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Kim

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

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(73) Assignee: **Samsung Display Co., Ltd.**, Yongin-si (KR)

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H01L 27/14 (2006.01)

(52) **U.S. Cl.**
USPC **257/72**; 257/E27.133

(58) **Field of Classification Search**
USPC 257/72, E27.133
See application file for complete search history.

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Primary Examiner — Amar Movva
(74) *Attorney, Agent, or Firm* — Christie, Parker & Hale, LLP

(57) **ABSTRACT**

An organic light emitting display device includes: a first substrate; a plurality of organic light emitting diodes on the first substrate; a plurality of spacers spaced apart from each other on sides of light emitting regions corresponding to the plurality of organic light emitting diodes; and a second substrate facing the first substrate and spaced apart from the first substrate at an interval by the plurality of spacers.

20 Claims, 4 Drawing Sheets

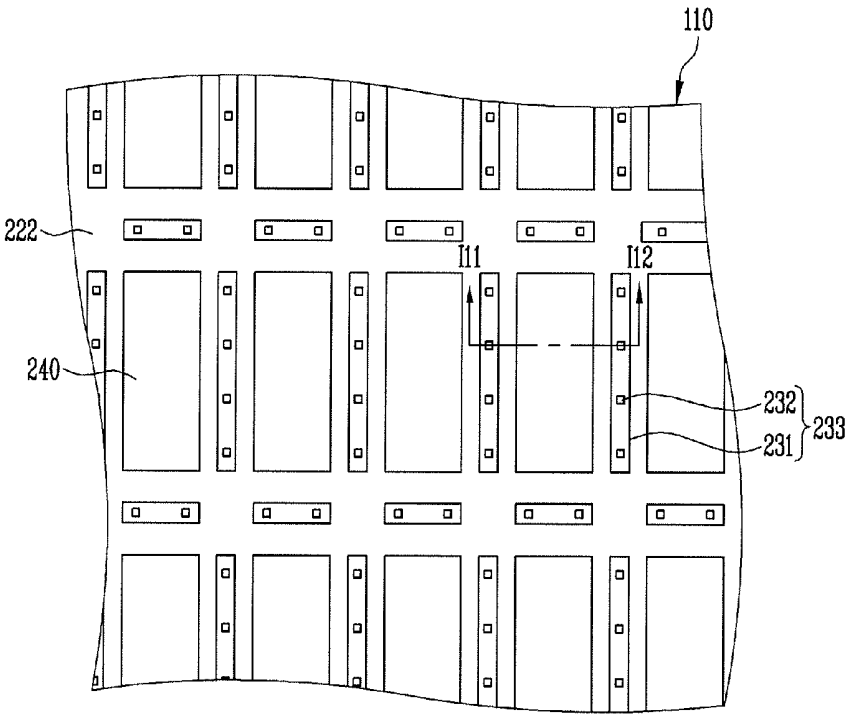


FIG. 1A

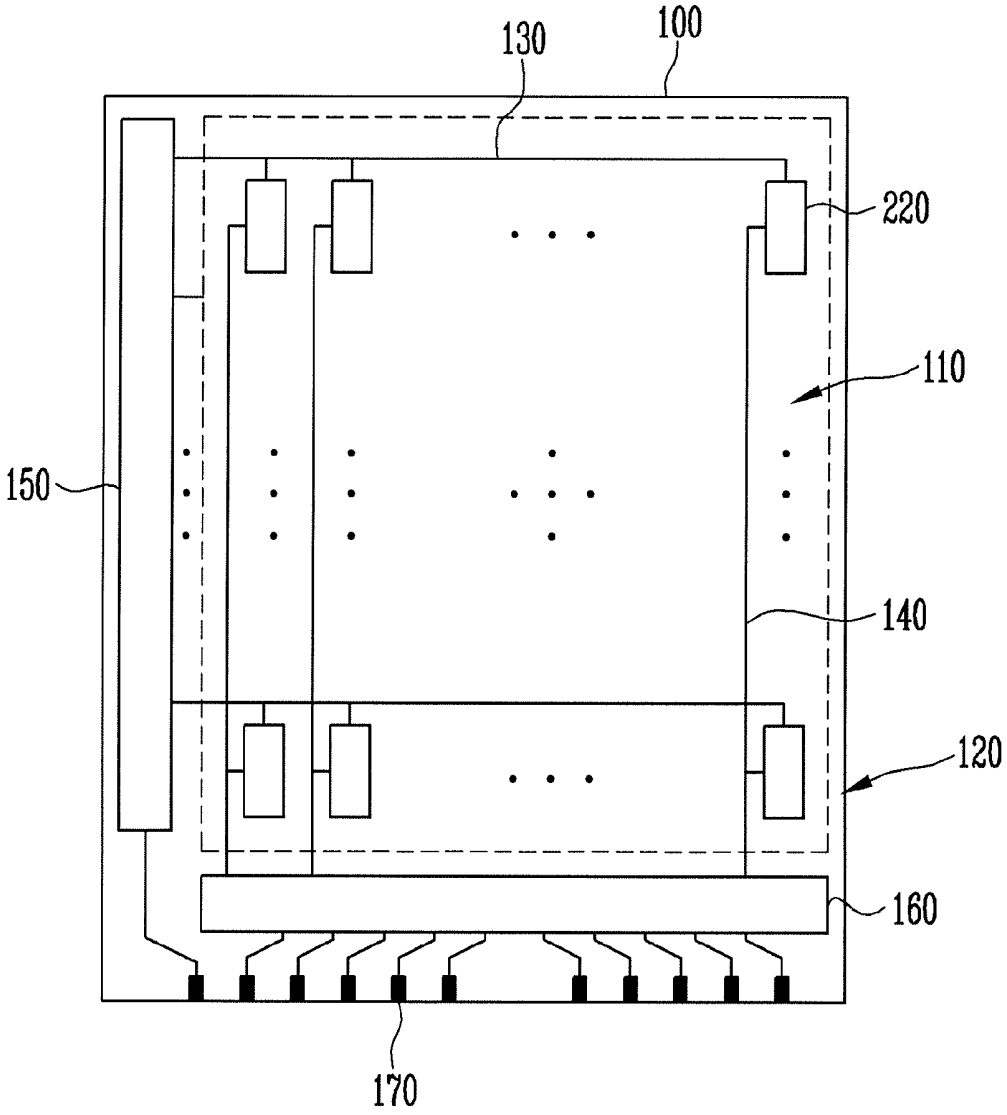


FIG. 1B

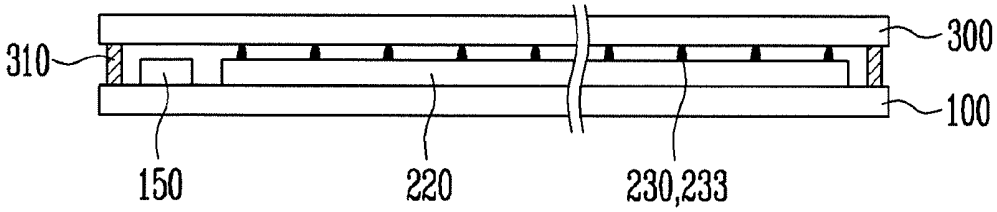


FIG. 2

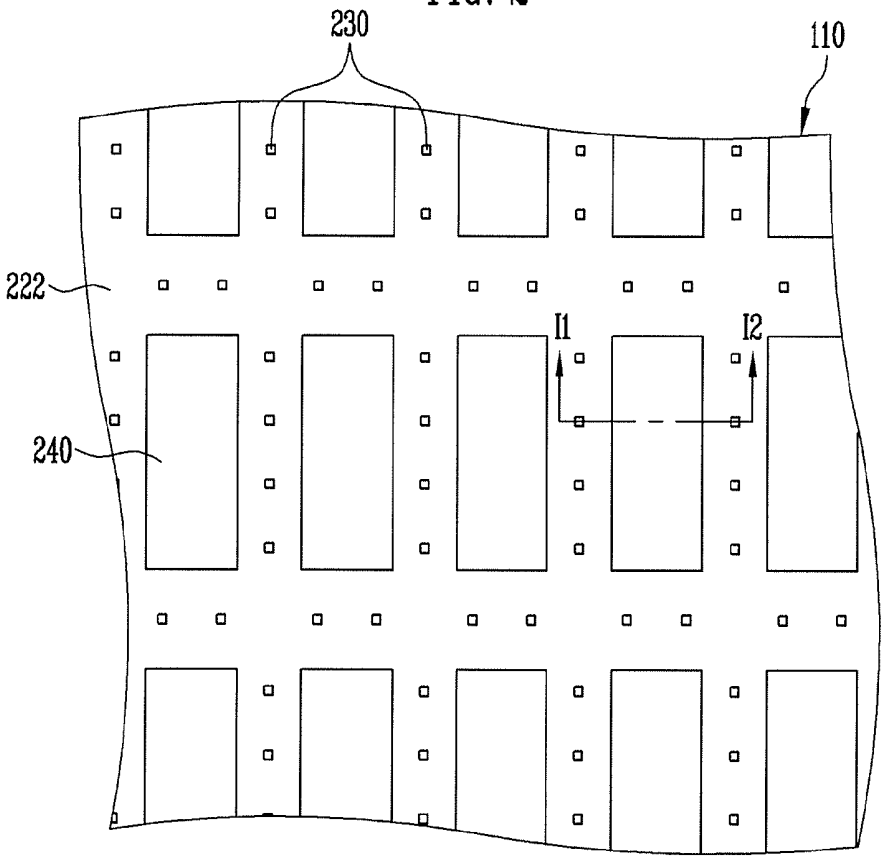

230
110
222
I1
I2
240

FIG. 3

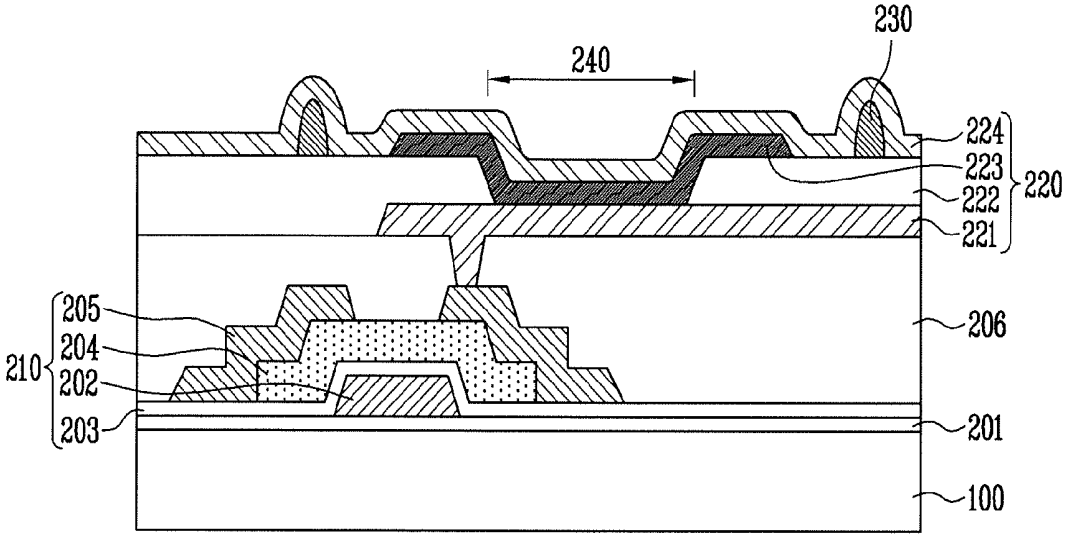

230
