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(54) **LIGHT EMITTING DEVICE**

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(57) **ABSTRACT**

Embodiments provide a light emitting device comprising a support member, a light emitting structure disposed on the support member, the light emitting structure comprising a first semiconductor layer comprises a first and second regions, a second semiconductor layer disposed on the second region, and an active layer between the first and second semiconductor layers, a first electrode disposed on the first semiconductor layer and a second electrode disposed on the second semiconductor layer, wherein the support member includes metal ions to convert light of a first wavelength emitted from the active layer into light of a second wavelength different from the first wavelength.

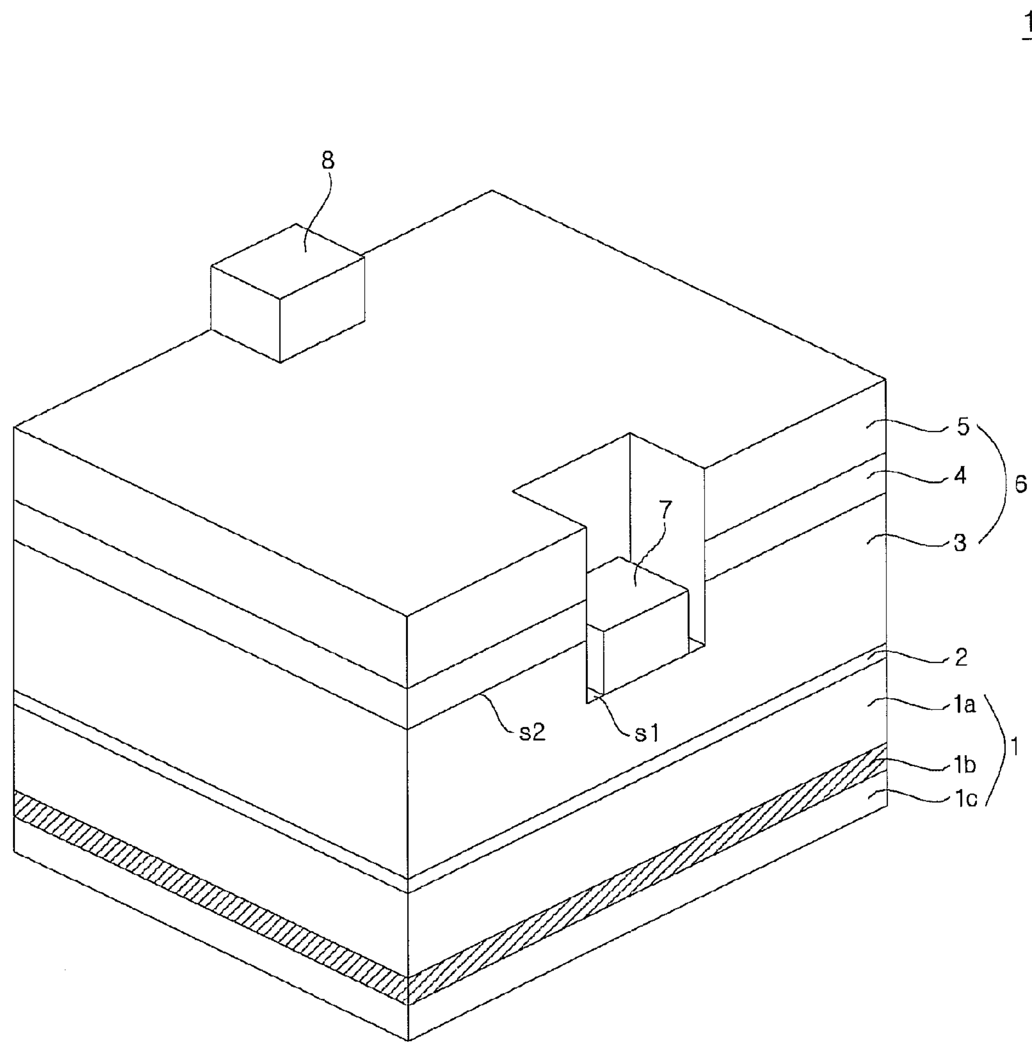


FIG. 1

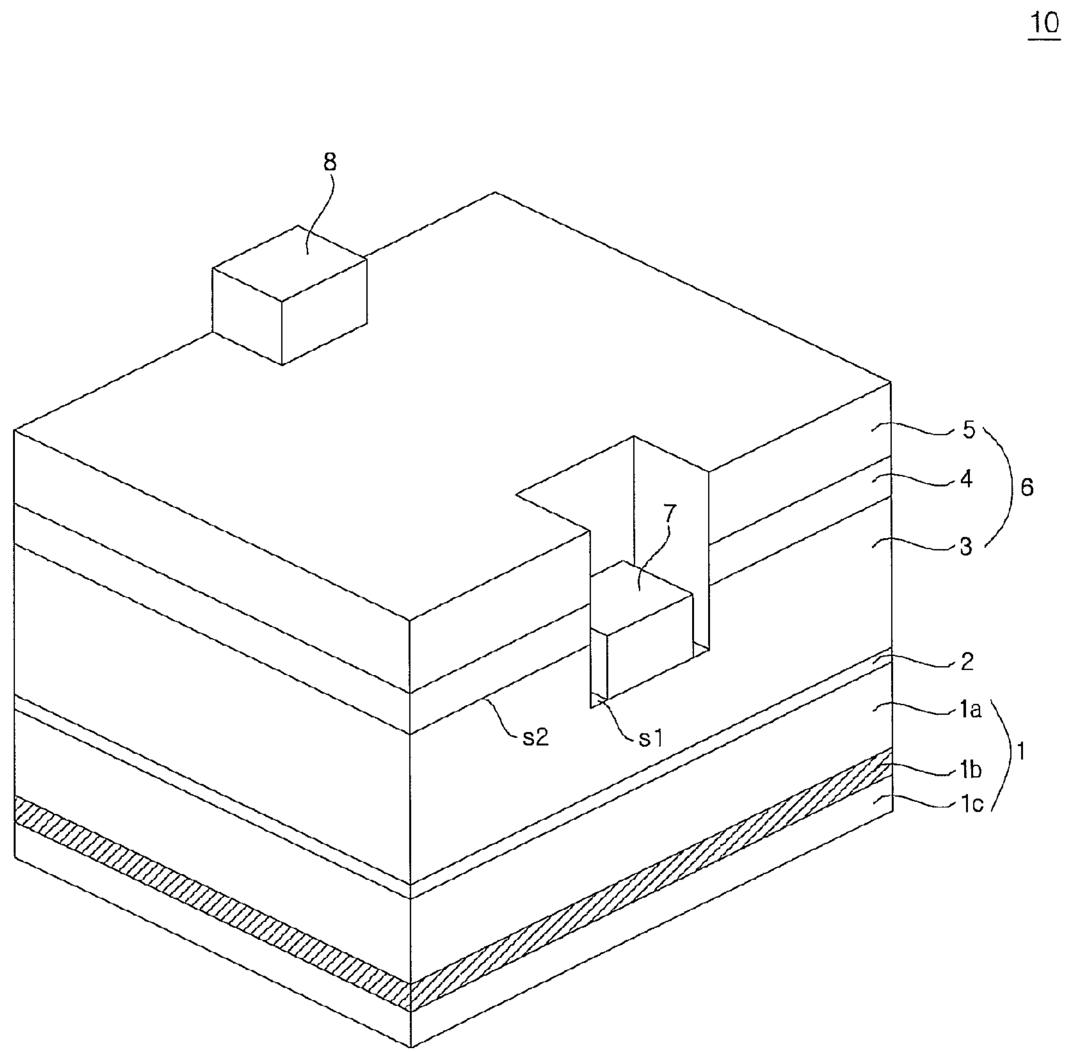


FIG. 2

