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(71) Applicant: **SEOUL VIOSYS CO., LTD.** [KR/KR]; 65-16, Sandan-ro 163beon-gil, Danwon-gu, Ansan-si, Gyeonggi-do 15609 (KR).

(72) Inventors: **KIM, Chang Yeon**; 65-16, Sandan-ro 163beon-gil, Danwon-gu, Ansan-si, Gyeonggi-do 15609 (KR). **SON, Sung Su**; 65-16, Sandan-ro 163beon-gil, Danwon-gu, Ansan-si, Gyeonggi-do 15609 (KR). **LEE, Joon Sup**; 65-16, Sandan-ro 163beon-gil, Danwon-gu, Ansan-si, Gyeonggi-do 15609 (KR). **CHAE, Jong Hyeon**; 65-16, Sandan-ro 163beon-gil, Danwon-gu, Ansan-si, Gyeonggi-do 15609 (KR).

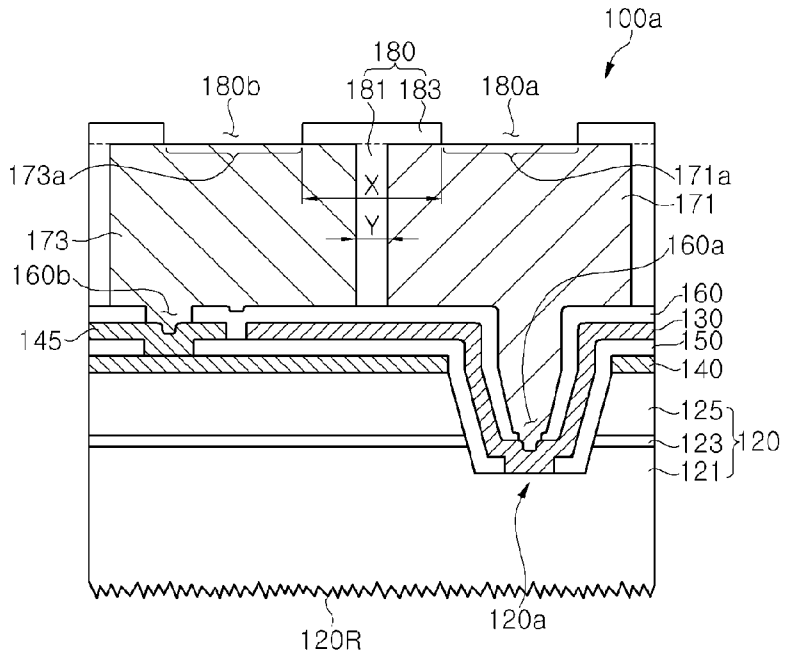
(74) Agent: **AIP PATENT & LAW FIRM**; 30-1, Teheran-ro 14-gil, Gangnam-gu, Seoul 06239 (KR).

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[Continued on next page]

(54) Title: LIGHT EMITTING DEVICE



(57) Abstract: Disclosed herein is a light emitting device. The light emitting device includes a light emitting structure; a first contact electrode and a second contact electrode; an insulation layer; a first bulk electrode and a second bulk electrode disposed on the light emitting structure; an insulation support layer covering side surfaces of the first and second bulk electrodes and portions of upper surfaces of the first and second bulk electrodes and including first and second openings; and a first pad electrode and a second pad electrode at least partially filling the first and second openings, respectively, wherein exposed regions of the upper surfaces of the first and second bulk electrodes exposed through the first and second opening are smaller than horizontal cross-sectional areas of the first and second bulk electrodes, respectively.

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Description

Title of Invention: LIGHT EMITTING DEVICE

Technical Field

[1] Exemplary embodiments relate to a light emitting device, and more particularly, to a light emitting device configured to improve heat dissipation efficiency, electrical characteristics and mechanical stability.

Background Art

[2] Recently, with increasing demand for small high-output light emitting devices, demand for large flip-chip type light emitting devices having good heat dissipation efficiency is also increasing. A flip-chip type light emitting device includes electrodes directly bonded to a secondary substrate and does not require a wire for supplying electric power to the flip-chip type light emitting device from an external power source and thus has much higher heat dissipation efficiency than a lateral type light emitting device. Thus, upon application of high density current, the flip-chip type light emitting device can effectively conduct heat towards the secondary substrate and thus can be suitably used as a high-output light emitting source.

[3] In addition, for size reduction and high output of a light emitting device, there is increasing demand for a chip scale package in which the light emitting device is used per se as a package by omitting a process of packaging the light emitting device in a separate housing or the like. Particularly, since the electrodes of the flip-chip type light emitting device can provide a similar function to leads of the package, the flip-chip type light emitting device can be suitably applied to such a chip scale package.

[4] When such a chip scale package type device is used as a high-output light emitting device, high density electric current is applied to the chip scale package. When high density electric current is applied to the package, the amount of heat generated from the light emitting chip is also increased in proportion to the electric current, so that heat dissipation efficiency of the high-output light emitting device becomes a major factor determining reliability of the light emitting device. Therefore, there is a need for a high-output chip scale package that has high heat dissipation efficiency and good mechanical stability to secure high reliability. Moreover, when the chip scale package is mounted on a board including a conductive circuit via an adhesive material such as solder, pastes, and the like, the adhesive material flows along the electrodes of the chip and the circuit of the board, thereby causing short circuit between the electrodes. Therefore, there is a need for a structure having good mechanical and electrical stability so as to prevent short circuit upon mounting.

Disclosure of Invention

Technical Problem

[5] Exemplary embodiments provide a light emitting device capable of efficiently dissipating heat and having mechanical stability.

[6] Exemplary embodiments provide a light emitting device having uniform luminous characteristics and securing excellent heat dissipation efficiency.

[7] Exemplary embodiments provide a light emitting device having high heat dissipation efficiency and excellent mechanical and electrical stability by preventing short circuit between electrodes.

Solution to Problem

[8] In accordance with one aspect of the present disclosure, a light emitting device includes: a light emitting structure including a first conductive type semiconductor layer, a second conductive type semiconductor layer, and an active layer disposed between the first and second conductive type semiconductor layers; a first contact electrode and a second contact electrode disposed on the light emitting structure and forming ohmic contact with the first and second conductive type semiconductor layers, respectively; an insulation layer disposed on the light emitting structure and insulating the first contact electrode and the second contact electrode from each other; a first bulk electrode and a second bulk electrode disposed on the light emitting structure and electrically connected to the first and second contact electrodes, respectively; an insulation support layer covering side surfaces of the first and second bulk electrodes and portions of upper surfaces of the first and second bulk electrodes, and including a first opening and a second opening partially exposing the upper surfaces of the first and second bulk electrodes, respectively; and a first pad electrode and a second pad electrode at least partially filling the first and second openings, respectively, wherein areas of exposed regions on the upper surfaces of the first and second bulk electrodes exposed through the first and second openings are smaller than horizontal cross-sectional areas of the first and second bulk electrodes, respectively.

[9] With this structure, the light emitting device can have improved properties in terms of mechanical stability and heat dissipation.

[10] A separation distance between the first and second bulk electrodes may be smaller than a separation distance between the first and second openings.

[11] The separation distance between the first and second bulk electrodes may be 100 ㎛ or less.

[12] The separation distance between the first and second openings may be 80 ㎛ or more.

[13] The insulation support layer may include a lower insulation support layer covering side surfaces of the first and second bulk electrodes, and an upper insulation support layer covering the portions of the upper surfaces of the first and second bulk

electrodes, and the upper and lower insulation support layers may be formed of the same material or different materials.

[14] The upper insulation support layer may cover an interface between the first bulk electrode and the lower insulation support layer and an interface between the second bulk electrode and the lower insulation support layer.

[15] The upper and lower insulation support layers may be formed of different materials and the upper insulation support layer may include a photoresist or a photo-solder resist.

[16] An upper surface of the first pad electrode, an upper surface of the second pad electrode and an upper surface of the insulation support layer may be flush with each other.

[17] The insulation layer may include a first insulation layer and a second insulation layer. The first insulation layer may partially cover the second contact electrode; the first contact electrode may partially cover the first insulation layer; and the second insulation layer may include a third opening and a fourth opening partially covering the first contact electrode to partially expose the first contact electrode and the second contact electrode.

[18] The first bulk electrode may be electrically connected to the first contact electrode through the third opening, and the second bulk electrode may be electrically connected to the second contact electrode through the fourth opening.

[19] The light emitting device may further include a connection electrode disposed between the second contact electrode and the second bulk electrode.

[20] An upper surface of the connection electrode may be formed of the same material as the first contact electrode.

[21] The upper surface of the connection electrode may be coplanar with an upper surface of the first contact electrode.

[22] The light emitting structure may include at least one hole partially exposing the first conductive type semiconductor layer, and the first contact electrode may be electrically connected to the first conductive type semiconductor layer through the at least one hole.

[23] In accordance with another aspect of the present disclosure, a light emitting device includes: a light emitting structure including a first conductive type semiconductor layer, a second conductive type semiconductor layer, and an active layer disposed between the first and second conductive type semiconductor layers; a first contact electrode and a second contact electrode disposed on the light emitting structure and forming ohmic contact with the first and second conductive type semiconductor layers, respectively; an insulation layer disposed on the light emitting structure and insulating the first contact electrode and the second contact electrode from each other; a first bulk

electrode and a second bulk electrode disposed on the light emitting structure and electrically connected to the first and second contact electrodes, respectively; and an insulation support layer covering side surfaces of the first and second bulk electrodes and portions of upper surfaces of the first and second bulk electrodes and including a first opening and a second opening partially exposing the upper surfaces of the first and second bulk electrodes, respectively, wherein a separation distance between the first and second openings may be greater than a separation distance between the first and second bulk electrodes.

[24] The second conductive type semiconductor layer may be a p-type semiconductor layer, and an area of an exposed region of the upper surface of the second bulk electrode exposed through the second opening may be larger than a contact area between the second bulk electrode and the second contact electrode.

[25] The first conductive type semiconductor layer may be an n-type semiconductor layer, and an area of an exposed region of the upper surface of the first bulk electrode exposed through the first opening may be smaller than a contact area between the first bulk electrode and the first contact electrode.

[26] A horizontal cross-sectional area of the first bulk electrode may be larger than that of the second bulk electrode.

[27] In accordance with a further aspect of the present disclosure, a light emitting device includes: a light emitting structure including a first conductive type semiconductor layer, a second conductive type semiconductor layer, and an active layer disposed between the first and second conductive type semiconductor layers; a first contact electrode and a second contact electrode disposed on the light emitting structure and forming ohmic contact with the first and second conductive type semiconductor layers, respectively; an insulation layer disposed on the light emitting structure and insulating the first contact electrode and the second contact electrode from each other; a first bulk electrode and a second bulk electrode disposed on the light emitting structure and electrically connected to the first and second contact electrodes, respectively; and an insulation support layer covering side surfaces of the first and second bulk electrodes and portions of upper surfaces of the first and second bulk electrodes and including a first opening and a second opening partially exposing the upper surfaces of the first and second bulk electrodes, wherein the insulation support layer is disposed between the first and second bulk electrodes and on portions of the upper surfaces of the first and second bulk electrodes above sides surfaces of the first and second bulk electrodes facing each other.

[28] The insulation support layer may be disposed on outer peripheral side surfaces of the first and second bulk electrodes and on portions of the upper surfaces of the first and second bulk electrodes above the outer peripheral side surfaces of the first and second

bulk electrodes.

[29] In accordance with yet another aspect of the present disclosure, a light emitting device includes: a light emitting structure including a first conductive type semiconductor layer, a second conductive type semiconductor layer, and an active layer disposed between the first and second conductive type semiconductor layers; a first contact electrode and a second contact electrode disposed on the light emitting structure and forming ohmic contact with the first and second conductive type semiconductor layers, respectively; first and second insulation layers partially covering the first contact electrode and the second contact electrode, respectively; a first electrode and a second electrode disposed on the light emitting structure and electrically connected to the first and second contact electrodes, respectively; an insulation support layer covering side surfaces of the first electrode and the second electrode; a connection layer disposed on the first electrode, the second electrode and the insulation support layer; and a first pad electrode and a second pad electrode disposed on the connection layer, wherein the first pad electrode and the second pad electrode are electrically connected to the first electrode and the second electrode through the connection layer, respectively, a horizontal area of the first pad electrode is smaller than that of the first electrode, and a horizontal area of the second pad electrode is larger than that of the second electrode.

[30] With this structure, the light emitting device has improved heat dissipation efficiency to improve reliability and lifespan, and can exhibit uniform luminous characteristics.

[31] The first electrode may be disposed on an ohmic contact region between the first contact electrode and the first conductive type semiconductor layer.

[32] The ohmic contact between the first contact electrode and the first conductive type semiconductor layer may not be formed under the second electrode.

[33] The first contact electrode may include a plurality of ohmic contact regions contacting the first conductive type semiconductor layer to form ohmic contact therewith, and the first electrode may contact all of the plurality of ohmic contact regions of the first contact electrode.

[34] The first contact electrode may include a plurality of ohmic contact regions contacting the first conductive type semiconductor layer to form ohmic contact therewith, and the first electrode may contact some of the plurality of ohmic contact regions of the first contact electrode.

[35] The light emitting device may further include a first interconnection layer disposed under the first electrode and a second interconnection layer disposed under the second electrode, wherein a portion of the first interconnection layer may contact the first contact electrode and a portion of the second interconnection layer may contact the second contact electrode.

[36] The second insulation layer may be partially disposed between the first inter-connection layer and the first contact electrode.

[37] A horizontal cross-sectional area of the first electrode may be 0.8 times to less than 1 times the sum of horizontal cross-sectional areas of the first electrode and the second electrode.

[38] The first pad electrode may have the same horizontal area as the second pad electrode.

[39] The connection layer may include an insulation material layer; a first connection layer electrically connecting the first electrode to the first pad electrode and penetrating the insulation material layer; and a second connection layer electrically connecting the second electrode to the second pad electrode and penetrating the insulation material layer.

[40] The light emitting device may further include a plurality of second electrodes, and the second electrodes may be electrically connected to the second pad electrode.

[41] The first contact electrode may include a plurality of ohmic contact regions contacting the first conductive type semiconductor layer to form ohmic contact therewith, and some of the plurality of ohmic contact regions may be disposed between the second electrodes.

[42] Each of the first and second electrodes may include metal particles and a non-metallic material interposed between the metal particles.

[43] The metal particles and the non-metallic material may take the form of sintered metal particles.

[44] Each of the first and second electrodes may include an inclined side surface, and the inclined side surface may include a side surface on which a gradient of a tangential line of a vertical cross-section of each of the first and second electrodes with respect to the side surface varies.

[45] Each of the first and second electrodes may include 80 wt% to 98 wt% of metal particles.

[46] In some exemplary embodiments, the light emitting structure may further include a partially exposed region of the first conductive type semiconductor layer formed by partially removing the active layer and the second conductive type semiconductor layer, and the first contact electrode may form ohmic contact with the first conductive type semiconductor layer through the partially exposed region of the first conductive type semiconductor layer.

[47] The partially exposed region of the first conductive type semiconductor layer may take the form of a plurality of holes.

[48] The second contact electrode may be disposed on the second conductive type semi-conductor layer; the first insulation layer may cover the second contact electrode and

the light emitting structure and include a first opening and a second opening exposing a portion of the exposed region of the first conductive type semiconductor layer and a portion of the second contact electrode, respectively; the first contact electrode may at least partially cover the first insulation layer while contacting the first conductive type semiconductor layer through the first opening; and the second insulation layer may partially cover the first contact electrode and include a third opening partially exposing the first contact electrode, and a fourth opening formed at a location corresponding to the second opening and exposing a portion of the second contact electrode.

[49] The first electrode may contact the first contact electrode through the third opening, the second electrode may contact the second contact electrode through the fourth opening, and all of the plurality of holes may be disposed under a region of the third opening.

[50] In accordance with yet another aspect of the present disclosure, a light emitting device includes: a light emitting structure including a first conductive type semiconductor layer, a second conductive type semiconductor layer disposed on the first conductive type semiconductor layer, and an active layer disposed between the first conductive type semiconductor layer and the second conductive type semiconductor layer; a first electrode electrically connected to the first conductive type semiconductor layer; a second electrode disposed on the second conductive type semiconductor layer and electrically connected to the second conductive type semiconductor layer; a support structure including a first metal bulk and a second metal bulk disposed on the first electrode and the second electrode to be separated from each other and electrically connected to the first electrode and the second electrode, respectively, and an insulation support layer disposed between the first metal bulk and the second metal bulk; and a substrate adjacent to the support structure, wherein each of the first and second metal bulks includes an upper region and a lower region; the substrate includes a first interconnection portion and a second interconnection portion electrically connected to the first metal bulk and the second metal bulk, respectively; and a distance between the first interconnection portion and the second interconnection portion is greater than a distance between the upper regions. According to this structure, it is possible to prevent the light emitting device from suffering from cracking or damage due to heat. Further, it is possible to prevent disconnection of the first and second metal bulks due to an adhesive material such as solder when the first and second metal bulks are mounted on the substrate. With this structure, the light emitting device can secure electrical stability.

[51] The first metal bulk may include a first plane facing the second metal bulk and a second plane disposed opposite the first plane; the second metal bulk may include a third plane facing the first metal bulk and a fourth plane disposed opposite the third

plane; and the first and second metal bulks may include a first depression depressed from lower edges of the first plane and the third plane, respectively. In this structure, the first depression can be filled with the insulation support layer, thereby suppressing the adhesive materials such as solder from flowing into a space between the first bulk and the second metal bulk. Accordingly, it is possible to prevent the first and second metal bulks from being disconnected by the adhesive material. Further, contact regions between the first and second metal bulks and the insulation support layer can be increased, thereby improving adhesion between the first and second metal bulks and the insulation support layer. With this structure, the light emitting device can secure mechanical stability.

[52] The first depression may be composed of a single plane. With this structure, the distance between the first bulk and the second metal bulk can be gradually decreased, thereby increasing a heat dissipation zone capable of dissipating heat generated from the light emitting device. Further, since the distance between lower surfaces of the first and second metal bulks may be greater than the distance between the upper regions, it is possible to prevent the first and second metal bulks from being disconnected by the adhesive material such as solder.

[53] The first depression may be composed of a convex plane or a concave plane.

[54] The first depression may be composed of a plurality of planes. In this structure, contact regions between the first and second metal bulks and the insulation support layer are further increased, thereby further improving adhesion between the first bulk and the second metal bulk and the insulation support layer. Accordingly, the light emitting device can secure mechanical stability.

[55] The first and second metal bulks may include a second depression depressed from lower edges of the second and fourth planes, respectively. In this structure, the second depressions can be filled with the insulation support layer, thereby suppressing the adhesive materials such as solder from flowing towards an outer surface of the light emitting device. Further, contact regions between the first and second metal bulks and the insulation support layer are further increased, thereby improving adhesion between the first bulk and the second metal bulk and the insulation support layer. With this structure, the light emitting device can secure mechanical stability.

[56] A distance between the lower regions may be greater than the distance between the upper regions. With this structure, it is possible to more effectively prevent disconnection of the first and second metal bulks due to the adhesive material such as solder when the first and second metal bulks are mounted on the substrate. With this structure, the light emitting device can secure electrical stability.

[57] The distance between the upper regions may be 100 ㎛ or less. Within this range, the first and second metal bulks can achieve further improvement in heat dissipation.

[58] The distance between the lower regions may be 250 ㎛ or less. Within this range, it is possible to prevent the first and second metal bulks from being disconnected by the adhesive material such as solder.

[59] The distance between the first interconnection portion and the second interconnection portion may be greater than the distance between the lower regions. With this structure, it is possible to more effectively prevent disconnection of the first and second interconnection portions due to the adhesive material such as solder. Further, since it is possible to prevent the adhesive material from flowing into a region between lower surfaces of the first and second metal bulks along the first and second interconnection portions, disconnection of the first and second metal bulks can be more effectively prevented. With this structure, the light emitting device can secure electrical stability.

[60] The first metal bulk and the second metal bulk may have a thickness 5 to 20 times the thickness of the first electrode and the second electrode, respectively. With this structure, the light emitting device allows effective dissipation of heat generated from the light emitting structure through the side surfaces of the first and second metal bulks, and thus can be prevented from cracking or damage due to heat.

[61] The light emitting device may further include a first insulation layer covering a lower surface of the light emitting structure and lower and side surfaces of the second electrode, and disposed between the light emitting structure and the first electrode to insulate the first electrode from the second electrode.

[62] The light emitting device may further include a second insulation layer covering a portion of the first electrode. The second insulation layer can more effectively prevent disconnection of the first electrode and the second electrode, and can protect the light emitting structure from external contaminants or impact.

[63] The substrate may further include a base supporting the first interconnection portion and the second interconnection portion, and may include a via-hole formed through the base.

[64] The via-hole may be disposed on the first metal bulk and the second metal bulk. With this structure, heat transferred to the first metal bulk and the second metal bulk can be effectively dissipated through an internal space of the via-hole and the first interconnection portion and the second interconnection portion disposed inside the via-hole.

[65] The via-hole may not overlap the first metal bulk and the second metal bulk in a vertical direction. With this structure, it is possible to prevent the adhesive material such as solder from flowing outwards along the via-hole when the first metal bulk and the second metal bulk are mounted on the substrate. Further, it is possible to prevent the first metal bulk and the second metal bulk from being damaged through the via-hole by external impact or contaminants.

[66] Each of the first and second metal bulks may be a monolithic layer. With this structure, it is possible to prevent disconnection of the first and second metal bulks while improving adhesion of the first and second metal bulks to the substrate by adjusting the shape of the lower regions without forming a separate layer at lower sides of the first metal bulk and the second metal bulk.

[67] The light emitting device may further include a solder between the first metal bulk and the first interconnection portion and between the second metal bulk and the second interconnection portion.

Advantageous Effects of Invention

[68] According to exemplary embodiments, the light emitting device includes an insulation support layer, which includes an upper insulation support layer and a lower insulation support layer and covers side surfaces and portions of upper surfaces of bulk electrodes. With this structure, the light emitting device has high heat dissipation efficiency, can exhibit excellent mechanical stability, and can suppress a possibility of contamination due to external factors such as moisture, thereby providing high reliability.

[69] According to exemplary embodiments, the light emitting device includes a first electrode, the horizontal cross-sectional area of which is larger than that of a second electrode thereof, thereby achieving improvement in reliability and lifespan through improvement in heat dissipation efficiency. Further, the ratio of an area occupied by the first electrode to other areas is increased, so that the light emitting device has uniform luminous characteristics throughout the overall structure thereof.

[70] According to exemplary embodiments, since the distance between upper regions of first and second metal bulks is relatively short, the light emitting device allows heat generated from the light emitting structure to be effectively dissipated through side surfaces of the first metal bulk and the second metal bulk. Accordingly, the light emitting device can be prevented from cracking or damage due to heat. In addition, since the distance between lower regions of the first and second metal bulks is relatively long, it is possible to prevent disconnection of the first and second metal bulks by an adhesive material such as solder upon mounting of the first and second metal bulks on a substrate. Further, since the distance between a first interconnection portion and a second interconnection portion is relatively long, it is possible to prevent disconnection of the first and second interconnection portions by the adhesive material such as solder upon mounting of the first and second metal bulks on a substrate. With this structure, the light emitting device can secure electrical stability.

Brief Description of Drawings

[71] Figure 1 and Figure 2 are a sectional view and a plan view of a light emitting device

according to one exemplary embodiment, respectively.

[72] Figure 3 is a cross-sectional view of a light emitting device according to another exemplary embodiment.

[73] Figure 4a and Figure 4b are plan views of a light emitting device according to a further exemplary embodiment.

[74] Figure 5 is a cross-sectional view of the light emitting device according to the exemplary embodiment.

[75] Figure 6a, Figure 6b and Figure 7 are plan views and a cross-sectional view of a light emitting device according to yet another exemplary embodiment, respectively.

[76] Figure 8 is a sectional view of a light emitting device according to yet another exemplary embodiment.

[77] Figure 9a, Figure 9b and Figure 10 are plan views and a cross-sectional view of a light emitting device according to yet another exemplary embodiment, respectively.

[78] Figure 11a, Figure 11b and Figure 12 are plan views and a cross-sectional view of a light emitting device according to yet another exemplary embodiment, respectively.

[79] Figure 13a, Figure 13b and Figure 14 are plan views and a cross-sectional view of a light emitting device according to yet another exemplary embodiment, respectively.

[80] Figure 15 and Figure 16 are a plan view and a cross-sectional view of a light emitting device according to yet another exemplary embodiment, respectively.

[81] Figure 17 is a sectional view of a light emitting device according to yet another exemplary embodiment.

[82] Figure 18 is a sectional view of a light emitting device according to yet another exemplary embodiment.

[83] Figure 19 is a sectional view of a light emitting device according to yet another exemplary embodiment.

[84] Figure 20 is a sectional view of a light emitting device according to yet another exemplary embodiment.

[85] Figure 21 is a sectional view of a light emitting device according to yet another exemplary embodiment.

[86] Figure 22 is a sectional view of a light emitting device according to yet another exemplary embodiment.

[87] Figure 23 is an exploded perspective view of an exemplary lighting apparatus to which a light emitting device according to some embodiments of the present disclosure is applied.

[88] Figure 24 is a sectional view of an exemplary display device to which a light emitting device according to some embodiments of the present disclosure is applied.

[89] Figure 25 is a sectional view of an exemplary display device to which a light emitting device according to some embodiments of the present disclosure is applied.

[90] Figure 26 is a sectional view of an exemplary headlight to which a light emitting device according to some embodiments of the present disclosure is applied.

Mode for the Invention

[91] Hereinafter, exemplary embodiments will be described in more detail with reference to the accompanying drawings. The following embodiments are provided by way of example so as to fully convey the spirit of the present disclosure to those skilled in the art to which the present disclosure pertains. Accordingly, the present disclosure is not limited to the embodiments disclosed herein and can also be implemented in different forms. In the drawings, widths, lengths, thicknesses, and the like of elements can be exaggerated for clarity and descriptive purposes. When an element or layer is referred to as being "disposed above" or "disposed on" another element or layer, it can be directly "disposed above" or "disposed on" the other element or layer or intervening elements or layers can be present. Throughout the specification, like reference numerals denote like elements having the same or similar functions.

[92] Figure 1 and Figure 2 are a sectional view and a plan view of a light emitting device according to one exemplary embodiment, respectively. Figure 1 shows a cross-section of the light emitting device taken along line A-A' of Figure 2.

[93] Referring to Figure 1 and Figure 2, a light emitting device 100a according to one exemplary embodiment includes a light emitting structure 120, a first contact electrode 130, a second contact electrode 140, insulation layers 150, 160, first and second bulk electrodes 171, 173 and an insulation support layer 180. The light emitting device 100a may further include a growth substrate (not shown), a wavelength conversion portion (not shown), and a connection electrode 145.

