



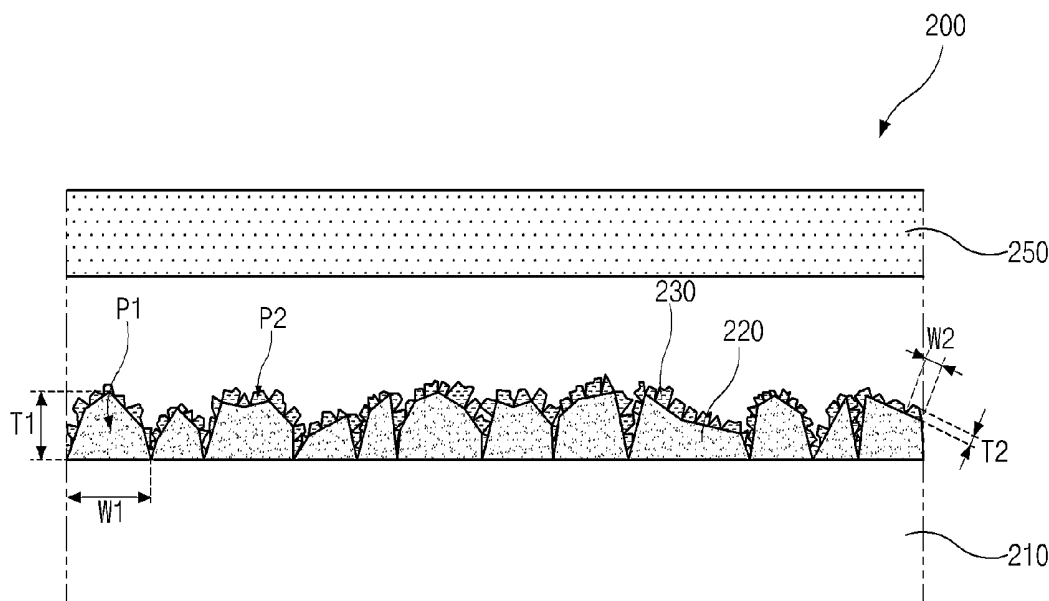
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JO et al.(10) **Pub. No.: US 2013/0285540 A1**(43) **Pub. Date: Oct. 31, 2013**(54) **ORGANIC LIGHT EMITTING DISPLAY
DEVICE AND METHOD FOR
MANUFACTURING THE SAME****Publication Classification**(51) **Int. Cl.**
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ABSTRACT

An organic light emitting display device (OLED) includes: a substrate; a first anode layer disposed on the substrate and including a plurality of first projections; a second anode layer formed on the first anode layer and including a plurality of second projections; an organic emission layer formed on the second anode layer; and a cathode layer formed on the organic emission layer. As a result, the anodes are formed to have a double projection structure to enhance light extraction efficiency.