240
224
223
222
221
220
205
204
202
203
210
206
201
100

FIG. 4

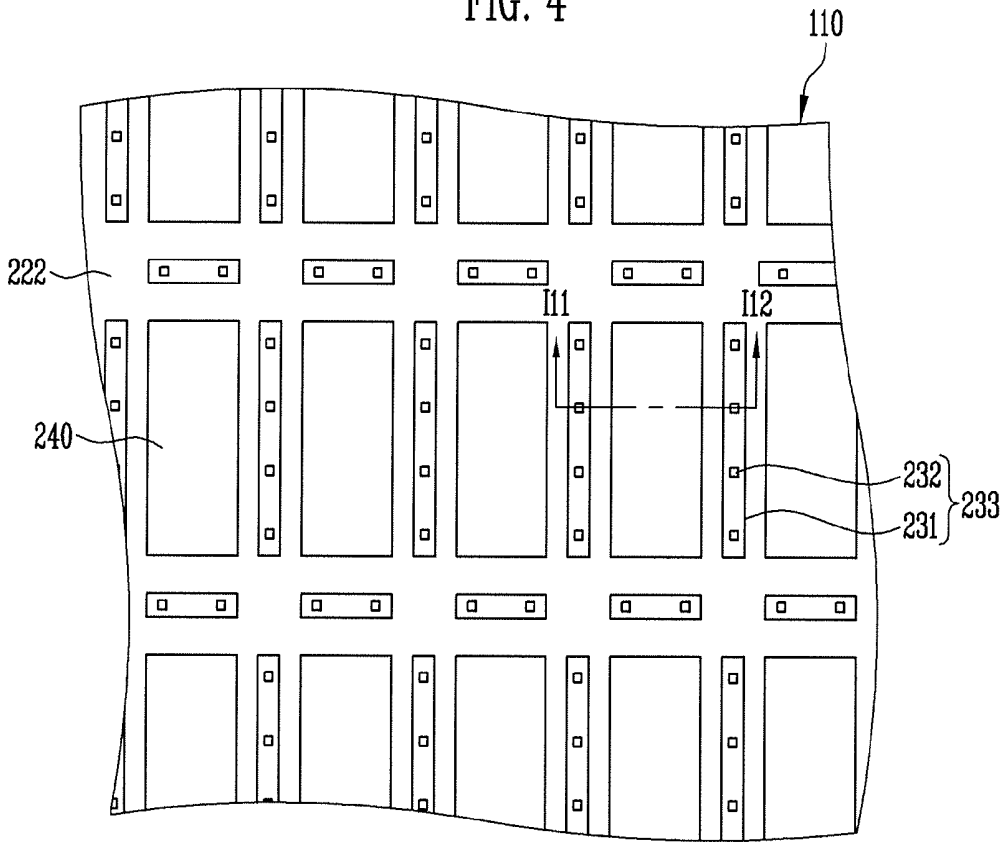

110
222
I11
I12
240
232
231
233

FIG. 5

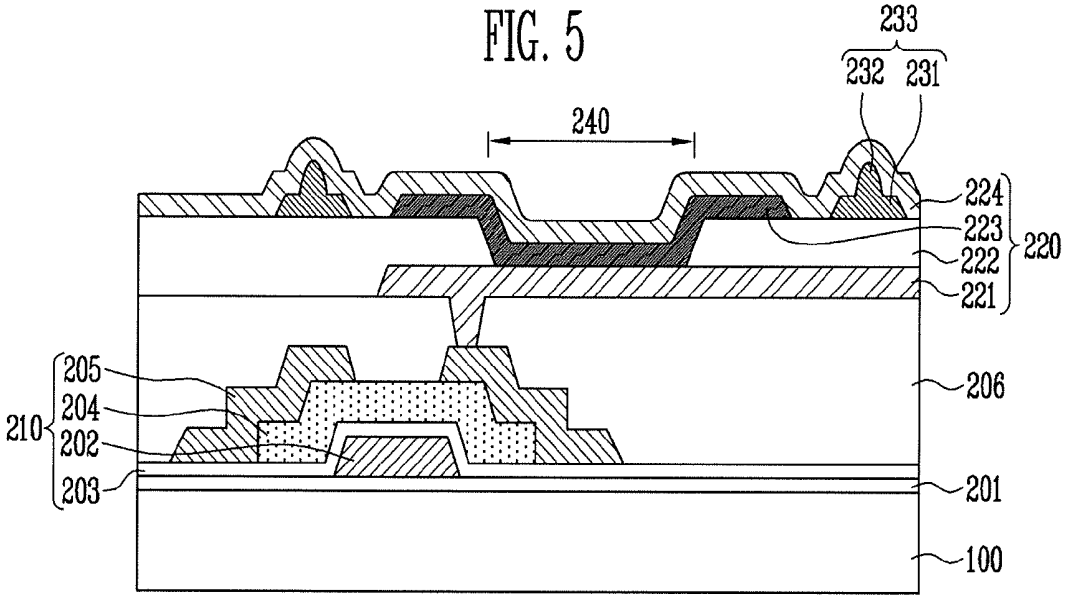

233
232
231
240
224
223
222
221
220
205
204
202
203
210
206
201
100

FIG. 6A

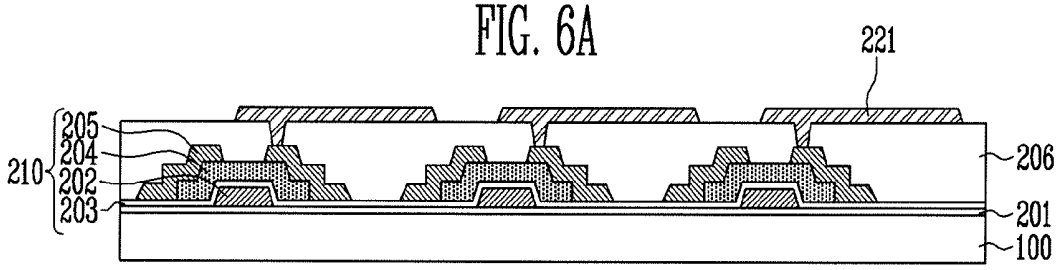


FIG. 6B

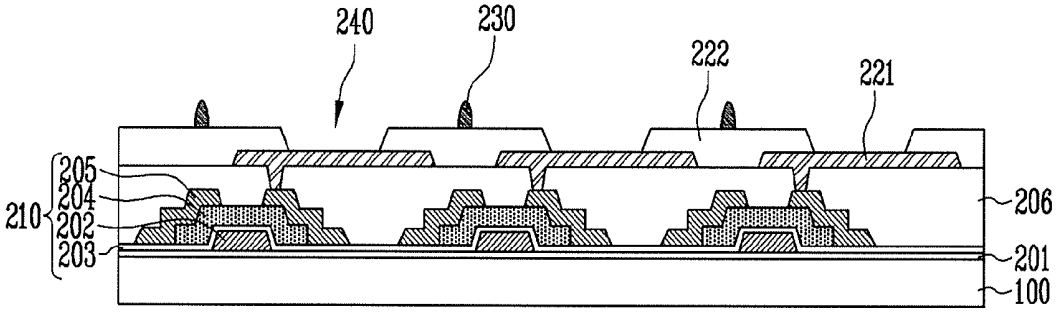


FIG. 6C

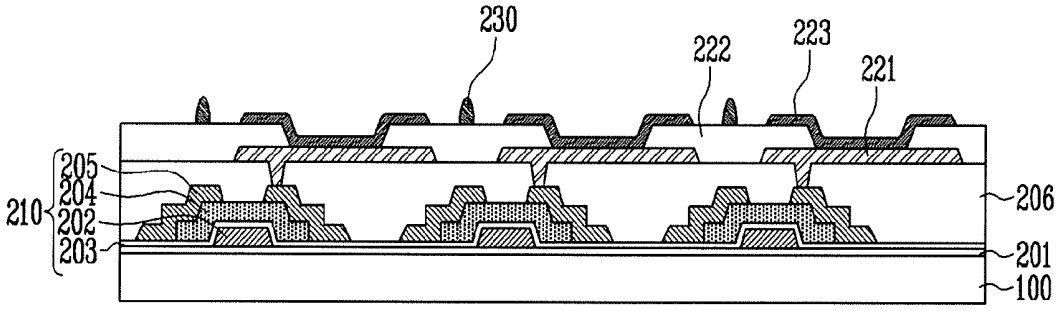
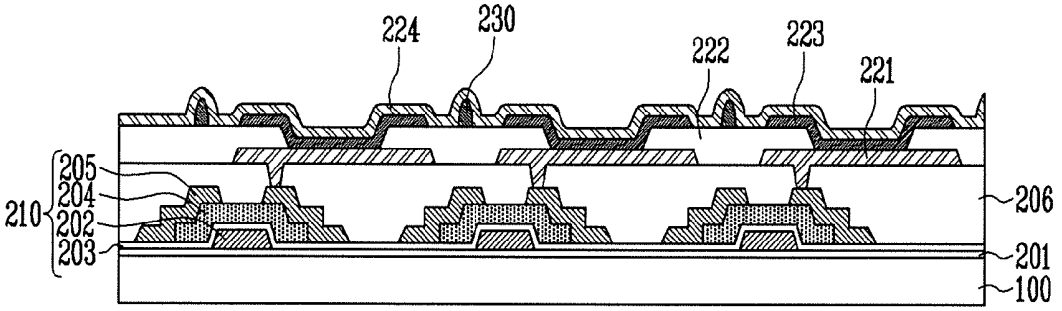