[94] The light emitting structure 120 may include a first conductive type semiconductor layer 121, an active layer 123 disposed on the first conductive type semiconductor layer 121, and a second conductive type semiconductor layer 125 disposed on the active layer 123. The first conductive type semiconductor layer 121, the active layer 123 and the second conductive type semiconductor layer 125 may include a III-V-based compound semiconductor, for example, a nitride-based semiconductor such as (Al, Ga, In)N. The first conductive type semiconductor layer 121 may include n-type dopants (for example, Si), and the second conductive type semiconductor layer 125 may include p-type dopants (for example, Mg), or vice versa. The active layer 123 may include a multi-quantum well (MQW) structure.

[95] The light emitting structure 120 may include a partially exposed region of the first conductive type semiconductor layer 121 formed by partially removing the second conductive type semiconductor layer 125 and the active layer 123. For example, as shown in the drawings, the light emitting structure 120 may include at least one hole

120a formed through the second conductive type semiconductor layer 125 and the active layer 123 to expose the first conductive type semiconductor layer 121 therethrough. The light emitting structure 120 may include a plurality of holes 120a, and the shape and arrangement of the holes 120a are not limited to those shown in the drawings. In some exemplary embodiments, the partially exposed region of the first conductive type semiconductor layer 121 may be provided by partially removing the second conductive type semiconductor layer 125 and the active layer 123 to form a mesa including the second conductive type semiconductor layer 125 and the active layer 123.

[96] The light emitting structure 120 may further include a roughness 120R formed on a lower surface thereof by increasing roughness of the lower surface. The roughness 120R may be formed by at least one of dry etching, wet etching and electrochemical etching. For example, the roughness 120R may be formed by PEC etching or by wet etching in an etching solution containing KOH and NaOH. With the roughness 120R, the light emitting structure may include a convex portion and a concave portion formed in micrometer or nanometer scale on a surface of the first conductive type semiconductor layer 121. With the structure wherein the roughness is formed on the surface of the light emitting structure 120, the light emitting device can achieve improvement in light extraction efficiency.

[97] The light emitting structure 120 may further include a growth substrate (not shown) disposed under the first conductive type semiconductor layer 121. As the growth substrate, any substrate may be used so long as the substrate allows growth of the light emitting structure 120 thereon. For example, the growth substrate may be a sapphire substrate, a silicon carbide substrate, a silicon substrate, a gallium nitride substrate, or an aluminum nitride substrate. Such a growth substrate may be removed from the light emitting structure 120 by a typical method known in the art after fabrication of the light emitting device.

[98] The second contact electrode 140 may be disposed on the second conductive type semiconductor layer 125 to form ohmic contact therewith. In addition, the second contact electrode 140 may cover at least a portion of an upper surface of the second conductive type semiconductor layer 125, and may cover an overall upper surface of the second conductive type semiconductor layer 125. Further, the second contact electrode 140 may be formed as a monolithic layer to cover the upper surface of the second conductive type semiconductor layer 125 excluding a region in which the holes 120a of the light emitting structure 120 are formed. With this structure, the light emitting device allows uniform supply of electric current to the entire region of the light emitting structure 120, thereby improving current spreading efficiency. However, it should be understood that the present disclosure is not limited thereto.

[99] The second contact electrode 140 may include a material capable of forming ohmic contact with the second conductive type semiconductor layer 125, for example, a metallic material and/or a conductive oxide.

[100] When the second contact electrode 140 includes the metallic material, the second contact electrode 140 may include a reflective layer and a cover layer covering the reflective layer. As described above, the second contact electrode 140 can reflect light while forming ohmic contact with the second conductive type semiconductor layer 125. Accordingly, the reflective layer may include a metal having high reflectivity and capable of forming ohmic contact with the second conductive type semiconductor layer 125. For example, the reflective layer may include at least one of Ni, Pt, Pd, Rh, W, Ti, Al, Mg, Ag and Au. In addition, the reflective layer may be composed of a single layer or multiple layers.

[101] The cover layer can prevent interdiffusion between the reflective layer and other materials and can prevent external materials from diffusing into and damaging the reflective layer. Accordingly, the cover layer may be formed to cover a lower surface and a side surface of the reflective layer. The cover layer may be electrically connected together with the reflective layer to the second conductive type semiconductor layer 125 to act as an electrode together with the reflective layer. The cover layer may include, for example, Au, Ni, Ti, Cr, Pt, or W, and may be composed of a single layer or multiple layers.

[102] When the second contact electrode 140 includes the conductive oxide, the conductive oxide may include ITO, ZnO, AZO, IZO, GZO, and the like. When the second contact electrode 140 includes the conductive oxide, the second contact electrode 140 can cover a larger area of an upper surface of the second conductive type semiconductor layer 125 than when the second contact electrode 140 includes a metal. That is, when the second contact electrode 140 is formed of the conductive oxide, a distance from an upper edge of the hole 120a to the second contact electrode 140 may be shorter than when the second contact electrode 140 is formed of the metallic material. In this exemplary embodiment, the shortest distance from a contact portion between the second contact electrode 140 and the second conductive type semiconductor layer 125 to a contact portion between the first contact electrode 130 and the first conductive type semiconductor layer 121 can be further decreased, whereby forward voltage (V_f) of the light emitting device 100a can be decreased.

[103] In addition, when the second contact electrode 140 includes ITO, the first insulation layer 150 includes SiO_2 and the first contact electrode 130 includes Ag, an omnidirectional reflector having a stack structure of ITO/SiO_2/Ag may be formed.

[104] The insulation layers 150, 160 may include a first insulation layer 150 and a second insulation layer 160. In addition, the insulation layers 150, 160 may partially cover the

first and second contact electrodes 130, 140. Next, the first insulation layer 150 will be described first and the second insulation layer 160 will be described thereafter.

[105] The first insulation layer 150 may partially cover an upper surface of the light emitting structure 120 and the second contact electrode 140. In addition, the first insulation layer 150 may cover a side surface of the hole 120a while partially exposing the exposed region of the first conductive type semiconductor layer 121 exposed through the hole 120a. The first insulation layer 150 may include an opening disposed corresponding to the hole 120a and an opening exposing a portion of the second contact electrode 140. The first conductive type semiconductor layer 121 and the second contact electrode 140 can be partially exposed through these openings.

[106] The first insulation layer 150 may include an insulating material, for example, SiO_2, SiN_x, MgF_2, and the like. Furthermore, the first insulation layer 150 may include multiple layers and may include a distributed Bragg reflector wherein materials having different indexes of refraction are alternately stacked one above another. The distributed Bragg reflector may include a structure wherein dielectric layers including at least one of SiO_2, TiO_2, ZrO_2, HfO_2, Nb_2O_5, and MgF_2 are stacked one above another.

[107] When the second contact electrode 140 includes the conductive oxide, the first insulation layer 150 includes the distributed Bragg reflector, thereby improving luminous efficacy of the light emitting device 100a. Alternatively, the second contact electrode 140 may include the conductive oxide and the first insulation layer 150 may be formed of a transparent insulating oxide (for example, SiO_2), an omnidirectional reflector having a stack structure of the second contact electrode 140, the first insulation layer 150 and the first contact electrode 130 may be formed.

[108] Although not shown in the drawings, in other exemplary embodiments, the first insulation layer 150 may further cover at least a portion of a side surface of the light emitting structure 120. A degree of covering the side surface of the light emitting structure 120 with the first insulation layer 150 can vary depending upon isolation into unit chips in the process of fabricating a light emitting device. That is, as in these exemplary embodiments, the first insulation layer 150 may be formed to cover only the upper surface of the light emitting structure 120, and otherwise, when the first insulation layer 150 is formed after isolation of the wafer into unit chips in the process of fabricating the light emitting device 100a, not only the upper surface but also the side surface of the light emitting structure 120 may be covered by the first insulation layer 150.

[109] The first contact electrode 130 may partially cover the light emitting structure 120 and may form ohmic contact with the first conductive type semiconductor layer 121 through the hole 120a and the opening of the first insulation layer 150 disposed corresponding to the hole 120a. The first contact electrode 130 may be formed to cover an

overall upper surface of the first insulation layer 150 excluding some region thereof. Further, the first contact electrode 130 may be electrically insulated from the second contact electrode 140 by the first insulation layer 150.

[110] With the structure wherein the first contact electrode 130 is formed to cover the overall upper surface of the light emitting structure 120 excluding some region thereof, the light emitting device can achieve further improvement in current spreading efficiency. Further, since a portion of the light emitting structure 120 not covered by the second contact electrode 140 can be covered by the first contact electrode 130, the light emitting device 100a allows more effective reflection of light, thereby achieving improvement in luminous efficacy.

[111] The first contact electrode 130 can reflect light while forming ohmic contact with the first conductive type semiconductor layer 121. Accordingly, the first contact electrode 130 may be composed of a single layer or multiple layers, and may include a highly reflective metal layer such as an Al layer. The highly reflective metal layer may be formed on a bonding layer formed of Ti, Cr or Ni, without being limited thereto. Alternatively, the first contact electrode 130 may include at least one of Ni, Pt, Pd, Rh, W, Ti, Al, Mg, Ag and Au.

[112] Although not shown in the drawings, in other exemplary embodiments, the first contact electrode 130 may also be formed to cover the side surface of the light emitting structure 120. When the first contact electrode 130 is also formed on the side surface of the light emitting structure 120, the first contact electrode 130 reflects light, which is emitted to the side surface of the light emitting structure 120 from the active layer 123, in an upward direction, thereby increasing the ratio of light emitted through an upper surface of the light emitting device 100a.

[113] The light emitting device 100a may further include the connection electrode 145.

[114] The connection electrode 145 may be disposed on the second contact electrode 140 and may be electrically connected to the second contact electrode 140 through the opening of the first insulation layer 150. Furthermore, the connection electrode 145 may electrically connect the second contact electrode 140 to a second bulk electrode 173. In addition, the connection electrode 145 may be formed to cover a portion of the first insulation layer 150 and may be separated and insulated from the first contact electrode 130.

[115] An upper surface of the connection electrode 145 may be flush with an upper surface of the first contact electrode 130. Further, the connection electrode 145 and the first contact electrode 130 may be formed by the same process. Accordingly, the connection electrode 145 and the first contact electrode 130 may include the same material, but are not limited thereto. Alternatively, the connection electrode 145 and the first contact electrode 130 may include different materials.

[116] The second insulation layer 160 may partially cover the first contact electrode 130, and may include a first opening 160a which partially exposes the first contact electrode 130 and a second opening 160b which partially exposes the second contact electrode 140. Each of the first and second openings 160a, 160b may be formed singly or in plural.

[117] The second insulation layer 160 may include an insulating material, for example, SiO_2, SiN_x, MgF_2, and the like. Furthermore, the second insulation layer 160 may be composed of multiple layers and may include a distributed Bragg reflector wherein materials having different indexes of refraction are alternately stacked one above another.

[118] The first bulk electrode 171 and the second bulk electrode 173 may be disposed on the light emitting structure 120 and may be electrically connected to the first contact electrode 130 and the second contact electrode 140, respectively. Particularly, the first bulk electrode 171 and the second bulk electrode 173 may be electrically connected to the first and second contact electrodes 130, 140 through direct contact therewith, respectively. Here, the first bulk electrode 171 and the second bulk electrode 173 may be electrically connected to the first and second contact electrodes 130, 140 through the first and second openings 160a, 160b, respectively.

[119] Each of the first bulk electrode 171 and the second bulk electrode 173 may have a thickness of several dozens of micrometers, for example, about 50 ㎛ to about 100 ㎛, specifically about 70 ㎛ to about 80 ㎛. Within this thickness range of the first and second bulk electrodes 171, 173, the light emitting device per se can be used as a chip scale package.

[120] The first bulk electrode 171 and the second bulk electrode 173 may be composed of a single layer or multiple layers and may include an electrically conductive material. For example, each of the first bulk electrode 171 and the second bulk electrode 173 may include Cu, Pt, Au, Ti, Ni, Al, Ag, and the like. Alternatively, each of the first bulk electrode 171 and the second bulk electrode 173 may include sintered metal particles and a non-metallic material interposed between the metal particles.

[121] A separation distance Y between the first bulk electrode 171 and the second bulk electrode 173 may be a predetermined value or less, which may be a minimum value between electrode pads exposed to a mounting plane of the light emitting device 100a required for mounting the light emitting device 100a on a separate substrate. Specifically, for example, when a certain light emitting device is mounted on a secondary substrate by soldering, the distance between the electrode pads exposed to the mounting plane of the light emitting device generally needs to be about 250 ㎛ or more in order to prevent short circuit. Alternatively, when the light emitting device is mounted on the secondary substrate by eutectic bonding, the distance between the

electrode pads exposed to the mounting plane of the light emitting device generally needs to be about 80 ㎛ or more in order to prevent short circuit. According to this exemplary embodiment, the separation distance Y between the first bulk electrode 171 and the second bulk electrode 173 may be such a predetermined value or less, for example, about 250 ㎛ or less, specifically about 100 ㎛ or less, more specifically about 80 ㎛ or less. With the structure wherein the separation distance Y between the first bulk electrode 171 and the second bulk electrode 173 has a predetermined value or less, the first bulk electrode 171 and the second bulk electrode 173 can be formed to have a relatively large horizontal cross-sectional area and volume, thereby allowing effective heat dissipation during operation of the light emitting device 100a. This feature will be described in more detail below.

[122] The first bulk electrode 171 and the second bulk electrode 173 may have different volumes and the horizontal cross-sectional area of the first bulk electrode 171 may be larger than the second bulk electrode 173. In this exemplary embodiment, the first conductive type semiconductor layer 121 may be an n-type semiconductor layer and the second conductive type semiconductor layer 125 may be a p-type semiconductor layer. Generally, heat generated from the light emitting device 100a upon operation is further concentrated on the first bulk electrode 171 acting as an n-type electrode than the second bulk electrode 173 acting as a p-type electrode. Thus, with the structure wherein the horizontal cross-sectional area of the first bulk electrode 171 is larger than the second bulk electrode 173, the light emitting device 100a can achieve improvement in heat dissipation efficiency. This feature will be described in more detail in other exemplary embodiments described below.

[123] The insulation support layer 180 is disposed on the light emitting structure 120 and covers side surfaces of the first and second bulk electrodes 171, 173 and portions of upper surfaces thereof. Further, the insulation support layer 180 may include a third opening 180a and a fourth opening 180b that partially expose the upper surfaces of the first bulk electrode 171 and the second bulk electrode 173, respectively.

[124] The insulation support layer 180 may include a lower insulation support layer 181 and an upper insulation support layer 183, in which the lower insulation support layer 181 may surround the side surfaces of the first and second bulk electrodes 171, 173 and the upper insulation support layer 183 may partially cover the upper surfaces of the first and second bulk electrodes 171, 173. Further, the upper insulation support layer 183 may cover interfaces between the lower insulation support layer 181 and the first and second bulk electrodes 171, 173.

[125] The insulation support layer 180 exhibits electrically insulating properties and covers the side surfaces of the first and second bulk electrodes 171, 173 to effectively insulate the first and second bulk electrodes 171, 173 from each other. At the same time, the in-

sulation support layer 180 may also serve to support the first bulk electrode 171 and the second bulk electrode 173.

[126] In the structure wherein the upper surfaces of the first and second bulk electrodes 171, 173 are partially covered by the upper insulation support layer 183, areas of exposed regions 171a, 173a of the upper surfaces of the first and second electrode 171, 173 may be smaller than the horizontal cross-sectional areas of the first and second bulk electrodes 171, 173, respectively. Particularly, the upper insulation support layer 183 may be disposed on the upper surfaces of the first and second bulk electrodes 171, 173 near side surfaces of the first bulk electrode 171 and the second bulk electrode 173 facing each other. Thus, a separation distance X between an exposed region 171a of the upper surface of the first bulk electrode 171 and an exposed region 171b of the upper surface of the second bulk electrode 173 is greater than the separation distance Y between the first bulk electrode 171 and the second bulk electrode 173.

[127] Specifically, a conductive material (for example, a solder, a conductive bonding agent, or a eutectic material) is disposed between the exposed regions 171a, 173a of the upper surfaces and a separate substrate to bond the light emitting device 100a to the separate substrate, thereby allowing the light emitting device 100a to be mounted on the separate substrate. In order to prevent short circuit between the bulk electrodes 171, 173 due to the conductive material provided for bonding, the separation distance X between the exposed regions 171a, 173a of the upper surface is required to be a predetermined value or more. According to this exemplary embodiment, since the insulation support layer 180 is formed to partially cover the upper surfaces of the bulk electrodes 171, 173, the separation distance X between the exposed region 171a of the upper surface of the first bulk electrode 171 and the exposed region 171b of the upper surface of the second bulk electrode 173 becomes greater than the separation distance Y between the first bulk electrode 171 and the second bulk electrode 173. Thus, the separation distance X can become a predetermined value or more to prevent short circuit between the first and second bulk electrodes 171, 173, and the separation distance Y between the first and second bulk electrodes 171, 173 can become a predetermined value or less to prevent short circuit between the first and second bulk electrodes 171, 173. With this structure, the light emitting device 100a can have improved heat dissipation efficiency while effectively preventing short circuit during a process of mounting the light emitting device 100a.

[128] The separation distance X between the exposed region 171a of the upper surface of the first bulk electrode 171 and the exposed region 171b of the upper surface of the second bulk electrode 173 may be about 250 ㎛ or more when the light emitting device 100a is mounted on a separate substrate by soldering, and may be about 80 ㎛ or more when the light emitting device 100a is mounted on a separate substrate by eutectic

bonding. However, it should be understood that the present disclosure is not limited thereto.

[129] In addition, there is no limitation as to the configuration of the upper insulation support layer 183 on other regions except that the upper insulation support layer 183 is disposed on the upper surfaces of the first and second bulk electrodes near the side surfaces of the first bulk electrode 171 and the second bulk electrode 173 facing each other such that the separation distance X between the exposed region 171a of the upper surface of the first bulk electrode 171 and the exposed region 171b of the upper surface of the second bulk electrode 173 becomes a predetermined value or more. For example, as shown in Figure 1 and Figure 2, a portion of the insulation support layer 180 disposed between the first and second bulk electrodes 171, 173 may have a T-shaped cross-section, and a portion of the insulation support layer 180 covering outer peripheral side surfaces of the first and second bulk electrodes 171, 173 may have an L-shaped cross-section.

[130] The insulation support layer 180 may be formed of a different material than the bulk electrodes 171, 173. Particularly, the insulation support layer 180 may include an insulating polymer and/or an insulating ceramic material, and the bulk electrodes 171, 173 may include a metallic material. Accordingly, delamination or cracking can occur at interfaces between the insulation support layer 180 and the bulk electrodes 171, 173, and failure caused by stress and strain due to bonding of different materials can also occur thereon. When the insulation support layer 180 and/or the bulk electrodes 171, 173 are damaged, the light emitting structure 120 can be contaminated, and the light emitting structure 120 can suffer from cracking, thereby deteriorating reliability of the light emitting device 100a. According to exemplary embodiments, the insulation support layer 180 is formed to cover the side surfaces of the first and second bulk electrodes 171, 173 and portions of the upper surfaces of the first and second bulk electrodes 171, 173, thereby improving mechanical stability between the insulation support layer 180 and the bulk electrodes 171, 173. As a result, the light emitting device 100a can have improved reliability.

[131] Further, as the mechanical stability of the light emitting device 100a is improved, it is possible to prevent damage to the light emitting structure 120 during a process of separating the growth substrate (not shown) from the light emitting structure 120.

[132] Furthermore, the lower insulation support layer 181 and the upper insulation support layer 183 may be formed of the same material or different materials.

[133] When the lower insulation support layer 181 and the upper insulation support layer 183 are formed of the same material, the insulation support layer 180 may include a material, for example, an epoxy molding compound (EMC) or a Si resin. Further, the insulation support layer 180 may include light reflective and light scattering particles

such as TiO_2 particles.

[134] When the lower insulation support layer 181 and the upper insulation support layer 183 are formed of different materials, the upper insulation support layer 183 may be formed of a material having lower brittleness and/or lower moisture absorptivity than the lower insulation support layer 181. For example, the lower insulation support layer 181 may include a material, for example, an epoxy molding compound (EMC) or a Si resin, and the upper insulation support layer 183 may include a material such as a photoresist (PR) and/or a photo-solder resist (PSR).

[135] As the upper insulation support layer 183 is formed of a material exhibiting relatively low brittleness, the upper insulation support layer 183 is less likely to suffer from breakage or cracking than the lower insulation support layer 181, thereby preventing infiltration of external contaminants through the interfaces between the lower insulation support layer 181 and the bulk electrodes 171, 173. Further, as the upper insulation support layer 183 is formed of a material exhibiting relatively low moisture absorptivity, it is possible to prevent infiltration of external contaminants through the interfaces between the lower insulation support layer 181 and the bulk electrodes 171, 173. For example, when the lower insulation support layer 181 is formed of a material such as EMC, which exhibits high moisture absorptivity, the light emitting device 100a can be more effectively protected from moisture by the upper insulation support layer 183 formed of a material such as PSR. Particularly, the structure wherein the upper insulation support layer 183 is formed to cover the interfaces between the lower insulation support layer 181 and the bulk electrodes 171, 173 can secure a more effective function in protection of the light emitting device 100a.

[136] The exposed region 171a of the upper surface of the first bulk electrode 171 may have a smaller area than a contact region between the first bulk electrode 171 and the first contact electrode 130, and the exposed region 173a of the upper surface of the second bulk electrode 173 may have a larger area than a contact region between the second bulk electrode 173 and the second contact electrode 140. In this structure, the first bulk electrode 171 may have a larger horizontal cross-sectional area than the second bulk electrode 173.

[137] That is, with the structure wherein the horizontal cross-sectional area of the first bulk electrode 171 is larger than that of the second bulk electrode 173, the light emitting device 100a can achieve improvement in heat dissipation efficiency. At the same time, a ratio of the area of the exposed region 171a of the upper surface of the first bulk electrode 171 to the area of the exposed region 173a of the upper surface of the second bulk electrode 173 is set to be lower than a ratio of the horizontal cross-sectional area of the first bulk electrode 171 to the horizontal cross-sectional area of the second bulk electrode 173 such that the exposed regions 171a, 173a of the upper surfaces exposed

to the mounting plane for the light emitting device 100a can have substantially similar areas. With this structure, the light emitting device 100a can achieve further improvement in heat dissipation efficiency without changing the process of mounting the light emitting device 100a on the separate substrate.

[138] In some exemplary embodiments, the insulation support layer 180 may also cover the side surface of the light emitting structure 120, thereby causing change of an emission angle of light emitted from the light emitting structure 120. For example, in the structure wherein the insulation support layer 180 further covers at least a portion of the side surface of the light emitting structure 120, some of light emitted through the side surface of the light emitting structure 120 can be reflected towards a lower surface of the light emitting structure 120. In this way, the light emission angle of the light emitting device 100a can be adjusted by adjusting a region to be formed with the insulation support layer 180.

[139] The light emitting device 100a may further include a wavelength conversion portion (not shown), through which light emitted from the light emitting structure 120 is subjected to wavelength conversion, so that the light emitting device 100a can realize various colors. For example, with a structure wherein the wavelength conversion portion includes phosphors emitting red and green light and the light emitting structure 120 emits blue light, the light emitting device 100a can emit white light. Accordingly, it is possible to provide a wafer level white light emitting device having a small size and high output.

[140] The wavelength conversion portion may be formed, for example, on the lower surface of the light emitting structure 120 and may also be formed to cover the side surface of the light emitting structure 120, without being limited thereto.

[141] Figure 3 is a sectional view of a light emitting device according to another exemplary embodiment.

[142] A light emitting device 100b according to the exemplary embodiment shown in Figure 3 is generally similar to the light emitting device 100a shown in Figure 1 and Figure 2 and further includes a first electrode pad 191 and a second electrode pad 193. Hereinafter, different features of the light emitting device 100b according to this exemplary embodiment will be mainly described, and detailed descriptions of the same components will be omitted.

[143] Referring to Figure 3, the light emitting device 100b includes a light emitting structure 120, a first contact electrode 130, a second contact electrode 140, insulation layers 150, 160, first and second bulk electrodes 171, 173, an insulation support layer 180, a first electrode pad 191, and a second electrode pad 193. The light emitting device 100b may further include a growth substrate (not shown), a wavelength conversion portion (not shown), and a connection electrode 145.

[144] The first electrode pad 191 and the second electrode pad 193 may be disposed on the first bulk electrode 171 and the second bulk electrode 173, respectively, and may at least partially fill the third opening 180a and the fourth opening 180b of the insulation support layer 180, respectively. With this structure, the first electrode pad 191 and the second electrode pad 193 may cover the exposed region 171a of the upper surface of the first bulk electrode 171 and the exposed region 173a of the upper surface of the second bulk electrode 173, respectively. Accordingly, a separation distance X between the first and second electrode pads 191, 193 may correspond to the separation distance Y between the exposed region 171a of the upper surface of the first bulk electrode 171 and the exposed region 171b of the upper surface of the second bulk electrode 173.

[145] Further, as shown in the drawings, upper surfaces of the first electrode pad 191 and the second electrode pad 193 may be flush with an upper surface of the insulation support layer 180. With this structure, the light emitting device 100b may have a substantially flat upper surface.

[146] The first and second electrode pads 191, 193 may be formed to fill the openings of the insulation support layer 180 by plating and the like. Then, the first and second electrode pads 191, 193 and the insulation support layer 180 are partially removed by physical and/or chemical methods, for example, lapping or chemical mechanical polishing (CMP), so that the upper surfaces of the first electrode pad 191 and the second electrode pad 193 can become generally flush with the upper surface of the insulation support layer 180.

[147] The first electrode pad 191 and the second electrode pad 193 may include a conductive material, particularly, a metallic material, for example, Ni, Pt, Pd, Rh, W, Ti, Al, Au, Sn, Cu, Ag, Bi, In, Zn, Sb, Mg, Pb, and the like. The first and second electrode pads 191, 193 may be formed of substantially the same material as the bulk electrodes 171, 173, or may be formed of a different material than the bulk electrodes 171, 173. The first and second electrode pads 191, 193 may be formed by deposition or plating, for example, electroless plating.

[148] In the structure wherein the light emitting device 100b further includes the first and second electrode pads 191, 193, the upper surface of the light emitting device 100b (which may be a surface of the light emitting device 100b mounted on a separate substrate) can become generally flat. With this structure, the light emitting device 100b can be easily mounted on the separate substrate.

[149] Further, in fabrication of the light emitting device 100b, when there is a step on a surface opposite the surface on which the growth substrate (not shown) is disposed, the light emitting structure 120 is highly likely to suffer from cracking or damage in the process of separating the growth substrate from the light emitting structure 120. According to this exemplary embodiment, the surface opposite the surface on which

the growth substrate (not shown) is disposed can become generally flat by the first and second electrode pads 191, 193, thereby preventing damage to the light emitting structure 120 during the process of separating the growth substrate. Accordingly, the light emitting device 100b can secure high yield and high reliability.

[150] Figure 4a and Figure 4b are plan views of a light emitting device according to a further exemplary embodiment, and Figure 5 is a cross-sectional view of the light emitting device according to the exemplary embodiment.