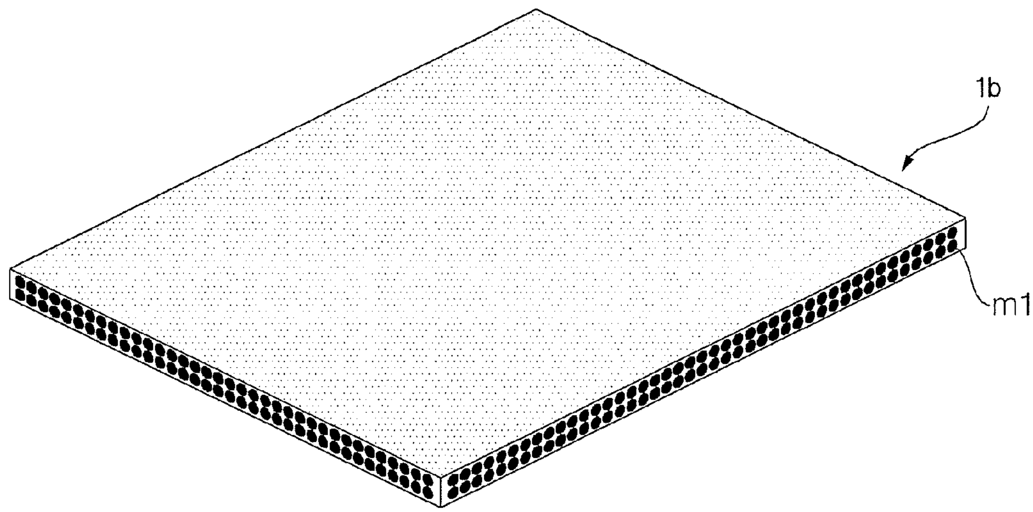


FIG. 3

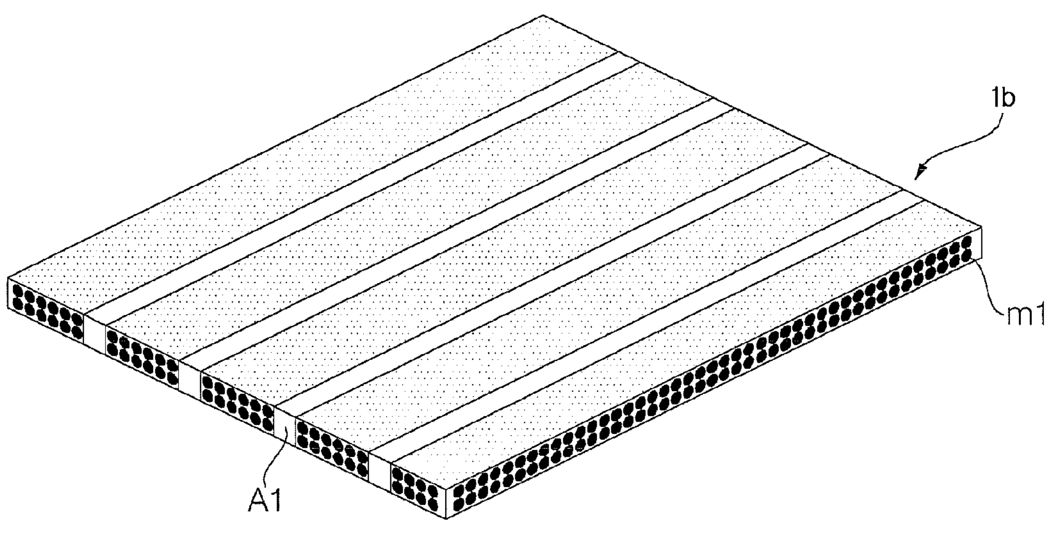


FIG. 4

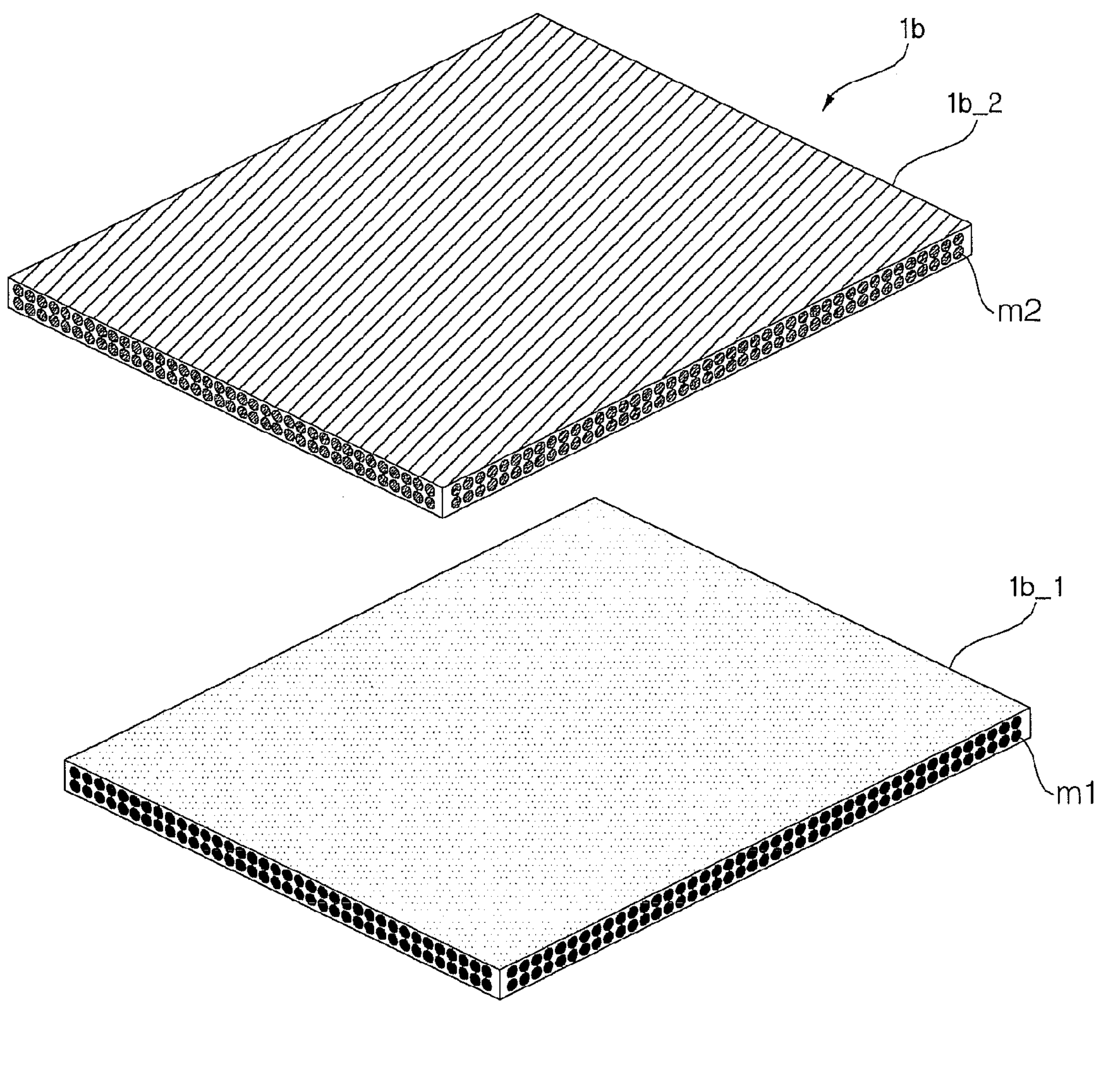


FIG. 5

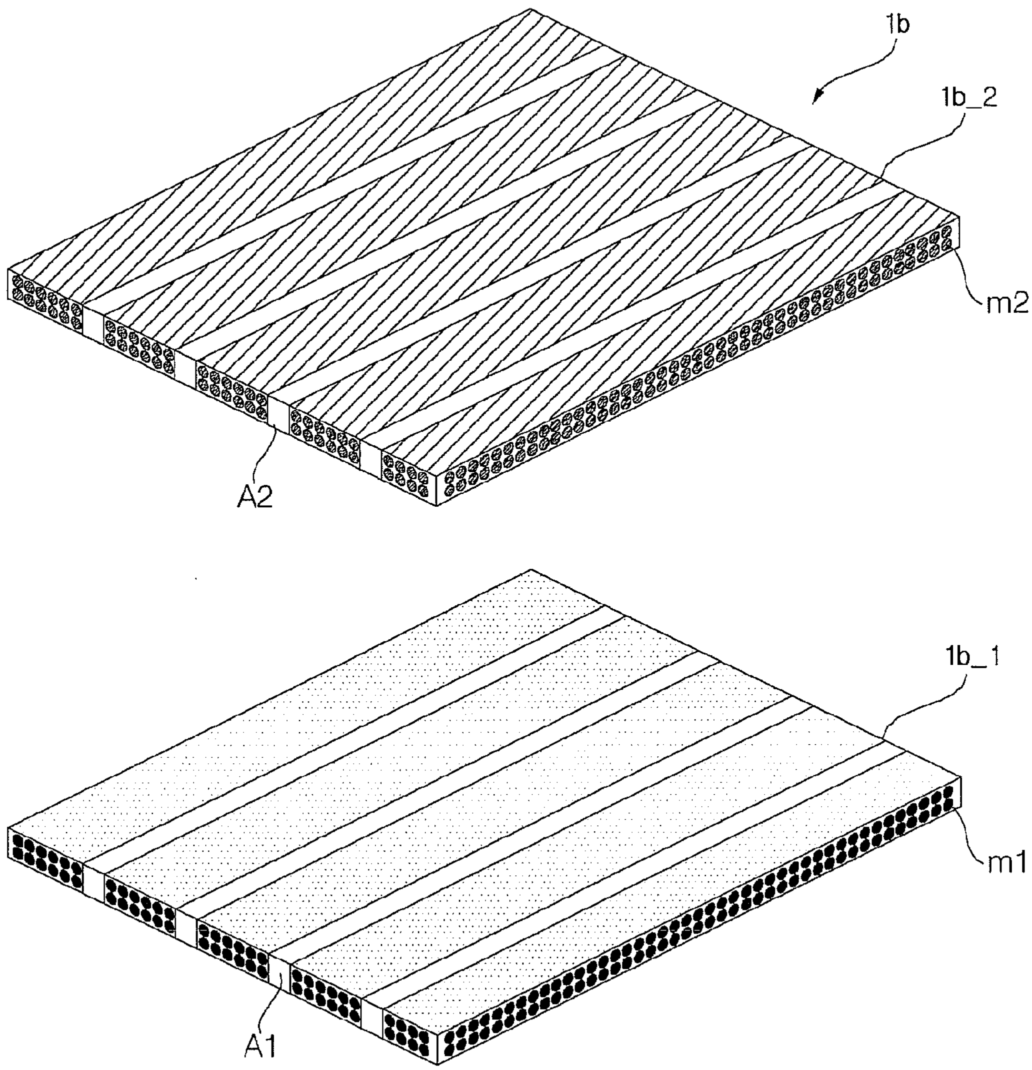


