substrate;

a first contact electrode disposed on at least one transistor and connected to a source or a drain of said at least one transistor;

a subpixel on the second substrate;

a first spacer projected to make an upper electrode included in the subpixel to be in contact with the first contact electrode;

a second contact electrode disposed on a second insulation layer to cover at an upper part of at least one of the transistor and a power line on the first substrate; and

a second spacer projected to be in contact with the second contact electrode,

wherein an upper surface area of the first spacer is about 0.5% to 20% of an upper surface area of the subpixel,

wherein the second contact electrode is connected to the power line on the first substrate, and a lower electrode is connected to the second contact electrode by the second spacer.

2. The organic light emitting display device of claim **1**, wherein the subpixel includes the lower electrode on the second substrate, a bank layer having an opening and disposed on the lower electrode, an organic light emitting layer disposed on the lower electrode exposed through the opening, and an upper electrode on the organic light emitting layer.

3. The organic light emitting display device of claim **2**, wherein the subpixel includes a barrier that defines an area of the subpixel, and the barrier is disposed on the bank layer.

4. The organic light emitting display device of claim **3**, wherein the first spacer is disposed on the bank layer between the barriers, and the upper electrode covers the first spacer.

5. The organic light emitting display device of claim **1**, wherein the first spacer is formed in a trapezium shape that has an upper area having a slop narrower than that of a base area.

6. The organic light emitting display device of claim **1**, wherein a slop of the first spacer is about 30° to 70°.

7. The organic light emitting display device of claim **3**, wherein the barrier is a taper type in which an upper area is narrower than a base area.

8. The organic light emitting display device of claim **2**, wherein the subpixel includes an auxiliary electrode connected to the lower electrode.

9. The organic light emitting display device of claim **3**, wherein the subpixel includes an auxiliary electrode disposed at a lower part of the bank layer, and the auxiliary electrode overlaps with an area where the barrier is disposed.

10. The organic light emitting display device of claim **1**, wherein the second spacer is disposed at an outline of the first substrate and the second substrate.

11. The organic light emitting display device of claim **1**, wherein the transistor includes a gate on the first substrate, a first insulation layer on the gate, an active layer on the first insulation layer, a source and a drain on the active layer, and the second insulation layer on the source and the drain.

12. The organic light emitting display device of claim **3**, wherein the upper electrode is divided into areas of the subpixels by the barrier.

13. The organic light emitting display device of claim **1**, wherein the first spacer is made of an organic material or an inorganic material.

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专利名称(译)	有机发光显示装置		
公开(公告)号	US8022621	公开(公告)日	2011-09-20
申请号	US12/314527	申请日	2008-12-11
[标]申请(专利权)人(译)	乐金显示有限公司		
申请(专利权)人(译)	LG DISPLAY CO. , LTD.		
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摘要(译)

提供一种有机发光显示装置。有机发光显示装置包括第一基板，面向第一基板的第二基板，第一基板上的晶体管，设置在晶体管上并连接到晶体管的源极或漏极的第一接触电极，第二基板和第一间隔物突出以使包括在子像素中的上电极与第一接触电极接触。第一间隔物的上表面区域是子像素的上表面区域的约0.5％至20％。