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(19) **United States**(12) **Patent Application Publication****Song et al.**(10) **Pub. No.: US 2007/0210706 A1**(43) **Pub. Date: Sep. 13, 2007**(54) **ORGANIC LIGHT EMITTING DIODE
DISPLAY DEVICE AND METHOD FOR
FABRICATING THE SAME**(76) Inventors: **Seung Yong Song, Yongin-si (KR);
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IRVINE, CA 92614**(21) Appl. No.: **11/701,821**(22) Filed: **Feb. 2, 2007**(30) **Foreign Application Priority Data**

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Publication Classification(51) **Int. Cl.****H05B 33/00** (2006.01)**H01L 51/50** (2006.01)(52) **U.S. Cl. 313/506; 313/509; 313/503**(57) **ABSTRACT**

Disclosed is an organic light emitting diode display capable of preventing a phenomenon of Newton's rings by maintaining a constant gap between a first substrate and a second substrate, and a method for fabricating the same. The organic light emitting diode display includes a first substrate including at least of pixel selected from the group consisting of a plurality of red, blue and green subpixels; and a second substrate arranged to be overlapped with the first substrate and having black matrixes respectively formed in positions corresponding to the subpixels and interfaces of the subpixels, wherein the organic light emitting diode display has a spacer between the first substrate and the second substrate.