FIG. 6D



ORGANIC LIGHT EMITTING DISPLAY DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to and the benefit of Korean Patent Application No. 10-2009-0012312, filed on Feb. 16, 2009, in the Korean Intellectual Property Office, the entire content of which is incorporated herein by reference.

BACKGROUND

1. Field of the Invention

The present invention relates to an organic light emitting display device, and more particularly, to an organic light emitting display device having spacers.

2. Description of Related Art

An organic light emitting display device emits light by itself and has excellent properties with respect to viewing angles, contrast, response times, and power consumption, among other properties, when compared to, for example, a liquid crystal display device (LCD).

An organic light emitting diode in a pixel of the organic light emitting display device includes an anode electrode, a cathode electrode and an organic light emitting layer, and emits light in accordance with an energy difference generated while a hole injected through the anode electrode and an electron injected through the cathode electrode are recombined in the organic light emitting layer.

The organic light emitting layer of the organic light emitting diode is commonly formed using an inkjet printing method or a vacuum deposition method. However, the inkjet printing method is a complicated process, because a surface of a substrate should be planarized so that an organic material can be printed, and organic layers are limited to particular materials. The vacuum deposition method uses a shadow mask in order to selectively expose a light emitting region. However, due to drooping of the mask, it is not easy to deposit the organic materials in an exact pattern (e.g., shape), and the method is not applicable to a large-sized substrate. Also, stains may be formed due to contact with the mask, thereby causing a defective external appearance.

SUMMARY OF THE INVENTION

Exemplary embodiments of the present invention provide an organic light emitting display device having spacers which evenly and stably maintain an interval between a substrate and a shadow mask to selectively deposit an organic material.

Exemplary embodiments of the present invention also provide an organic light display device having spacers which comes into minimal or reduced contact with a sealing substrate.

According to an aspect of an exemplary embodiment of the present invention, there is provided an organic light emitting display device, including: a first substrate; a plurality of organic light emitting diodes on the first substrate; a plurality of spacers spaced apart from each other on sides of light emitting regions corresponding to the plurality of organic light emitting diodes; and a second substrate facing the first substrate and spaced apart from the first substrate at an interval by the plurality of spacers.

According to an aspect of another exemplary embodiment of the present invention, there is provided an organic light emitting display device, including: a first substrate; a plurality of organic light emitting diodes on the first substrate; a plurality of spacers on sides of light emitting regions corresponding to the plurality of organic light emitting diodes, the plurality of spacers each including a stripe-shaped supporting portion on a corresponding side of one of the light emitting regions and a plurality of contact portions spaced apart from each other on the supporting portion; and a second substrate facing the first substrate and spaced apart from the first substrate at an interval by the plurality of spacers.

The organic light emitting display device according to exemplary embodiments of the present invention includes a plurality of spacers that are arranged in a dot configuration or arrangement along the outer sides of the light emitting regions, and have cross-sections with an upper portion smaller than a lower portion. The shadow masks that selectively deposit an organic material are evenly supported in the light emitting regions at an interval (e.g., a predetermined interval) by the spacers arranged in a dot configuration, such that the organic light emitting layer can be formed in an accurate pattern (e.g., shape). Also, the spacers form dot or point contacts with the sealing substrate and maintain an interval between the substrate and the sealing substrate, such that the contact areas with the sealing substrate are minimized or reduced, thereby and reducing or avoiding external appearance defects due to stains.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, together with the specification, illustrate exemplary embodiments of the present invention, and, together with the description, serve to explain the principles of embodiments of the present invention.

FIGS. **1**A and **1**B are a schematic plan view and a schematic cross-sectional view of an organic light emitting display device according to an embodiment of the present invention;

FIG. **2** is a schematic plan view of a pixel region including spacers of FIG. **1**B;

FIG. **3** is a schematic cross-sectional view taken along line I**1**-I**2** of FIG. **2**;

FIG. **4** is a schematic plan view of a pixel region illustrating another embodiment of spacers;

FIG. **5** is a cross-sectional view taken along line I**11**-I**12** of FIG. **4**; and

FIGS. **6**A to **6**D are cross-sectional views illustrating a method of manufacturing an organic light emitting display device according to an embodiment of the present invention.