FIG. 6

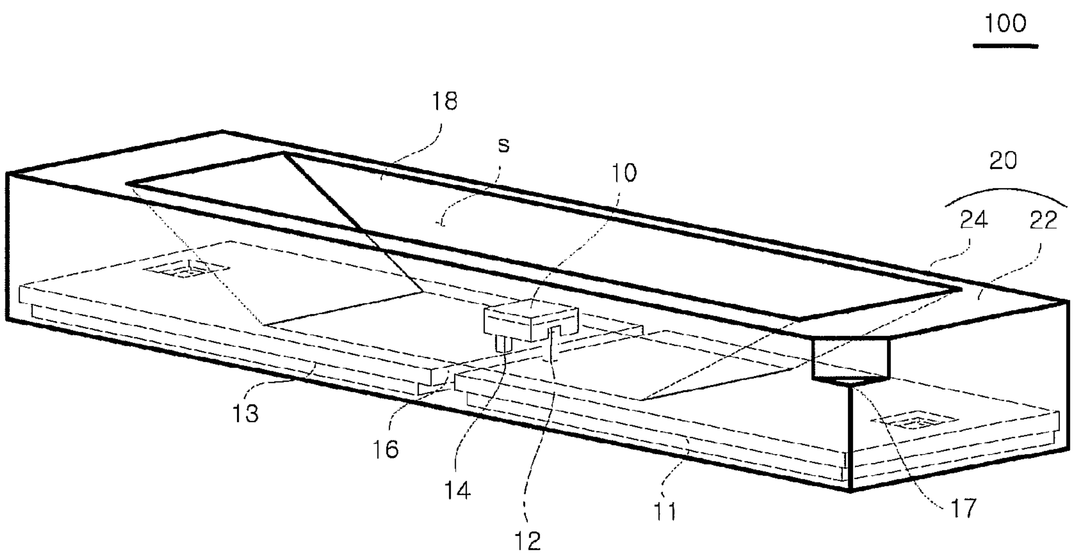


FIG. 7

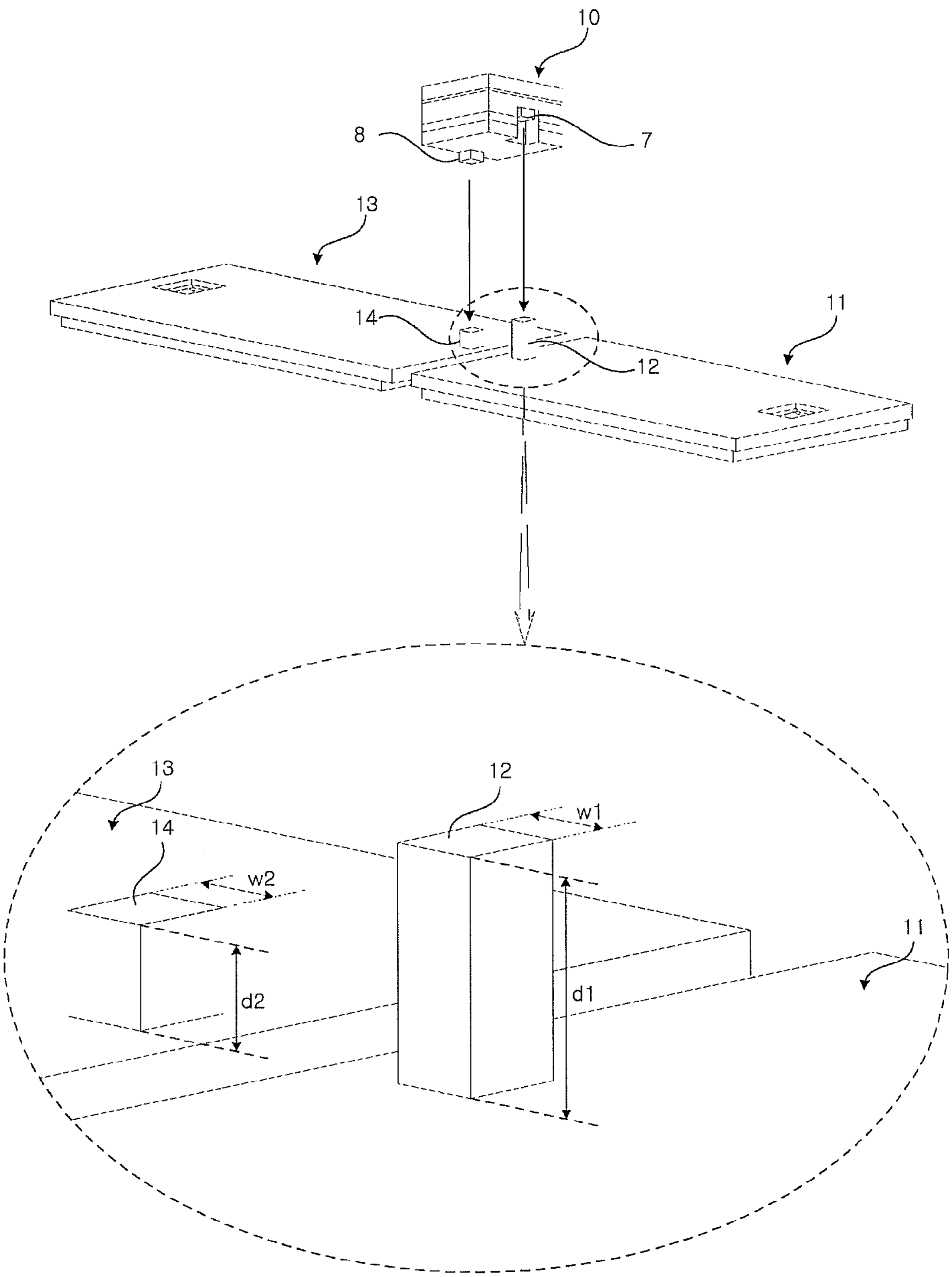


FIG. 8

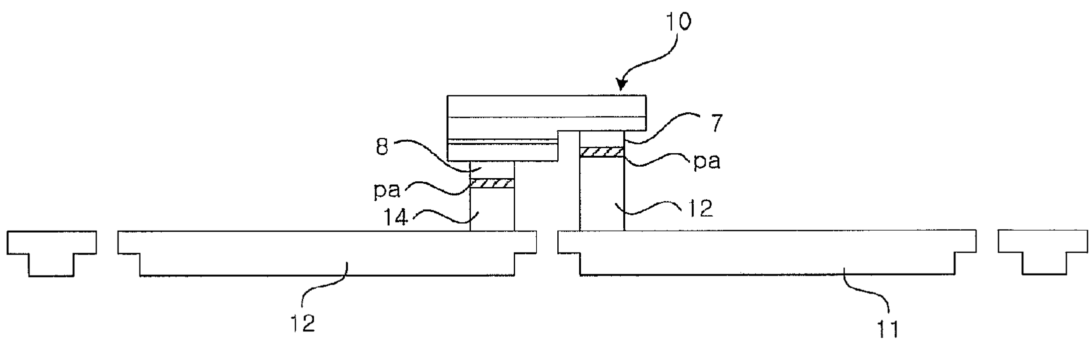


FIG. 9