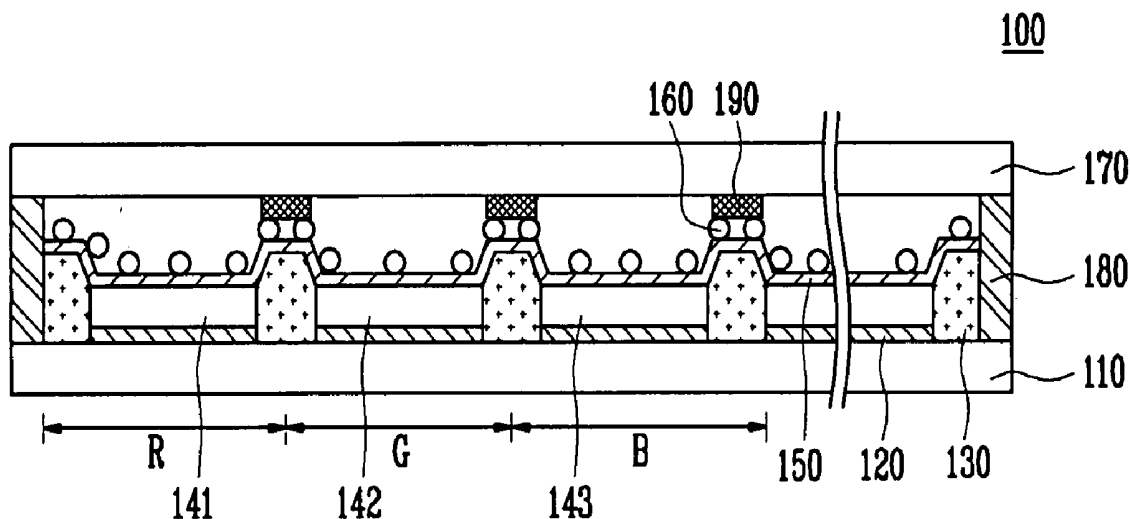


FIG. 1

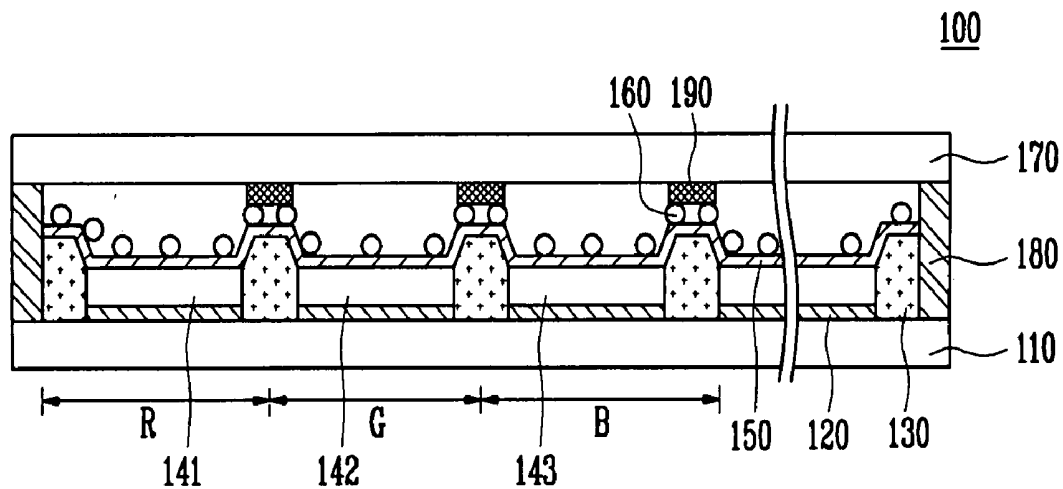


FIG. 2A

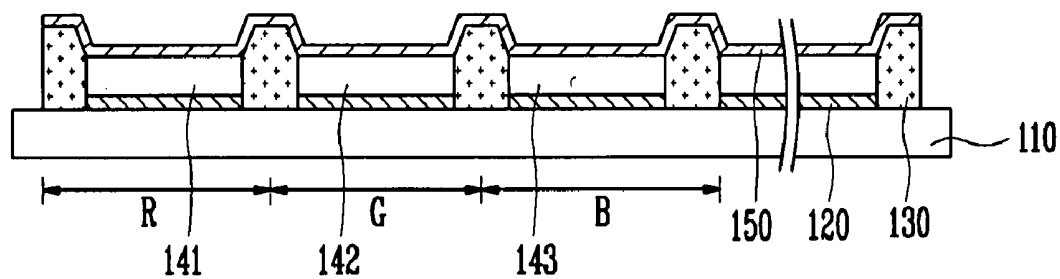


FIG. 2B

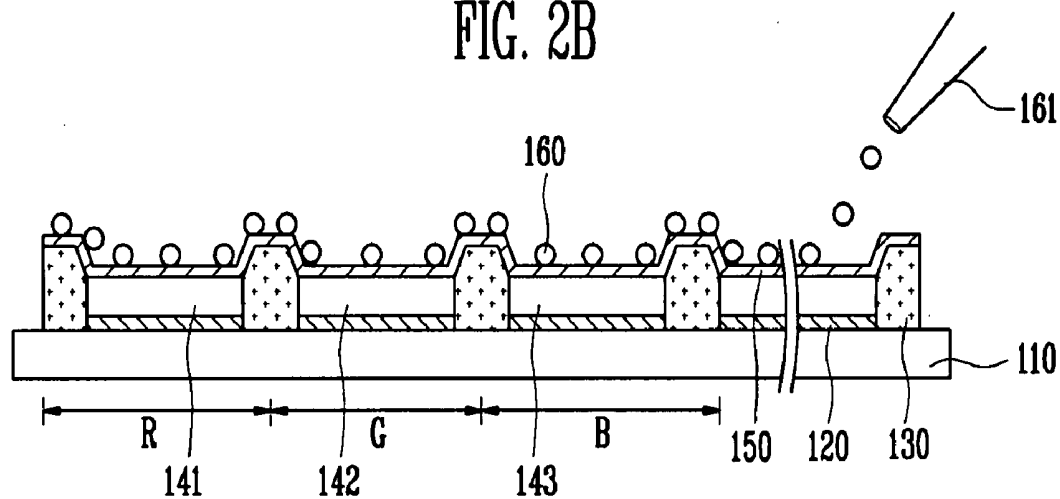


FIG. 2C

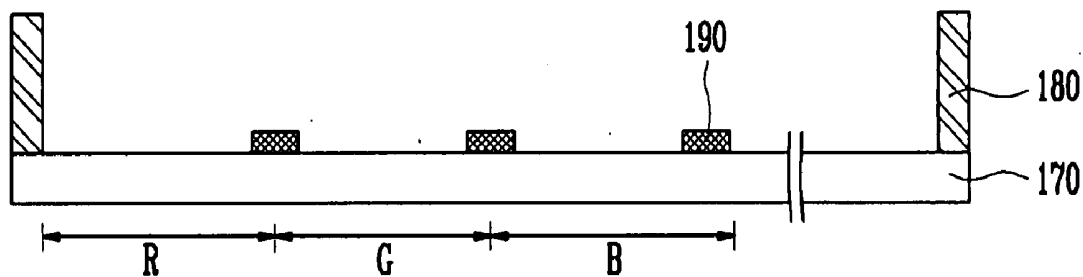


FIG. 2D

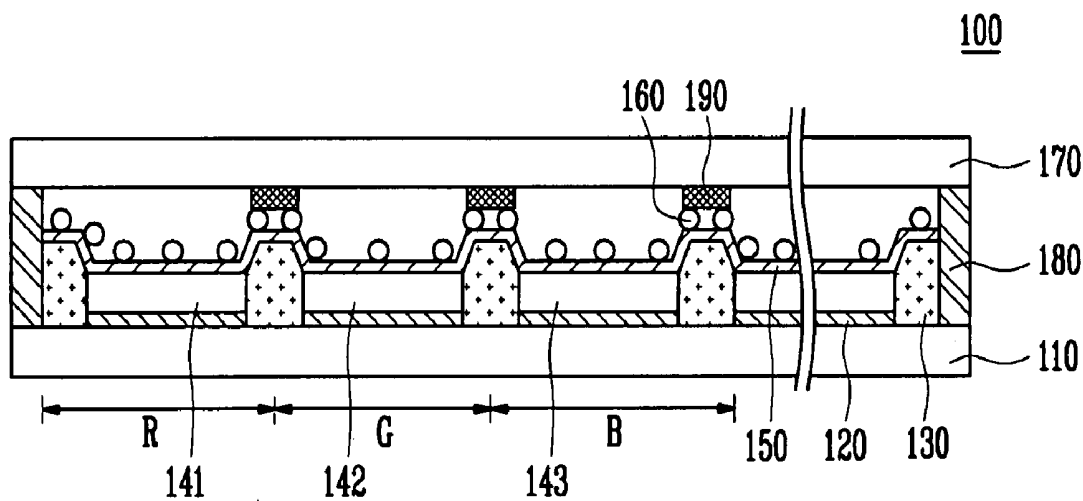


FIG. 3

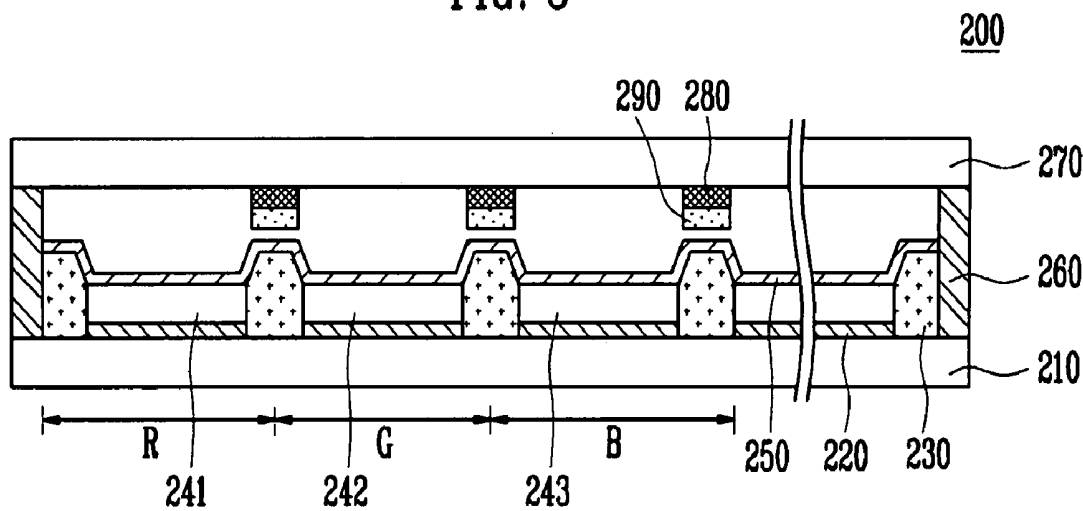


FIG. 4A

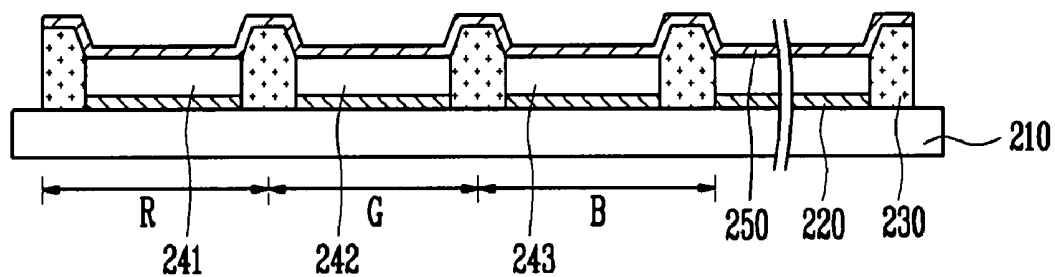


FIG. 4B

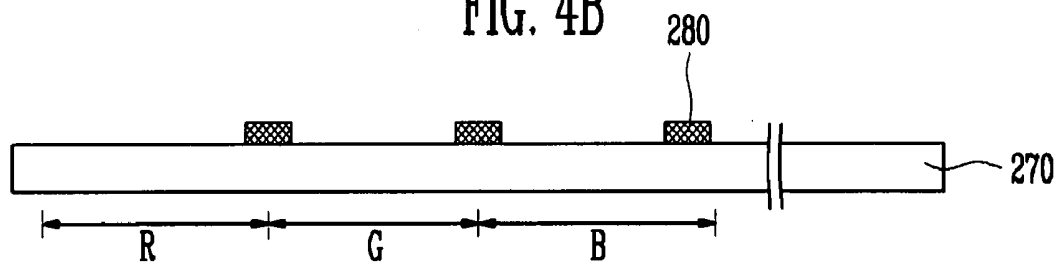


FIG. 4C

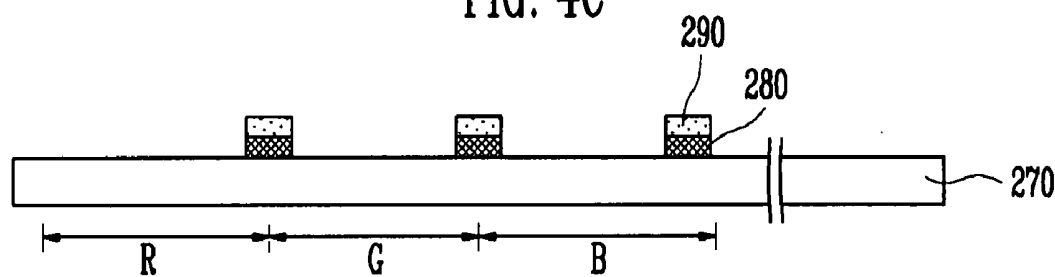


FIG. 4D

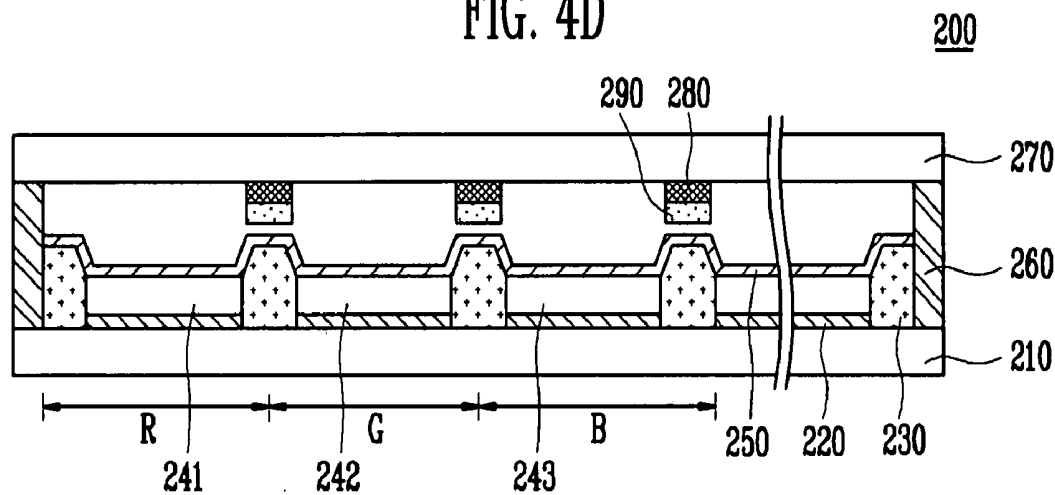


FIG. 5

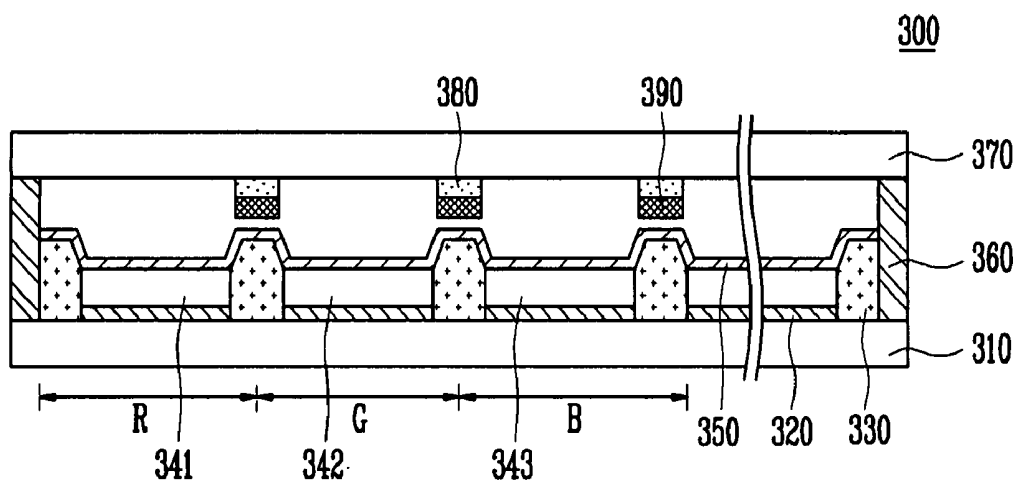
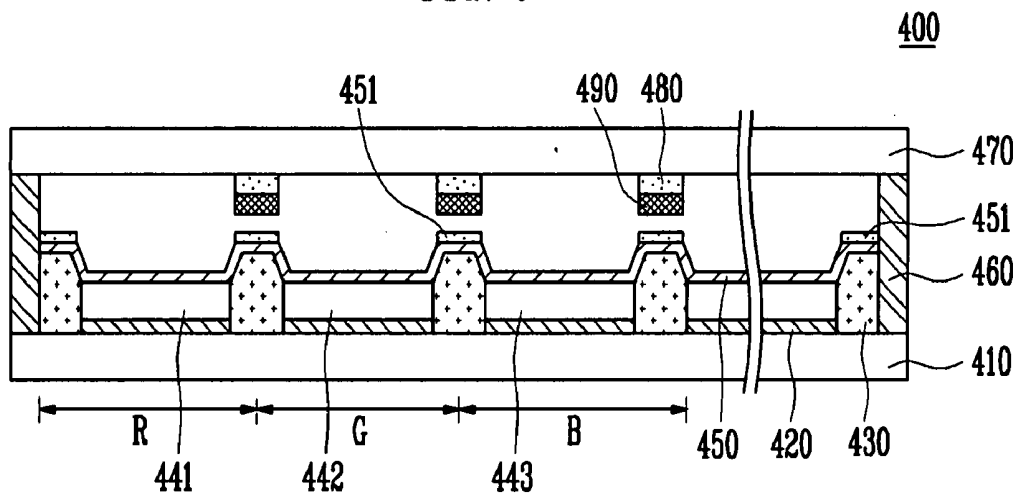


FIG. 6



**ORGANIC LIGHT EMITTING DIODE
DISPLAY DEVICE AND METHOD FOR
FABRICATING THE SAME**

**CROSS-REFERENCE TO RELATED
APPLICATIONS**

[0001] This application claims the benefit of Korean Patent Application No. 2006-0021889, filed on Mar. 8, 2006 and 2006-0067393, filed on Jul. 19, 2006, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

BACKGROUND

[0002] 1. Field of the Invention

[0003] The present invention relates to an organic light emitting diode display and a method for fabricating the same, more specifically to an organic light emitting diode display capable of preventing a phenomenon of Newton's rings by further forming a spacer between a first substrate and a second substrate having a black matrix formed therein, thereby to maintain a constant gap between the first substrate and the second substrate, and a method for fabricating the same.

[0004] 2. Discussion of Related Art

[0005] In recent years, the organic light emitting diode display has been widely used in this field and has a relatively simple configuration. The organic light emitting diode display, also referred to as an organic light emitting diode device, is a self-emissive display using an organic film layer as an emission layer, and the organic light emitting diode display itself is thin and light-weight since it does not need an additional back light for emitting the light unlike a liquid crystal display. Accordingly, there have been many active attempts to develop organic light emitting diode displays as display panels of portable information terminals, including portable computers, cell phones, portable game apparatuses, electronic books, etc.

[0006] Some top emissive organic light emitting diode display has a structure having an emission layer interposed between a first electrode and a second electrode. Generally, a substrate has a thin film transistor is formed on a substrate, and also a first electrode, electrically connected with the thin film transistor, is formed on the substrate. The first electrode functions as an anode for injecting a hole. An emission layer is formed on the first electrode, and a second electrode is formed on the emission layer. The second electrode functions as a cathode for injecting an electron. Also, the first electrode includes a reflective film having a high reflectivity, and the second electrode is formed of a transparent electrode.