DETAILED DESCRIPTION

In the following detailed description, only certain exemplary embodiments of the present invention have been shown and described by way of illustration. As those skilled in the art will recognize, the described embodiments may be modified in various different ways without departing from the spirit or scope of the present invention. Accordingly, the drawings and description are to be regarded as illustrative in nature and not restrictive. In addition, when an element is referred to as being "on" another element, it may be directly on the another element, or may be indirectly on the another element, with one or more elements interposed therebetween. Also, when an element is referred to as being "connected to" another element, it may be directly connected to the another element, or may be indirectly connected to the another element, with one or more elements connected therebetween. Hereinafter, like reference numerals refer to like elements.

Hereinafter, exemplary embodiments according to the present invention will be described in detail with reference to the accompanying drawings.

FIGS. **1**A and **1**B are a schematic plan view and a schematic cross-sectional view of an organic light emitting display device according to an embodiment of the present invention.

Referring to FIG. **1**A, a substrate **100** includes a display region **110** and a non-display region **120**. The non-display region **120** surrounds the display region **110**, and may be considered regions of the substrate **100** other than the display region **110**.

A plurality of organic light emitting diodes **220** coupled between scan lines **130** and data lines **140** in a matrix type are disposed on the substrate **100** in the display region **110**. On the substrate **100** the scan lines **130** and the data lines **140** in the display region **110** extend into the non-display region **120**, power supply lines for providing power to the organic light emitting diodes **220**, and a scan driver **150** and a data driver **160** for processing signals provided from the outside, for example, through pads **170**, and for supplying corresponding signals to the scan lines **130** and the data lines **140**. The scan driver **150** and the data driver **160** include driving circuits for generating scan signals and data signals, corresponding to the signals supplied from the outside via the pads **170**, to selectively drive the respective organic light emitting diodes **220**.

Referring to FIG. **1**B, in order to seal the display region **110**, the sealing substrate **300** is disposed over the substrate **100** and facing the substrate **100**, on which the organic light emitting diodes **220** are formed, and the sealing substrate **300** is bonded to the substrate **100** by sealant **310**. At this time, the sealing substrate **300** maintains an interval (e.g., a predetermined interval) from the substrate **100** by utilizing the plurality of spacers **230** and/or **233**.

The spacers **230** are arranged in a dot configuration or arrangement between the plurality of organic light emitting diodes **220**, and are arranged in a row direction and in a column direction. More particularly, the spacers **230** are arranged along the sides of the respective light emitting regions **240** of the plurality of organic light emitting diodes **220**, shown in FIG. **2**. In other words, the spacers **230** are spaced apart from each other along the sides of the respective light emitting regions **240** in both the row direction and the column direction, as shown in FIG. **2**.

FIG. **3** is a schematic cross-sectional view taken along the line I**1**-I**2** of FIG. **2**. A thin film transistor for controlling an operation of an organic light emitting diode and a capacitor for maintaining a signal corresponding to the operation of the organic light emitting diode are coupled to the organic light emitting diode in each pixel. However, for convenience of explanation, FIG. **3** shows only a thin film transistor **210** and an organic light emitting diode **220**.

Referring to FIG. **3**, the organic light emitting diode **220** includes an anode electrode **221**, a cathode electrode **224**, and an organic light emitting layer **223** between the anode electrode **221** and the cathode electrode **224**.

The anode electrode **221** is formed on the substrate **100**. The organic light emitting layer **223** is formed in at least a light emitting region **240** (a region where the anode electrode **221** is exposed), defined by a pixel definition layer **222**, and may include a hole injection layer, a hole transport layer, an electron transport layer and an electron injection layer. The cathode electrode **224** is formed on the organic light emitting layer **223** and the pixel definition layer **222**.

The thin film transistor **210** includes a semiconductor layer **204** that provides source and drain regions and a channel region, a gate electrode **202** insulated from the semiconductor layer **204** by a gate insulating film **203**, and source and drain electrodes **205** respectively coupled to the semiconductor layer **204** at the source and drain regions. Reference numerals **201** and **206** indicate a buffer layer and a planarization insulating layer, respectively.

Referring to FIGS. **2** and **3**, the plurality of spacers **230** are formed on the pixel definition layer **222** along the sides of the light emitting regions **240** and between adjacent light emitting regions **240**. The spacers **230** are arranged in a dot configuration or arrangement, so that an interval between a shadow mask (not shown) that selectively deposits an organic material and the substrate **100**, or an interval between the sealing substrate **300** and the substrate **100**, can be evenly and stably maintained, wherein the spacers generally have a hemisphere shape or a trapezoid shape having a cross-section with an upper portion smaller than a lower portion, for reducing or minimizing contact with the sealing substrate **300**. A dot configuration or arrangement may indicate that the plurality of spacers **230** are spaced apart from each other along the sides of the light emitting regions **240** in both the row direction and the column direction, as shown in FIG. **2**.