[151] A light emitting device 100c according to this exemplary embodiment includes a different light emitting structure 120 than the light emitting device 100a shown in Figure 1 and Figure 2. As a result, structural relationships between other components of the light emitting device according to this exemplary embodiment are different from those of the light emitting device according to the above exemplary embodiment, and the following description will be mainly given to such different features. Detailed descriptions of the same components will be omitted.

[152] Figure 4a is a plan view of the light emitting device according to this exemplary embodiment, Figure 4b is a plan view illustrating locations of holes 120h, a first opening 160a and second openings 160b of the light emitting device, and Figure 5 is a cross-sectional view taken along line B-B' of Figure 4a and Figure 4b.

[153] Referring to Figure 4a, Figure 4b and Figure 5, the light emitting device 100c includes a light emitting structure 120, a first contact electrode 130, a second contact electrode 140, insulation layers 150, 160, first and second bulk electrodes 171, 173, and an insulation support layer 180. The light emitting device 100c may further include a growth substrate (not shown), a wavelength conversion portion (not shown), a first electrode pad 191, and a second electrode pad 193.

[154] The light emitting structure 120 may include a partially exposed region of the first conductive type semiconductor layer 121 formed by partially removing the second conductive type semiconductor layer 125 and the active layer 123. For example, as shown in the drawings, the light emitting structure 120 may include a plurality of holes 120h formed through the second conductive type semiconductor layer 125 and the active layer 123 to expose the first conductive type semiconductor layer 121 therethrough. The holes 120h may be generally arranged in a regular pattern throughout the light emitting structure 120. However, it should be understood that the present disclosure is not limited thereto, and the arrangement and the number of holes 120h can be changed in various ways.

[155] Further, the structure exposing the first conductive type semiconductor layer 121 is not limited to the holes 120h. For example, the exposed region of the first conductive type semiconductor layer 121 may be realized in the form of lines and a combination of lines and holes.

[156] The second contact electrode 140 may be disposed on the second conductive type semiconductor layer 125 to form ohmic contact therewith. The second contact electrode 140 may be disposed to cover an overall upper surface of the second conductive type semiconductor layer 125, or may be formed to cover substantially the entirety of the upper surface of the second conductive type semiconductor layer 125. The second contact electrode 140 may be formed as a monolithic layer over the entirety of the light emitting structure 120. In this structure, the second contact electrode 140 may include opening regions corresponding to locations of the plurality of holes 120h. With this structure, the light emitting device allows uniform supply of electric current to the entire region of the light emitting structure 120, thereby improving current spreading efficiency.

[157] However, it should be understood that the present disclosure is not limited thereto. Alternatively, the second contact electrode 140 may be composed of a plurality of unit contact electrodes.

[158] The first insulation layer 150 may partially cover an upper surface of the light emitting structure 120 and the second contact electrode 140. The first insulation layer 150 may cover side surfaces of the plurality of holes 120h and may include an opening exposing portions of the first conductive type semiconductor layer 121 disposed on lower surfaces of the holes 120h. Accordingly, the opening may be disposed corresponding to the locations of the plurality of holes 120h. The first insulation layer 150 may include an opening exposing a portion of the second contact electrode 140. Furthermore, the first insulation layer 150 may further cover a side surface of at least a portion of the light emitting structure 120.

[159] The first contact electrode 130 may partially cover the light emitting structure 120 and may form ohmic contact with the first conductive type semiconductor layer 121 through the holes 120a and the opening of the first insulation layer 150 disposed corresponding to the holes 120a. Although not shown in the drawings, in other exemplary embodiments, the first contact electrode 130 may be formed to cover the side surface of the light emitting structure 120.

[160] The second insulation layer 160 may partially cover the first contact electrode 130, and may include a first opening 160a which partially exposes the first contact electrode 130 and a second opening 160b which partially exposes the second contact electrode 140. Each of the first and second openings 160a, 160b may be formed singly or in plural. Further, the openings 160a, 160b may be disposed near opposite sides of the light emitting device, respectively.

[161] The first bulk electrode 171 and the second bulk electrode 173 may be disposed on the light emitting structure 120 and may be electrically connected to the first contact electrode 130 and the second contact electrode 140, respectively.

[162] A separation distance Y between the first bulk electrode 171 and the second bulk electrode 173 may be a predetermined value or less, for example, about 250 ㎛ or less, specifically about 80 ㎛ or less. The first bulk electrode 171 and the second bulk electrode 173 may have different volumes and the horizontal cross-sectional area of the first bulk electrode 171 may be larger than that of the second bulk electrode 173.

[163] The insulation support layer 180 is disposed on the light emitting structure 120 and covers side surfaces of the first and second bulk electrodes 171, 173 and portions of upper surfaces thereof. The insulation support layer 180 may include a third opening 180a and a fourth opening 180b that partially expose the upper surfaces of the first bulk electrode 171 and the second bulk electrode 173, respectively. The insulation support layer 180 may include a lower insulation support layer 181 and an upper insulation support layer 183, in which the lower insulation support layer 181 may surround the side surfaces of the first and second bulk electrodes 171, 173 and the upper insulation support layer 183 may partially cover the upper surfaces of the first and second bulk electrodes 171, 173. Further, the upper insulation support layer 183 may cover interfaces between the lower insulation support layer 181 and the first and second bulk electrodes 171, 173.

[164] In the structure wherein the upper surfaces of the first and second bulk electrodes 171, 173 are partially covered by the upper insulation support layer 183, the areas of the exposed regions 171a, 173a of the upper surfaces of the first and second electrode 171, 173 may be smaller than the horizontal cross-sectional areas of the first and second bulk electrodes 171, 173, respectively. Particularly, the upper insulation support layer 183 may be disposed on the upper surfaces of the first and second bulk electrodes 171, 173 near the side surfaces of the first bulk electrode 171 and the second bulk electrode 173 facing each other. Thus, the separation distance X between the exposed region 171a of the upper surface of the first bulk electrode 171 and the exposed region 171b of the upper surface of the second bulk electrode 173 is greater than the separation distance Y between the first bulk electrode 171 and the second bulk electrode 173.

[165] The separation distance X between the exposed region 171a of the upper surface of the first bulk electrode 171 and the exposed region 171b of the upper surface of the second bulk electrode 173 may be about 250 ㎛ or more when the light emitting device 100c is mounted on a separate substrate by soldering, and may be about 80 ㎛ or more when the light emitting device 100c is mounted on a separate substrate by eutectic bonding. However, it should be understood that the present disclosure is not limited thereto.

[166] The lower insulation support layer 181 and the upper insulation support layer 183 may be formed of the same material or different materials.

[167] Particularly, when the lower insulation support layer 181 and the upper insulation support layer 183 are formed of different materials, the upper insulation support layer 183 may be formed of a material having lower brittleness and/or lower moisture absorptivity than the lower insulation support layer 181. For example, the lower insulation support layer 181 may include a material, for example, an epoxy molding compound (EMC) or a Si resin, and the upper insulation support layer 183 may include a material such as a photoresist (PR) and/or a photo-solder resist (PSR).

[168] The exposed region 171a of the upper surface of the first bulk electrode 171 may have a smaller area than a contact region between the first bulk electrode 171 and the first contact electrode 130, and the exposed region 173a of the upper surface of the second bulk electrode 173 may have a larger area than a contact region between the second bulk electrode 173 and the second contact electrode 140. In this structure, the first bulk electrode 171 may have a larger horizontal cross-sectional area than the second bulk electrode 173.

[169] The first electrode pad 191 and the second electrode pad 193 may be disposed on the first bulk electrode 171 and the second bulk electrode 173, respectively, and may at least partially fill the third opening 180a and the fourth opening 180b of the insulation support layer 180, respectively. With this structure, the first electrode pad 191 and the second electrode pad 193 may cover the exposed region 171a of the upper surface of the first bulk electrode 171 and the exposed region 173a of the upper surface of the second bulk electrode 173, respectively. Accordingly, the separation distance X between the first and second electrode pads 191, 193 may correspond to the separation distance Y between the exposed region 171a of the upper surface of the first bulk electrode 171 and the exposed region 171b of the upper surface of the second bulk electrode 173. Further, as shown in the drawings, upper surfaces of the first electrode pad 191 and the second electrode pad 193 may be flush with an upper surface of the insulation support layer 180. With this structure, the light emitting device 100c may have a substantially flat upper surface.

[170] Figure 6a, Figure 6b and Figure 7 are plan views and a cross-sectional view of a light emitting device according to yet another exemplary embodiment, respectively.

[171] Figure 6a is a plan view of a light emitting device 100d, Figure 6b is a plan view illustrating locations of holes 120h, a third opening 160a and fourth openings 160b of the light emitting device, and Figure 7 is a cross-sectional view taken along line C-C' of Figure 6a and Figure 6b.

[172] Referring to Figure 6a, Figure 6b and Figure 7, the light emitting device 100d includes light emitting structure 120 including a first conductive type semiconductor layer 121, an active layer 123 and a second conductive type semiconductor layer 125, a first contact electrode 130, a second contact electrode 140, first and second insulation

layers 150, 160, a first bulk electrode 171, a second bulk electrode 173, and an insulation support layer 180. The light emitting device 100d may further include first and second electrode pads (not shown), a growth substrate (not shown), and a wavelength conversion portion (not shown).

[173] The light emitting structure 120 includes a first conductive type semiconductor layer 121, an active layer 123 disposed on the first conductive type semiconductor layer 121, and a second conductive type semiconductor layer 125 disposed on the active layer 123.

[174] The light emitting structure 120 may include a partially exposed region of the first conductive type semiconductor layer 121 formed by partially removing the second conductive type semiconductor layer 125 and the active layer 123. For example, as shown in the drawings, the light emitting structure 120 may include at least one hole 120a formed through the second conductive type semiconductor layer 125 and the active layer 123 to expose the first conductive type semiconductor layer 121 therethrough.

[175] The light emitting structure 120 may include a plurality of holes 120h, which may be generally arranged in a regular pattern. For example, as shown in Figure 6a and Figure 6b, the holes 120h may be arranged at constant intervals in a predetermined pattern. With the structure wherein the holes 120h are arranged in a regular pattern throughout the light emitting structure, the light emitting device 100d allows uniform current spreading in the horizontal direction upon operation thereof. However, it should be understood that the present disclosure is not limited thereto, and the arrangement and the number of holes 120h can be changed in various ways.

[176] Further, the structure exposing the first conductive type semiconductor layer 121 is not limited to the holes 120h. For example, the exposed region of the first conductive type semiconductor layer 121 may be realized in the form of lines and a combination of lines and holes. When the exposed region of the first conductive type semiconductor layer 121 is realized in the form of plural lines, the light emitting structure 120 may be formed along the lines and may include at least one mesa including the active layer 123 and the second conductive type semiconductor layer 125. Thus, although the following description of this exemplary embodiment will be given with reference to the light emitting structure 120 including the plurality of holes 120h, it should be understood that the present disclosure is not limited thereto.

[177] The light emitting structure 120 may further include a roughness 120R formed on a lower surface thereof. The roughness 120R may be formed by at least one of dry etching, wet etching and electrochemical etching. For example, the roughness 120R may be formed by PEC etching or by wet etching in an etching solution containing KOH and NaOH.

[178] The light emitting structure 120 may further include a growth substrate (not shown) disposed under the first conductive type semiconductor layer 121. As the growth substrate, any substrate may be used so long as the substrate allows growth of the light emitting structure 120 thereon. For example, the growth substrate may be a sapphire substrate, a silicon carbide substrate, a silicon substrate, a gallium nitride substrate, or an aluminum nitride substrate. Such a growth substrate may be removed from the light emitting structure 120 by a typical method known in the art after fabrication of the light emitting device.

[179] The second contact electrode 140 may be disposed on the second conductive type semiconductor layer 125. The second contact electrode 140 may cover at least a portion of an upper surface of the second conductive type semiconductor layer 125 and may form ohmic contact with the second conductive type semiconductor layer 125. Further, the second contact electrode 140 may be disposed to cover the overall upper surface of the second conductive type semiconductor layer 125. That is, the second contact electrode 140 may be formed as a monolithic layer in a region covering the upper surface of the second conductive type semiconductor layer 125 excluding a region in which the holes 120a of the light emitting structure 120 are formed. With this structure, the light emitting device allows uniform supply of electric current to the entire region of the light emitting structure 120, thereby improving current spreading efficiency.

[180] However, it should be understood that the present disclosure is not limited thereto. Alternatively, the second contact electrode 140 may be composed of a plurality of unit reflective electrode layers separated from each other on the upper surface of the second conductive type semiconductor layer 125 instead of being composed of the monolithic layer. In this exemplary embodiment, the unit reflective electrode layers may be electrically connected to each other via connecting portions.

[181] The second contact electrode 140 may include a material capable of forming ohmic contact with the second conductive type semiconductor layer 125, for example, a metallic material and/or a conductive oxide.

[182] When the second contact electrode 140 includes the metallic material, the second contact electrode 140 may include a reflective layer and a cover layer covering the reflective layer. As described above, the second contact electrode 140 can reflect light while forming ohmic contact with the second conductive type semiconductor layer 125. Accordingly, the reflective layer may include a metal having high reflectivity and capable of forming ohmic contact with the second conductive type semiconductor layer 125. For example, the reflective layer may include at least one of Ni, Pt, Pd, Rh, W, Ti, Al, Mg, Ag and Au. In addition, the reflective layer may be composed of a single layer or multiple layers.

[183] The cover layer can prevent interdiffusion between the reflective layer and other materials and can prevent external materials from diffusing into and damaging the reflective layer. Accordingly, the cover layer may be formed to cover a lower surface and a side surface of the reflective layer. The cover layer may be electrically connected together with the reflective layer to the second conductive type semiconductor layer 125 to act as an electrode together with the reflective layer. The cover layer may include, for example, Au, Ni, Ti, or Cr, and may be composed of a single layer or multiple layers.

[184] When the second contact electrode 140 includes the conductive oxide, the conductive oxide may include ITO, ZnO, AZO, IZO, GZO, and the like. When the second contact electrode 140 includes the conductive oxide, the second contact electrode 140 can cover a larger area of the upper surface of the second conductive type semiconductor layer 125 than when the second contact electrode 140 includes a metal.

[185] The first and second insulation layers 150, 160 may partially cover the first and second contact electrodes 130, 140. Next, the first insulation layer 150 will be described first and the second insulation layer 160 will be described thereafter.

[186] The first insulation layer 150 may partially cover an upper surface of the light emitting structure 120 and the second contact electrode 140. In addition, the first insulation layer 150 may cover side surfaces of the plurality of holes 120h while partially exposing the regions of the first conductive type semiconductor layer 121 exposed through the holes 120a. Furthermore, the first insulation layer 150 may further cover at least a portion of the side surface of the light emitting structure 120.

[187] The first insulation layer 150 may include first openings disposed corresponding to the plurality of holes 120h and second openings exposing a portion of the second contact electrode 140. The first conductive type semiconductor layer 121 can be partially exposed through the first opening and the holes 120h, and the second contact electrode 140 can be partially exposed through the second openings.

[188] In this exemplary embodiment, the first openings and the second openings may be arranged in a certain pattern. For example, as shown in Figure 6a and Figure 6b, the second openings may be disposed near one side of the light emitting device 100d, and the first openings may be regularly disposed in a region in which the second openings are not disposed.

[189] The first insulation layer 150 may include an insulating material, for example, SiO_2, SiN_x, MgF_2, and the like. Furthermore, the first insulation layer 150 may include multiple layers and may include a distributed Bragg reflector wherein materials having different indexes of refraction are alternately stacked one above another. Particularly, when the second contact electrode 140 includes the conductive oxide, the first insulation layer 150 includes the distributed Bragg reflector, thereby improving luminous

efficacy of the light emitting device 100d.

[190] The first contact electrode 130 may partially cover the light emitting structure 120 and may form ohmic contact with the first conductive type semiconductor layer 121 through the plurality of holes 120h and the first openings. With this structure, the first contact electrode 130 may include an ohmic contact region 131 at which the first contact electrode 130 directly contacts the first conductive type semiconductor layer 121 to form ohmic contact. When the light emitting structure 120h includes the plurality of holes 120h, the ohmic contact region 131 may also be realized by a plurality of ohmic contact regions corresponding to the number of holes 120h.

[191] The first contact electrode 130 may be formed to cover an overall upper surface of the first insulation layer 150 excluding some region thereof. Further, the first contact electrode 130 may also be formed to cover the side surface of the light emitting structure 120. When the first contact electrode 130 is also formed on the side surface of the light emitting structure 120, the first contact electrode 130 reflects light, which is emitted to the side surface of the light emitting structure 120 from the active layer 123, in an upward direction, thereby increasing the ratio of light emitted through an upper surface of the light emitting device 100d. On the other hand, the first contact electrode 130 is not formed in a region corresponding to the second openings of the first insulation layer 150 and is separated and insulated from the second contact electrode 140.

[192] With the structure wherein the first contact electrode 130 is formed to cover the overall upper surface of the light emitting structure 120 excluding some region thereof, the light emitting device can have further improved current spreading efficiency. Further, since a portion of the light emitting structure 120 not covered by the second contact electrode 140 can be covered by the first contact electrode 130, the light emitting device 100d allows more effective reflection of light, thereby achieving improvement in luminous efficacy.

[193] The first contact electrode 130 may be composed of a single layer or multiple layers, and may include a highly reflective metal layer such as an Al layer. The highly reflective metal layer may be formed on a bonding layer formed of Ti, Cr or Ni, without being limited thereto. Alternatively, the first contact electrode 130 may include at least one of Ni, Pt, Pd, Rh, W, Ti, Al, Mg, Ag and Au.

[194] Since the first contact electrode 130 forms ohmic contact with the first conductive type semiconductor layer 121 through the holes 120h, a region from which the active layer 123 is removed to form an electrode connected to the first conductive type semiconductor layer 121 is the same as the region corresponding to the plurality of holes 120h. With this structure, the light emitting device can minimize the ohmic contact region between the first conductive type semiconductor layer 121 and the metal layer,

and has a large ratio of an area of a luminous region to a horizontal area of the overall light emitting structure.

[195] The light emitting device 100d may further include a connection electrode 145.

[196] The connection electrode 145 may be disposed on the second contact electrode 140 and may be electrically connected to the second contact electrode 140 through an opening of the first insulation layer 150. Furthermore, the connection electrode 145 can electrically connect the second contact electrode 140 to the second bulk electrode 173. Further, the connection electrode 145 may partially cover the first insulation layer 150 and be separated and insulated from the first contact electrode 130. The second insulation layer 160 may partially cover the first contact electrode 130. Further, the second insulation layer 160 may include a third opening 160a which partially exposes the first contact electrode 130 and a fourth opening 160b which partially exposes the second contact electrode 140. The fourth opening 160b may be formed at a location corresponding to the second opening.

[197] Each of the third and fourth openings 160a, 160b may be formed singly or in plural. Further, as shown in Figure 6(b), the fourth openings 160b may be disposed near one side of the light emitting device 100d and the third opening 160a may be formed to expose some region in which at least some of the plurality of holes 120h is formed. Furthermore, the third opening 160a may be formed to expose all of the holes 120h. With this structure, the ohmic contact regions 131 can be exposed through the third opening 160a.

[198] The second insulation layer 160 may include an insulating material, for example, SiO_2, SiN_x, MgF_2, and the like. Furthermore, the second insulation layer 160 may include multiple layers and may include a distributed Bragg reflector wherein materials having different indexes of refraction are alternately stacked one above another.

[199] The first bulk electrode 171 and the second bulk electrode 173 may be disposed on the light emitting structure 120 and may be electrically connected to the first contact electrode 130 and the second contact electrode 140, respectively. Particularly, the first bulk electrode 171 and the second bulk electrode 173 may be electrically connected to the first and second contact electrodes 130, 140 through direct contact therewith, respectively.

[200] At least some holes 120h may be disposed under the first bulk electrode 171, and alternatively, all of the holes 120h may be disposed under the first bulk electrode 171. Thus, the ohmic contact region 131 of the first contact electrode 130 may be interposed between the first bulk electrode 171 and the first conductive type semiconductor layer 121, and all of the ohmic contact regions 131 of the first contact electrode 130 may directly contact the first bulk electrode 171.

[201] On the other hand, the holes 120h may not be disposed under the second bulk

electrode 173. Specifically, ohmic contact between the first contact electrode 130 and the first conductive type semiconductor layer 121 may not be formed under a region in which the second bulk electrode 173 is formed. Accordingly, as shown in Figure 6a and Figure 6b, the holes 120h of the light emitting structure 120 may be formed on regions other than a region near one side of the light emitting device 100d.

[202] The first bulk electrode 171 and the second bulk electrode 173 may have different volumes and the first bulk electrode 171 may have a larger volume than the second bulk electrode 173. Further, the first bulk electrode 171 and the second bulk electrode 173 may have a thickness of about 70 ㎛ to 80 ㎛ or more, and may have substantially the same thickness. Accordingly, the first bulk electrode 171 may have a larger horizontal cross-sectional area than the second bulk electrode 173. For example, the horizontal cross-sectional area of the first bulk electrode 171 may be 0.8 times to less than 1 times the sum of the horizontal cross-sectional areas of the first and second bulk electrodes 171, 173.

[203] That is, the light emitting device 100d includes the first bulk electrode 171, the horizontal cross-sectional area of which is much larger than the horizontal cross-sectional area of the second bulk electrode 173. When the first conductive type semiconductor layer 121 is an n-type semiconductor layer, the first bulk electrode 171 can also act as an N-electrode, and as described above, upon operation of the light emitting device 100d, light emission and heat generation mainly occur from the region in which the first bulk electrode 171 is disposed. Accordingly, as in this exemplary embodiment, with the structure wherein the horizontal cross-sectional area of the first bulk electrode 171 is much larger than the horizontal cross-sectional area of the second bulk electrode 173, the light emitting device 100d can uniformly emit light throughout the overall luminous region to achieve improvement in luminous characteristics, and can allow efficient heat dissipation through the first bulk electrode 171 to achieve improvement in heat dissipation efficiency.

[204] Furthermore, the first bulk electrode 171 may directly contact the first contact electrode 130 and also directly contact all of the ohmic contact regions 131 of the first contact electrode 130. Here, the ohmic contact regions 131 correspond to the locations of the plurality of holes 120h, and the holes 120h are generally arranged in a regular pattern throughout the light emitting structure 120. With this structure, the light emitting device 100d can achieve improvement in electrical characteristics through uniform current spreading in the horizontal direction, and can efficiently dissipate heat generated from the light emitting structure 120 through the ohmic contact regions 131 and the first bulk electrode 171.

[205] In addition, with the structure wherein the ohmic contact region between the first contact electrode 130 and the first conductive type semiconductor layer 121 is not

present under the region in which the second bulk electrode 173 is formed, the light emitting device can permit heat generated from the ohmic contact region between the first conductive type semiconductor layer 121 and the first contact electrode 130 to be completely dissipated through the first bulk electrode 171. Accordingly, the light emitting device 100d can achieve further improvement in heat dissipation efficiency.

[206] As described above, according to the exemplary embodiment, the light emitting device 100d can achieve improvement in luminous efficacy and heat dissipation efficiency, thereby improving reliability and lifespan.

[207] Each of the first bulk electrode 171 and the second bulk electrode 173 may include metal particles and a non-metallic material interposed between the metal particles. Further, each of the first and second bulk electrodes 171, 173 may include sintered metal particles including the metal particles and the non-metallic material. Within the sintered metal particles, the metal particles are sintered to have a plurality of grains and the non-metallic material is interposed in at least some region between the metal particles. Such a non-metallic material can act as a buffer capable of relieving stress exerted upon the first bulk electrode 171 and the second bulk electrode 173. With this structure, mechanical stability of the first bulk electrode 171 and the second bulk electrode 173 can be improved, thereby relieving stress applied from the electrode 160 to the light emitting structure 120.

[208] In each of the first bulk electrode 171 and the second bulk electrode 173, the metal particles may be present in an amount of 80 wt% to 98 wt%. Within this content range of the metal particles, the first bulk electrode 171 and the second bulk electrode 173 can exhibit excellent properties in terms of thermal conductivity and electrical conductivity, and can effectively relieve stress, which can be applied to the bulk electrodes 171, 173, thereby improving mechanical stability of the bulk electrodes 171, 173.

[209] The metal particles may be formed of any material so long as the material can exhibit thermal conductivity and electrical conductivity, and may include, for example, Cu, Au, Ag, Pt, and the like. The non-metallic material may be derived from a material, for example, a carbon-containing polymer material, which is used as a sintering target for formation of electrodes.

[210] Although the metal particles are included in the form of the sintered metal particles in the first and second bulk electrodes 171, 173 in the above exemplary embodiment, it should be understood that the present disclosure is not limited thereto. In an alternative exemplary embodiment, the first bulk electrode 171 and the second bulk electrode 173 may be formed through deposition and/or plating of metal. In this alternative exemplary embodiment, the first bulk electrode 171 and the second bulk electrode 173 may be composed of multiple layers.

[211] In this exemplary embodiment, the first bulk electrode 171 and the second bulk

electrode 173 may have side surfaces substantially perpendicular to an upper surface of the second insulation layer 160. However, it should be understood that the present disclosure is not limited thereto. In an alternative exemplary embodiment, as shown in Figure 3, each of first and second bulk electrodes 271, 273 may include an inclined side surface.

[212] Figure 8 is a sectional view of a light emitting device 100e according to yet another exemplary embodiment, in which the bulk electrodes 271, 273 have inclined side surfaces unlike the light emitting device 100d shown in Figure 6a, Figure 6b and Figure 7.

[213] Referring to Figure 8, each of the first bulk electrode 271 and the second bulk electrode 273 may include an inclined side surface. Particularly, as shown in Figure 8, each of the first bulk electrode 271 and the second bulk electrode 273 may include an inclined side surface on which a gradient of a tangential line TL of a vertical cross-section thereof with respect to the side surface varies. Specifically, the gradient of the tangential line TL of each of the first and second bulk electrodes 271, 273 with respect to the side surface thereof may gradually increase from a lower side thereof in an upwards direction and may gradually decrease from a predetermined point of inflection in an upwards direction. Accordingly, the inclined side surface of each of the first and second bulk electrodes 271, 273 may include a region in which the gradient of the tangential line TL increases and a region in which the gradient of the tangential line TL decreases.

[214] With the structure wherein each of the first and second bulk electrodes 271, 273 has the inclined side surface on which the gradient of the tangential line TL of the vertical cross-section thereof with respect to the side surface varies, the horizontal cross-section of each of the first and second bulk electrodes 271, 273 varies in the vertical direction. For example, as shown in the drawings, the horizontal cross-section of each of the first and second bulk electrodes 271, 273 may gradually decrease with increasing distance from the upper surface of the light emitting structure 120.

[215] Accordingly, each of the first and second bulk electrodes 271, 273 may have a shape capable of providing the side surface as described above, for example, a frusto-conical shape. With the structure wherein each of the first and second bulk electrodes 271, 273 includes the inclined side surface on which the gradient of the tangential line TL of the vertical cross-section thereof with respect to the side surface varies, mechanical stability at interfaces between the first and second bulk electrodes 271, 273 and the insulation support layer 180 can be improved.