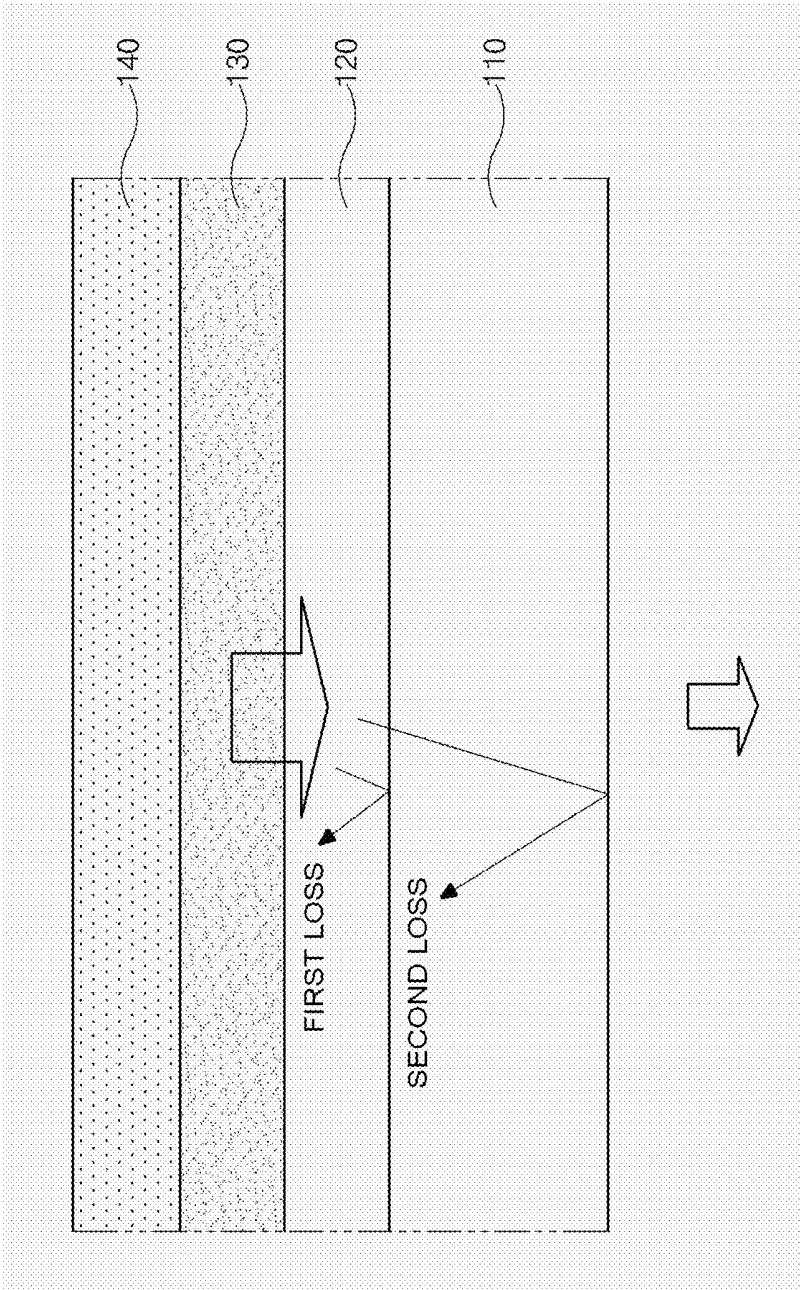


FIG 1
Related Art

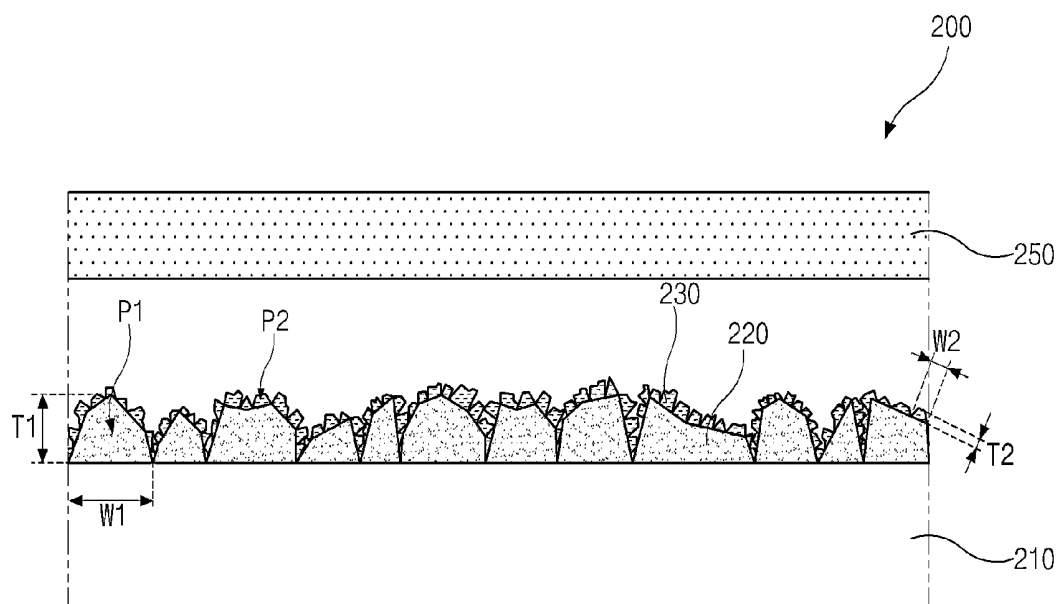


FIG. 2

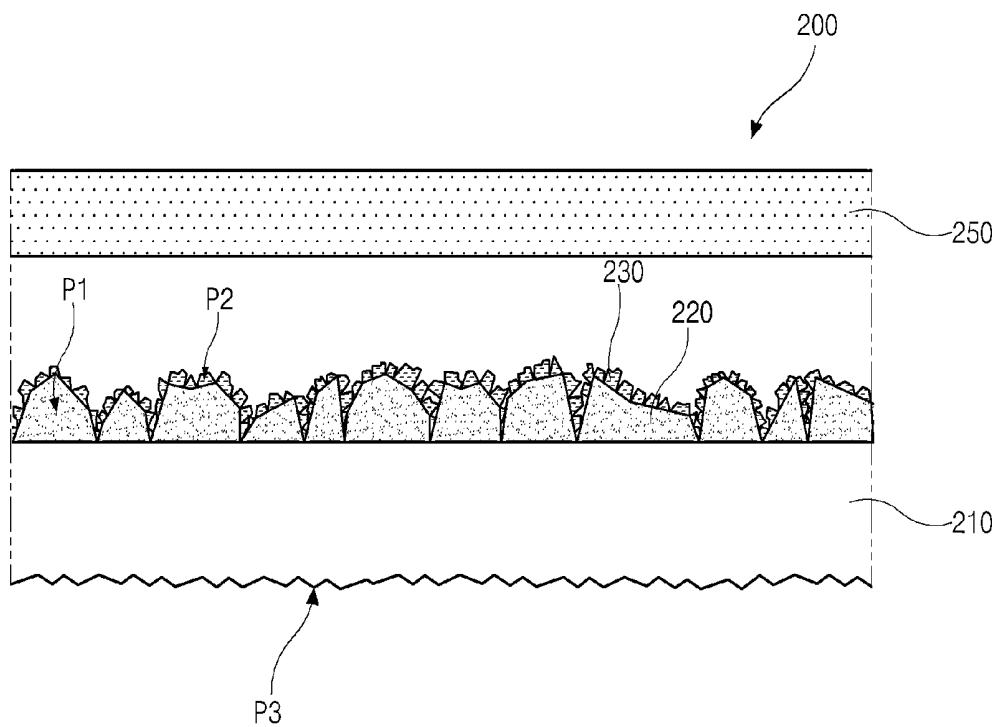


FIG. 3

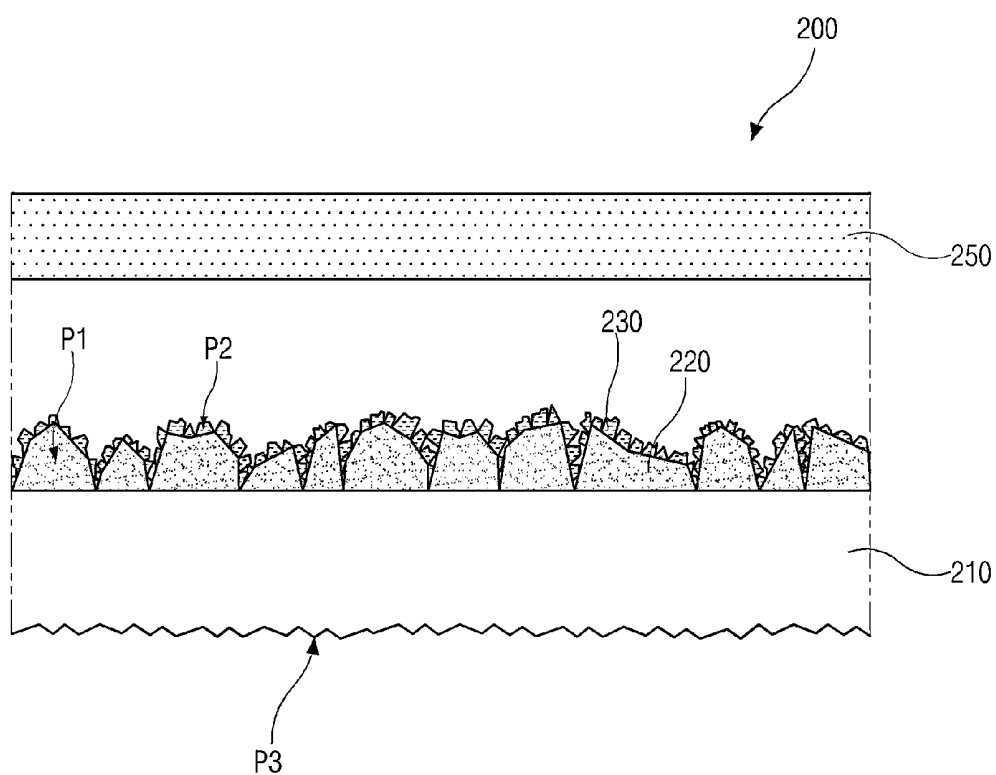


FIG. 4

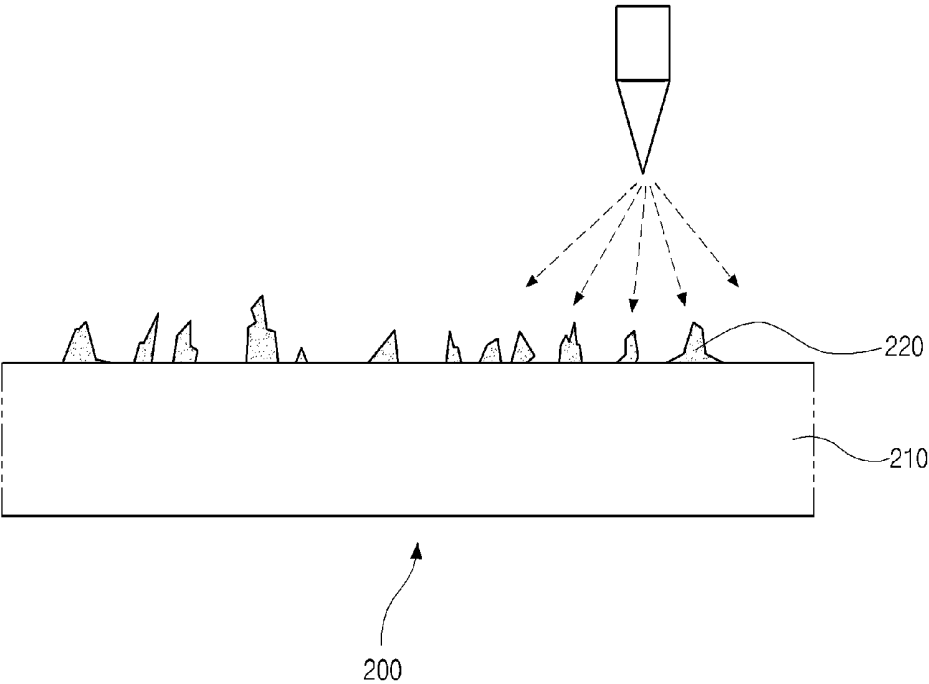


FIG 5A

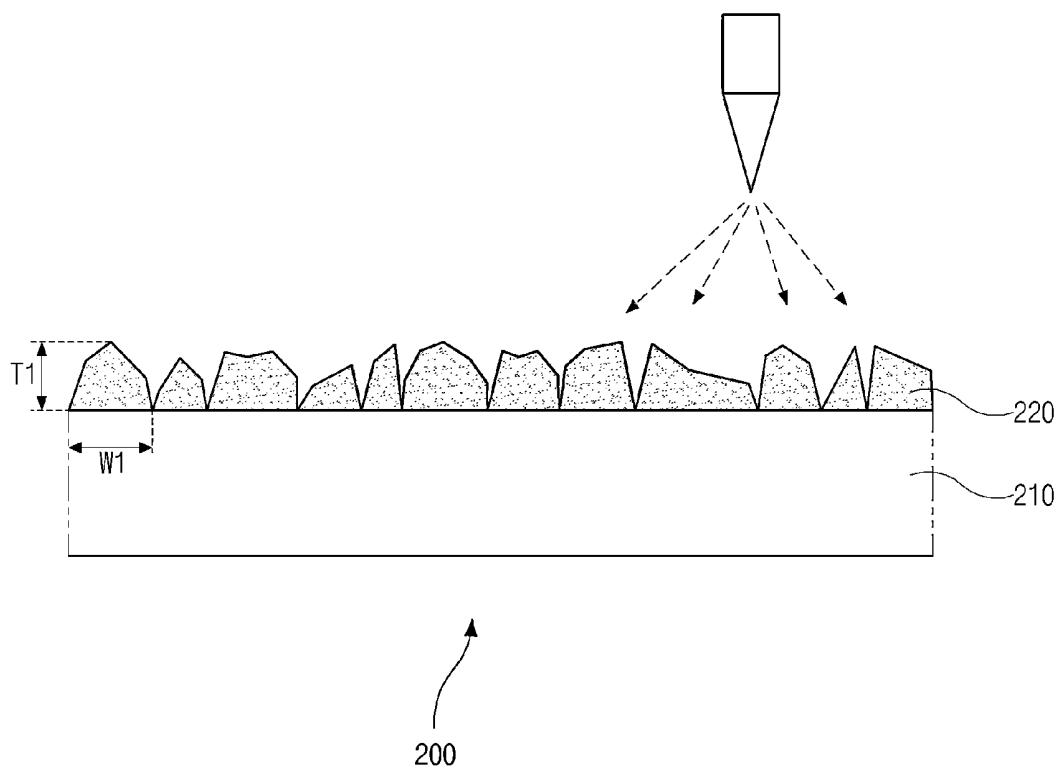


FIG 5B

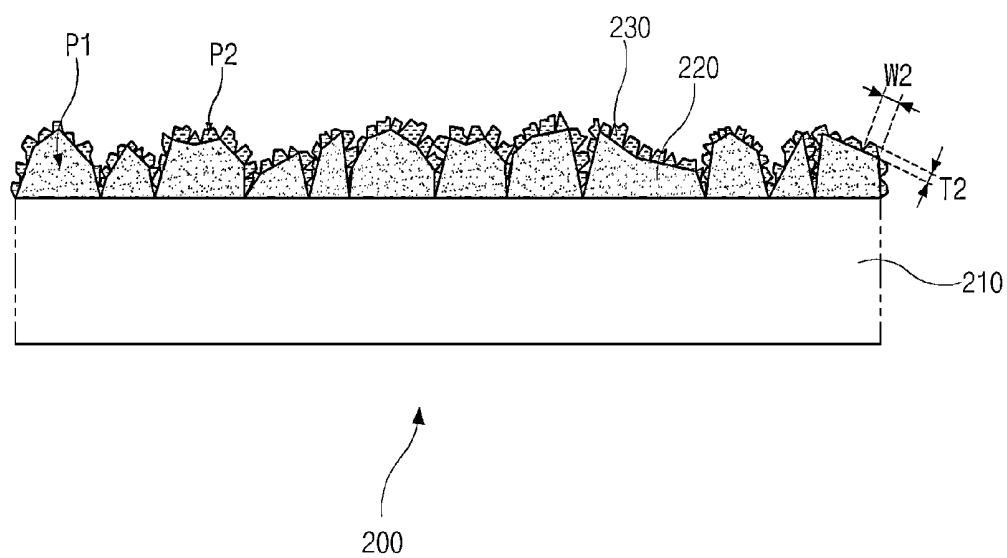


FIG 5C

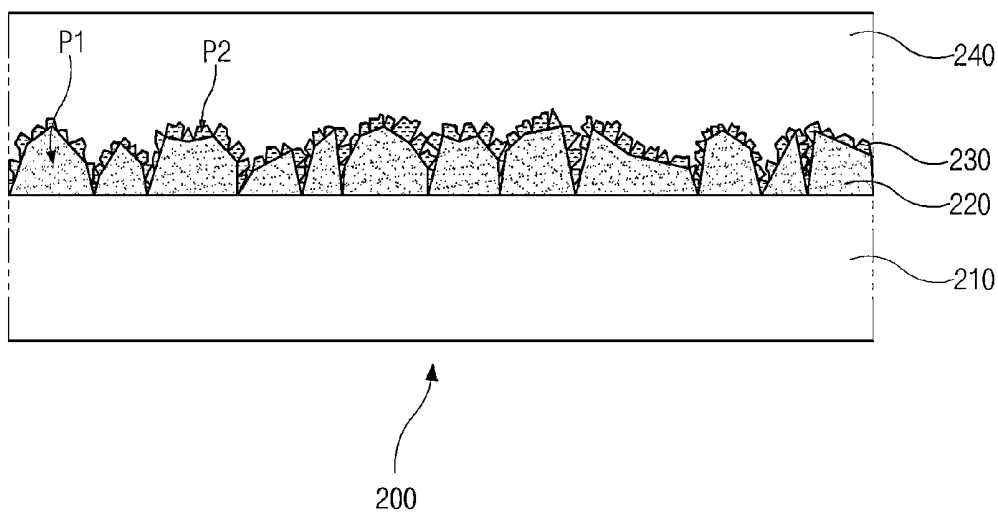


FIG 5D

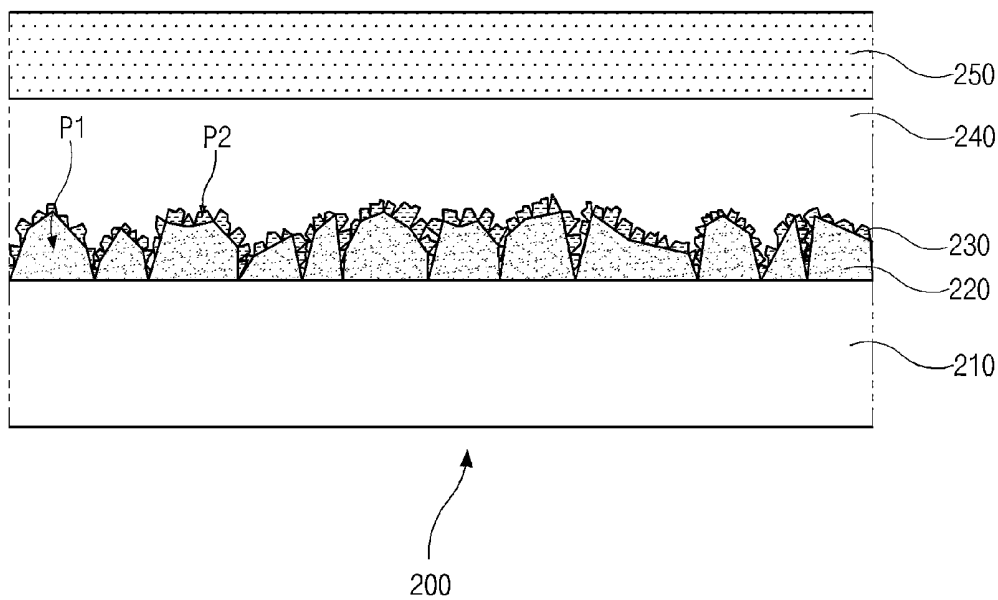


FIG 5E

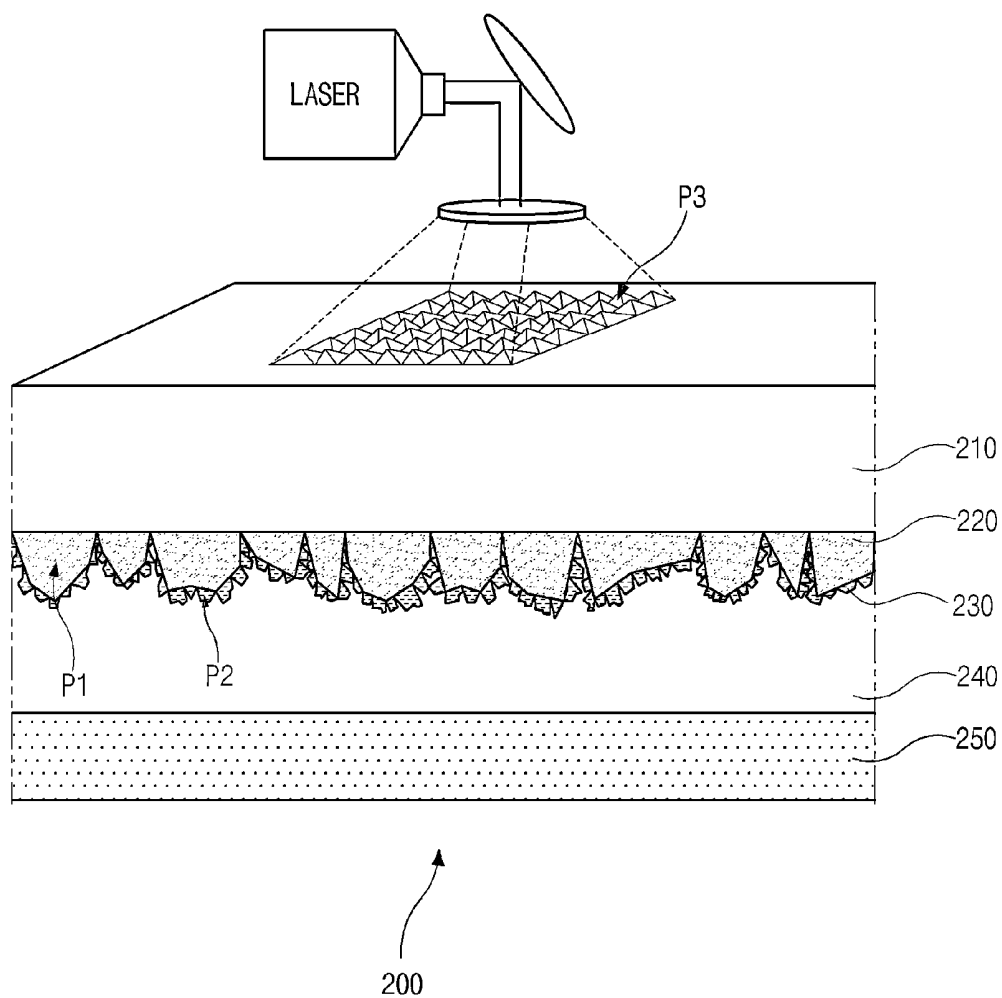


FIG 6

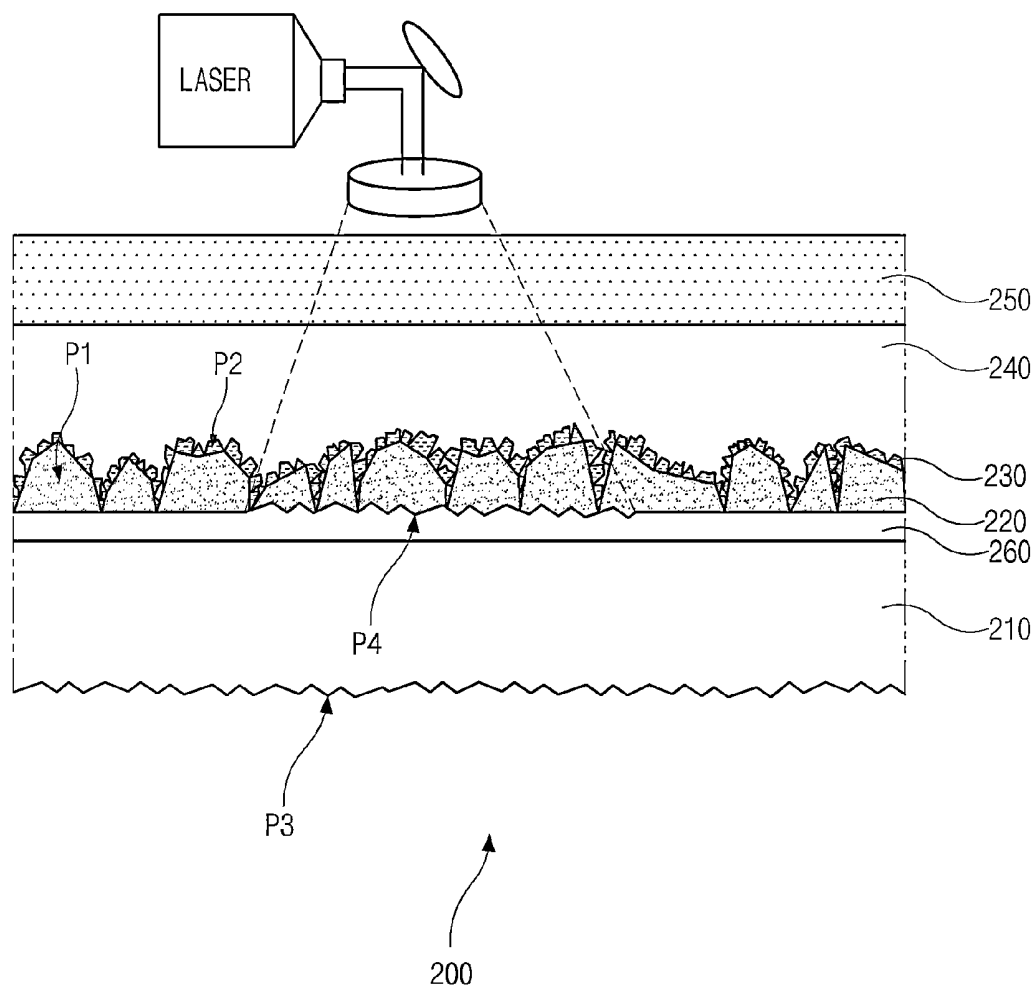


FIG. 7

ORGANIC LIGHT EMITTING DISPLAY DEVICE AND METHOD FOR MANUFACTURING THE SAME

[0001] The present application claims the priority benefit of Korean Patent Application No. 10-2012-0045561 filed in Republic of Korea on Apr/ 30, 2012, which is hereby incorporated by reference in its entirety.

BACKGROUND

[0002] 1. Field of the Disclosure

[0003] The present disclosure relates to an organic light emitting display device (OLED) and a method of fabricating the same, and more particularly, to an OLED whose light extraction efficiency is improved and a method of fabricating the same.