The embodiment has been explained with reference to a structure where the hemisphere-shape or trapezoid-shape spacers **230** are arranged in a dot configuration or arrangement. However, in another embodiment, spacers **233** may include supporting portions **231** along the sides of the light emitting regions **240** in a stripe configuration or arrangement (e.g., the supporting portions **231** are stripe-shaped) and having a thickness (e.g., a predetermined thickness), and a plurality of contact portions **232** arranged on the supporting portions **231** in a dot configuration or arrangement, as shown in FIGS. **4** and **5**. The contact portions **232** are arranged in a dot configuration so that an interval between a mask (not shown) that selectively deposits an organic material and the substrate **100**, or an interval between the sealing substrate **300** and the substrate **100**, can be evenly and stably maintained. Such contact portions **232** generally have a hemisphere shape or a trapezoid shape having a cross-section with an upper portion smaller than a lower portion, for reducing or minimizing contact with the sealing substrate **300**. The supporting portions **231** generally have a thickness such that the contact portions **232** are stably supported thereupon, such that the intervals between the sealing substrate **300** and the substrate **100** can be properly secured.

A method of manufacturing an organic light emitting display device according to an embodiment of the present invention will be explained with reference to FIGS. **6**A to **6**D.

Referring to FIG. **6**A, after a thin film transistor **210** is formed as shown in FIG. **3**, the planarization insulating layer **206** is formed on the substrate **100**. Thereafter, via holes are formed on the planarization insulating layer **206** to expose the source or drain electrodes **205** of the thin film transistors **210**, and the anode electrodes **221** coupled to the source or drain electrodes **205** through the via holes are formed.

Referring to FIG. **6**B, the pixel definition layer **222** is formed on the substrate on the anode electrodes **221**, and then the pixel definition layer **222** is patterned or etched so that the anode electrodes **221** are exposed in light emitting regions **240**. The spacers **230** are formed along the sides of the light emitting regions **240** on the pixel definition layer **222**.

Spacers **230** may be formed, for example, by forming photoresist films or insulating films on upper surfaces of the substrate **100**, and then patterning the films using a photolithography method or an etching method using masks, as described with respect to FIG. **2**. At this time, if the interval which would be formed by the spacers **230** is determined to be below a range (e.g., a predetermined range), the lower ends of

the spacers **230** may be coupled to each other, and spacers **233** may be formed in a shape including supporting parts **231** and contacting parts **232** as shown in FIG. **4**.

Referring to FIG. **6**C, the organic light emitting layers **223** are formed on the exposed anode electrodes **221** in the light emitting regions **240**. When using the vacuum deposition method, masks (not shown) are mounted on the upper portion of the substrate **100** so that the organic light emitting layers **223** are selectively deposited in the light emitting regions **240**. At this time, the masks are evenly supported by the spacers **230** arranged in a dot configuration, and at the same time, intervals (e.g., predetermined intervals) are maintained therein, so that the organic light emitting layers **223** can be formed in an accurate pattern (e.g., shape).

Referring to FIG. **6**D, the cathode electrodes **224** are formed on the pixel definition layer **222**, the organic light emitting layers **223**, and the spacers **230**.

If the manufacturing of the organic light emitting diode **220** is completed as shown in FIG. **6**D, the sealing substrate **300** is disposed over the substrate **100** and bonded to the substrate **100** by the sealant **310**, shown in FIG. **1**B. At this time, the plurality of spacers **230** and/or **233** form dot contacts (or point contacts) with the sealing substrate **300** and allow the substrate **100** and the sealing substrate **300** to be maintained at an interval (e.g., a predetermined interval), such that contact with the sealing substrate **300** is minimized or reduced, thereby also minimizing or reducing external appearance defects due to stains.

In these embodiments, only the spacers **230** and/or **233** formed in the display region **110** are explained through the drawings, but the spacers may also be arranged in portions other than the display region **110** (e.g., in the non-display region **120**), to more properly support masks or sealing substrates.

While the present invention has been described in connection with certain exemplary embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but is instead intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims, and equivalents thereof.

What is claimed is:

1. An organic light emitting display device, comprising:

a first substrate;

a plurality of organic light emitting diodes on the first substrate, each of the organic light emitting diodes comprising a light emitting region comprising one side;

a plurality of spacers that are spaced apart from each other and alongside a region between two ends of the one side of the light emitting region of one of the organic light emitting diodes; and

a second substrate facing the first substrate and spaced apart from the first substrate at an interval by the plurality of spacers,

wherein adjacent ones of the spacers that are each alongside the region between the two ends of the one side of the light emitting region of the one of the organic light emitting diodes are discontinuous, unconnected, and spaced apart from each other.

2. The organic light emitting display device as claimed in claim **1**, wherein each of the plurality of organic light emitting diodes comprises:

a first electrode on the first substrate;

a pixel definition layer on the first substrate and the first electrode, and exposing the first electrode in a corresponding one of the light emitting regions;

an organic light emitting layer on the first electrode in the corresponding one of the light emitting regions; and

a second electrode on the pixel definition layer and the organic light emitting layer,

wherein the plurality of spacers are arranged on the pixel definition layer.