[216] Referring again to Figure 6a, Figure 6b and Figure 7, the first bulk electrode 171 and the second bulk electrode 173 may directly contact the first contact electrode 130 and the second contact electrode 140, respectively. That is, the first bulk electrode 171 and

the second bulk electrode 173 may be directly formed on the first and second contact electrodes, respectively, thereby allowing elimination of an additional component such as a seed layer required for plating or a wetting layer required for soldering. However, it should be understood that the present disclosure is not limited thereto.

[217] A minimum distance between the first bulk electrode 171 and the second bulk electrode 173 may be about 10 ㎛ to about 80 ㎛. With this structure, the light emitting device 100d can prevent increase in forward voltage (V_f) due to increase in distance between the electrodes, and can increase the horizontal cross-sectional areas of the bulk electrodes 171, 173 due to the decreased distance between the electrodes, thereby achieving improvement in heat dissipation efficiency.

[218] The insulation support layer 180 may be formed on the light emitting structure 120 to at least partially cover the side surfaces of the first and second bulk electrodes 171, 173. The first bulk electrode 171 and the second bulk electrode 173 may be exposed to an upper surface of the insulation support layer 180.

[219] The insulation support layer 180 exhibits electrically insulating properties and covers the side surfaces of the first and second bulk electrodes 171, 173 to effectively insulate the first and second bulk electrodes 171, 173 from each other. At the same time, the insulation support layer 180 may also serve to support the first bulk electrode 171 and the second bulk electrode 173. The upper surface of the insulation support layer 180 may be substantially flush with the upper surfaces of the first bulk electrode 171 and the second bulk electrode 173.

[220] The insulation support layer 180 may include an insulating polymer and/or an insulating ceramic material, for example, an epoxy molding compound (EMC) or a Si resin. Further, the insulation support layer 180 may include light reflective and light scattering particles such as TiO_2 particles.

[221] Although not shown in the drawings, in other exemplary embodiments, the insulation support layer 180 may also cover the side surface of the light emitting structure 120, thereby causing change of an emission angle of light emitted from the light emitting structure 120. For example, in the structure wherein the insulation support layer 180 further covers at least a portion of the side surface of the light emitting structure 120, some of light emitted through the side surface of the light emitting structure 120 can be reflected towards a lower surface of the light emitting structure 120. In this way, the light emission angle of the light emitting device 100d can be adjusted by adjusting a region in which the insulation support layer 180 will be formed.

[222] The light emitting device 100d may further include a first electrode pad (not shown) and a second electrode pad (not shown). The first and second electrode pads may be disposed on the insulation support layer 180 and electrically connected to the first and second bulk electrodes 171, 173, respectively.

[223] When the light emitting device 100d is applied to a module and the like, the first and second electrode pads allow the light emitting device 100d to be more stably mounted on a separate substrate. For example, when the first and second bulk electrodes 171, 173 include sintered Cu or Ag particles, the first and second bulk electrodes 171, 173 exhibit poor wettability with respect to solder and the like. Accordingly, with the structure wherein the first and second electrode pads are disposed on the insulation support layer 180, the light emitting device 100d can be stably mounted on the separate substrate.

[224] Further, the first and second electrode pads (not shown) may be formed in a shape as shown in Figure 3. That is, the light emitting device 100d according to this exemplary embodiment may further include the first and second electrode pads, in which the insulation support layer 180 may include a lower insulation support layer covering the side surfaces of the first and second bulk electrodes 171, 173 and an upper insulation support layer partially covering the upper surfaces of the first and second bulk electrodes 171, 173. In this exemplary embodiment, at least portions of the side surfaces of the first and second electrode pad may be covered by the upper insulation support layer.

[225] The first and second electrode pads may include a conductive material such as a metal, for example, Ni, Pt, Pd, Rh, W, Ti, Al, Ag, Sn, Cu, Ag, Bi, In, Zn, Sb, Mg, Pb, and the like. In addition, each of the first and second electrode pads may be composed of a single layer or multiple layers.

[226] A wavelength conversion portion (not shown) may be disposed on the lower surface of the light emitting structure 120. The wavelength conversion portion converts the wavelength of light emitted from the light emitting structure 120 such that the light emitting device can emit light in a desired wavelength band. The wavelength conversion portion may include a phosphor and a support containing the phosphor. The phosphor may include various phosphors known to a person having ordinary knowledge in the art, and may include at least one type of phosphor selected from among garnet phosphors, aluminate phosphors, sulfide phosphors, oxynitride phosphors, nitride phosphors, fluoride phosphors, and silicate phosphors. The supporter may be selected from any material well known to a person having ordinary knowledge in the art, and may include, for example, a polymer resin such as an epoxy resin or acryl resin, or a silicon resin. Further, the wavelength conversion portion may be composed of a single layer or multiple layers.

[227] The wavelength conversion portion may cover the lower surface of the light emitting structure 120 and may further cover the side surface of the light emitting structure 120. In some exemplary embodiments, the wavelength conversion portion may further cover the side surface of the insulation support layer 180.

[228] Although the light emitting device 100d according to this exemplary embodiment has the light emitting structure 120 including the plurality of holes 120h, it should be understood that the present disclosure is not limited thereto. The connection and positional relationship between the light emitting structure 120, the first and second contact electrodes 130, 140, and the first and second insulation layers 150, 160 can be modified in various ways without departing from the scope of the present disclosure.

[229] Figure 9a, Figure 9b and Figure 10 are plan views and a cross-sectional view of a light emitting device according to yet another exemplary embodiment, respectively.

[230] A light emitting device 100f according to the exemplary embodiment shown in Figure 9a, Figure 9b and Figure 10 is generally similar to the light emitting device 100d shown in Figure 6a, Figure 6b and Figure 7 excluding some features of the third opening 160a and further includes first and second interconnection layers 191, 193. Hereinafter, different features of the light emitting device 100f according to this exemplary embodiment will be mainly described, and detailed descriptions of the same components will be omitted.

[231] Figure 9a is a plan view of the light emitting device 100f, Figure 9b is a plan view illustrating locations of holes 120h, a third opening 160a and fourth openings 160b, and Figure 10 is a cross-sectional view taken along line D-D' of Figure 9a and Figure 9b.

[232] Referring to Figure 9a, Figure 9b and Figure 10, the light emitting device 100f includes a light emitting structure 120 that includes a first conductive type semiconductor layer 121, an active layer 123 and a second conductive type semiconductor layer 125, a first contact electrode 130, a second contact electrode 140, first and second insulation layers 150, 160, a first bulk electrode 171, a second bulk electrode 173, an insulation support layer 180, a first interconnection layer 191, and a second interconnection layer 193. The light emitting device 100f may further include first and second electrode pads (not shown), a growth substrate (not shown), and a wavelength conversion portion (not shown).

[233] The third opening 160a of the second insulation layer 160 may partially expose the first contact electrode 130 while covering the first contact electrode 130. Here, the third opening 160a may be formed only in a region in which some of the holes 120h are disposed. Accordingly, only some of ohmic contact regions 131 may be exposed through the third opening 160a and the other ohmic contact regions 131 may be covered by the second insulation layer 160.

[234] The third opening 160a may be disposed at a location opposite the location of the fourth openings 160b. Specifically, when the fourth openings 160b are disposed near one side of the light emitting device 100f, the third opening 160a may be disposed near the other side of the light emitting device 100f opposite the one side thereof.

[235] The light emitting device 100f according to this exemplary embodiment may further

include a first interconnection layer 191 and a second interconnection layer 193 respectively disposed under the first bulk electrode 171 and the second bulk electrode 173.

[236] The first interconnection layer 191 may electrically connect the first contact electrode 130 to the first bulk electrode 171, and the second interconnection layer 193 may electrically connect the second contact electrode 140 to the second bulk electrode 173.

[237] Furthermore, when the first bulk electrode 171 and the second bulk electrode 173 are formed by deposition or plating, the first and second interconnection layers 191, 193 may act as seed layers. Furthermore, when the first bulk electrode 171 and the second bulk electrode 173 are formed by sintering, the first and second interconnection layers 191, 193 may act as wetting layers to assist in stable formation of the first bulk electrode 171 and the second bulk electrode 173. Accordingly, the first and second bulk electrodes 171, 173 can be stably bonded to the light emitting structure 120 by the first and second interconnection layers 191, 193.

[238] Thus, the interconnection layers 191, 193 may include a metallic material so as to act as the seed layers or the wetting layers. For example, the interconnection layers 191, 193 may include Cu, Au, Ag, Ni, Pt, and the like.

[239] The interconnection layers 191, 193 are not limited to this exemplary embodiment and may be applied to other exemplary embodiments.

[240] Figure 11a, Figure 11b and Figure 12 are plan views and a cross-sectional view of a light emitting device according to yet another exemplary embodiment, respectively.

[241] A light emitting device 100g according to the exemplary embodiment shown in Figure 11a, Figure 11b and Figure 12 is generally similar to the light emitting device 100d shown in Figure 6a, Figure 6b and Figure 7, and further includes connection layers 211, 213 and electrode pads 231, 233. Hereinafter, different features of the light emitting device 100g according to this exemplary embodiment will be mainly described, and detailed descriptions of the same components will be omitted.

[242] Figure 11a is a plan view of the light emitting device 100g, Figure 11b is a plan view illustrating locations of holes 120h, a third opening 160a and fourth openings 160b, and Figure 12 is a cross-sectional view taken along line E-E' of Figure 11a and Figure 11b.

[243] Referring to Figure 11a, Figure 11b and Figure 12, the light emitting device 100g includes a light emitting structure 120 that includes a first conductive type semiconductor layer 121, an active layer 123 and a second conductive type semiconductor layer 125, a first contact electrode 130, a second contact electrode 140, first and second insulation layers 150, 160, a first bulk electrode 171, a second bulk electrode 173, an insulation support layer 180, connection layers 211, 213, and electrode pads 231, 233. The light emitting device 100g may further include a growth substrate (not shown) and

a wavelength conversion portion (not shown).

[244] The connection layers 211, 213 may be disposed on the first bulk electrode 171 and the second bulk electrode 173, respectively.

[245] The connection layers 211, 213 may include a first connection layer 211 and a second connection layer 213. The first connection layer 211 and the second connection layer 213 are disposed on the first bulk electrode 171 and the second bulk electrode 173 and are electrically connected thereto, respectively. In this exemplary embodiment, the insulation support layer 180 may include a lower insulation support layer 181 and an upper insulation support layer 183. The lower insulation support layer 181 covers side surfaces of the first and second bulk electrodes 171, 173 and the upper insulation support layer 183 partially covers upper surfaces of the first and second bulk electrodes 171, 173. The upper insulation support layer 183 may include openings, through which the upper surfaces of the first and second bulk electrodes 171, 173 are partially exposed. The openings partially exposing the upper surfaces of the first and second bulk electrodes 171, 173 may be at least partially filled with the connection layers 211, 213. Upper surfaces of the upper insulation support layer 183, the first connection layer 211 and the second connection layer 213 may be generally flush with each other to constitute a coplanar surface.

[246] The first connection layer 211 and the second connection layer 213 may include an electrically conductive metal, a conductive oxide, or a conductive nitride, and particularly, may be formed of a metal having high electrical conductivity, such as Au, Ag, Cu, Ni, Pt, and the like. The first electrode pad 231 and the second electrode pad 233 may be disposed on the connection layers 211, 213 and electrically connected to the bulk electrodes 171, 173 through the connection layers 211, 213, respectively. Specifically, the first and second electrode pads 231, 233 may be electrically connected to the first and second bulk electrodes 171, 173 by the first and second connection layers 211, 213, respectively.

[247] The first electrode pad 231 and the second electrode pad 233 allow the light emitting device 100g to be more stably mounted on a separate substrate or the like. For example, when the first and second bulk electrodes 171, 173 include sintered Cu or Ag particles, the first and second bulk electrodes 171, 173 exhibit poor wettability with respect to solder, and the like. Accordingly, with the structure wherein the first and second electrode pads are disposed on the insulation support layer 180, the light emitting device 100g can be stably mounted on the separate substrate.

[248] Furthermore, the first electrode pad 231 may have a smaller horizontal cross-sectional area than the first bulk electrode 171 and the second electrode pad 233 may have a larger horizontal cross-sectional area than the second bulk electrode 173. Particularly, the horizontal cross-sectional area of the first electrode pad 231 may be sub-

stantially the same as that of the second electrode pad 233.

[249] In a structure wherein the horizontal cross-sectional area of the first bulk electrode 171 is much larger than that of the second bulk electrode 173, there can be a problem of failure upon mounting of the light emitting device on a secondary substrate such as a PCB. Moreover, in order to stably mount such a light emitting device on the secondary substrate, it is necessary to change a conductive pattern of a portion of the secondary substrate on which the light emitting device will be mounted. On the contrary, since the light emitting device 100g according to this exemplary embodiment further includes the first electrode pad 231 and the second electrode pad 233, electrodes on a surface of the light emitting device 100g mounted on the secondary substrate can be formed similarly to those of the light emitting device 100g. Accordingly, the light emitting device 100g according to this exemplary embodiment can be applied to various applications through a general mounting process without addition or change of a process, and can reduce defects in the mounting process.

[250] The first and second electrode pads 231, 233 may include a conductive material such as a metal, and may include, for example, Ni, Pt, Pd, Rh, W, Ti, Al, Ag, Sn, Cu, Ag, Bi, In, Zn, Sb, Mg, Pb, and the like.

[251] The upper insulation support layer 183 may have a thickness of about 10 ㎛ or less, thereby preventing deterioration in heat dissipation efficiency upon dissipation of heat from the first and second bulk electrodes 171, 173 through the upper insulation support layer 183.

[252] Figure 13a, Figure 13b and Figure 14 are plan views and a cross-sectional view of a light emitting device according to yet another exemplary embodiment, respectively.

[253] A light emitting device 100h according to the exemplary embodiment shown in Figure 13a, Figure 13b and Figure 14 is generally similar to the light emitting device 100d shown in Figure 11a, Figure 11b and Figure 12 and further includes a plurality of second bulk electrodes 173. Hereinafter, different features of the light emitting device 100h according to this exemplary embodiment will be mainly described, and detailed descriptions of the same components will be omitted.

[254] Figure 13a is a plan view of the light emitting device 100h, Figure 13b is a plan view illustrating locations of holes 120h, a third opening 160a and fourth openings 160b, and Figure 14 is a cross-sectional view taken along line F-F' of Figure 13a and Figure 13b.

[255] Referring to Figure 13a, Figure 13b and Figure 14, the light emitting device 100h includes a light emitting structure 120 including a first conductive type semiconductor layer 121, an active layer 123 and a second conductive type semiconductor layer 125, a first contact electrode 130, a second contact electrode 140, first and second insulation layers 150, 160, a first bulk electrode 171, a second bulk electrode 173, an insulation

support layer 180, a connection layer 210, and electrode pads 231, 233. The light emitting device 100h may further include a growth substrate (not shown) and a wavelength conversion portion (not shown).

[256] The light emitting device 100h may further include a plurality of second bulk electrodes 173. With this structure, the light emitting device 100h has a greater number of holes 120h, a larger area of the third opening 160a, and a larger horizontal cross-sectional area of the first bulk electrode 171 than the light emitting device 100g shown in Figure 11a, Figure 11b and Figure 12. The second bulk electrodes 173 may be separated from each other and some of the holes 120h may be disposed between the second bulk electrodes 173.

[257] According to this exemplary embodiment, the horizontal cross-sectional area of the first bulk electrode 171 is further increased, whereby the light emitting device 100h can achieve further improvement in heat dissipation efficiency and luminous characteristics.

[258] On the other hand, the light emitting device 100h can omit the electrode pads 231, 233.

[259] Figure 15 and Figure 16 are a plan view and a cross-sectional view of a light emitting device 200a according to yet another exemplary embodiment, respectively. Figure 16 is a cross-sectional view taken along line G-G' of Figure 15. Detailed descriptions of the substantially same components as those of the exemplary embodiments described above will be omitted.

[260] Referring to Figure 15 and Figure 16, the light emitting device 200a includes a light emitting structure 120, a first contact electrode 130, a second contact electrode 140, a support structure 310, and a substrate 410. The light emitting device may further include a growth substrate (not shown) and a connection electrode 145.

[261] The light emitting structure 120 includes a first conductive type semiconductor layer 121, an active layer 123 disposed on the first conductive type semiconductor layer 121, and a second conductive type semiconductor layer 125 disposed on the active layer 123.

[262] The light emitting structure 120 may include a partially exposed region of the first conductive type semiconductor layer 121 formed by partially removing the second conductive type semiconductor layer 125 and the active layer 123. For example, as shown in Figure 15, the light emitting structure 120 may include at least one hole 120a formed through the second conductive type semiconductor layer 125 and the active layer 123 to expose the first conductive type semiconductor layer 121 therethrough. The light emitting structure 120 may include a plurality of holes 120a, and the shape and arrangement of the holes 120a are not limited to those shown in the drawings.

[263] The light emitting structure 120 may further include a roughness 120R. The

roughness 120R may be formed by at least one of dry etching, wet etching and electro-chemical etching. For example, the roughness 120R may be formed by PEC etching or by wet etching in an etching solution containing KOH and NaOH.

[264] The light emitting structure 120 may further include a growth substrate (not shown) disposed on an upper surface of the first conductive type semiconductor layer 121. Such a growth substrate may be removed from the light emitting structure 120 by a typical method known in the art after fabrication of the light emitting device.

[265] The second contact electrode 140 may be disposed on the second conductive type semiconductor layer 125 and electrically connected thereto. Further, the second contact electrode 140 may at least partially cover a lower surface of the second conductive type semiconductor layer 125. Alternatively, the second contact electrode 140 may be disposed to cover the overall lower surface of the second conductive type semi-conductor layer 125. Further, the second contact electrode 140 may be formed as a monolithic layer in a region covering the lower surface of the second conductive type semiconductor layer 125 excluding a region in which the exposed region of the first conductive type semiconductor layer 121 of the light emitting structure 120 (for example, the holes 120a) is formed. With this structure, the light emitting device allows uniform supply of electric current to the entire region of the light emitting structure 120, thereby improving current spreading efficiency. However, it should be understood that the present disclosure is not limited thereto. Alternatively, the second contact electrode 140 may be composed of a plurality of unit electrodes separated from each other.

[266] The first contact electrode 130 may be electrically connected to the first conductive type semiconductor layer 121. The first contact electrode 130 may be electrically connected to the first conductive type semiconductor layer 121 through the exposed region of the first conductive type semiconductor layer 121, for example, the holes 120a. The first contact electrode 130 may be disposed on the overall upper surface of the light emitting structure. With this structure, the first contact electrode 130 may be insulated from the second contact electrode 140 through an insulation layer such as a first insulation layer 150 described below.

[267] Referring to Figure 16, the light emitting device 200a according to this exemplary embodiment may further include the first insulation layer 150. The first insulation layer 150 covers a lower surface of the light emitting structure 120 and lower and side surfaces of the second contact electrode 140, and is disposed between the light emitting structure 120 and the first contact electrode 130 to insulate the first contact electrode 130 from the second contact electrode 140. The first insulation layer 150 may include openings 150a, 150b formed at certain locations to achieve electrical connection to the first conductive type semiconductor layer 121 and the second conductive type semi-

conductor layer 125. For example, the first insulation layer 150 includes openings 150a which expose the first conductive type semiconductor layer 121 and openings 150b which expose the second contact electrode 140. The first insulation layer 150 may be formed of an oxide such as SiO_2, a nitride such as SiN_x, or an insulating material such as MgF_2 by chemical vapor deposition (CVD) and the like. The first insulation layer 150 may be composed of a single layer or multiple layers. Furthermore, the first insulation layer 150 may include a distributed Bragg reflector (DBR) in which a low refractivity material layer and a high refractivity material layer are alternately stacked one above another.

[268] Referring to Figure 16, the light emitting device 200a according to this exemplary embodiment may further include a second insulation layer 160. The second insulation layer 160 can more effectively prevent disconnection of the first contact electrode 130 and the second contact electrode 140 while acting to protect the light emitting structure from external contaminants or impact. The second insulation layer 160 may cover a portion of the first contact electrode 130. The second insulation layer 160 may include an opening 160a which exposes the first contact electrode 130 and openings 160b which expose the second contact electrode 140. Sidewalls of the first contact electrode 130 may be covered by the second insulation layer 160. The second insulation layer 160 may be prepared by depositing an oxide insulation layer, a nitride insulation layer or a polymer such as polyimides, Teflon, or Parylene, on the first contact electrode 130, followed by patterning.

[269] The support structure 310 may include a first bulk electrode 311, a second bulk electrode 312, and an insulation support layer 313. The first bulk electrode 311, the second bulk electrode 312 and the insulation support layer 313 according to this exemplary embodiment may correspond to the first bulk electrode 171, the second bulk electrode 173 and the insulation support layer 180 according to the exemplary embodiments described above.

[270] The first bulk electrode 311 and the second bulk electrode 312 may be disposed on the light emitting structure 120 and separated from each other to be disposed on the first contact electrode 130 and the second contact electrode 140, respectively. The first and second bulk electrodes 311, 312 are formed of a metallic material and generally have a larger thickness than the light emitting structure 120. The first bulk electrode 311 and the second bulk electrode 312 may be electrically connected to the first contact electrode 130 and the second contact electrode 140, respectively, and thus may be electrically connected to the first conductive type semiconductor layer 121 and the second conductive type semiconductor layer 125, respectively. The first and second bulk electrodes 311, 312 enable efficient dissipation of heat generated from the light emitting structure 120 and may include a material having a similar coefficient of

thermal expansion to the coefficient of thermal expansion of the light emitting structure 120.

[271] The first bulk electrode 311 and the second bulk electrode 312 may be thicker than the first contact electrode 130 and the second contact electrode 140 in order to facilitate heat dissipation. Specifically, the thicknesses of the first bulk electrode 311 and the second bulk electrode 312 may be 5 times to 20 times the thicknesses of the first contact electrode 130 and the second contact electrode 140, respectively. With this structure, the light emitting device allows efficient dissipation of heat generated from the light emitting structure 120 to the outside through side surfaces of the first bulk electrode 311 and the second bulk electrode 312, thereby preventing cracking or failure due to heat.

[272] The first bulk electrode 311 may include a lower region 311a and an upper region 311b, and the second bulk electrode 312 may include a lower region 312a and an upper region 312b. Each of the first bulk electrode 311 and the second bulk electrode 312 may be formed as a monolithic layer. Referring to Figure 16, the lower region 311a of the first bulk electrode 311 and the lower region 312a of the second bulk electrode 312 may be disposed near a substrate 410 described below, and the upper region 311b of the first bulk electrode 311 and the upper region 312b of the second bulk electrode 312 may be disposed near the light emitting structure 120. The lower regions 311a, 312a may include lower surfaces of the first bulk electrode 311 and the second bulk electrode 312, respectively. Specifically, lower surfaces of the lower regions 311a, 312a may be coincident to the lower surfaces of the first and second bulk electrodes 311, 312. With this structure, the light emitting device can prevent disconnection of the first and second bulk electrodes 311, 312 and can achieve improvement in adhesion to the substrate 410 through adjustment of the configuration of the lower regions 311a, 312a without formation of separate layers on the lower surfaces of the first bulk electrode 311 and the second bulk electrode 312.

[273] In various exemplary embodiments, the lower region 311a and the upper region 311b of the first bulk electrode 311 may correspond to the first bulk electrode 171 and the first pad electrode 191 according to the exemplary embodiments described above, respectively. Similarly, the lower region 312a and the upper region 312b of the second bulk electrode 312 may correspond to the second bulk electrode 173 and the second pad electrode 193 according to the exemplary embodiments described above, respectively. The lower region 311a or 312a may be formed of a different material from the upper region 311b or 312b.

[274] A distance L_2 between the lower region 311a of the first bulk electrode and the lower region 312a of the second bulk electrode may be greater than a distance L_1 between the upper region 311b of the first bulk electrode and the upper region 312b of the second

bulk electrode. Since the distance L_1 between the upper regions 311b, 312b is relatively short, heat generated from the light emitting structure 120 can be efficiently dissipated through the side surfaces of the first bulk electrode 311 and the second bulk electrode 312. With this structure, the light emitting device can be prevented from suffering from cracking or damage due to heat. Since the distance L_2 between the lower regions 311a, 312a is relatively long, it is possible to prevent disconnection of the first and second bulk electrodes 311, 312 due to an adhesive material such as solder when the first and second bulk electrodes 311, 312 are mounted on the substrate 410 through solder bonding or eutectic bonding. With this structure, the light emitting device can secure electrical stability.

[275] The first bulk electrode 311 may include a first plane facing the second bulk electrode 312 and a second plane disposed opposite the first plane; the second bulk electrode 312 may include a third plane facing the first bulk electrode 311 and a fourth plane disposed opposite the third plane. The first and second bulk electrodes 311, 312 may include a first depression h_1 depressed from lower edges of the first plane and the third plane, respectively. Referring to Figure 16, the first depression h_1 may be constituted by a plurality of planes. Specifically, the first depression h_1 may include planes parallel to the first plane and the third plane of the first and second bulk electrodes 311, 312, and planes parallel to lower surfaces of the first and second bulk electrodes 311, 312. With the depression structure described above, the first depression h_1 can be filled with an insulation support layer 313 described below, thereby suppressing an adhesive material such as solder from flowing into a space between the first and second bulk electrodes 311, 312. Accordingly, it is possible to prevent the first and second bulk electrodes 311, 312 from being disconnected by the adhesive material. Further, contact regions between the first and second bulk electrodes 311, 312 and the insulation support layer 313 can be increased, thereby improving adhesion between the first and second bulk electrodes 311, 312 and the insulation support layer. With this structure, the light emitting device can secure mechanical stability. The first depression h1 may be formed by an etching process using a photoresist, without being limited thereto.

[276] The distance L_1 between the upper regions 311b, 312b may be 100 ㎛ or less. Within this range, heat dissipation from the first and second bulk electrodes 311, 312 can be further improved. The distance L_2 between the lower regions 311a, 312a may be 250 ㎛ or more. Within this range, it is possible to effectively prevent disconnection of the first and second bulk electrodes 311, 312 by the adhesive material such as solder.

[277] The insulation support layer 313 may be disposed between the first and second bulk electrodes 311, 312. The insulation support layer 313 may include an upper insulation support layer 313a and a lower insulation support layer 313b. The upper insulation support layer 313a and the lower insulation support layer 313b according to this

exemplary embodiment may correspond to the lower insulation support layer 181 and the upper insulation support layer 183, respectively. The insulation support layer 313 insulates the first and second bulk electrodes 311, 312 from each other, thereby insulating the first contact electrode 130 and the second contact electrode 140 from each other, and fills a space between the first and second bulk electrodes 311, 312 to improve durability while relieving stress caused by thermal expansion of the first and second bulk electrodes 311, 312. In addition, as shown in Figure 16, the insulation support layer 313 may be configured to surround not only the space between the first and second bulk electrodes 311, 312, but also the entirety of the side surfaces of the first and second bulk electrodes 311, 312. With this structure, the light emitting device can be protected from external contaminants or impact. The insulation support layer 313 may include an epoxy molding compound (EMC). The insulation support layer 313 may be coated to cover the lower surfaces of the first and second bulk electrodes 311, 312. In this exemplary embodiment, a lower surface of the insulation support layer 313 may be flattened by lapping or chemical mechanical polishing, and the first and second bulk electrodes 311, 312 may be exposed.