[0004] 2. Discussion of the Related Art

[0005] Following a liquid crystal display, an organic light emitting display device (OLED) characterized by thin thickness, high definition and driving at low power has been drawing an increasing amount of attention as a next-generation display. Reflecting such a current trend, research aimed at mass production of OLEDs has been extensively underway.

[0006] In particular, in order to enhance a device, new emission materials have been developed, and a multiple-layered structure for facilitating provision of electrons or holes has been researched. In addition, a technique enhancing efficiency of extracting internally generated light to the outside of a device has been developed.

[0007] Currently, light that is not outwardly extracted by total internal reflection in the OLED but blocked takes up 70% or more of the total emission amount, and if this light is outwardly extracted, light efficiency of the OLED may be significantly improved.

[0008] FIG. 1 is a cross-sectional view of a general OLED, and illustrates a bottom emission type in which light penetrates in a direction of a substrate 110. According to FIG. 1, the OLED has a structure in which an anode layer 120 formed of indium tin oxide (ITO) and/or indium zinc oxide (IZO), an organic emission layer 130 and a cathode layer 140 formed of a metal, are sequentially stacked on the substrate 110.

[0009] Light emitted from the organic emission layer 130 exhibits total reflection on a boundary between the anode layer 120 and the substrate 110. Here, in principal, an amount of the first loss of the light takes up 46% or more of the total emission amount. Also, among the remaining 54% of penetrating light, an amount of a second loss of the light that is totally reflected on the boundary between the substrate 110 and air is 34% or more in principal. Therefore, the light extracted outside of the substrate 110 is 20% or less of an emission rate of light emitted from the organic emission layer 130.

[0010] The OLED is formed as an ultra-thin film, and emitted light should penetrate the thin film to be outwardly emitted, so that significant light loss may be caused by the total reflection. When these problems are overcome, the OLED may be more efficiently implemented.

SUMMARY

[0011] Accordingly, the present invention relates to an organic light emitting display device (OLED) in which anodes formed on a substrate are formed to have a double projection structure to improve light extraction efficiency.

[0012] one object of the present disclosure is to provide an OLED having a substrate; a first anode layer disposed on the substrate and including a plurality of first projections; a second anode layer formed on the first anode layer and including a plurality of second projections; an organic emission layer formed on the second anode layer; and a cathode layer formed on the organic emission layer.

[0013] Another object of the present disclosure is to provide a method of fabricating an OLED, including forming a first anode layer including a plurality of first projections on a substrate; forming a second anode layer including a plurality of second projections on the first anode layer; forming an organic emission layer on the second anode layer; and forming a cathode layer on the organic emission layer.