[0007] Also, the organic light emitting diode display further includes an encapsulation substrate so that the organic light emitting diode device can be isolated from the outside environment to prevent moisture from being penetrated since a life span of the display may be shortened due to oxidation, peeling, etc. of electrode materials, and therefore a luminescence efficiency may be deteriorated if moisture and oxygen flow in from the neighboring environment. The encapsulation substrate has an edge in the outer region of the substrate.

[0008] However, the mentioned-above organic light emitting diode display includes a polarizer attached to a top surface of the encapsulation substrate so as to prevent a

contrast of the organic light emitting diode device from being deteriorated by reflection of an external light since the contrast may be deteriorated when the external light reflects from a metallized material. However, the polarizer has disadvantages that its manufacturing cost is expensive and a luminescence efficiency may be deteriorated due to reduction of transmissivity of the light reflecting from the emission layer.

[0009] For this, a black matrix, patterned on a plurality of subpixels and encapsulation substrates corresponding to interfaces of the subpixels, is formed to function in place of the polarizer.

[0010] There has been proposed a method in which the organic light emitting diode display fabricated using the mentioned-above method is fabricated with a flat and thin glass encapsulation substrate by removing off an edge of the encapsulation substrate as the displays get slim.

[0011] However, such an encapsulation substrate droops from a central region, and therefore an optical interference phenomenon by the light generated from the light emitting diode display formed on the substrate is caused to form a concentric pattern from a contact point of the encapsulation substrate if a gap between the substrate and the encapsulation substrate is formed very close to each other, or if the substrate or the encapsulation substrate attached to each other is bended. An optical phenomenon where such a concentric pattern is displayed in an image is called a Newton's ring, which distorts the image.

SUMMARY

[0012] An organic light emitting display device is provided. The device comprises: a first substrate; a second substrate comprising a display surface configured to display an image thereon; an array of organic light emitting pixels provided between the first substrate and the second substrate; a black matrix provided between the array and the second substrate; and a plurality of inserts formed between the array and the second substrate. The black matrix and at least part of the inserts in combination keep the second substrate and the array apart from each other.

[0013] At least part of the inserts may be aligned with the black matrix along a direction generally perpendicular to the display surface. At least part of the inserts may be fixed to the black matrix or the array.

[0014] The array may comprise a plurality of emissive surfaces for emitting visible light and a plurality of non-emissive surfaces for partitioning the plurality of emissive surfaces, wherein each emissive surface has a distance to the display surface of the second substrate, wherein the distance of one of the emissive surfaces generally in the center of the array is substantially the same as the distance of one of the emissive surfaces away from the center of the array.

[0015] The array may comprise a plurality of emissive surfaces for emitting visible light and a plurality of non-emissive surfaces for partitioning the plurality of emissive surfaces, wherein each emissive surface and the second substrate forms a gap therebetween. The gap has a distance defined between each emissive surface and the second substrate is at least about 6 μm . Each insert has a height in a direction perpendicular to the display surface from about 3 μm to about 12 μm .

[0016] At least part of the inserts may be substantially transparent.

[0017] The array may comprise a plurality of emissive surfaces for emitting visible light and a plurality of non-emissive surfaces for partitioning the plurality of emissive surfaces, and wherein the black matrix is aligned with at least part of the non-emissive surfaces such that the black matrix does not substantially block visible light from the emissive surface.

[0018] The inserts may be provided between the black matrix and the second substrate.

[0019] The inserts may comprise a plurality of beads.

[0020] The inserts may comprise a plurality of stripes generally aligned with the black matrix.

[0021] The device of claim 1, wherein the array comprises a plurality of emissive surfaces for emitting visible light and a plurality of non-emissive surfaces for partitioning the plurality of emissive surfaces, wherein at least part of the inserts contact at least one of the emissive and non-emissive surfaces.

[0022] The black matrix may be generally aligned with the non-emissive surfaces such that visible light from the emissive surface can pass through openings defined by the black matrix, and wherein at least part of the inserts are provided between the black matrix and at least part of the non-emissive surfaces. The non-emissive surfaces comprise a bump portion which is closer to the second substrate than a non-bump portion, wherein at least part of the inserts are provided between the black matrix and the bump portion of the non-emissive surface.

[0023] The black matrix is formed on the second substrate.

[0024] The black matrix comprises a plurality of stripes defining a plurality of opening between two neighboring stripes, wherein at least part of the plurality of inserts are stripes aligned with at least part of the black matrix stripes.

[0025] A method for fabricating an organic light emitting display device is provided. The method comprises: providing a first plate comprising a first substrate and an array of organic light emitting pixels; providing a second plate comprising a second substrate and a black matrix formed on the second substrate; aligning the first plate and the second plate such that the black matrix and the array are interposed between the first and second substrates; forming a plurality of inserts between the array and the second substrate such that the black matrix and at least part of the inserts in combination keep the second substrate and the array apart from each other; and integrating the first plate with the second plate using an adhesive member. The black matrix may comprise a plurality of stripes defining a plurality of opening between two neighboring stripes, wherein at least part of the plurality of inserts are stripes aligned with at least part of the black matrix stripes.

[0026] Accordingly, an aspect of the present invention is designed to solve such drawbacks, and therefore an object of the present invention is to provide an organic light emitting diode display capable of preventing a phenomenon of Newton's rings by further forming a spacer between a first substrate and a second substrate having a black matrix formed therein, thereby to maintain a constant gap between the first substrate and the second substrate, and a method for fabricating the same.

[0027] The first aspect of the present invention is achieved by providing an organic light emitting diode display, including a first substrate including at least of pixel selected from the group consisting of a plurality of red, blue and green subpixels; and a second substrate arranged to be overlapped

with the first substrate and having black matrixes respectively formed in positions corresponding to the subpixels and interfaces of the subpixels, wherein the organic light emitting diode display has a spacer between the first substrate and the second substrate.

[0028] Preferably, the spacer has a thickness of 3 to 12 μm , and the spacer is a transparent polystyrene-based material. The spacer is a spherical ball spacer, or the spacer is composed of at least one material selected from the group consisting of organic materials and an organic/inorganic mixtures.

[0029] The first aspect of the present invention is achieved by providing a method for fabricating an organic light emitting diode display, including steps of preparing a first substrate having at least one pixel selected from the group consisting of a plurality of red, blue and green subpixels; distributing a spacer on the first substrate; arranging a second substrate arranged to be overlapped with the first substrate and having black matrixes respectively formed in positions corresponding to the subpixels and interfaces of the subpixels; coating the outermost region of the second substrate with an adhesive member; and attaching the first substrate to the second substrate by means of the adhesive member, followed by curing the adhesive member.

[0030] The first aspect of the present invention is achieved by providing a method for fabricating an organic light emitting diode display, including steps of preparing a first substrate having at least one pixel selected from the group consisting of a plurality of red, blue and green subpixels; arranging a second substrate arranged to be overlapped with the first substrate and having black matrixes respectively formed in positions corresponding to the subpixels and interfaces of the subpixels; forming a spacer on the black matrix; coating the outermost region of the first substrate with a sealant; and attaching the first substrate to the second substrate by means of the sealant, followed by curing the sealant.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031] These and/or other aspects and advantages of the invention will become apparent and more readily appreciated from the following description of the preferred embodiments, taken in conjunction with the accompanying drawings of which:

[0032] FIG. 1 is a cross-sectional view showing an organic light emitting diode display according to a first embodiment of the present invention.