3. The organic light emitting display device as claimed in claim **2**, wherein the plurality of spacers are between the pixel definition layer and the second electrode.

4. The organic light emitting display device as claimed in claim **2**, wherein the plurality of spacers are arranged on the pixel definition layer prior to forming the organic light emitting layer, and wherein a mask for forming the organic light emitting layer is spaced apart from the first substrate by the plurality of spacers.

5. The organic light emitting display device as claimed in claim **2**, further comprising a thin film transistor coupled to the first electrode.

6. The organic light emitting display device as claimed in claim **1**, wherein a cross-section of each of the plurality of spacers comprises an upper portion smaller than a lower portion.

7. The organic light emitting display device as claimed in claim **6**, wherein the cross-section of each of the plurality of spacers is hemisphere shaped or trapezoid shaped.

8. The organic light emitting display device as claimed in claim **1**, wherein the organic light emitting display device is separated into a display region and a non-display region, wherein the plurality of organic light emitting diodes are arranged in the display region, and wherein the plurality of spacers are arranged in the display region on the sides of the light emitting regions and in the non-display region.

9. The organic light emitting display device as claimed in claim **1**, wherein the plurality of light emitting diodes are arranged in rows and columns; and

wherein each of the plurality of spacers is between adjacent ones of the light emitting diodes in a same row or a same column.

10. The organic light emitting display device as claimed in claim **9**,

wherein at least one of the spacers is at a point along a path between a middle portion of the one side of the light emitting region of a first organic light emitting diode and a middle portion of the one side of the light emitting region of a second organic light emitting diode, and

wherein the second organic light emitting diode is a next diode from the first organic light emitting diode in the same row or the same column.

11. An organic light emitting display device, comprising:

a first substrate;

a plurality of organic light emitting diodes on the first substrate, each of the organic light emitting diodes comprising a light emitting region comprising one side;

a plurality of spacers each arranged along the one side of a corresponding one of the light emitting regions, the plurality of spacers each comprising a stripe-shaped supporting portion along the one side of the corresponding one of the light emitting regions and a plurality of contact portions that are discontinuous, unconnected, and spaced apart from each other and alongside a region between two ends of the one side of the light emitting region of one of the organic light emitting diodes on the supporting portion; and

a second substrate facing the first substrate and spaced apart from the first substrate at an interval by the plurality of spacers.

12. The organic light emitting, display device as claimed in claim **11**, wherein each of the plurality of organic light emitting diodes comprises:

a first electrode on the first substrate;

a pixel definition layer on the first substrate and the first electrode, and exposing the first electrode in a corresponding one of the light emitting regions;

an organic light emitting layer on the first electrode in the corresponding one of the light emitting regions; and

a second electrode on the pixel definition layer and the organic light emitting layer,

wherein the plurality of spacers are arranged on the pixel definition layer.

13. The organic light emitting display device as claimed in claim **12**, wherein the plurality of spacers are between the pixel definition layer and the second electrode.

14. The organic light emitting display device as claimed in claim **12**, wherein the plurality of spacers are arranged on the pixel definition layer prior to forming the organic light emitting layer, and wherein a mask for forming the organic light emitting layer is spaced apart from the first substrate by the plurality of spacers.

15. The organic light emitting display device as claimed in claim **12**, further comprising a thin film transistor coupled to the first electrode.

16. The organic light emitting display device as claimed in claim **11**, wherein a cross-section of each of the contact portions comprises an upper portion smaller than a lower portion.

17. The organic light emitting display device as claimed in claim **16**, wherein the cross-section of each of the contact portions is hemisphere shaped or trapezoid shaped.

18. The organic light emitting display device as claimed in claim **11**, wherein

the organic light emitting display device is separated into a display region and a non-display region, wherein the plurality of organic light emitting diodes are arranged in the display region, and wherein the plurality of spacers are arranged in the display region on the sides of the light emitting regions and in the non-display region.

19. The organic light emitting display device as claimed in claim **11**, wherein the plurality of contact portions are in discontinuous contact with the second substrate.

20. The organic light emitting display device as claimed in claim **19**, wherein the plurality of contact portions are in a dot configuration on the stripe-shaped supporting portion.

* * * * *

专利名称(译)	有机发光显示装置		
公开(公告)号	US8829525	公开(公告)日	2014-09-09
申请号	US12/638052	申请日	2009-12-15
[标]申请(专利权)人(译)	金泰GON		
申请(专利权)人(译)	金泰GON		
当前申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
[标]发明人	KIM TAE GON		
发明人	KIM, TAE-GON		
IPC分类号	H01L27/14		
CPC分类号	H01L51/5237 H01L51/525 H01L27/3246		
优先权	1020090012312 2009-02-16 KR		
其他公开文献	US20100207107A1		
外部链接	Espacenet USPTO		

摘要(译)

一种有机发光显示装置，包括：第一基板;第一基板上的多个有机发光二极管;多个间隔物，在与多个有机发光二极管对应的发光区域的侧面上彼此间隔开;第二基板面向第一基板并且通过多个间隔件以一定间隔与第一基板间隔开。