[0014] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate exemplary embodiments of the invention and together with the description serve to explain the principles of the invention. In the drawings:

[0016] FIG. 1 is a cross-sectional view of a general organic light emitting display device (OLED);

[0017] FIG. 2 is a cross-sectional view of an organic light emitting display device (OLED) according to some embodiments of the present invention;

[0018] FIG. 3 is a cross-sectional view of an OLED according to additional embodiments of the present invention;

[0019] FIG. 4 is a cross-sectional view of an OLED according to yet additional embodiments of the present invention;

[0020] FIGS. 5A to 5E are cross-sectional views illustrating a method of fabricating an OLED according to some embodiments of the present invention;

[0021] FIG. 6 is a cross-sectional view illustrating a method of fabricating an OLED according to additional embodiments of the present invention; and

[0022] FIG. 7 is a cross-sectional view illustrating a method of fabricating an OLED according to yet additional embodiments of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0023] Reference will be made in detail to the exemplary embodiments, examples of which are illustrated in the accompanying drawings.

[0024] FIG. 2 is a cross-sectional view of an organic light emitting display device (OLED) according to some embodiments of the present invention. As illustrated in FIG. 2, the OLED 200 according to some embodiments of the present invention includes a substrate 210, a first anode layer 220, a second anode layer 230, an organic emission layer 240 and a cathode layer 250.

[0025] First and second projections P1 and P2 may be formed on the first and second anode layers 220 and 230 formed on the substrate 210, so that a total reflection phenomenon is reduced and light extraction efficiency is improved. The projections P1 and P2 may be formed by crystalline particles generated by gradually hardening a material consti-

tuting the first and second anode layers **220** and **230** formed by sputtering. The size of the crystalline particles is different depending on a material, and the first and second anode layers **220** and **230** may be formed of different materials, and thus widths **W1** and **W2** of the projections **P1** and **P2** are differently formed. The widths **W1** and **W2** used herein denote the lengths in a horizontal direction of bottoms of the projections **P1** and **P2**.

[0026] Meanwhile, the material constituting the first and second anode layers **220** and **230** may be determined by thicknesses **T1** and **T2** of the first and second anode layers **220** and **230** depending on a film forming amount of the material constituting the first and second anode layers **220** and **230**. The thickness **T1** of the first anode layer **220** as used herein denotes a length from a lowermost end to an uppermost end in a direction vertical to a surface in contact with a substrate **210**, and the thickness **T2** of the second anode layer **220** and **230** denotes a length from a lowermost end to an uppermost end in a direction vertical to a curved surface in contact with the first anode layer **220**. For example, the second anode layer **230** exhibits a curve on the surface in contact with the first anode layer **220**, and thus the vertical direction on which the thickness **T2** is based may be varied. A difference between the thicknesses **T1** and **T2** of the first and second anode layers **220** and **230** and that between the widths **W1** and **W2** of the projections **P1** and **P2** may have a direct effect on light extraction efficiency, which is the basic principle of the present invention.

[0027] First, the substrate **210** may be formed of glass, or may include polyimide that is a bendable material.

[0028] The first anode layer **220** may be formed on the substrate **210**. The first anode layer **220** may be formed of tin oxide or zinc oxide using a sputtering method. The first anode layer **220** may be formed to a thickness **T1** from about 500 to about 2500 Å, from about 1000 to about 2000 Å, from about 1000 to about 2500 Å, or from about 1500 to about 2000 Å. A plurality of projections **P1** formed on the first anode layer **220** may be formed to a width **W1** from about 1000 to 5000 Å, from about 2000 to about 4000 Å, from about 2000 to about 5000 Å, or from about 3000 to 4000 Å. The first projection **P1** may be in the shape of a pillar that is upwardly narrowed and sharp. The detailed shape may be varied. Therefore, the first projection **P1** that is in the uniform shape in the drawing may be in various shapes.

[0029] In some embodiments, the anode layer of the OLED **200** may include a material (e.g. indium tin oxide, indium zinc oxide, and a mixture thereof) taking into account transmission rate, resistance and work function. Therefore, the second anode layer **230** may be formed of indium tin oxide and/or indium zinc oxide to employ a double projection structure capable of maintaining functions of the anode layer and having a smoother surface.

[0030] The second anode layer **230** may be formed on the first anode layer **220**. The second anode layer **230** may be formed of indium tin oxide and/or indium zinc oxide using a sputtering method. The second anode layer **230** may be formed to a thickness **T2** from about 5 to about 250 Å, from about 10 to about 200 Å, or from about 50 to about 100 Å, and the plurality of second projections **P2** formed on the second anode layer **230** may be formed to a width **W2** from about 10 to about 500 Å, from about 50 to about 400 Å, from about 100 to about 300 Å, or from about 200 to about 300 Å. Similar to the first projection **P1**, while the second projection **P2** may be in the shape of a pillar that is gradually upwardly narrowed

and sharp, its detailed shape may be varied. Therefore, while the second projection **P2** is in a uniform shape in the drawing, the second projection **P2** may have various shapes like the first projection **P1**.

[0031] Accordingly, the double projection structure of the anode layers **220** and **230** may cause many diffraction points of light, so that total reflection of the light at a boundary of the stacked structure may be further reduced.

[0032] In addition, when the second anode layer **230** may include indium tin oxide and/or indium zinc oxide, work function of the anode layers **220** and **230** may be improved, which may facilitate injection of holes into the organic emission layer **240**.

[0033] The organic emission layer **240** may be formed on the second anode layer **230**. The organic emission layer **240** may be formed of a multiple-layered structure in which several layers are stacked to help holes and electrons move as well as a layer that actually emits light. The organic emission layer **240** may emit light having energy as great as a band gap by flowing electrons provided from the cathode layer **250** from a conduction band to a valence band to be combined with holes provided from the anode layers **220** and **230**.

[0034] Meanwhile, when the projection is large and has a sharp upper end, the organic emission layer **240** formed on the anode layers **220** and **230** may be divided and damaged, and the damage is mainly exhibited on a cusp of the uppermost end of the projection, i.e., a crack point. In the double projection structure of the present invention, since the width **W2** of the second projection **P2** may be from about 2 to about 500 times, from about 10 to about 100 times, from about 50 to about 300 times, or from about 100 to about 300 times smaller than the width **W1** of the first projection **P1**, the second projection **P2** may reduce the degree of sharpness of the first projection **P1**. Accordingly, the double projection structure may remove the crack point to prevent the organic emission layer **240** from being damaged.

[0035] The cathode layer **250** may be formed on the organic emission layer **240**. Since the cathode layer **250** may comprise a material that exhibits high reflectance (e.g. silver (Ag) and aluminum (Al)) and may function as a reflection plate as well as an electrode.

[0036] FIG. 3 is a cross-sectional view of an OLED according to a second embodiment of the present invention.

[0037] As illustrated in FIG. 3, an OLED **200** according to additional embodiments of the present invention includes a plurality of third projections **P3** on the substrate **210**. The substrate **210** has a refraction index of about 1.5, and the air has a refraction index of 1.0, and thus total reflection frequently may occur at a boundary between the substrate **210** and the outside. Similarly to the first and second projections **P1** and **P2**, the third projection **P3** may reduce the total reflection of light penetrating the first and second anode layers **220** and **230** at the boundary between the substrate **210**, so that light extraction efficiency is increased.