[0033] FIGS. 2A to 2D are cross-sectional views showing a method for fabricating the organic light emitting diode display according to the first embodiment of the present invention.

[0034] FIG. 3 is a cross-sectional view showing an organic light emitting diode display according to a second embodiment of the present invention.

[0035] FIGS. 4A to 4D are cross-sectional views showing a method for fabricating the organic light emitting diode display according to the second embodiment of the present invention.

[0036] FIG. 5 is a cross-sectional view showing an organic light emitting diode display according to a third embodiment of the present invention.

[0037] FIG. 6 is a cross-sectional view showing an organic light emitting diode display according to a fourth embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0038] Hereinafter, preferable embodiments according to the present invention will be described with reference to the accompanying drawings. Here, when one element is connected to another element, one element may be not only directly connected to another element but also indirectly connected to another element via another element. Further, irrelative elements are omitted for clarity. Also, like reference numerals refer to like elements throughout.

[0039] FIG. 1 is a cross-sectional view showing an organic light emitting diode display according to a first embodiment of the present invention.

[0040] Referring to FIG. 1, the organic light emitting diode display 100 includes a first substrate 110 including at least one pixel selected from the group consisting of a plurality of red (R), green (G) and blue (B) subpixels; and a second substrate 170 arranged to be overlapped with the first substrate 110 and having black matrix 190 respectively formed in positions corresponding to the subpixels and interfaces of the subpixels, wherein the organic light emitting diode display 100 has a spacer 160 between the first substrate 110 and the second substrate 170.

[0041] On the first substrate 110 is formed a plurality of pixels selected from the group consisting of red (R), green (G) and blue (B) subpixels. Each of the subpixels (R,G,B) includes a thin film transistor and an organic light emitting diode device. The organic light emitting diode device includes a first electrode, an emission layer and a second electrode. For convenience's sake of description, a detailed disclosure and specific description of a thin film transistor are omitted. The first substrate 110 is made of insulating materials such as glass, plastic, silicon or synthetic resin, and preferably a glass substrate.

[0042] The first electrode 120 is patterned on the first substrate 110 having subpixel regions of the red (R), green (G) and blue (B) colors, respectively. The first electrode 120 is made of conductive metal compounds such as, but is not limited to, aluminum (Al), aluminum alloy, silver (Ag), silver alloy, MoW, molybden (Mo), copper (Cu) or ITO, IZO and like. However, an aspect of the present invention relates to a top emissive organic light emitting diode display 100 in which a reflector layer is further formed on at least one surface of the first electrode 120.

[0043] The pixel definition layer 130 is formed on the first electrode 110, and an opening for at least partially exposing the first electrode 110 is formed on the pixel definition layer 130. The pixel definition layer 130 defines each pixel formed on the first electrode 110.

[0044] A red emission layer 141, a green emission layer 142 and a blue emission layer 143 corresponding to each pixel region are patterned on the first electrode 110. The red emission layer 141, the green emission layer 142 and the blue emission layer 143 may further include some of a hole injection layer, a hole transport layer, an electron transport layer and an electron injection layer. The red emission layer 141, the green emission layer 142 and the blue emission layer 143 generate the lights by binding to holes and electrons injected from the first electrode 120 and the second electrode 150.

[0045] The second electrodes 150 are formed on the pixel definition layer 130, the red emission layer 141, the green emission layer 142 and the blue emission layer 143. The second electrode 150 is preferably formed of one material out of transparent ITO, IZO and ZnO.

[0046] Meanwhile, the spacer 160 is distributed on the second electrode 150. The spacer 160 is formed of a transparent polystyrene-based material, which transmits the lights generated in the red emission layer 141, the green emission layer 142 and the blue emission layer 143, and formed into a spherical ball spacer. Also, the sum of thicknesses of the spacer 160 and the black matrix 190 accounts for at least 6 μm . This is preventing a phenomenon of Newton's rings since the phenomenon of Newton's rings is generated if the gap between the first substrate 110 and the second substrate 170 is 5 μm or less. Also, the spacer 160 has a thickness, namely a diameter of 3 to 12 μm . Also, if a protective layer is further formed on the second electrode 150, the spacer 160 is distributed on the protective layer.

[0047] The spacer 160 maintains a constant gap between the first substrate 110 and the second substrate 170. That is to say, the spacer 160, distributed on the second electrode 150 formed on the pixel definition layer 130, is in direct contact with the black matrix 190, formed in a lower surface of the second substrate 170, thereby to prevent the second substrate 170 from being in direct contact with the first substrate 110. Accordingly, a phenomenon of Newton's rings, generated as the second substrate 170 droops, may be prevented by maintaining a constant gap between the first substrate 110 and the second substrate 170.

[0048] The second substrate 170 is formed on the first substrate 110 to prevent the red emission layer 141, the green emission layer 142 and the blue emission layer 143 from being exposed to oxygen or moisture from the outside environment. The first substrate 110 is in contact with the second substrate 170 by means of an adhesive member 180 coated along a circumferential direction of the second substrate 170. The adhesive member 180 may be formed of a sealant or a frit. The frit may be formed of one selected from the group consisting of K_2O , Fe_2O_3 , Sb_2O_3 , ZnO , P_2O_5 , V_2O_5 , TiO_2 , Al_2O_3 , B_2O_3 , WO_3 , SnO and PbO .

[0049] The second substrate 170 is formed of a flat and thin glass. A transparent substrate transmitting the lights generated in the red emission layer 141, the green emission layer 142 and the blue emission layer 143 is preferably used as the second substrate 170. Also the second substrate 170 may be formed into a thin glass substrate provided with a color filter. In this case, an emission layer is formed with a single color, and the color filter converts the lights, emitted from the emission layers (141,142,143), into predetermined colors.

[0050] Also, the black matrixes 190 having a predetermined pattern are formed in lower surfaces of the second substrates 170, namely lower surfaces of the second substrates 170 corresponding to the subpixels (R,G,B) and interfaces of the subpixels (R,G,B). The black matrix 190 makes each color of the subpixels (R,G,B) vivid by shielding the lights, emitted from the red, green and blue emission layers (141,142,143) in every subpixels (R,G,B), and makes an image vivid by minimizing reflectivity of the lights incident from the outside environment. Organic polymeric resins having a low photorefectivity, or metal materials such as chromium (Cr) and molybden (Mo) are used for the black matrix 190.

[0051] FIGS. 2A to 2D are cross-sectional views showing a method for fabricating the organic light emitting diode display according to the first embodiment of the present invention.