[278] The substrate 410 may be disposed adjacent to the support structure 310. The substrate 410 may include a first interconnection portion 411 electrically connected to the first bulk electrode 311 and a second interconnection portion 412 electrically connected to the second bulk electrode 312. The first interconnection portion 411 and the second interconnection portion 412 may be disposed on a base 413 of the substrate 410, without being limited thereto. The first and second interconnection portions 411, 412 may include a material having high electrical conductivity, for example, Cu, Au, Ag, Pt, Al, and the like. The base 413 of the substrate 410 may include a ceramic material and may include a metallic material in order to improve heat dissipation of the light emitting device. The first and second bulk electrodes 311, 312 may be mounted on the substrate 410 through solder bonding or eutectic bonding, without being limited thereto. For example, for solder bonding, solder S may be disposed between the first bulk electrode 311 and the first interconnection portion 411 and between the second bulk electrode 312 and the second interconnection portion 412.

[279] A distance L_3 between the first interconnection portion 411 and the second interconnection portion 412 may be greater than the distance L_1 between the upper regions 311b, 312b. Since the distance L_3 between the first interconnection portion 411 and the second interconnection portion 412 is relatively long, it is possible to prevent disconnection of the first and second bulk electrodes 311, 312 due to an adhesive material such as solder when the first and second bulk electrodes 311, 312 are mounted on the substrate 410 through solder bonding or eutectic bonding. With this structure, the light emitting device can secure electrical stability.

[280] Figure 17 is a sectional view of a light emitting device according to yet another exemplary embodiment. The light emitting device shown in Figure 17 is generally similar to the light emitting device shown in Figure 15 and Figure 16, and further includes a second depression h_2 depressed from lower edges of the second plane of the first bulk electrode 311 and the fourth plane of the second bulk electrode 312. Referring to Figure 17, the second depression h_1 may be constituted by a plurality of planes. Specifically, the second depression h_2 may include planes parallel to the second plane and the fourth plane of the first and second bulk electrodes 311, 312, and planes parallel to the lower surfaces of the first and second bulk electrodes 311, 312. With the depression structure described above, the second depression h_2 can be filled with an insulation support layer 313 described below, thereby suppressing an adhesive material such as solder from flowing towards an outer surface of the light emitting device. Accordingly, it is possible to prevent the first and second bulk electrodes 311, 312 from being disconnected by the adhesive material. Further, contact regions between the first and second bulk electrodes 311, 312 and the insulation support layer 313 can be further increased, thereby improving adhesion between the first and second bulk electrodes 311, 312 and the insulation support layer. With this structure, the light emitting device can secure mechanical stability.

[281] Figure 18 and Figure 19 are sectional views of light emitting devices according to other exemplary embodiments. The light emitting devices shown in Figure 18 and Figure 19 are generally similar to the light emitting device shown in Figure 15 and Figure 16 except that the first depression h1 is composed of a single plane or a concave plane. Specifically, the first depression h_1 of the light emitting device shown in Figure 18 may have a single planar chamfered plane. The first depression h_1 of the light emitting device shown in Figure 19 may be formed in a concave shape, the inclination of which gradually increases towards the lower surfaces of the first and second bulk electrodes 311, 312. Alternatively, although not shown in the drawings, the first depression h_1 may be composed of a convex plane. Specifically, the first depression h_1 may be formed in a convex shape, the inclination of which gradually decreases towards the lower surfaces of the first and second bulk electrodes 311, 312. With this structure, since the distance between the first and second bulk electrodes 311, 312 can be gradually decreased, a section capable of dissipating heat from the light emitting device can be increased. At the same time, since the distance between the lower surfaces of the first and second bulk electrodes 311, 312 can be greater than the distance between the upper regions 311b, 312b, it is still possible to prevent disconnection of the first and second bulk electrodes 311, 312 due to an adhesive material such as solder.

[282] Figure 20 is a sectional view of a light emitting device according to yet another

exemplary embodiment. The light emitting device shown in Figure 20 is generally similar to the light emitting device shown in Figure 15 and Figure 16 except that the distance L_3 between the first interconnection portion 411 and the second interconnection portion 412 may be greater than the distance L_2 between the lower regions 311a, 312a. In this structure, since the distance L_3 between the first interconnection portion 411 and the second interconnection portion 412 is relatively long, it is possible to more effectively prevent disconnection of the first and second interconnection portions 411, 412 due to an adhesive material such as solder when the first and second bulk electrodes 311, 312 are mounted on the substrate 410 through solder bonding or eutectic bonding. Further, since the adhesive material can be prevented from flowing into a region between the lower surfaces of the first and second bulk electrodes 311, 312 along the first and second interconnection portions 411, 412, disconnection of the first and second bulk electrodes 311, 312 can be more effectively prevented. With this structure, the light emitting device can secure electrical stability.

[283] Figure 21 is a sectional view of a light emitting device according to yet another exemplary embodiment. Referring to Figure 21, a substrate 410 according to this exemplary embodiment further includes a base 413 supporting a first interconnection portion 411 and a second interconnection portion 412. The substrate 410 may include a via-hole V formed through the base 413, in which the via-hole V may be disposed on a first bulk electrode 311 and a second bulk electrode 312. Specifically, the base 413 may include a ceramic material, without being limited thereto. Referring to Figure 21, the base 413 may include a metallic material such as Cu in order to improve heat dissipation of the light emitting device. In this exemplary embodiment, in order to prevent the first interconnection portion 411 and the second interconnection portion 412 from being disconnected through the base 413, an insulating material may be disposed between the first and second interconnection portions 411, 412 and the base 413. As shown in Figure 21, an inner surface of the via-hole V may be covered by the first interconnection portion 411 or the second interconnection portion 412. Further, although the via-hole V is shown as a hollow hole, it should be understood that the present disclosure is not limited thereto. Alternatively, the interior of the via-hole V may be filled with a conductive material. The via-hole V may be disposed to overlap the first bulk electrode 311 and the second bulk electrode 312 in the vertical direction. With this structure, the light emitting device allows heat transferred to the first and second bulk electrodes 311, 312 to be efficiently dissipated through the internal space of the via-hole V and the first and second interconnection portions 411, 412 disposed inside the via-hole V. With this structure, the light emitting device can be prevented from suffering from cracking or damage due to heat.

[284] Figure 22 is a sectional view of a light emitting device according to yet another

exemplary embodiment. Although the light emitting device shown in Figure 22 is similar to the light emitting device shown in Figure 20, there is a difference in that the via-hole V does not overlap the first bulk electrode 311 and the second bulk electrode 312 in the vertical direction. According to this exemplary embodiment, it is possible to prevent an adhesive material such as solder from flowing to the outside along the via-hole V during the process of mounting the first bulk electrode 311 and the second bulk electrode 312 on the substrate 410. Further, it is also possible to prevent the first bulk electrode 311 and the second bulk electrode 312 from being damaged by external impact or contaminants through the via-hole V.

[285] Figure 23 is an exploded perspective view of an exemplary lighting apparatus to which a light emitting device according to some embodiments of the present disclosure is applied.

[286] Referring to Figure 23, the lighting apparatus according to this embodiment includes a diffusive cover 1010, a light emitting diode module 1020, and a body 1030. The body 1030 may receive the light emitting diode module 1020 and the diffusive cover 1010 may be disposed on the body 1030 to cover an upper side of the light emitting diode module 1020.

[287] The body 1030 may have any shape so long as the body can supply electric power to the light emitting diode module 1020 while receiving and supporting the light emitting diode module 1020. For example, as shown in the drawing, the body 1030 may include a body case 1031, a power supply 1033, a power supply case 1035, and a power source connection section 1037.

[288] The power supply 1033 is received in the power supply case 1035 to be electrically connected to the light emitting diode module 1020, and may include at least one IC chip. The IC chip may regulate, change or control electric power supplied to the light emitting diode module 1020. The power supply case 1035 may receive and support the power supply 1033. The power supply case 1035 having the power supply 1033 secured therein may be disposed within the body case 1031. The power source connection section 1037 is disposed at a lower end of the power supply case 1035 and coupled thereto. Accordingly, the power source connection section 1037 is electrically connected to the power supply 1033 within the power supply case 1035 and may serve as a passage through which power can be supplied from an external power source to the power supply 1033.

[289] The light emitting diode module 1020 includes a substrate 1023 and a light emitting diode 1021 disposed on the substrate 1023. The light emitting diode module 1020 may be disposed at an upper portion of the body case 1031 and electrically connected to the power supply 1033.

[290] As the substrate 1023, any substrate capable of supporting the light emitting diode

1021 may be used without limitation. For example, the substrate 1023 may include a printed circuit board having interconnects formed thereon. The substrate 1023 may have a shape corresponding to a securing portion formed at the upper portion of the body case 1031 so as to be stably secured to the body case 1031. The light emitting diode 1021 may include at least one of the light emitting diodes and the light emitting devices according to the embodiments described above.

[291] The diffusive cover 1010 is disposed on the light emitting diode 1021 and may be secured to the body case 1031 to cover the light emitting diode 1021. The diffusive cover 1010 may be formed of or include a light-transmitting material, and light orientation of the lighting apparatus may be adjusted through regulation of the shape and optical transmissivity of the diffusive cover 1010. As such, the diffusive cover 1010 may be modified in various shapes depending on usage and applications of the lighting apparatus.

[292] Figure 24 is a sectional view of an exemplary display device to which a light emitting device according to some embodiments of the present disclosure is applied.

[293] The display device according to this embodiment includes a display panel 2110, a backlight unit supplying light to the display panel 2110, and a panel guide supporting a lower edge of the display panel 2110.

[294] The display panel 2110 is not particularly limited and may be, for example, a liquid crystal panel including a liquid crystal layer. Gate driving PCBs may be further disposed at the edge of the display panel 2110 to supply driving signals to a gate line. Here, the gate driving PCBs 2112 and 2113 may be formed on a thin film transistor substrate instead of being formed on separate PCBs.

[295] The backlight unit includes a light source module, which includes at least one substrate and a plurality of light emitting diodes 2160. The backlight unit may further include a bottom cover 2180, a reflective sheet 2170, a diffusive plate 2131, and optical sheets 2130.

[296] The bottom cover 2180 may be open at an upper side thereof to receive the substrate, the light emitting diodes 2160, the reflective sheet 2170, the diffusive plate 2131, and the optical sheets 2130. In addition, the bottom cover 2180 may be coupled to the panel guide The substrate may be disposed under the reflective sheet 2170 to be surrounded by the reflective sheet 2170. However, it should be understood that other implementations are also possible. When a reflective material is coated onto a surface thereof, the substrate may be disposed on the reflective sheet 2170. Further, in this embodiment, a plurality of substrates may be arranged parallel to one other. However, it should be understood that other implementations are also possible and the light source module may include a single substrate.

[297] The light emitting diodes 2160 may include at least one of the light emitting diodes

and the light emitting devices according to the embodiments described above. The light emitting diodes 2160 may be arranged in a regular pattern in a predetermined pattern on the substrate. In addition, a lens 2210 is disposed on each of the light emitting diodes 2160 to improve uniformity of light emitted from the plurality of light emitting diodes 2160.

[298] The diffusive plate 2131 and the optical sheets 2130 are disposed on the light emitting devices 2160. Light emitted from the light emitting devices 2160 may be supplied in the form of sheet light to the display panel 2110 through the diffusive plate 2131 and the optical sheets 2130.

[299] In this way, the light emitting diodes according to the embodiments of the present disclosure may be applied to direct type displays like the display according to this embodiment.

[300] Figure 25 is a sectional view of an exemplary display device to which a light emitting device according to some embodiments of the present disclosure is applied.

[301] The display device according to this embodiment includes a display panel 3210 on which an image is displayed, and a backlight unit disposed at a rear side of the display panel 3210 and emitting light thereto. Further, the display device includes a frame 240 supporting the display panel 3210 and receiving the backlight unit , and covers 3240 and 3280 surrounding the display panel 3210.

[302] The display panel 3210 is not particularly limited and may be or include, for example, a liquid crystal panel including a liquid crystal layer. A gate driving PCB may be further disposed at an edge of the display panel 3210 to supply driving signals to a gate line. Here, the gate driving PCB may be formed on a thin film transistor substrate instead of being formed on a separate PCB. The display panel 3210 is secured by the covers 3240 and 3280 disposed at upper and lower sides thereof, and the cover 3280 disposed at the lower side of the display panel 3210 may be coupled to the backlight unit .

[303] The backlight unit supplying light to the display panel 3210 includes a lower cover 3270 partially open at an upper side thereof, a light source module disposed at one side inside the lower cover 3270, and a light guide plate 3250 disposed parallel to the light source module and converting spot light into sheet light. In addition, the backlight unit according to this embodiment may further include optical sheets 3230 disposed on the light guide plate 3250 to spread and collect light, and a reflective sheet 3260 disposed at a lower side of the light guide plate 3250 and reflecting light traveling in a downward direction of the light guide plate 3250 towards the display panel 3210.

[304] The light source module includes a substrate 3220 and a plurality of light emitting diodes 3110 arranged at constant intervals on one surface of the substrate 3220. As the substrate 3220, any substrate capable of supporting the light emitting diodes 3110 and

being electrically connected thereto may be used without limitation. For example, the substrate 3220 may include a printed circuit board.

[305] The light emitting diodes 3110 may include at least one of the light emitting diodes and the light emitting devices according to the embodiments of the present disclosure described above. Light emitted from the light source module enters the light guide plate 3250 and is supplied to the display panel 3210 through the optical sheets 3230. The light guide plate 3250 and the optical sheets 3230 convert spot light emitted from the light emitting diodes 3110 into sheet light.

[306] In this way, the light emitting diodes according to the embodiments may be applied to edge type displays like the display according to this embodiment.

[307] Figure 26 is a sectional view of an exemplary headlight to which a light emitting device according to some embodiments of the present disclosure is applied.

[308] Referring to Figure 26, the headlight includes a lamp body 4070, a substrate 4020, a light emitting diode 4010, and a cover lens 4050. The headlight may further include a heat dissipation unit 4030, a support rack 4060, and a connection member 4040.

[309] The substrate 4020 is secured by the support rack 4060 and disposed above the lamp body 4070. As the substrate 4020, any member capable of supporting the light emitting diode 4010 may be used without limitation. For example, the substrate 4020 may be or include a substrate having a conductive pattern, such as a printed circuit board. The light emitting diode 4010 is disposed on the substrate 4020 and may be supported and secured by the substrate 4020. In addition, the light emitting diode 4010 may be electrically connected to an external power source through the conductive pattern of the substrate 4020. Further, the light emitting diode 4010 may include at least one of the light emitting diodes and the light emitting devices according to the embodiments of the present disclosure described above.

[310] The cover lens 4050 is disposed on a path of light emitted from the light emitting diode 4010. For example, as shown in the drawing, the cover lens 4050 may be spaced apart from the light emitting diode 4010 by the connection member 4040 and may be disposed in a direction of supplying light emitted from the light emitting diode 4010. By the cover lens 4050, an orientation angle and/or a color of light emitted by the headlight can be adjusted. On the other hand, the connection member 4040 is disposed to secure the cover lens 4050 to the substrate 4020 while surrounding the light emitting diode 4010, and thus may act as a light guide that provides a luminous path 4045. The connection member 4040 may be formed of or include a light reflective material or coated therewith. On the other hand, the heat dissipation unit 4030 may include heat dissipation fins 4031 and/or a heat dissipation fan 4033, and dissipates heat generated upon operation of the light emitting diode 4010.

[311] In this way, the light emitting diodes according to the embodiments of the present

disclosure may be applied to headlights, particularly, headlights for vehicles, like the display device according to this embodiment.

[312] Although some exemplary embodiments are disclosed herein, it should be understood that these embodiments are not intended to be exclusive. For example, individual structures, elements or features of a particular embodiment are not limited to that particular embodiment and can be applied to other embodiments without departing from the spirit and scope of the present disclosure.

Claims

[Claim 1] A light emitting device comprising:
a light emitting structure including a first conductive type semiconductor layer, a second conductive type semiconductor layer, and an active layer disposed between the first and second conductive type semiconductor layers;
a first contact electrode and a second contact electrode disposed on the light emitting structure and forming ohmic contact with the first and second conductive type semiconductor layers, respectively;
an insulation layer disposed on the light emitting structure and insulating the first contact electrode and the second contact electrode from each other;
a first bulk electrode and a second bulk electrode disposed on the light emitting structure and electrically connected to the first and second contact electrodes, respectively;
an insulation support layer covering side surfaces of the first and second bulk electrodes and portions of upper surfaces of the first and second bulk electrodes, and including a first opening and a second opening partially exposing the upper surfaces of the first and second bulk electrodes, respectively; and
a first pad electrode and a second pad electrode at least partially filling the first and second openings, respectively,
wherein areas of exposed regions on the upper surfaces of the first and second bulk electrodes exposed through the first and second openings are smaller than horizontal cross-sectional areas of the first and second bulk electrodes, respectively.

[Claim 2] The light emitting device of claim 1, wherein a separation distance between the first and second bulk electrodes is smaller than a separation distance between the first and second openings.

[Claim 3] The light emitting device of claim 2, wherein the separation distance between the first and second bulk electrodes is 100 ㎛ or less.

[Claim 4] The light emitting device of claim 2, wherein the separation distance between the first and second openings is 80 ㎛ or more.

[Claim 5] The light emitting device of claim 1, wherein the insulation support layer includes a lower insulation support layer covering side surfaces of the first and second bulk electrodes, and an upper insulation support layer covering the portions of the upper surfaces of the first and second

bulk electrodes, and
the upper and lower insulation support layers are formed of the same material or different materials.

[Claim 6] The light emitting device of claim 5, wherein the upper insulation support layer covers an interface between the first bulk electrode and the lower insulation support layer and an interface between the second bulk electrode and the lower insulation support layer.

[Claim 7] The light emitting device of claim 1, wherein the upper and lower insulation support layers are formed of different materials, and the upper insulation support layer includes a photoresist or a photo-solder resist.

[Claim 8] The light emitting device of claim 1, wherein an upper surface of the first pad electrode, an upper surface of the second pad electrode and an upper surface of the insulation support layer are flush with each other.

[Claim 9] The light emitting device of claim 1, wherein the insulation layer includes a first insulation layer and a second insulation layer,
the first insulation layer partially covering the second contact electrode,
the first contact electrode partially covering the first insulation layer,
the second insulation layer partially covering the first contact electrode and including a third opening and a fourth opening partially expose the first contact electrode and the second contact electrode, respectively.

[Claim 10] The light emitting device of claim 9, wherein the first bulk electrode is electrically connected to the first contact electrode through the third opening, and the second bulk electrode is electrically connected to the second contact electrode through the fourth opening.

[Claim 11] The light emitting device of claim 9, further including:
a connection electrode disposed between the second contact electrode and the second bulk electrode.

[Claim 12] The light emitting device of claim 11, wherein an upper surface of the connection electrode is formed of the same material as the first contact electrode.

[Claim 13] The light emitting device of claim 11, wherein an upper surface of the connection electrode is flush with an upper surface of the first contact electrode.

[Claim 14] The light emitting device of claim 1, wherein the light emitting structure includes at least one hole partially exposing the first conductive type semiconductor layer, and the first contact electrode is electrically connected to the first conductive type semiconductor layer through the at least one hole.

[Claim 15] A light emitting device comprising:
a light emitting structure including a first conductive type semiconductor layer, a second conductive type semiconductor layer, and an active layer disposed between the first and second conductive type semiconductor layers;
a first contact electrode and a second contact electrode disposed on the light emitting structure and forming ohmic contact with the first and second conductive type semiconductor layers, respectively;
an insulation layer disposed on the light emitting structure and insulating the first contact electrode and the second contact electrode from each other;
a first bulk electrode and a second bulk electrode disposed on the light emitting structure and electrically connected to the first and second contact electrodes, respectively; and
an insulation support layer covering side surfaces of the first and second bulk electrodes and portions of upper surfaces of the first and second bulk electrodes, and including a first opening and a second opening partially exposing the upper surfaces of the first and second bulk electrodes, respectively,
wherein a separation distance between the first and second openings is greater than a separation distance between the first and second bulk electrodes.

[Claim 16] The light emitting device of claim 15, wherein the second conductive type semiconductor layer is a p-type semiconductor layer, and an area of an exposed region of the upper surface of the second bulk electrode exposed through the second opening is greater than a contact area between the second bulk electrode and the second contact electrode.

[Claim 17] The light emitting device of claim 15, wherein the first conductive type semiconductor layer is an n-type semiconductor layer, and an area of an exposed region of the upper surface of the first bulk electrode exposed through the first opening is smaller than a contact area between the first bulk electrode and the first contact electrode.

[Claim 18] The light emitting device of claim 16 or 17, wherein a horizontal cross-sectional area of the first bulk electrode is greater than that of the second bulk electrode.

[Claim 19] A light emitting device comprising:
a light emitting structure including a first conductive type semiconductor layer, a second conductive type semiconductor layer, and an

active layer disposed between the first and second conductive type semiconductor layers;
a first contact electrode and a second contact electrode disposed on the light emitting structure and forming ohmic contact with the first and second conductive type semiconductor layers, respectively;
an insulation layer disposed on the light emitting structure and insulating the first contact electrode and the second contact electrode from each other;
a first bulk electrode and a second bulk electrode disposed on the light emitting structure and electrically connected to the first and second contact electrodes, respectively; and
an insulation support layer covering side surfaces of the first and second bulk electrodes and portions of upper surfaces of the first and second bulk electrodes, and including a first opening and a second opening partially exposing the upper surfaces of the first and second bulk electrodes, respectively,
wherein the insulation support layer is disposed between the first and second bulk electrodes and on portions of the upper surfaces of the first and second bulk electrodes above sides surfaces of the first and second bulk electrodes facing each other.

[Claim 20] The light emitting device of claim 19, wherein the insulation support layer is disposed on outer peripheral side surfaces of the first and second bulk electrodes and on portions of the upper surfaces of the first and second bulk electrodes above the outer peripheral side surfaces of the first and second bulk electrodes.

[Claim 21] A light emitting device comprising:
a light emitting structure including a first conductive type semiconductor layer, a second conductive type semiconductor layer, and an active layer disposed between the first and second conductive type semiconductor;
a first contact electrode and a second contact electrode disposed on the light emitting structure and forming ohmic contact with the first and second conductive type semiconductor layers, respectively;
first and second insulation layers partially covering the first contact electrode and the second contact electrode, respectively;
a first electrode and a second electrode disposed on the light emitting structure and electrically connected to the first and second contact electrodes, respectively;

an insulation support layer covering side surfaces of the first electrode and the second electrode;
a connection layer disposed on the first electrode, the second electrode and the insulation support layer ; and
a first pad electrode and a second pad electrode disposed on the connection layer,
wherein the first pad electrode and the second pad electrode are electrically connected to the first electrode and the second electrode through the connection layer, respectively, a horizontal area of the first pad electrode is smaller than that of the first electrode, and a horizontal area of the second pad electrode is larger than that of the second electrode.

[Claim 22] The light emitting device of claim 21, wherein the first electrode is disposed on an ohmic contact region between the first contact electrode and the first conductive type semiconductor layer.

[Claim 23] The light emitting device of claim 22, wherein the ohmic contact region between the first contact electrode and the first conductive type semiconductor layer is not disposed under the second electrode.

[Claim 24] The light emitting device of claim 22, wherein the first contact electrode includes a plurality of ohmic contact regions contacting the first conductive type semiconductor layer to form ohmic contact therewith, and the first electrode contacts all of the plurality of ohmic contact regions of the first contact electrode.

[Claim 25] The light emitting device of claim 22, wherein the first contact electrode includes a plurality of ohmic contact regions contacting the first conductive type semiconductor layer to form ohmic contact therewith, and the first electrode contacts some of the plurality of ohmic contact regions of the first contact electrode.

[Claim 26] The light emitting device of claim 25, further including:
a first interconnection layer disposed under the first electrode; and
a second interconnection layer disposed under the second electrode,
wherein a portion of the first interconnection layer contacts the first contact electrode and a portion of the second interconnection layer contacts the second contact electrode.

[Claim 27] The light emitting device of claim 26, wherein the second insulation layer is partially disposed between the first interconnection layer and the first contact electrode.

[Claim 28] The light emitting device of claim 21, wherein a horizontal cross-

sectional area of the first electrode is 0.8 times to less than 1 times the sum of horizontal cross-sectional areas of the first electrode and the second electrode.

[Claim 29] The light emitting device of claim 21, wherein the first pad electrode has the same horizontal area as the second pad electrode.

[Claim 30] The light emitting device of claim 21, wherein the connection layer includes:
an insulation material layer;
a first connection layer electrically connecting the first electrode to the first pad electrode and penetrating the insulation material layer; and
a second connection layer electrically connecting the second electrode to the second pad electrode and penetrating the insulation material layer.

[Claim 31] The light emitting device of claim 21, further comprising:
a plurality of second electrodes,
wherein the plurality of second electrodes are electrically connected to the second pad electrode.

[Claim 32] The light emitting device of claim 21, wherein the first contact electrode includes a plurality of ohmic contact regions contacting the first conductive type semiconductor layer to form ohmic contact therewith, and some of the plurality of ohmic contact regions are disposed between the second electrodes.

[Claim 33] The light emitting device of claim 21, wherein each of the first and second electrodes includes metal particles and a non-metallic material interposed between the metal particles.

[Claim 34] The light emitting device of claim 33, wherein the metal particles and the non-metallic material take the form of sintered metal particles.

[Claim 35] The light emitting device of claim 34, wherein each of the first and second electrodes includes an inclined side surface, the inclined side surface including a side surface on which a gradient of a tangential line of a vertical cross-section of each of the first and second electrodes with respect to the side surface varies.

[Claim 36] The light emitting device of claim 33, wherein each of the first and second electrodes includes 80 wt% to 98 wt% of the metal particles.

[Claim 37] The light emitting device of claim 21, wherein the light emitting structure further includes a partially exposed region of the first conductive type semiconductor layer formed by partially removing the active layer and the second conductive type semiconductor layer, and

the first contact electrode forms ohmic contact with the first conductive type semiconductor layer through the partially exposed region of the first conductive type semiconductor layer.

[Claim 38] The light emitting device of claim 37, wherein the partially exposed region of the first conductive type semiconductor layer takes the form of a plurality of holes.