[0038] FIG. 4 is a cross-sectional view of an OLED according to some embodiments of the present invention.

[0039] As illustrated in FIG. 4, the OLED **200** according to some embodiments of the present invention includes a low refraction layer **260** between the substrate **210** and the first anode layer **220**.

[0040] Since the low refraction layer **260** may be formed of a material exhibiting a different refraction index from the substrate, when light passing through the low refraction layer **260** travels toward the substrate **210**, total reflection occurs

less, so that light loss is reduced, and at the same time, linearity of light emitted from the substrate **210** may be improved.

[0041] In addition, when the linearity of light is improved, the total reflection of light emitted from the OLED **200** is reduced, so that light extraction efficiency is improved. As previously described, the substrate **210** according to some embodiments has a refraction index of about 1.5 that is the refraction index of glass, and the air has a refraction index of 1.0, and thus when light is outwardly emitted from the substrate **210**, the total reflection occurs. However, when linearity of light is improved before the light is outwardly emitted from the substrate **210**, since most of the light travels toward a boundary between the substrate **210** and the outside at an incidence angle smaller than a critical angle, the total reflection may be reduced even though the light travels from a medium exhibiting low refraction to that exhibiting high refraction.

[0042] Meanwhile, when the light travels from the anode layer **220** to the low refraction layer **260**, a significant difference in refraction index therebetween causes total reflection to frequently occur. In order to prevent this problem, when a plurality of fourth projections **P4** are formed on a surface of the low refraction layer **260** in contact with the anode layer **220**, an incidence angle of the light partially incident on the fourth projections **P4** may be smaller than a critical angle, and the diffraction phenomenon of the light occurs on an irregular part, so that the total reflection is reduced.

[0043] Therefore, the low refraction layer **260** may be formed of a material exhibiting a different (lower or higher) refraction index than 1.5 that is a refraction index of glass. The material constituting the different refraction layer **260** includes, for example, SiO_2 exhibiting a refraction index of about 1.54.

[0044] A method of fabricating an OLED according to some embodiments of the present invention will be described in detail below with reference to FIGS. 5A to 5G.

[0045] As illustrated in FIG. 5A, first anode layers **220** may be formed on a substrate **210** using a sputtering method. In an initial step of film forming of a material constituting the first anode layers **220**, the first anode layers **220** may be grown in a plurality of pillars spaced apart from each other as illustrated in the drawing. In the subsequent process, empty spaces between the pillars may be filled to be formed in the shape of a layer, and an upper region in the pillar shape becomes a first projection **P1** of the first anode layer **220**.

[0046] In forming the first projection **P1**, the temperature of the substrate is maintained similar to a melting point of a sputtering material to gradually lower the temperature, so that crystals may be fully generated. When a difference in temperature between the melting point and the substrate is great and the material rapidly hardens, the material may be solidified in an amorphous state before forming the crystals, so that a projection with a desired width cannot be formed. Therefore, a double projection structure is formed by adjusting the temperature of the substrate.

[0047] In FIG. 5B, the first anode layers **220** on which a plurality of projections **P1** are formed are illustrated. The first anode layers **220** may be formed to have a thickness **T1** from about 500 to about 2500 Å, from about 1000 to about 2500 Å, from about 1000 to about 2000 Å, from about 1500 to about 2000 Å, and the plurality of first projections **P1** formed on the first anode layer **220** may be formed to a width **W1** from about 1000 to about 5000 Å, from about 2000 to about 4000 Å, or

from about 3000 to about 4000 Å. The first anode layer **220** may include tin oxide or zinc oxide.

[0048] While it is not illustrated in the drawing, an etching or laser process may be further employed after the sputtering process, and the first projection **P1** may be elaborately handled to a desired size and shape.

[0049] The etching process is a process in which a dipping or spray process may be performed on a layer to be formed to expose the layer to an alkaline solution, so that its surface is etched. After performing the sputtering process, the surface of the first anode layer **220** may be exposed to an alkaline solution to further smooth the plurality of first projections **P1**. Also, the etching process may enable the formed projections to be smoothed, and new projections to be formed on the smooth surface on which no projection is formed.

[0050] The laser process includes radiating a laser in a specific wavelength absorbed by the layer to be formed to form projections. When the laser is radiated, the layer absorbing the laser generates heat, so that its surface is melted. At this time, when radiation of the laser is stopped, the temperature around the layer is maintained at a lower temperature than the melting point to form crystals, and the melted part is hardened again. When crystallization is performed while the layer is hardened, since its surface is hardened in the same shape as the crystal, the first projection **P1** may be adjusted again in a similar manner to adjusting the size of crystals constituting a material.

[0051] The first anode layer **220** may include tin oxide or zinc oxide, and a laser wavelength absorbed by the materials is in a wavelength of a near infrared ray, which is about 1064 nm. While the melted part is hardened again after radiating a laser in the wavelength, the width **W1** of the plurality of first projections **P1** may be adjusted. The laser process may be possible after other layers are formed.

[0052] Like the etching process, in the laser process, the formed projections may be smoothed through recrystallization, and new projections may be formed on a smooth surface on which no projection is formed.

[0053] Next, as illustrated in FIG. 5C, a second anode layer **230** may be formed on the first anode layer **220**. The second anode layer **230** may be formed by a sputtering method as well. The second anode layer **230** is formed to a thickness **T2** from 5 to 250 Å, from 10 to 200 Å, from 50 to 150 Å, from 100 to 250 Å, or from 100 to 200 Å, and a plurality of second projections **P2** formed on the second anode layer **230** may be formed to a width **W2** from about 10 to 500 Å, from about 100 to 400 Å, from about 150 to 300 Å, or from about 200 to 300 Å. The second anode layer **230** may include a material whose growing crystals are smaller than the materials in the first anode layer **220**. For example, the second anode layer **230** may include indium tin oxide and/or indium zinc oxide, and growing crystals are smaller than tin oxide or zinc oxide in the first anode layer **220**, and thus the width **W2** of the second projection **P2** may be smaller than the width **W1** of the first projection **P1**.

[0054] Further, tin oxide and zinc oxide are superior to indium tin oxide and/or indium zinc oxide in terms of transparency and price, and thus are good materials capable of improving brightness and reducing manufacturing costs. However, tin oxide and zinc oxide exhibit low work function, and thus have lower efficiency of providing holes to the organic emission layer **240**. In order to overcome the problem with work function, the second anode layer **230** may include indium tin oxide and/or indium zinc oxide.

[0055] When the width, thickness and density of the projections are insufficiently adjusted using only the sputtering method in forming the second anode layer **230**, the etching or laser process may be further employed after the sputtering process, so that the second projection **P2** may be smoothed to a desired size and shape.