[0052] Referring to FIG. 2A, a first substrate 110 is prepared for the first time to fabricate the organic light emitting diode display 100. On the first substrate 110 is formed a plurality of pixels selected from the group consisting of subpixels of red (R), green (G) and blue (B) colors. On the first substrate 110 are formed a thin film transistor and an organic light emitting diode device corresponding to each of the subpixels. The organic light emitting diode device includes a first electrode, an emission layer and a second electrode. On the first substrate 110 are formed first electrodes 120 corresponding to subpixel regions of the red (R), green (G) and blue (B) colors. A pixel definition layer 130 is formed on the first electrode 120, and includes an opening for exposing at least one region of the first electrode 110. On the first electrode 110 are patterned the red emission layer 141, the green emission layer 142 and the blue emission layer 143 corresponding to each of the subpixels (R,G,B). The red emission layer 141, the green emission layer 142 and the blue emission layer 143 may be made of a single-layer film or a plurality of multi-layer films selected from the group consisting of a hole injection layer, a hole transport layer, an emission layer, a hole inhibition layer, an electron transport layer and an electron injection layer. The second electrodes 150 are deposited on top surfaces of the pixel definition layer 130, the red emission layer 141, the green emission layer 142 and the blue emission layer 143.

[0053] Referring to FIG. 2B, a spacer 160 is distributed on the second electrode 150 of the first substrate 110. The spacer 160 is distributed on the first substrate 110 using an automatic spacer dispenser 161. Also, the spacer 160 is formed into a transparent polystyrene-based ball spacer, and the spacer 160 has diameter of 3 to 12 μm .

[0054] Referring to FIG. 2C, a black matrix 190 having a predetermined pattern is formed on a lower surface of the second substrate 170 in positions corresponding to the subpixels (R,G,B) and interfaces of the subpixels (R,G,B). That is to say, the black matrix 190 is formed on the second substrate 160 corresponding to pixel definition layer 130 for defining pixels among the red emission layer 141, the green emission layer 142 and the blue emission layer 143. The black matrix 190 is patterned into a predetermined shape by coating the lower surface of the second substrate 170 with at least one metal material selected from the groups consisting of organic polymeric resins having a low photorefectivity, chromium (Cr) and molybden (Mo), followed by undergoing exposure and development processes using a photomask, etc. However, a height and a width of the black matrix 190 are limited to the range where the red, green and blue colors (141,142,143) are not deteriorated. Also, an adhesive member 180 is coated at a predetermined thickness along a circumferential direction of the second substrate 170, namely along the outermost region of the second substrate 170 so as to seal the first substrate 110 and the second substrate 170.

[0055] Referring to FIG. 2D, the second substrate 170, coated with the adhesive member 180, is in contact with the first substrate 110. At this time, the black matrix 190, formed in the lower surface of the second substrate 170, is arranged to face against the first substrate 110. Then, an organic light emitting diode device, formed on the first substrate 110, is

prevented from moisture or oxygen by curing the adhesive member 180 using an ultraviolet ray (UV), a laser, an infrared ray or the like.

[0056] FIG. 3 is a cross-sectional view showing an organic light emitting diode display according to a second embodiment of the present invention.

[0057] In order to avoid an overlapped description, detailed descriptions of the same components as in the mentioned-above first embodiment, for example a first substrate 110, a first electrode 120, a second electrode 170 and a black matrix 190 are omitted.

[0058] Referring to FIG. 3, the organic light emitting diode display 200 includes a first substrate 210 including at least one pixel selected from the group consisting of a plurality of red (R), green (G) and blue (B) subpixels; and a second substrate 270 arranged to be overlapped with the first substrate 210 and having black matrix 280 respectively formed in positions corresponding to the subpixels and interfaces of the subpixels, wherein a spacer 290 is formed on the black matrix 280.

[0059] The first electrode 220 is patterned on the first substrate 210 having subpixel regions of the red (R), green (G) and blue (B) colors, respectively.

[0060] The pixel definition layer 230 is formed on the first electrode 220, and an opening for at least partially exposing the first electrode 220 is formed on the pixel definition layer 230.

[0061] On the first electrode 220 are patterned the red emission layer 241, the green emission layer 242 and the blue emission layer 243 corresponding to each pixel region. The red emission layer 241, the green emission layer 242 and the blue emission layer 243 generate the lights by binding to holes and electrons injected from the first electrode 220 and the second electrode 250.

[0062] The second electrode 250 is formed on top surfaces of the pixel definition layer 230, the red emission layer 241, the green emission layer 242 and the blue emission layer 243.

[0063] Meanwhile, the spacer 290 is formed on the black matrix 280. The spacer 290 maintains a constant gap between the first substrate 210 and the second substrate 270. The spacer 290 prevents the second substrate 270 and the black matrix 280 from being in direct contact with the first substrate 210. Accordingly, a phenomenon of Newton's rings, caused when the second substrate 270 droops, may be prevented by maintaining a constant gap between the first substrate 210 and the second substrate 270. The spacer 290 is composed of at least one material selected from the group consisting of organic materials and organic/inorganic mixtures. Also, the sum of thicknesses of the spacer 290 and the black matrix 280 accounts for at least 6 μm . At this time, the spacer 290 has a thickness of 3 to 12 μm . This is preventing a phenomenon of Newton's rings since the phenomenon of Newton's rings is generated if the gap between the first substrate 210 and the second substrate 270 is 5 μm or less.

[0064] FIGS. 4A to 4D are cross-sectional views showing a method for fabricating the organic light emitting diode display according to the second embodiment of the present invention.

[0065] Referring to FIG. 4A, a first substrate 210 is firstly prepared to fabricate the organic light emitting diode display 200. On the first substrate 210 are formed a plurality of pixels selected from the group consisting of red (R), green (G) and blue (B) subpixels. The subpixels (R,G,B) have a

thin film transistor and an organic light emitting diode device formed in the first substrate **210**, the thin film transistor and the organic light emitting diode device corresponding to each of the subpixels. The organic light emitting diode device includes a first electrode, an emission layer and a second electrode. On the first substrate **210** are formed first electrodes **220** corresponding to subpixel regions of the red (R), green (G) and blue (B) colors. A pixel definition layer **230** is formed on the first electrode **220**, and includes an opening for exposing at least one region of the first electrode **220**. On the first electrode **220** are patterned the red emission layer **241**, the green emission layer **242** and the blue emission layer **243** corresponding to each of the subpixels (R,G,B). The red emission layer **241**, the green emission layer **242** and the blue emission layer **243** may be made of a single-layer film or a plurality of multi-layer films selected from the group consisting of a hole injection layer, a hole transport layer, an emission layer, a hole inhibition layer, an electron transport layer and an electron injection layer. The second electrodes **270** are deposited on top surfaces of the pixel definition layer **230**, the red emission layer **241**, the green emission layer **242** and the blue emission layer **243**.

[0066] Referring to FIG. 4B, the second substrate **270** is prepared to seal the first substrate **210**. The black matrixes **280** having a predetermined pattern are formed in positions corresponding to the subpixels (R,G,B) and interfaces of the subpixels (R,G,B) on a lower surface of the second substrate **270**. That is to say, the black matrix **280** is formed on the second substrate **260** corresponding to pixel definition layer **230** for defining pixels among the red emission layer **241**, the green emission layer **242** and the blue emission layer **243**. The black matrix **280** is patterned into a predetermined shape by coating the lower surface of the second substrate **270** with at least one metal material selected from the groups consisting of organic polymeric resins having a low photo-reflectivity, chromium (Cr) and molybden (Mo), followed by undergoing exposure and development processes using a photomask, etc. However, a height and a width of the black matrix **280** are limited to the range where colors of the red, green and blue (**241,242,243**) emission layers are not deteriorated.