[Claim 39] The light emitting device of claim 38, wherein the second contact electrode is disposed on the second conductive type semiconductor layer;
the first insulation layer covers the second contact electrode and the light emitting structure and includes a first opening and a second opening exposing a portion of the exposed region of the first conductive type semiconductor layer and a portion of the second contact electrode, respectively;
the first contact electrode at least partially covers the first insulation layer while contacting the first conductive type semiconductor layer through the first opening; and
the second insulation layer partially covers the first contact electrode and includes a third opening partially exposing the first contact electrode, and a fourth opening formed at a location corresponding to the second opening and exposing a portion of the second contact electrode.

[Claim 40] The light emitting device of claim 39, wherein the first electrode contacts the first contact electrode through the third opening, the second electrode contacts the second contact electrode through the fourth opening, and all of the plurality of holes are disposed under a region of the third opening.

[Claim 41] A light emitting device comprising:
a light emitting structure including a first conductive type semiconductor layer, a second conductive type semiconductor layer disposed on the first conductive type semiconductor layer, and an active layer disposed between the first conductive type semiconductor layer and the second conductive type semiconductor layer;
a first electrode electrically connected to the first conductive type semiconductor layer;
a second electrode disposed on the second conductive type semiconductor layer and electrically connected to the second conductive type semiconductor layer;

a support structure including a first bulk electrode and a second bulk electrode disposed on the first electrode and the second electrode to be separated from each other and electrically connected to the first electrode and the second electrode, respectively, and an insulation support layer disposed between the first bulk electrode and the second bulk electrode; and

a substrate disposed adjacent to the support structure,

wherein each of the first and second bulk electrodes includes an upper region and a lower region,

the substrate includes a first interconnection portion and a second inter-connection portion electrically connected to the first bulk electrode and the second bulk electrode, respectively, and

a distance between the first interconnection portion and the second interconnection portion is greater than a distance between the upper regions.

[Claim 42] The light emitting device of claim 41, wherein

the first bulk electrode includes a first plane facing the second bulk electrode and a second plane disposed opposite the first plane;

the second bulk electrode includes a third plane facing the first bulk electrode and a fourth plane disposed opposite the third plane; and

the first and second bulk electrodes includes a first depression depressed from lower edges of the first and third planes, respectively.

[Claim 43] The light emitting device of claim 42, wherein the first depression is composed of a single plane.

[Claim 44] The light emitting device of claim 42, wherein the first depression is composed of a convex plane or a concave plane.

[Claim 45] The light emitting device of claim 42, wherein the first depression is composed of a plurality of planes.

[Claim 46] The light emitting device of claim 42, wherein each of the first and second bulk electrodes includes a second depression depressed from lower edges of the second and fourth planes, respectively.

[Claim 47] The light emitting device of claim 41, wherein a distance between the lower regions is greater than the distance between the upper regions.

[Claim 48] The light emitting device of claim 47, wherein the distance between the upper regions is 100 ㎛ or less.

[Claim 49] The light emitting device of claim 47, wherein the distance between the lower regions is 250 ㎛ or less.

[Claim 50] The light emitting device of claim 41, wherein the distance between the

first interconnection portion and the second interconnection portion is greater than a distance between the lower regions.

[Claim 51] The light emitting device of claim 41, wherein the first bulk electrode and the second bulk electrode have a thickness 5 to 20 times the thickness of the first electrode and the second electrode, respectively.

[Claim 52] The light emitting device of claim 41, further including:
a first insulation layer covering a lower surface of the light emitting structure and lower and side surfaces of the second electrode, and disposed between the light emitting structure and the first electrode to insulate the first electrode from the second electrode.

[Claim 53] The light emitting device of claim 41, further including: a second insulation layer covering a portion of the first electrode.

[Claim 54] The light emitting device of claim 41, wherein the substrate further includes a base supporting the first interconnection portion and the second interconnection portion, the substrate including a via-hole formed through the base.

[Claim 55] The light emitting device of claim 54, wherein the via-hole is disposed on the first bulk electrode and the second bulk electrode.

[Claim 56] The light emitting device of claim 54, wherein the via-hole does not overlap the first bulk electrode and the second bulk electrode in a vertical direction.

[Claim 57] The light emitting device of claim 41, wherein each of the first and second bulk electrodes is a monolithic layer.

[Claim 58] The light emitting device of claim 41, further including:
a solder between the first bulk electrode and the first interconnection portion and between the second bulk electrode and the second interconnection portion.

AMENDED CLAIMS
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【Claim 1】

A light emitting device comprising:

a light emitting structure including a first conductive type semiconductor layer, a second conductive type semiconductor layer disposed on the first conductive type semiconductor layer, and an active layer disposed between the first conductive type semiconductor layer and the second conductive type semiconductor layer;

a first electrode electrically connected to the first conductive type semiconductor layer;

a second electrode disposed on the second conductive type semiconductor layer and electrically connected to the second conductive type semiconductor layer;

a support structure including a first bulk electrode and a second bulk electrode disposed on the first electrode and the second electrode to be separated from each other and electrically connected to the first electrode and the second electrode, respectively, and an insulation support layer disposed between the first bulk electrode and the second bulk electrode; and

a substrate disposed adjacent to the support structure,

wherein each of the first and second bulk electrodes includes an upper region and a lower region,

the substrate includes a first interconnection portion and a second interconnection portion electrically connected to the first bulk electrode and the second bulk electrode, respectively, and

a distance between the first interconnection portion and the second interconnection portion is greater than a distance between the upper regions.

【Claim 2】

The light emitting device of claim 1, wherein

the first bulk electrode includes a first plane facing the second bulk electrode and a second plane disposed opposite the first plane;

the second bulk electrode includes a third plane facing the first bulk electrode and a fourth plane disposed opposite the third plane; and

the first and second bulk electrodes includes a first depression depressed from lower edges of the first and third planes, respectively.

【Claim 3】

The light emitting device of claim 2, wherein the first depression is composed of a single plane.

【Claim 4】

The light emitting device of claim 2, wherein the first depression is composed of a convex plane or a concave plane.

【Claim 5】

The light emitting device of claim 2, wherein the first depression is composed of a plurality of planes.

【Claim 6】

The light emitting device of claim 2, wherein each of the first and second bulk electrodes includes a second depression depressed from lower edges of the second and fourth planes, respectively.

【Claim 7】

The light emitting device of claim 1, wherein a distance between the lower regions is greater than the distance between the upper regions.

【Claim 8】

The light emitting device of claim 7, wherein the distance between the upper regions is 100 ㎛ or less.

【Claim 9】

The light emitting device of claim 7, wherein the distance between the lower regions is 250 ㎛ or less.

【Claim 10】

The light emitting device of claim 1, wherein the distance between the first interconnection portion and the second interconnection portion is greater than a distance between the lower regions.

【Claim 11】

The light emitting device of claim 1, wherein the first bulk electrode and the second bulk electrode have a thickness 5 to 20 times the thickness of the first electrode and the second electrode, respectively.

【Claim 12】

The light emitting device of claim 1, further including:

a first insulation layer covering a lower surface of the light emitting structure and lower and side surfaces of the second electrode, and disposed between the light emitting structure and the first electrode to insulate the first electrode from the second electrode.

【Claim 13】

The light emitting device of claim 1, further including: a second insulation layer covering a portion of the first electrode.

【Claim 14】

The light emitting device of claim 1, wherein the substrate further includes a base supporting the first interconnection portion and the second interconnection portion, the substrate including a via-hole formed through the base.

【Claim 15】

The light emitting device of claim 14, wherein the via-hole is disposed on the first bulk electrode and the second bulk electrode.

【Claim 16】

The light emitting device of claim 14, wherein the via-hole does not overlap the first bulk electrode and the second bulk electrode in a vertical direction.

【Claim 17】

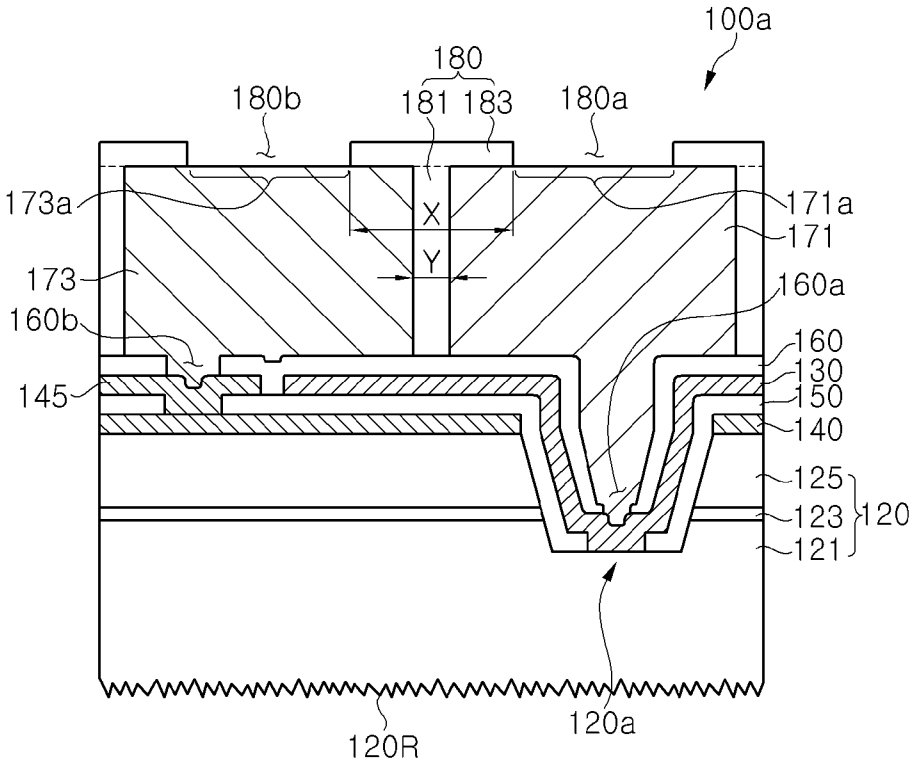
The light emitting device of claim 1, wherein each of the first and second bulk electrodes is a monolithic layer.

【Claim 18】

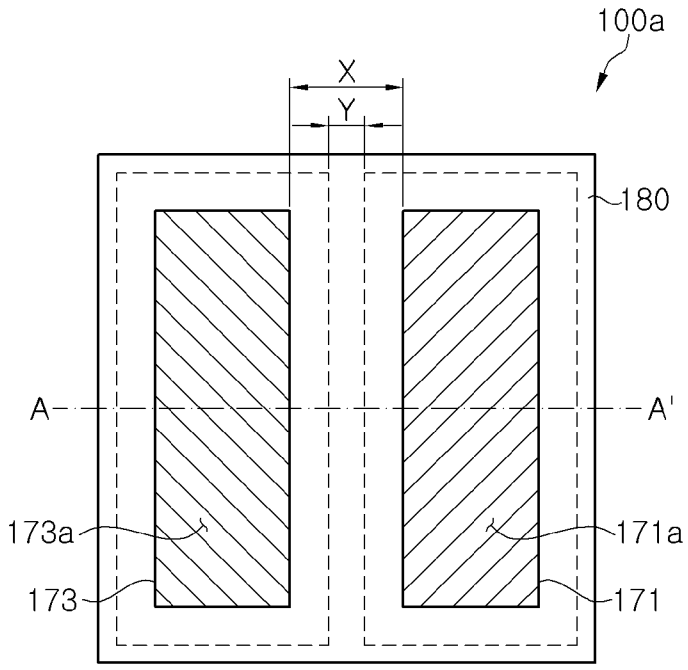
The light emitting device of claim 1, further including:

a solder between the first bulk electrode and the first interconnection portion and between the second bulk electrode and the second interconnection portion.

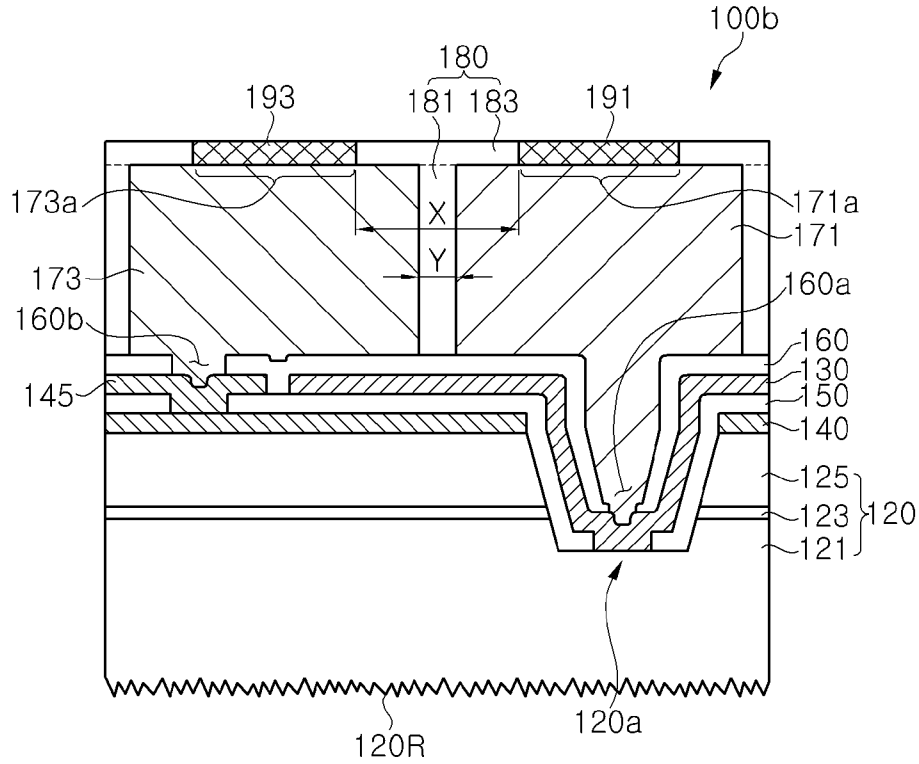
[Fig. 1]


100a
180
180b
181 183
180a
173a
171a
X
171
Y
173
160a
160b
160
130
145
150
140
125
120
123
121
120a
120R

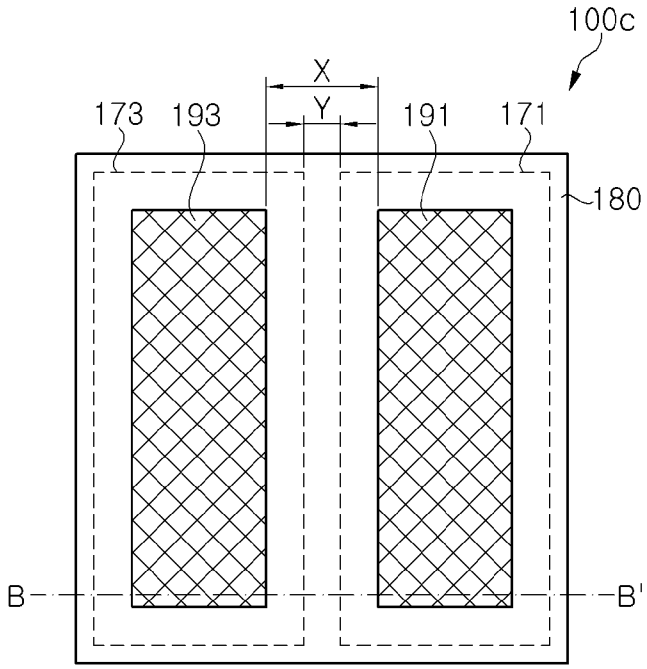
[Fig. 2]


100a
X
Y
180
A
A'
173a
171a
173
171

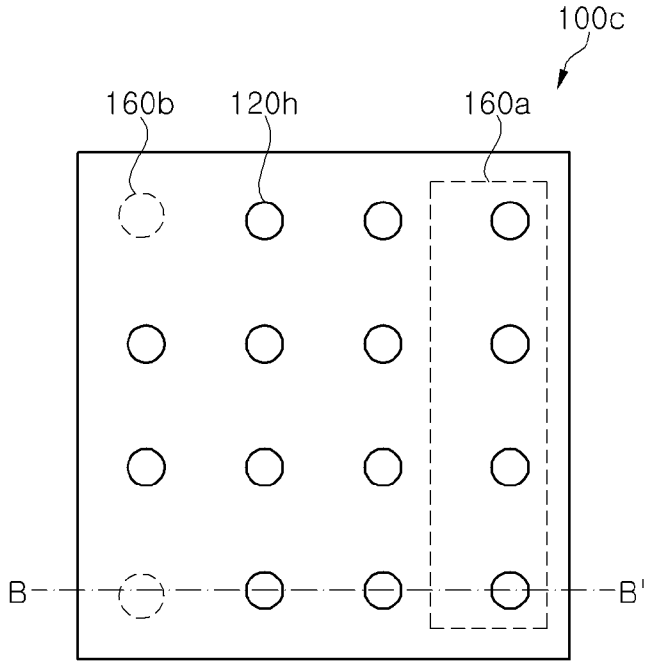
[Fig. 3]


100b
180
193
181
183
191
173a
171a
X
Y
171
173
160a
160b
160
130
145
150
140
125
123
120
121
120R
120a

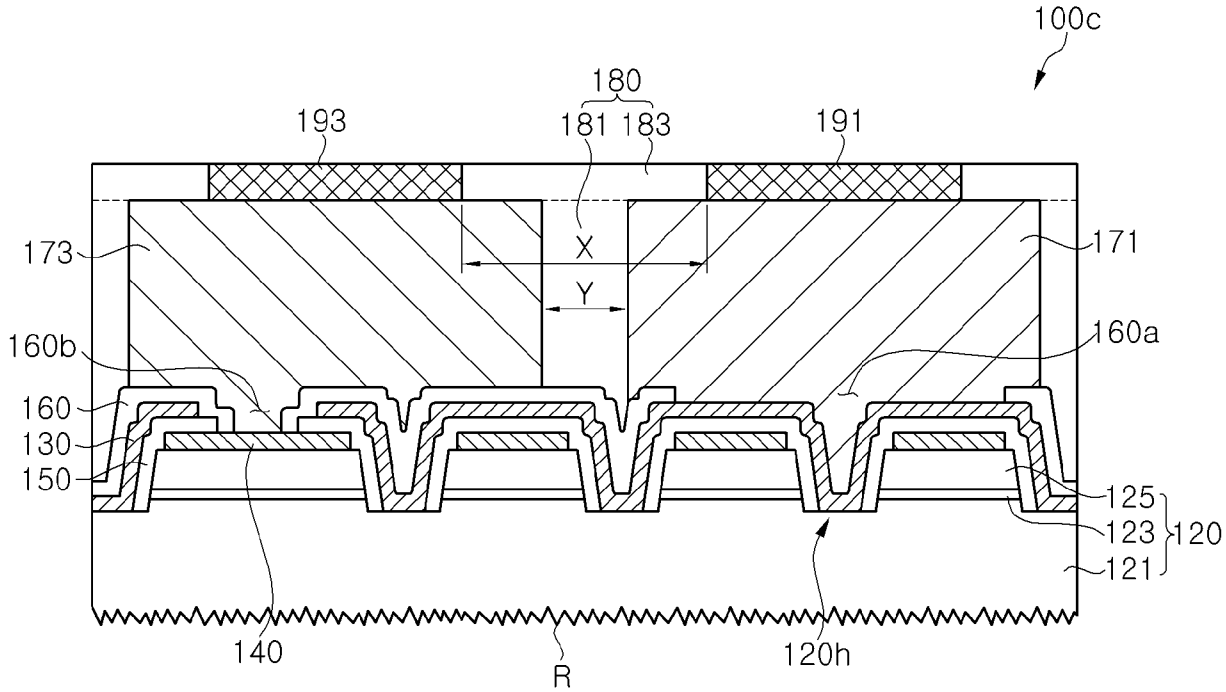
[Fig. 4a]


100c
X
Y
173
193
191
171
180
B
B'

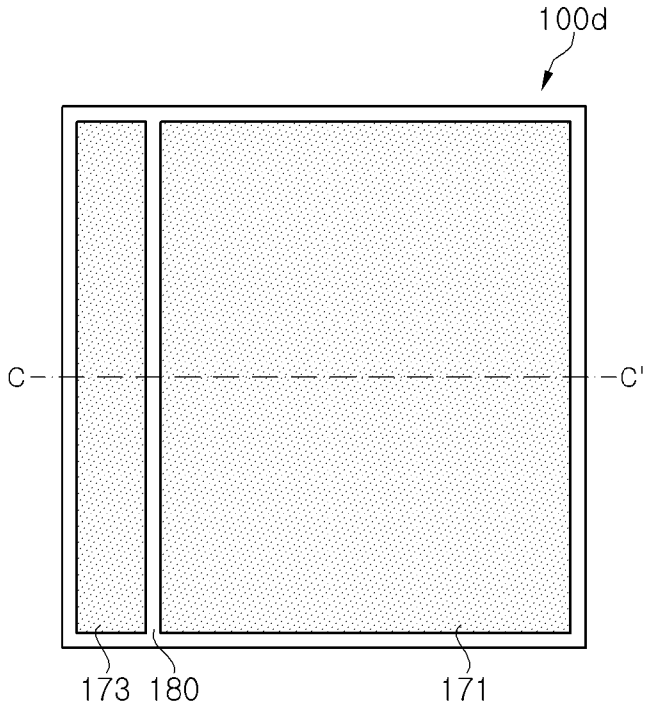
[Fig. 4b]


100c
160b
120h
160a
B
B'

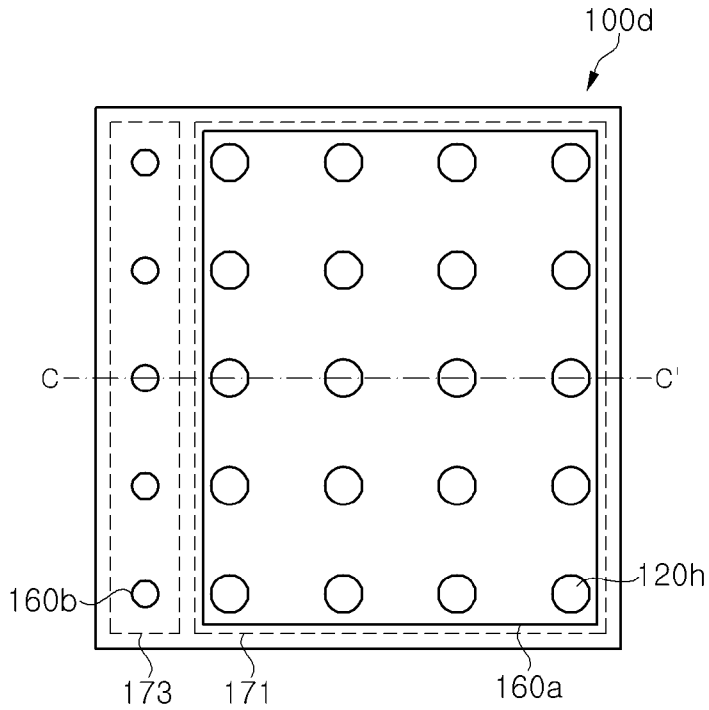
[Fig. 5]


100c
180
193
181 183
191
173
X
Y
171
160b
160a
160
130
150
125
123
120
121
140
R
120h

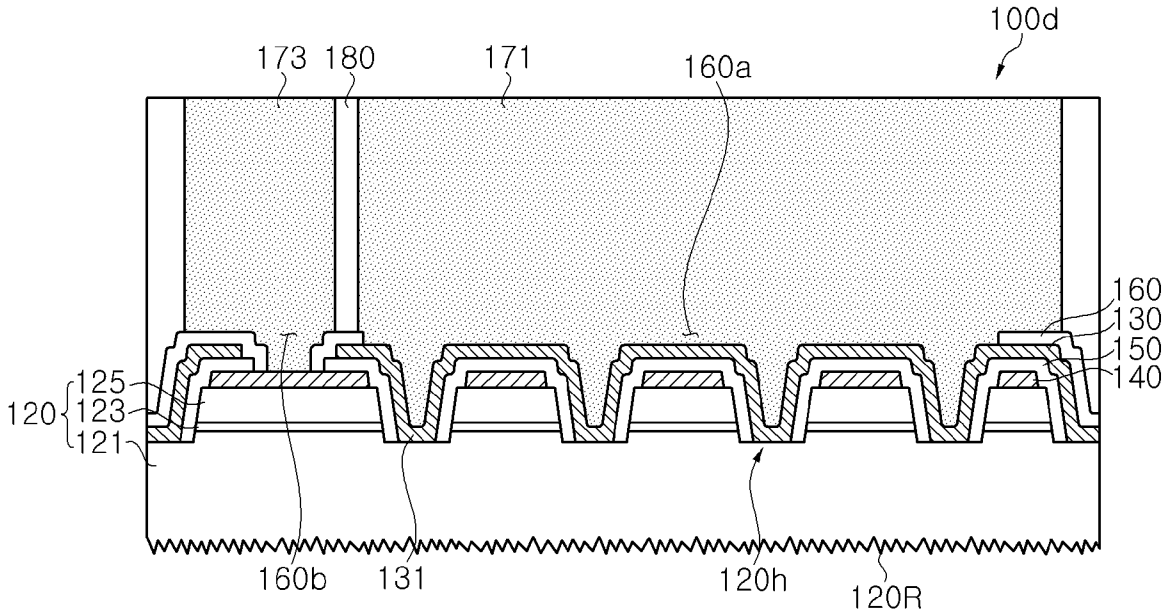
[Fig. 6a]



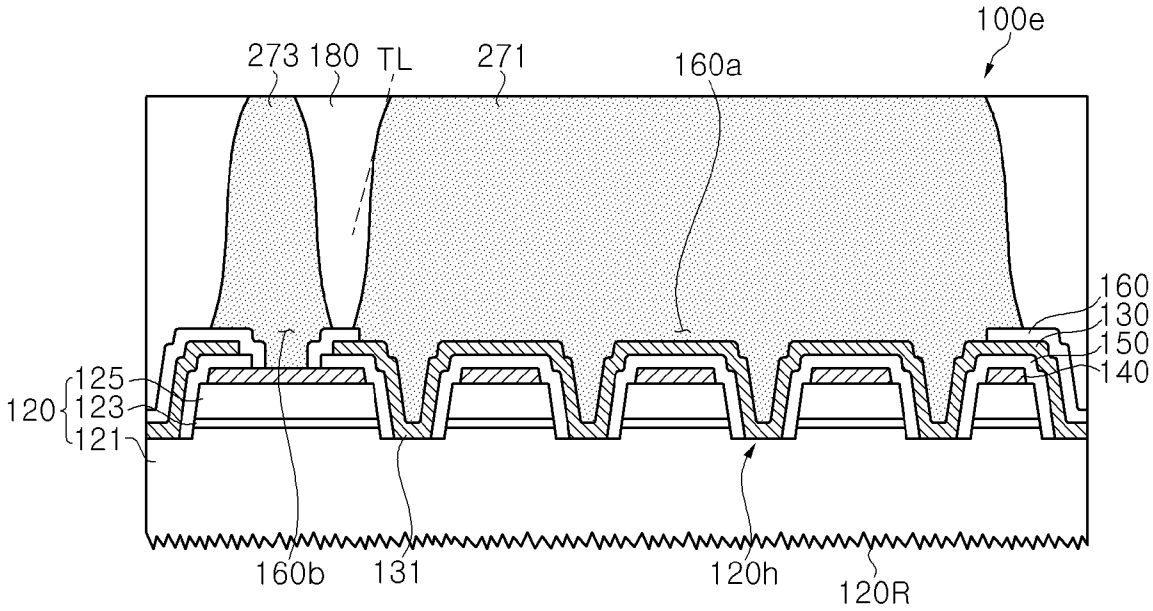
[Fig. 6b]