[0056] Afterwards, as illustrated in FIG. 5D, the organic emission layer **240** may be formed on the second anode layer **230**. The organic emission layer **240** may be formed by a thermal evaporation method. The organic emission layer **240** is formed on the anode layers **220** and **230** from which a crack point is removed, and thus may not be damaged in or after the formation of the layer.

[0057] Then, as illustrated in FIG. 5E, a cathode layer **250** is formed on the organic emission layer **240**. The cathode layer **250** may be formed by a sputtering method, and may be formed of a metal (e.g. silver (Ag) or aluminum (Al)) exhibiting a high reflection index. The light emitted to a rear surface of the organic emission layer **240** is reflected from the cathode layer **250** to be emitted to the outside, so that brightness may be enhanced.

[0058] FIG. 6 is a cross-sectional view illustrating a method of fabricating an OLED according to further embodiments of the present invention, and is a view illustrating a method of fabricating only parts different from those described in the first embodiment.

[0059] As illustrated in FIG. 6, a plurality of third projections **P3** may be formed on the substrate **210**. The third projections **P3** may be formed through the above-described etching process or laser process. It is illustrated in the drawing that the third projections **P3** may be formed on the substrate **210** using a laser after the cathode layer **250** is formed. That is, the substrate **210** may be exposed to an alkaline solution to etch a surface of the substrate or a laser is radiated to melt the surface of the substrate **210**, so that the third projections **P3** are formed through recrystallization.

[0060] FIG. 7 is a cross-sectional view illustrating a method of fabricating an OLED according to yet further embodiments of the present invention, and is a view illustrating a method of fabricating only parts different from those described in the second embodiment.

[0061] As illustrated in FIG. 7, a plurality of fourth projections **P4** may be formed on a surface of a low refraction layer **260** in contact with the substrate **210**. It is illustrated in the drawing that the fourth projections **P4** may be formed on the low refraction layer **260** using a laser after forming the cathode layer **250**. While the etching process of the methods of forming the fourth projections **P4** may be performed before forming the anode layers **220** and **230**, the laser process may be performed regardless of time after the low refraction layer **260** is formed.

[0062] According to the present invention, anodes formed on a substrate have a double projection structure to improve light extraction efficiency.

[0063] Also, the anodes that are in contact with an organic emission layer employ a double projection structure to remove a crack point, so that the organic emission layer may be prevented from being damaged.

[0064] Further, according to the present invention, light extraction efficiency is enhanced, so that high brightness can be implemented with low power consumption.

[0065] It will be apparent to those skilled in the art that various modifications and variations can be made in a display device of the present disclosure without departing from the

sprit or scope of the invention. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. An organic light emitting display device (OLED), comprising:

- a substrate;
- a first anode layer disposed on the substrate and including a plurality of first projections;
- a second anode layer disposed on the first anode layer and including a plurality of second projections;
- an organic emission layer formed on the second anode layer; and
- a cathode layer formed on the organic emission layer.

2. The OLED according to claim 1, wherein the first and second anode layers are formed of different materials.

3. The OLED according to claim 1, wherein the first anode layer comprises tin oxide or zinc oxide, and the second anode layer comprises indium tin oxide or indium zinc oxide.

4. The OLED according to claim 1, wherein widths **W1** and **W2** of the first and the second projections, respectively, are different, and/or thickness **T1** and **T2** of the first and the second projections, respectively, are different.

5. The OLED according to claim 1, wherein the first anode layer has a thickness **T1** from about 500 to about 2500 Å, the first projections has a width **W1** from about 1000 to 5000 Å, the second anode layer has a thickness **T2** from about 5 to about 250 Å, and the second projections as a width **W2** from about 10 to about 500 Å.

6. The OLED according to claim 1, wherein a width **W2** of the second projections are from about 2 to about 500 times smaller than a width **W1** of the first projections.

7. The OLED according to claim 1, wherein the cathode layer comprises silver or aluminum.

8. The OLED according to claim 1, wherein the substrate includes a plurality of third projections.

9. The OLED according to claim 1, further comprising a low refraction layer disposed on the substrate, wherein the low refraction layer includes a plurality of fourth projections in contact with the first or second anode layer.

10. A method of fabricating an organic light emitting display device (OLED), comprising:

- forming a first anode layer including a plurality of first projections on a substrate;
- forming a second anode layer including a plurality of second projections on the first anode layer;
- forming an organic emission layer on the second anode layer; and
- forming a cathode layer on the organic emission layer.

11. The method according to claim 10, wherein the first and second anode layers are formed of different materials.

12. The method according to claim 10, wherein the first anode layer comprises tin oxide or zinc oxide, and the second anode layer comprises indium tin oxide and/or indium zinc oxide.

13. The method according to claim 10, wherein widths **W1** and **W2** of the first and the second projections, respectively, are different, and/or thickness **T1** and **T2** of the first and the second projections, respectively, are different.

14. The method according to claim 10, wherein the first anode layer has a thickness **T1** from about 500 to about 2500 Å, the first projections has a width **W1** from about 1000 to 5000 Å, the second anode layer has a thickness **T2** from about

5 to about 250 Å, and the second projections as a width W2 from about 10 to about 500 Å.

15. The method according to claim 10, wherein a width W2 of the second projections are from about 2 to about 500 times smaller than a width W1 of the first projections.

16. The method according to claim 10, wherein the substrate includes a plurality of third projections.

17. The method according to claim 10, further comprising forming a low refraction layer disposed on the substrate, wherein the low refraction layer includes a plurality of fourth projections in contact with the first or second anode layer.

18. The method according to claim 10, wherein the first anode layer is formed by a sputtering method comprising growing the first anode layer in a plurality of pillars spaced between the pillars, and filling the space and an upper region of the pillar.

19. The method according to claim 18, wherein the method further comprises etching or laser process to form the plurality of the third projections.

20. The method according to claim 10, wherein in forming the first projections, the temperature of the substrate is maintained similar to a melting point of a sputtering material to gradually lower the temperature.

* * * * *

专利名称(译)	有机发光显示装置及其制造方法		
公开(公告)号	US20130285540A1	公开(公告)日	2013-10-31
申请号	US13/719320	申请日	2012-12-19
[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.		
当前申请(专利权)人(译)	LG DISPLAY CO. , LTD.		
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优先权	1020120045561 2012-04-30 KR		
其他公开文献	US8686633		
外部链接	Espacenet USPTO		

摘要(译)

有机发光显示装置 (OLED) 包括：基板;第一阳极层，设置在基板上并包括多个第一凸起;第二阳极层，形成在第一阳极层上并包括多个第二突起;形成在第二阳极层上的有机发光层;和在有机发光层上形成的阴极层。结果，阳极形成为具有双凸起结构，以提高光提取效率。