[0067] Referring to FIG. 4C, a spacer **290** is formed on the black matrix **280**. The spacer **290** is at least one material selected from the group consisting of organic materials and organic/inorganic mixtures, and has a height of 3 to 12 μm which corresponds to a width of the black matrix **280**. Also, the sum of thicknesses of the black matrix **280** and the spacer **290** thickness accounts for at least 6 μm .

[0068] Referring to FIG. 4D, a sealant **260** is coated at a predetermined thickness along a circumferential direction of the first substrate **210**, namely along the outermost region of the first substrate **210** so as to seal the first substrate **210** and the second substrate **270**. The second substrate **270** is in contact with the first substrate **210** coated with the sealant **260**. At this time, the spacer **290**, formed in the lower surface of the second substrate **270**, is arranged to face against the first substrate **210**. Then, the first substrate **210** and the second substrate **270** are completely sealed by curing the sealant **260** using a UV-ray or the like.

[0069] FIG. 5 is a cross-sectional view showing an organic light emitting diode display according to a third embodiment of the present invention.

[0070] In order to avoid an overlapped description, detailed descriptions of the same components as in the mentioned-above first embodiment, for example a first substrate **110**, a first electrode **120**, a second electrode **170** and a black matrix **190** are omitted.

[0071] Referring to FIG. 5, the organic light emitting diode display **300** includes a first substrate **310** including at least one pixel selected from the group consisting of a plurality of red (R), green (G) and blue (B) subpixels; a spacer **380** arranged to be overlapped with the first substrate **310** and respectively formed with a predetermined pattern in positions corresponding to the subpixels and interfaces of the subpixels on a lower surface of the second substrate **370**; and a black matrix **390** formed on the spacer **380**.

[0072] On the first substrate **310** are formed a plurality of pixels selected from the group consisting of the red (R), green (G) and blue (B) subpixels. Generally, the subpixels have a thin film transistor and an organic light emitting diode device formed on the first substrate **310**. The organic light emitting diode device includes a first electrode, an emission layer and a second electrode.

[0073] The first electrode **320** is patterned on the first substrate **310** having subpixel regions of the red (R), green (G) and blue (B) colors.

[0074] The pixel definition layer **330** is formed on the first electrode **320**, and an opening for at least partially exposing the first electrode **320** is formed on the pixel definition layer **330**.

[0075] The red emission layer **341**, the green emission layer **342** and the blue emission layer **343** corresponding to each of the pixel regions are patterned on the first electrode **320**. The red emission layer **341**, the green emission layer **342** and the blue emission layer **343** generate the lights by binding to holes and electrons injected from the first electrode **320** and the second electrode **350**.

[0076] The second electrodes **350** are formed on top surfaces of the pixel definition layer **330**, the red emission layer **341**, the green emission layer **342** and the blue emission layer **343**.

[0077] The second substrate **370** is formed on the first substrate **310** to prevent the red emission layer **341**, the green emission layer **342** and the blue emission layer **343** from being exposed to the outside environment. The second substrate **370** is in contact with the first substrate **310** by means of the sealant **360** coated along a circumferential direction of the first substrate **310**.

[0078] Meanwhile, the spacer **380** is formed with a predetermined pattern on a lower surface of the second substrate **370**, namely on a lower surface of the second substrate **370** corresponding to the subpixels (R,G,B) and interfaces of the subpixels (R,G,B). The spacer **380** is formed into a predetermined pattern by coating the lower surface of the second substrate **370** with one material selected from the groups consisting of organic materials and organic/inorganic mixtures, followed by undergoing exposure and development processes. The spacer **380** maintains a constant gap between the first substrate **310** and the second substrate **370**. The spacer **380** prevents the second substrate **370** from being in direct contact with the first substrate **310**. Accordingly, a phenomenon of Newton's rings, generated as the second substrate **370** droops, is prevented. The spacer **380** is composed of at least one material selected from the group consisting of organic materials and organic/inorganic mixtures. Also, the sum of thicknesses of the spacer **380** and the

black matrix 390 accounts for at least 6 μm . This is preventing a phenomenon of Newton's rings since the phenomenon of Newton's rings is generated if the gap between the first substrate 310 and the second substrate 370 is 5 μm or less. At this time, the spacer 380 has a thickness of 3 to 12 μm .

[0079] The black matrix 390 is formed on the second spacer 380. The black matrix 390 makes each color of the subpixels (R,G,B) vivid by shielding the lights, emitted from the red, green and blue emission layers (341,342,343), in every subpixels (R,G,B), and makes an image vivid by minimizing reflectivity of the lights incident from the outside environment. Organic polymeric resins having a low photorefectivity, or metal materials such as chromium (Cr) and molybden (Mo) are used for the black matrix 390.

[0080] FIG. 6 is a cross-sectional view showing an organic light emitting diode display according to a fourth embodiment of the present invention.

[0081] In order to avoid an overlapped description, detailed descriptions of the same components as in the mentioned-above first embodiment, for example a first substrate 110, a first electrode 120, a second electrode 170 and a black matrix 190 are omitted.

[0082] Referring to FIG. 6, the organic light emitting diode display 400 includes a first substrate 410 including at least one pixel selected from the group consisting of a plurality of red (R), green (G) and blue (B) subpixels and a first spacer 451 formed on the subpixel and an interface of the subpixel; a black matrix 480 arranged to be overlapped with the first substrate 410 and respectively formed with a predetermined pattern in a position corresponding to the spacer 451 on a lower surface of the second substrate 470; and a second spacer 490 formed on the black matrix 480.

[0083] The first electrode 420 is patterned on the first substrate 410 having subpixel regions of the red (R), green (G) and blue (B) colors.

[0084] The pixel definition layer 430 is formed on the first electrode 420, and an opening for at least partially exposing the first electrode 420 is formed on the pixel definition layer 430.

[0085] The red emission layer 441, the green emission layer 442 and the blue emission layer 443 corresponding to each of the pixel regions are patterned on the first electrode 420. The red emission layer 441, the green emission layer 442 and the blue emission layer 443 generate the lights by binding to holes and electrons injected from the first electrode 420 and the second electrode 450.

[0086] The second electrodes 450 are formed on top surfaces of the pixel definition layer 430, the red emission layer 441, the green emission layer 442 and the blue emission layer 443.

[0087] Meanwhile, the first spacers 451 are formed with a predetermined pattern on the subpixels (R,G,B) and interfaces of the subpixels (R,G,B), namely on the second electrode 450 having the pixel definition layer 430 formed therein. The first spacer 451 is formed into a predetermined pattern by coating the lower surface of the second substrate 470 with one material selected from the groups consisting of organic materials and organic/inorganic mixtures, followed by undergoing exposure and development processes. The first spacer 451 has a thickness of 1 to 5 μm . The most preferably, the first spacer 451 has a thickness of 1.2 μm . This is why the first spacer 451 desirably has a thickness as thin as possible, but it is difficult to form a thick first spacer

451 in the process itself since the first spacer 451 is composed of organic materials and organic/inorganic mixtures. As described above, the first spacer 451 maintains a constant gap between the first substrate 410 and the second substrate 470 in addition to the black matrix 480 and the second spacer 490 and prevents drooping of the second substrate 470.