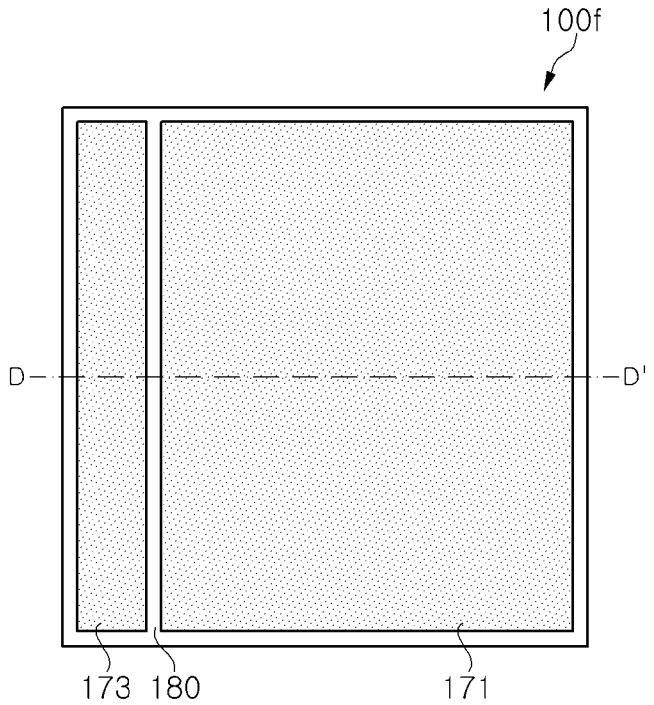
[Fig. 7]


100d
173
180
171
160a
160
130
150
140
125
120
123
121
160b
131
120h
120R

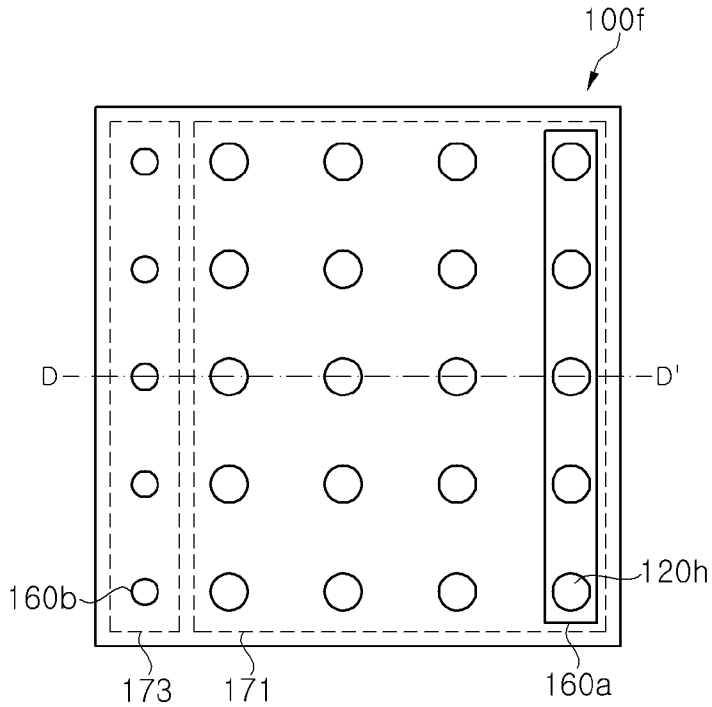
[Fig. 8]


100e
273
180
TL
271
160a
160
130
150
140
125
120
123
121
160b
131
120h
120R

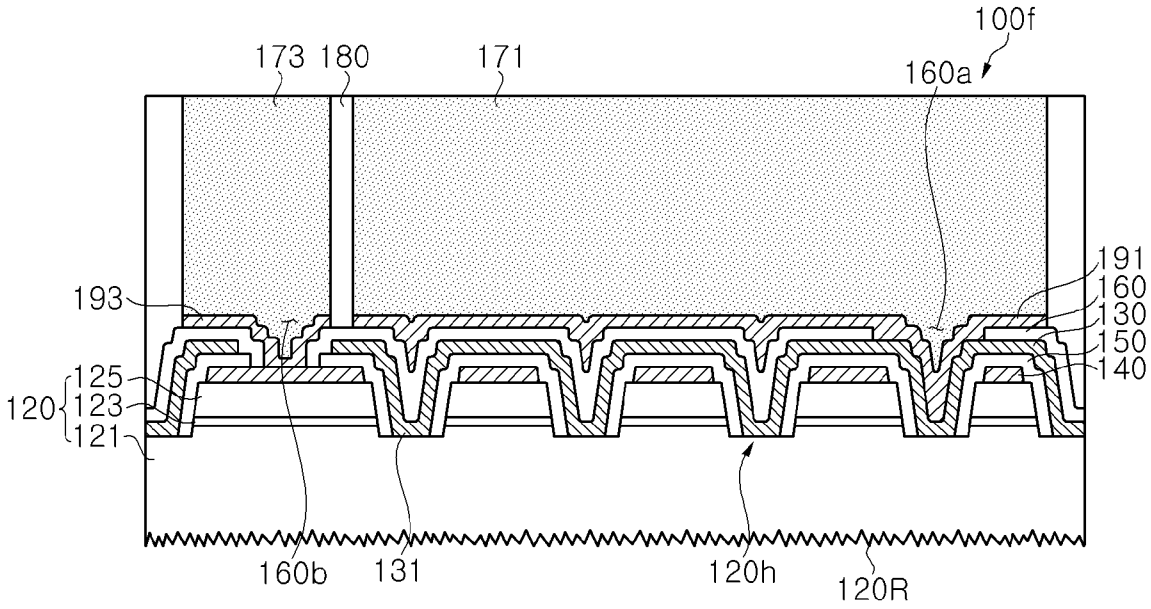
[Fig. 9a]



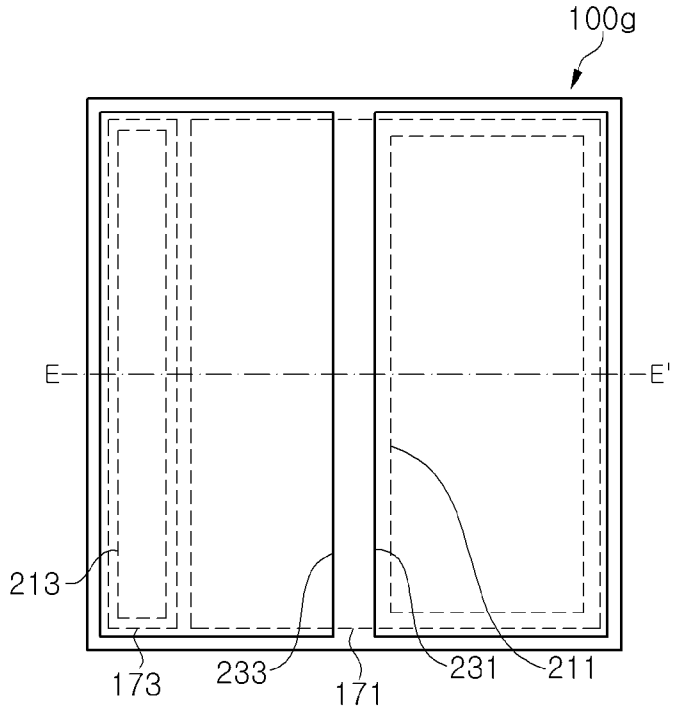
[Fig. 9b]



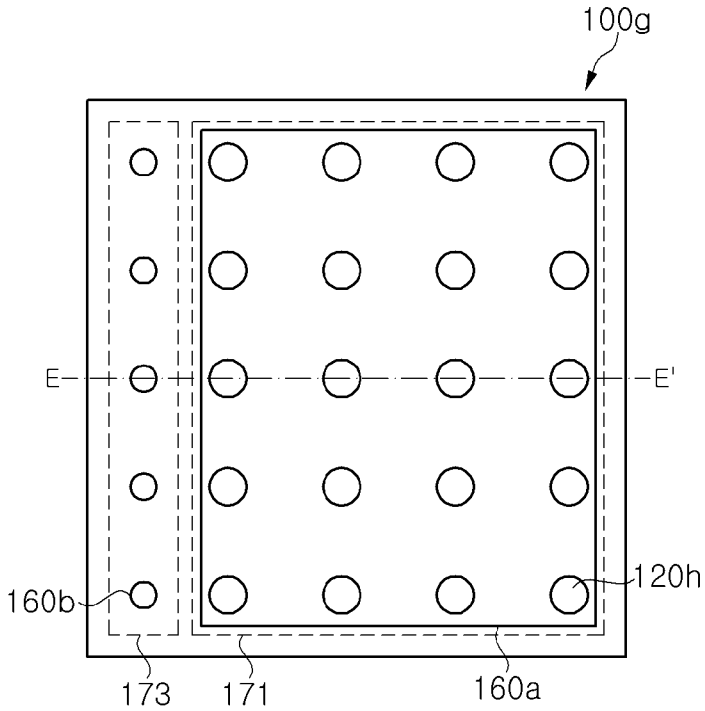
[Fig. 10]



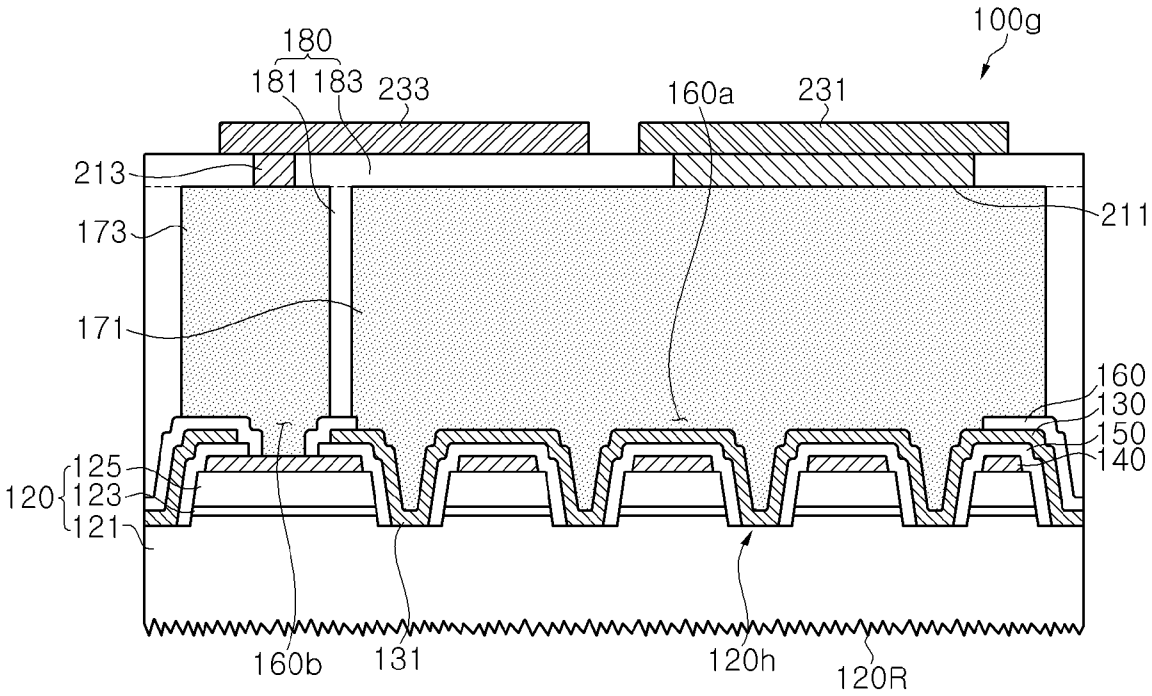
[Fig. 11a]



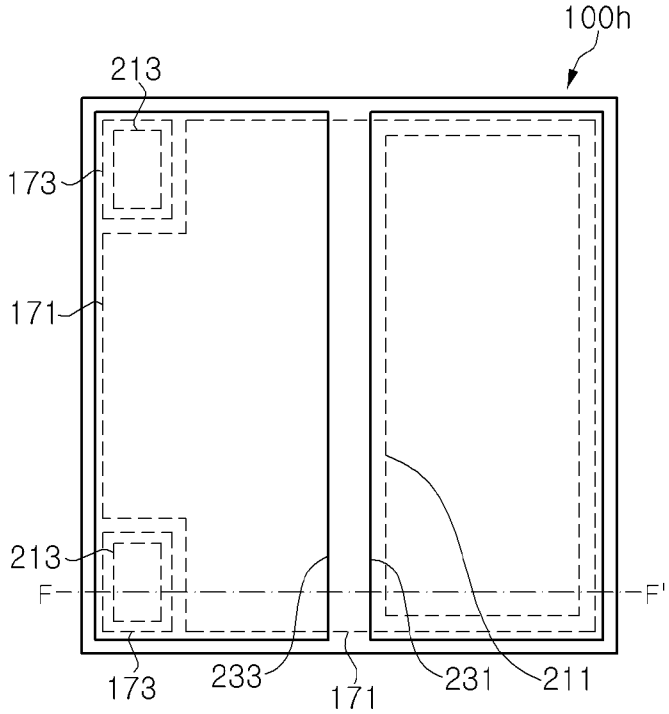
[Fig. 11b]



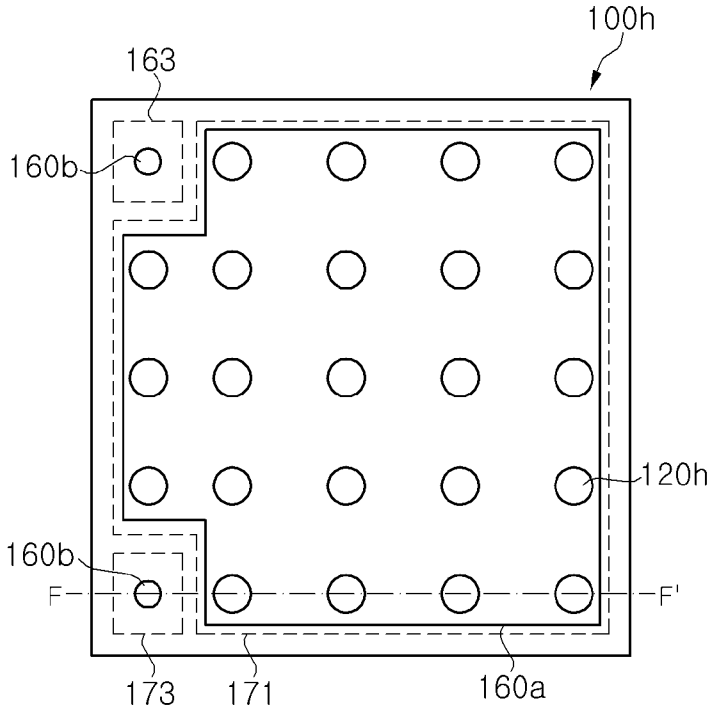
[Fig. 12]



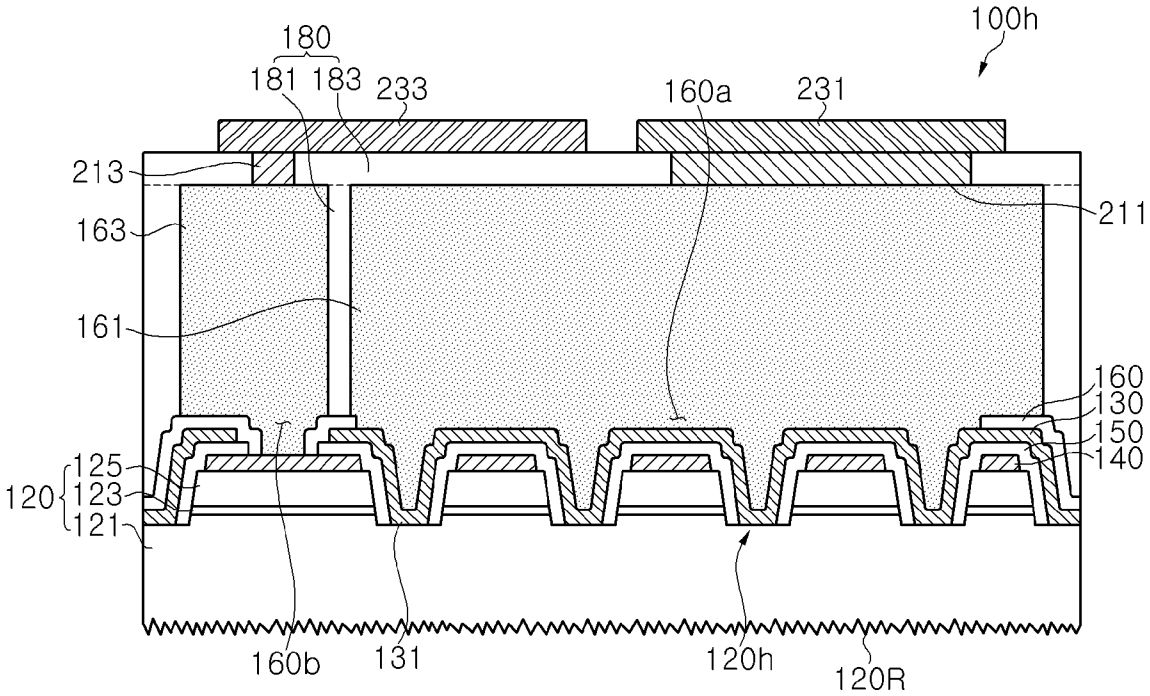
[Fig. 13a]



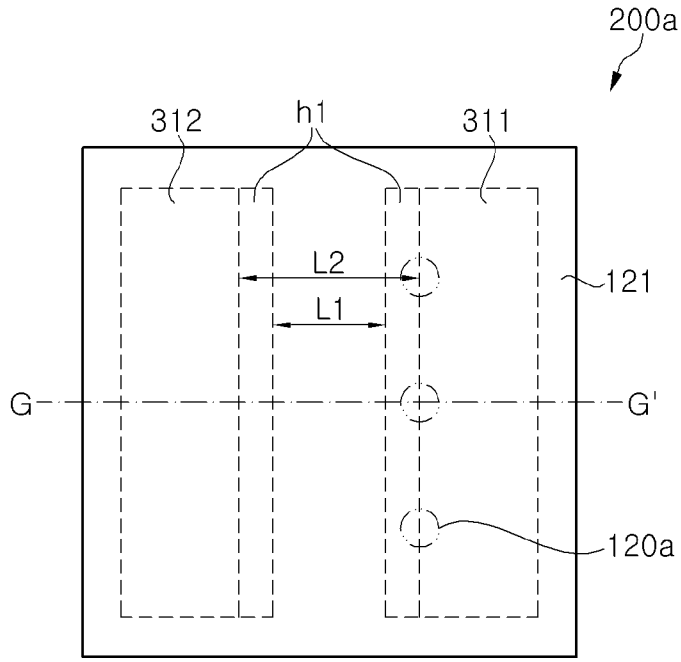
[Fig. 13b]



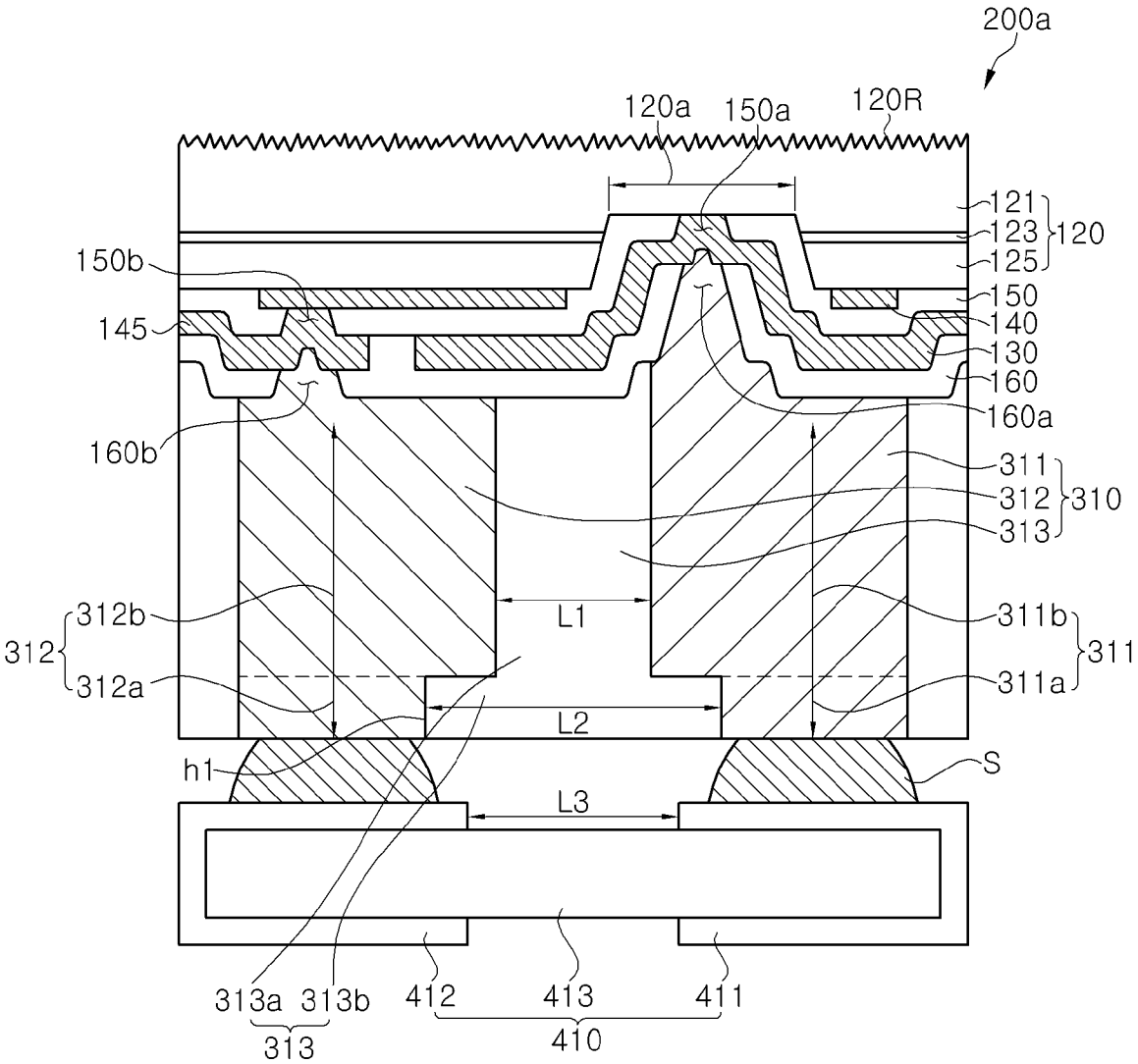
[Fig. 14]


100h
180
181
183
233
160a
231
213
211
163
161
160
130
150
140
125
120
123
121
160b
131
120h
120R

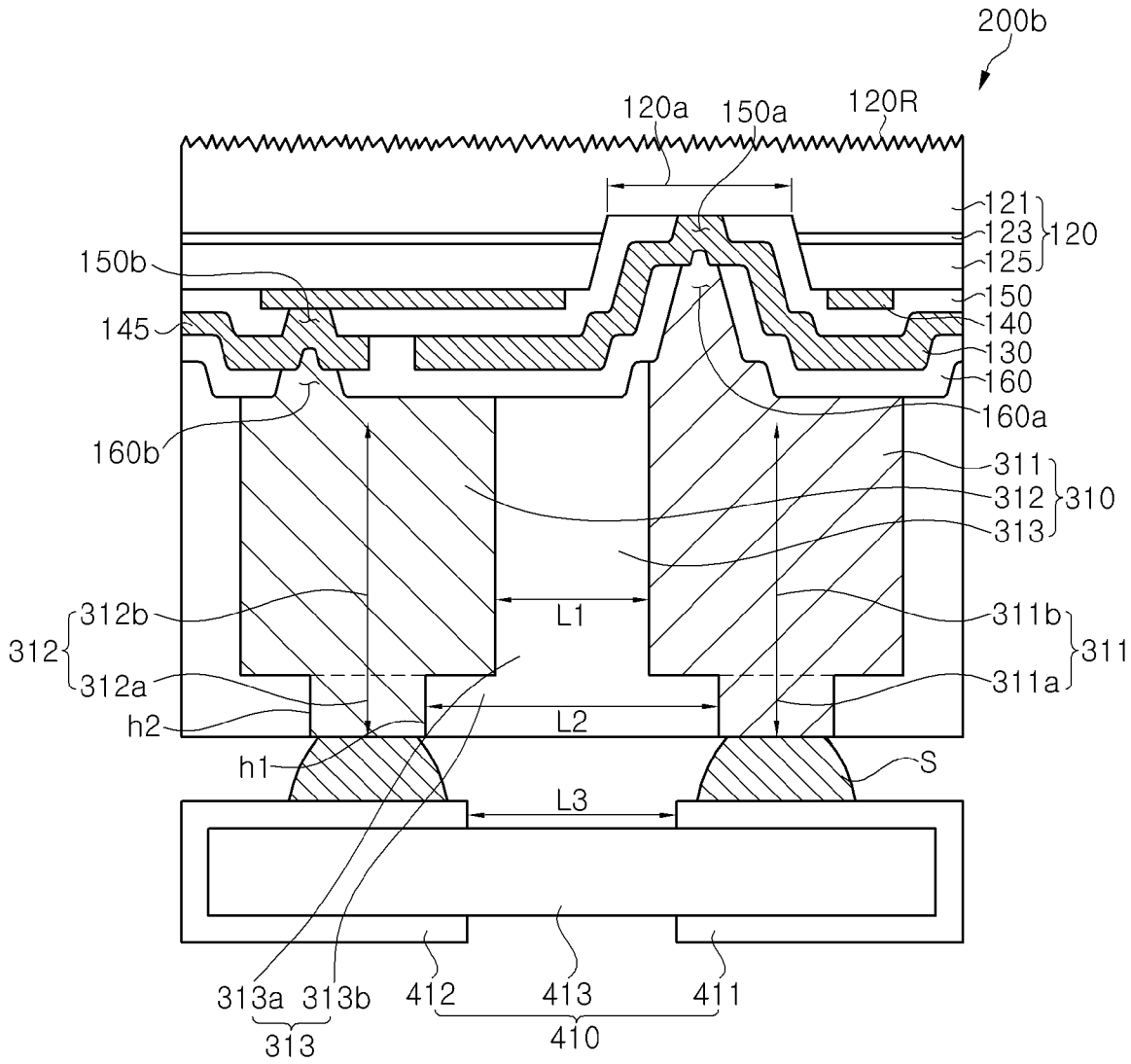
[Fig. 15]