[0088] The second substrate 470 is formed on the first substrate 410 so as to prevent the red emission layer 441, the green emission layer 442 and the blue emission layer 443 from being exposed to the outside environment. The second substrate 470 is in contact with the first substrate 410 by means of the sealant 460 coated along a circumferential direction of the first substrate 410.

[0089] Meanwhile, the second spacers 480 are formed with a predetermined pattern on a lower surface of the second electrode 470, namely on a lower surface of the second substrate 470 corresponding to the first spacer 451. The second spacer 480 is formed into a predetermined pattern by coating the lower surface of the second substrate 470 with one material selected from the groups consisting of organic materials and organic/inorganic mixtures, followed by undergoing exposure and development processes. The second spacer 480 maintains a constant gap between the first substrate 410 and the second substrate 470 in addition to the first spacer 451 and the black matrix 490. The second spacer 480, the first spacer 451 and the black matrix 490 prevent the second substrate 470 from being in direct contact with the first substrate 410. Accordingly, a phenomenon of Newton's rings, generated as the second substrate 470 droops, is prevented. The sum of thicknesses of the second spacer 480 and the black matrix 490 accounts for at least 5 μm . At this time, the second spacer 480 has a thickness of 3 to 12 μm . Also, the phenomenon of Newton's rings is prevented if the gap between the first substrate 410 and the second substrate 470 accounts for at least 6 μm , and therefore a thickness of the second spacer 480 and the black matrix 490 is set to at least 5 μm if the first spacer 451 has a thickness of 1 μm . That is to say, the phenomenon of Newton's rings is prevented if the gap between the first substrate 410 and the second substrate 470 accounts for at least 6 μm , and therefore the sum of thicknesses of the first spacer 451, the black matrix 490 and the second spacer 480 accounts for at least 6 μm .

[0090] Accordingly, the phenomenon of Newton's rings is generated as the second substrate 470 droops, and the gap between the first substrate 410 and the second substrate 470 is maintained at a length of at least 6 μm to prevent the phenomenon of Newton's rings.

[0091] The black matrix 490 is formed on the second spacer 480. The black matrix 490 makes each color of the subpixels (R,G,B) vivid by shielding the lights, emitted from the red, green and blue emission layers (441,442,443), in every subpixels (R,G,B), and makes an image vivid by minimizing reflectivity of the lights incident from the outside environment. Organic polymeric resins having a low photorefectivity, or metal materials such as chromium (Cr) and molybden (Mo) are used for the black matrix 490. For convenience's sake of description, it goes without saying that the black matrix 490 is formed on the second spacer 480, but a position on which the second spacer 480 and the black matrix 490 are formed may be changed herein.

[0092] As described above, according to embodiments of the present invention, a second substrate is prevented from

being in direct contact with a first substrate by further forming a spacer between the first substrate and the second substrate on which a black matrix is formed, thereby to maintain a constant gap between the first substrate and the second substrate. Accordingly, a drooping phenomenon of the second substrate is prevented, and therefore a phenomenon of Newton's rings generated in the display, namely a concentric pattern appearing on a screen is inhibited.

[0093] Although a few embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes might be made in this embodiment without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.

What is claimed is:

1. An organic light emitting display device comprising: a first substrate; a second substrate comprising a display surface configured to display an image thereon; an array of organic light emitting pixels provided between the first substrate and the second substrate; a black matrix provided between the array and the second substrate; and a plurality of inserts formed between the array and the second substrate, wherein the black matrix and at least part of the inserts in combination keep the second substrate and the array apart from each other.
2. The device of claim 1, wherein at least part of the inserts are aligned with the black matrix along a direction generally perpendicular to the display surface.
3. The device of claim 1, wherein at least part of the inserts are fixed to the black matrix or the array.
4. The device of claim 1, wherein the array comprises a plurality of emissive surfaces for emitting visible light and a plurality of non-emissive surfaces for partitioning the plurality of emissive surfaces, wherein each emissive surface has a distance to the display surface of the second substrate, wherein the distance of one of the emissive surfaces generally in the center of the array is substantially the same as the distance of one of the emissive surfaces away from the center of the array.
5. The device of claim 1, wherein the array comprises a plurality of emissive surfaces for emitting visible light and a plurality of non-emissive surfaces for partitioning the plurality of emissive surfaces, wherein each emissive surface and the second substrate forms a gap therebetween.
6. The device of claim 5, wherein the gap has a distance defined between each emissive surface and the second substrate is at least about 6 μm .
7. The device of claim 5, wherein each insert has a height in a direction perpendicular to the display surface from about 3 μm to about 12 μm .
8. The device of claim 1, wherein at least part of the inserts are substantially transparent.
9. The device of claim 1, wherein the array comprises a plurality of emissive surfaces for emitting visible light and

a plurality of non-emissive surfaces for partitioning the plurality of emissive surfaces, and wherein the black matrix is aligned with at least part of the non-emissive surfaces such that the black matrix does not substantially block visible light from the emissive surface.

10. The device of claim 1, wherein the inserts are provided between the black matrix and the second substrate.

11. The device of claim 1, wherein the inserts comprise a plurality of beads.

12. The device of claim 1, wherein the inserts comprise a plurality of stripes generally aligned with the black matrix.

13. The device of claim 1, wherein the array comprises a plurality of emissive surfaces for emitting visible light and a plurality of non-emissive surfaces for partitioning the plurality of emissive surfaces, wherein at least part of the inserts contact at least one of the emissive and non-emissive surfaces.

14. The device of claim 13, wherein the black matrix is generally aligned with the non-emissive surfaces such that visible light from the emissive surface can pass through openings defined by the black matrix, and wherein at least part of the inserts are provided between the black matrix and at least part of the non-emissive surfaces.

15. The device of claim 14, wherein the non-emissive surfaces comprise a bump portion which is closer to the second substrate than a non-bump portion, wherein at least part of the inserts are provided between the black matrix and the bump portion of the non-emissive surface.

16. The device of claim 1, wherein the black matrix is formed on the second substrate.

17. The device of claim 1, wherein the black matrix comprises a plurality of stripes defining a plurality of opening between two neighboring stripes, wherein at least part of the plurality of inserts are stripes aligned with at least part of the black matrix stripes.

18. A method for fabricating an organic light emitting display device comprising:

- providing a first plate comprising a first substrate and an array of organic light emitting pixels;
- providing a second plate comprising a second substrate and a black matrix formed on the second substrate;
- aligning the first plate and the second plate such that the black matrix and the array are interposed between the first and second substrates;
- forming a plurality of inserts between the array and the second substrate such that the black matrix and at least part of the inserts in combination keep the second substrate and the array apart from each other; and
- integrating the first plate with the second plate using an adhesive member.

19. The method of claim 18, wherein the black matrix comprises a plurality of stripes defining a plurality of opening between two neighboring stripes, wherein at least part of the plurality of inserts are stripes aligned with at least part of the black matrix stripes.

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摘要(译)

公开了一种能够通过第一基板和第二基板之间保持恒定间隙来防止牛顿环现象的有机发光二极管显示器及其制造方法。有机发光二极管显示器包括第一基板，该第一基板包括选自多个红色，蓝色和绿色子像素组成的组中的至少一个像素；第二基板，设置为与第一基板重叠，并且具有分别形成在与子像素的子像素和界面对应的位置的黑矩阵，其中，有机发光二极管显示器在第一基板和第二基板之间具有间隔物。