200a
312
h1
311
L2
L1
121
G
G'
120a

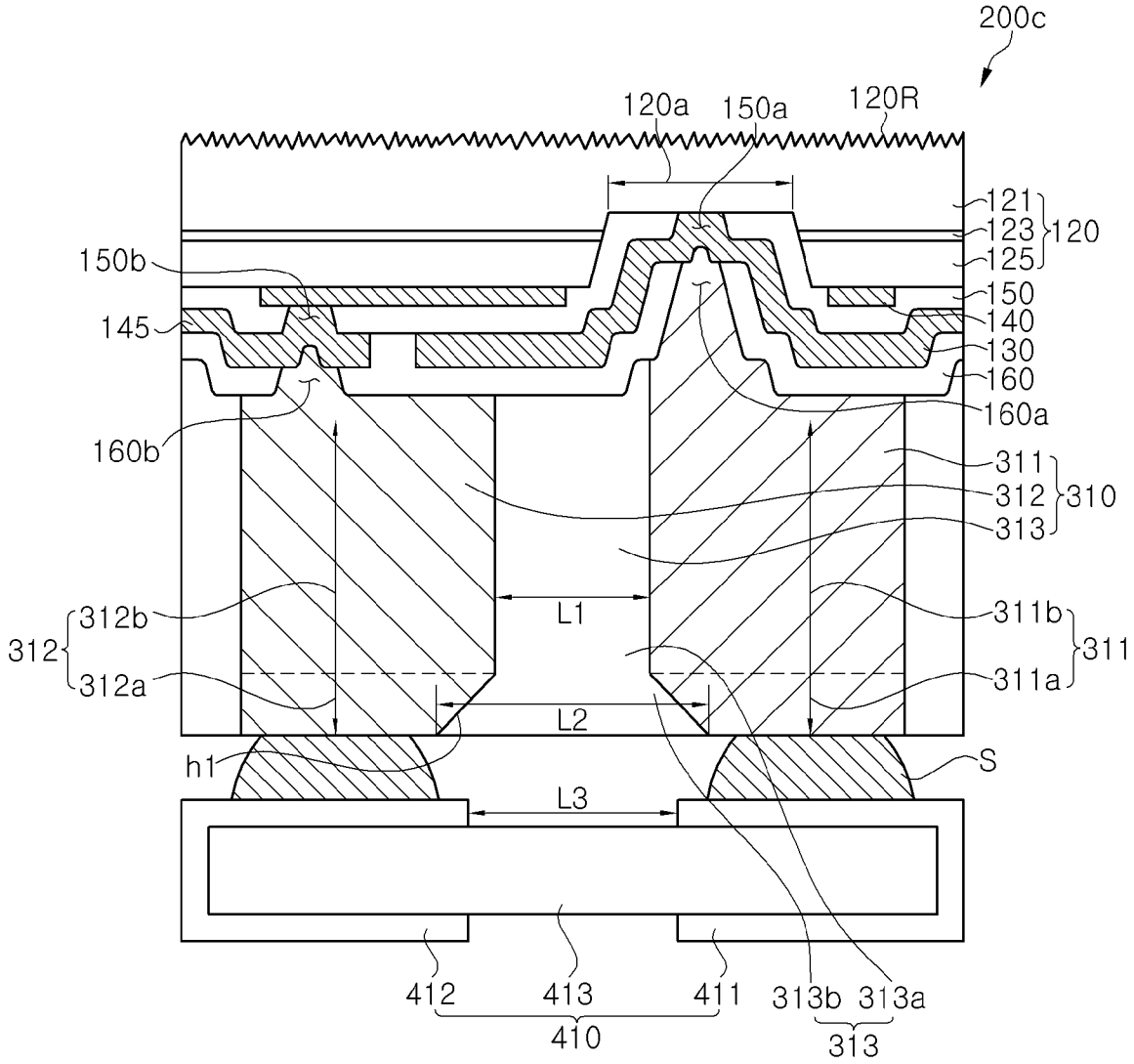
[Fig. 16]


200a
120a
150a
120R
121
123
125
120
150b
150
145
140
130
160
160a
160b
311
312
313
310
L1
312b
312
312a
311b
311
311a
L2
h1
S
L3
313a
313b
313
412
413
411
410

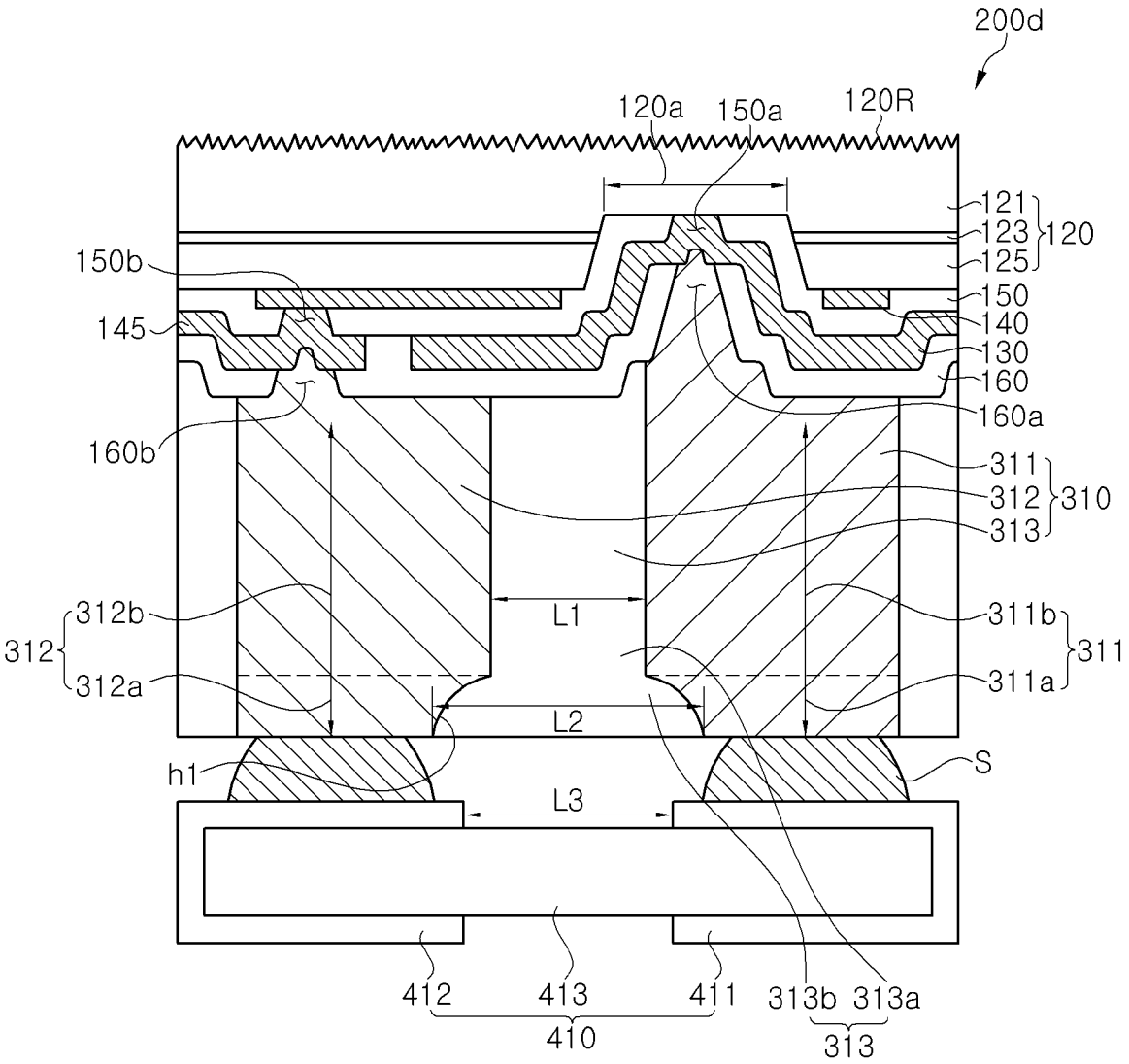
[Fig. 17]


200b
120a
150a
120R
121
123
125
120
150b
150
145
140
130
160
160a
160b
311
312
313
310
L1
312b
311b
312
311
312a
311a
h2
L2
h1
S
L3
313a
313b
412
413
411
313
410

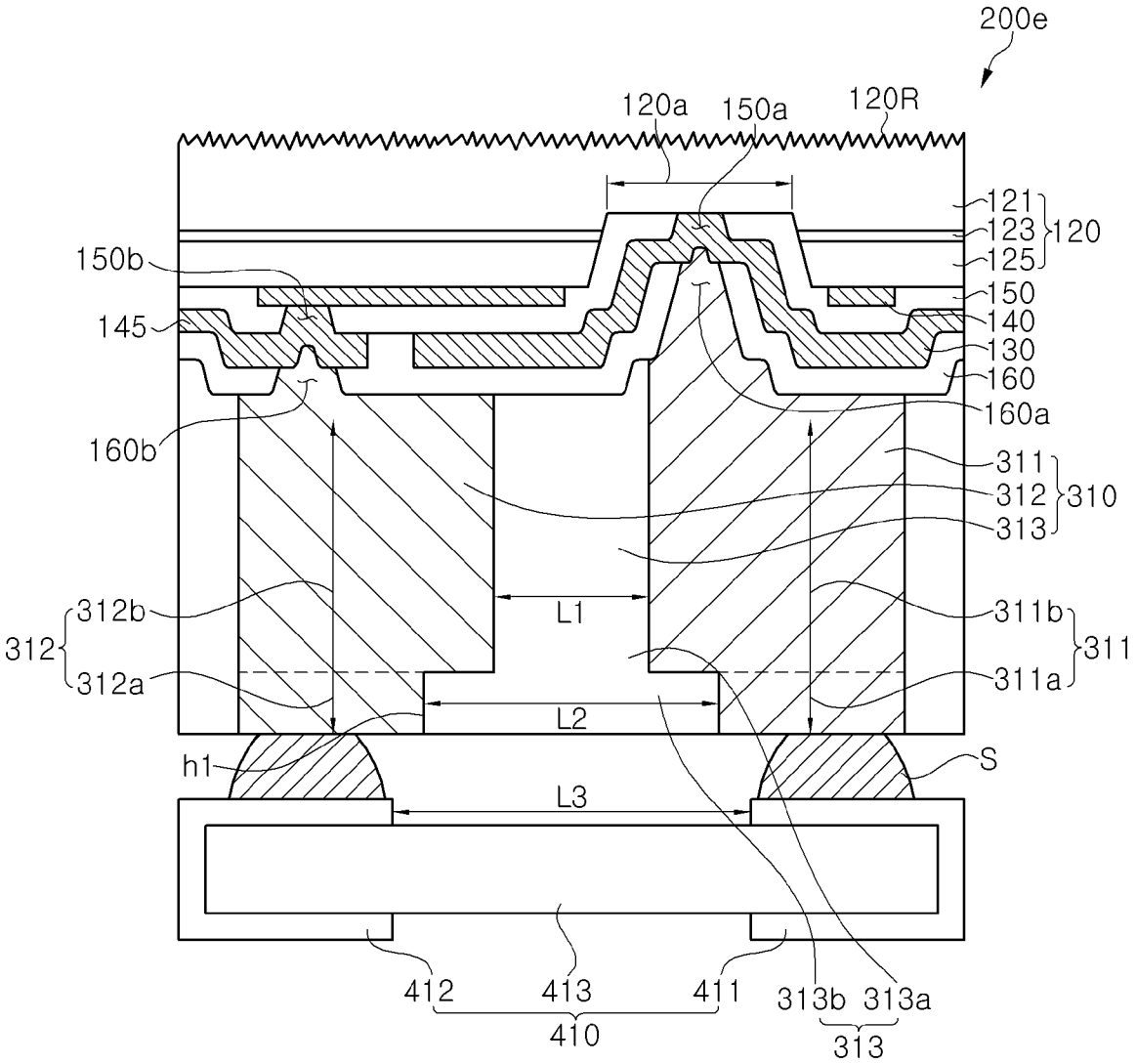
[Fig. 18]


200c
120a
150a
120R
121
123
125
120
150b
150
145
140
130
160
160a
160b
311
312
313
310
L1
312b
312
312a
311b
311
311a
L2
h1
S
L3
412
413
411
313b
313a
410
313

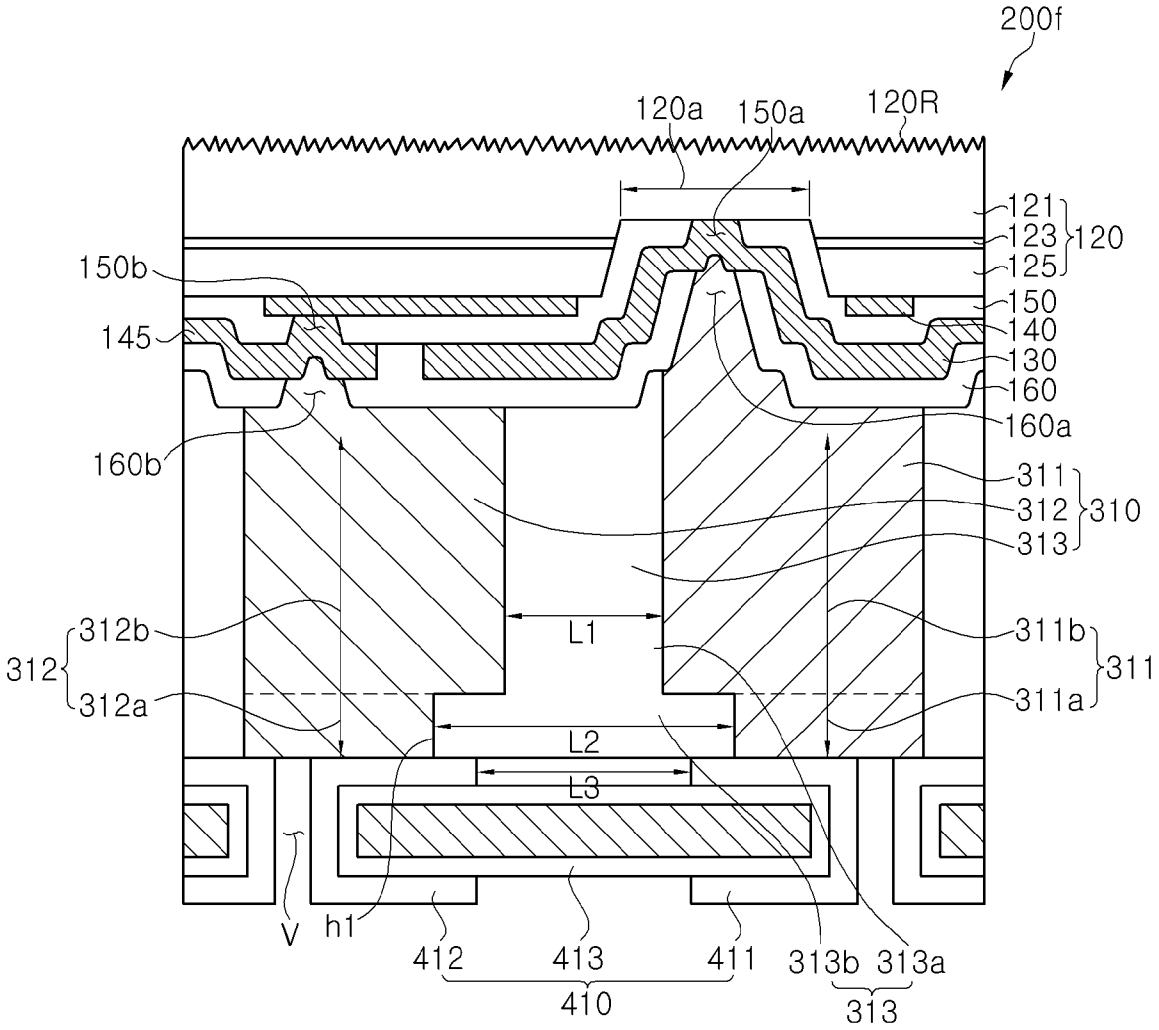
[Fig. 19]


200d
120a
150a
120R
121
123
125
120
150b
150
145
140
130
160
160a
160b
311
312
313
310
312b
312
312a
L1
311b
311
311a
L2
h1
S
L3
412
413
411
313b
313a
410
313

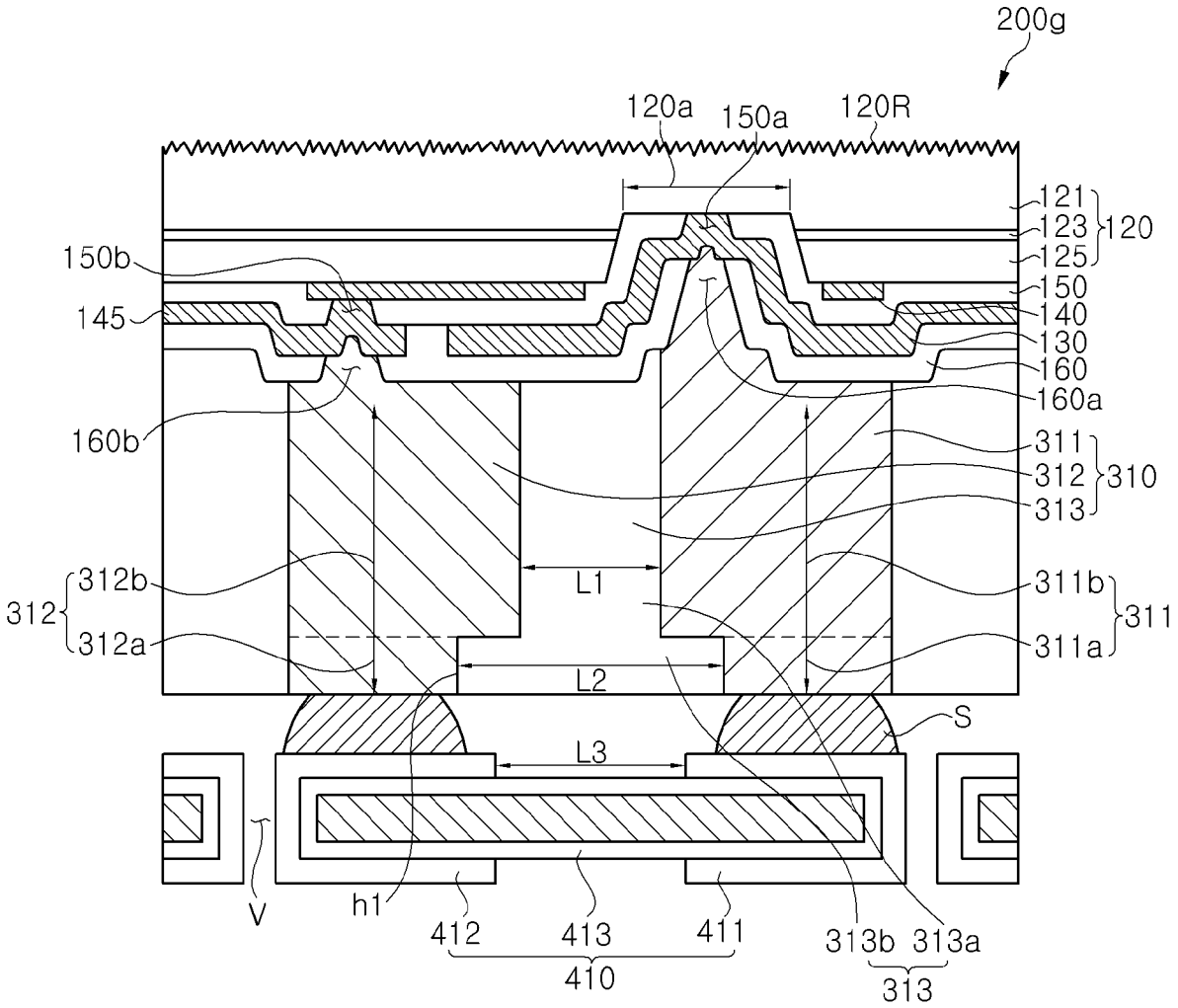
[Fig. 20]


200e
120a
150a
120R
121
123
125
120
150b
150
145
140
130
160
160a
160b
311
312
313
310
L1
312b
312
312a
311b
311
311a
L2
h1
S
L3
412
413
411
313b
313a
410
313

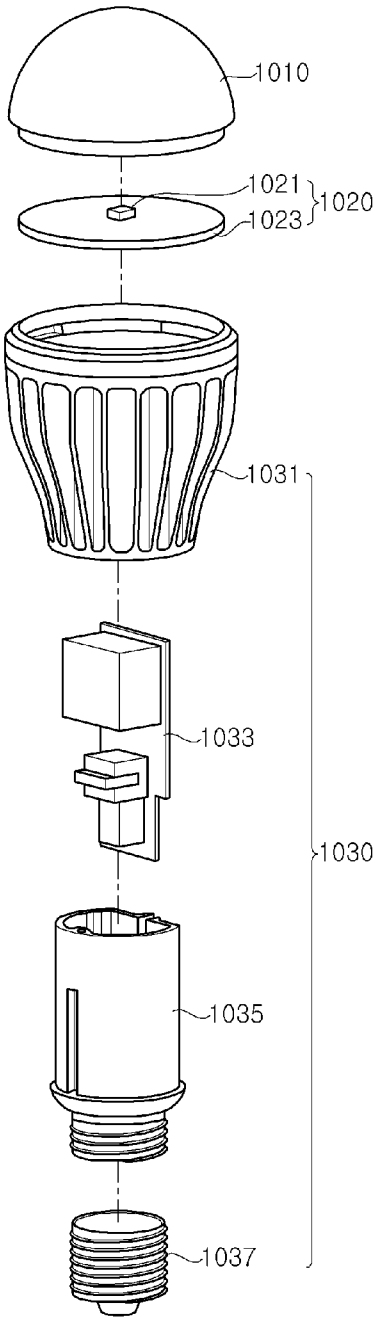
[Fig. 21]


200f
120a
150a
120R
121
123
125
120
150b
150
145
140
130
160
160a
160b
311
312
313
310
312b
312
312a
L1
311b
311
311a
L2
L3
V
h1
412
413
411
313b
313a
410
313

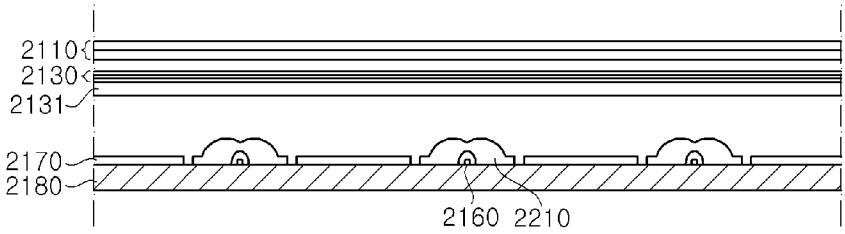
[Fig. 22]


200g
120a
150a
120R
121
123
125
120
150b
150
145
140
130
160
160a
160b
311
312
313
310
L1
312b
312
312a
311b
311
311a
L2
S
L3
V
h1
412
413
411
410
313b
313a
313

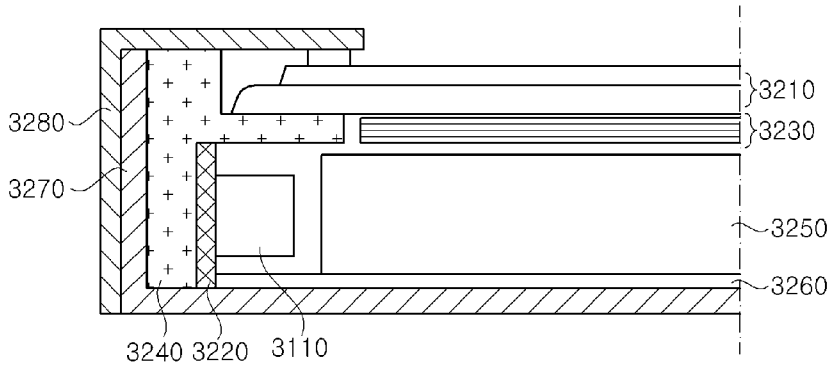
[Fig. 23]


1010
1021
1020
1023
1031
1033
1030
1035
1037

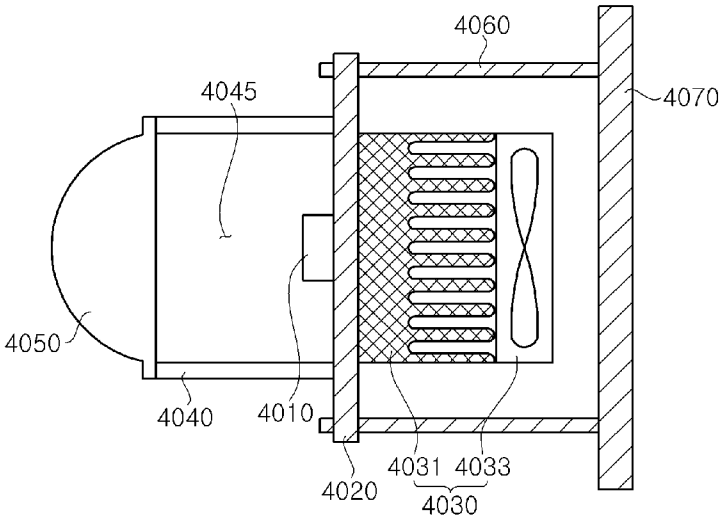
[Fig. 24]


2110
2130
2131
2170
2180
2160
2210

[Fig. 25]


3280
3270
3210
3230
3250
3260
3240
3220
3110

[Fig. 26]


4060
4045
4070
4050
4040
4010
4020
4031
4033
4030

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2015/012153

A. CLASSIFICATION OF SUBJECT MATTER

H01L 33/64(2010.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H01L 33/64; H01L 33/10; H01L 33/60; H01L 33/36; H01L 33/00; H01L 21/78; H01L 33/38

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: light emitting device, semiconductor layer, contact electrode, bulk, pad, opening

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2014-0252390 A1 (SAMSUNG ELECTRONICS CO., LTD.) 11 September 2014 See abstract, paragraphs [0040]-[0058],[0130],[0142] and figures 1,6,8.	1-40
A		41-58
Y	KR 10-1362081 B1 (WIIVIEW) 13 February 2014 See abstract, paragraphs [0039]-[0046],[0117] and figures 1,15.	1-40
A	US 2013-0015483 A1 (KAZUO SHIMOKAWA et al.) 17 January 2013 See abstract, paragraphs [0028]-[0196] and figures 1B-17B.	1-58
A	US 2014-0227813 A1 (NICHIA CORPORATION) 14 August 2014 See abstract, paragraphs [0079]-[0103] and figures 1A-9B.	1-58
A	JP 2014-179469 A (TOSHIBA CORP.) 25 September 2014 See abstract, claims 1-19 and figures 1-12.	1-58

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☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
26 February 2016 (26.02.2016)	**26 February 2016 (26.02.2016)**

Name and mailing address of the ISA/KR
International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea
Facsimile No. +82-42-472-7140

Authorized officer
PARK, Hye Lyun
Telephone No. +82-42-481-3463

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2015/012153

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