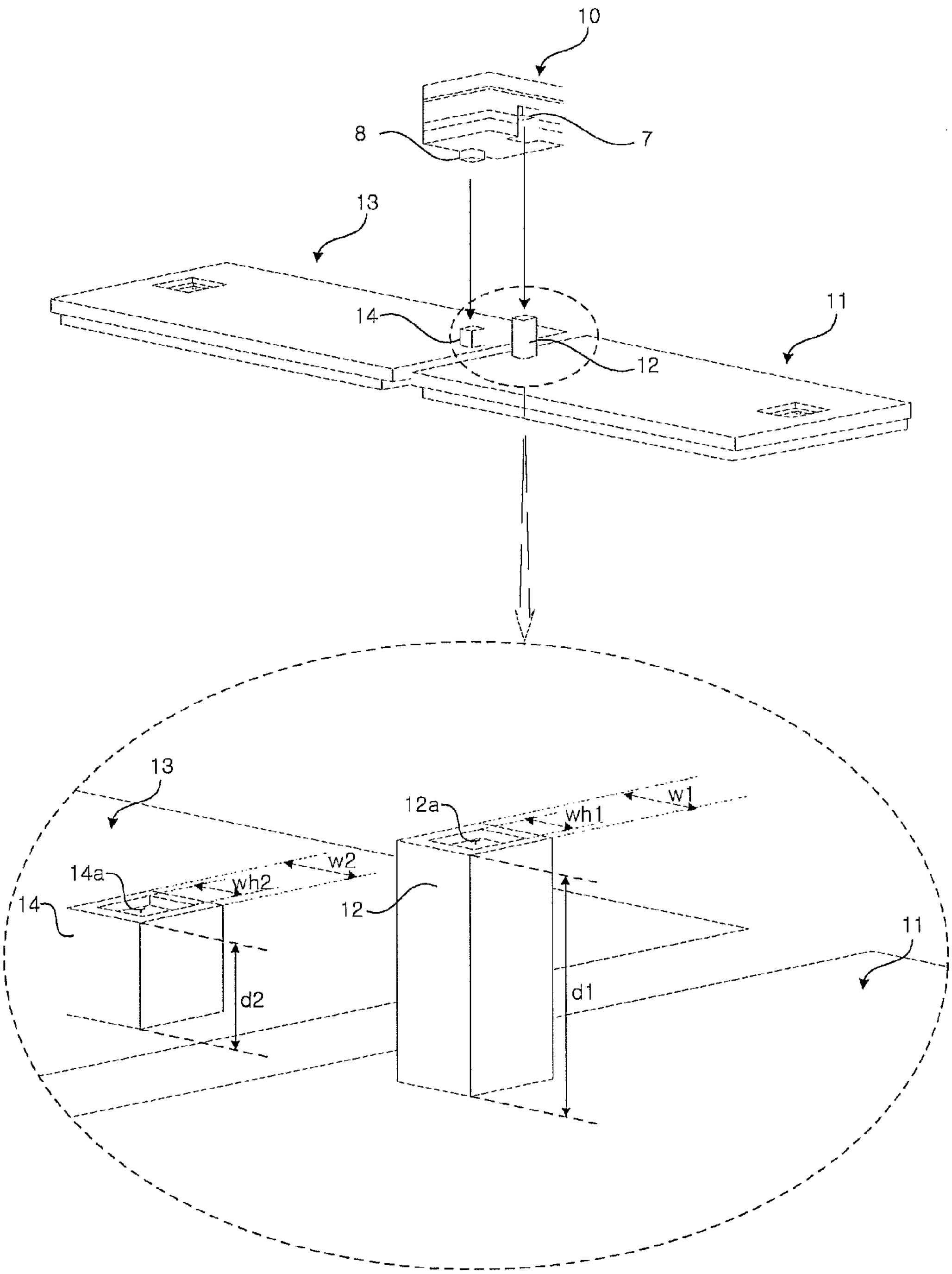


FIG. 10

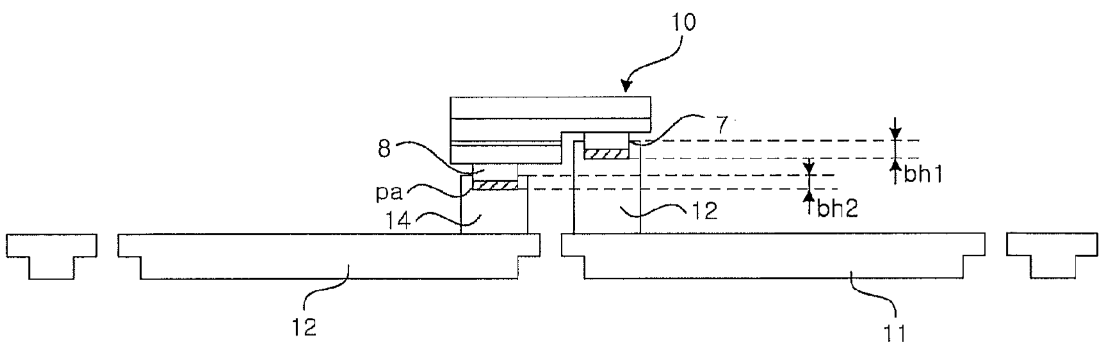


FIG. 11

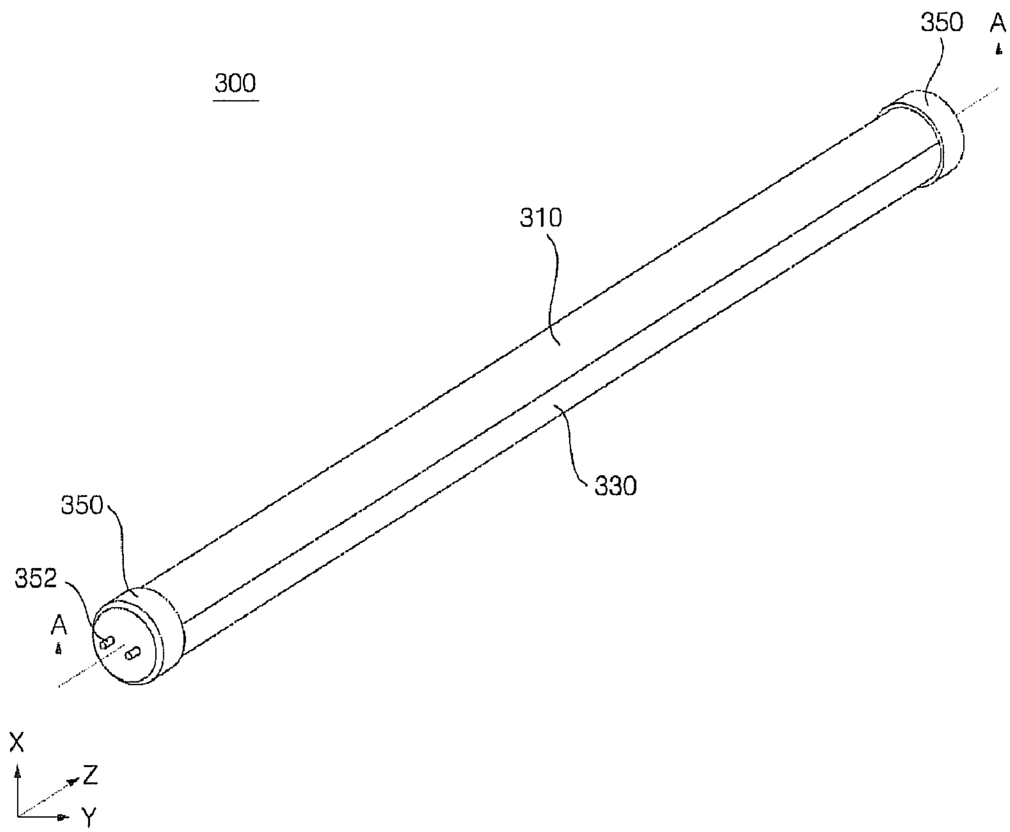


FIG. 12

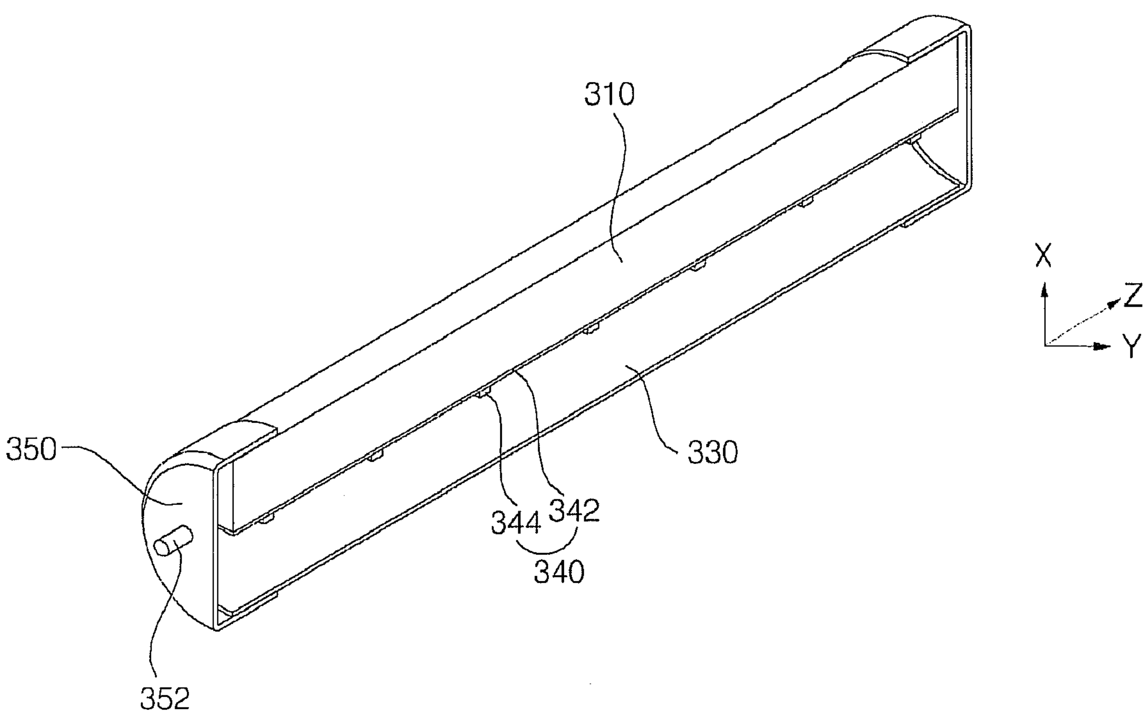


FIG. 13

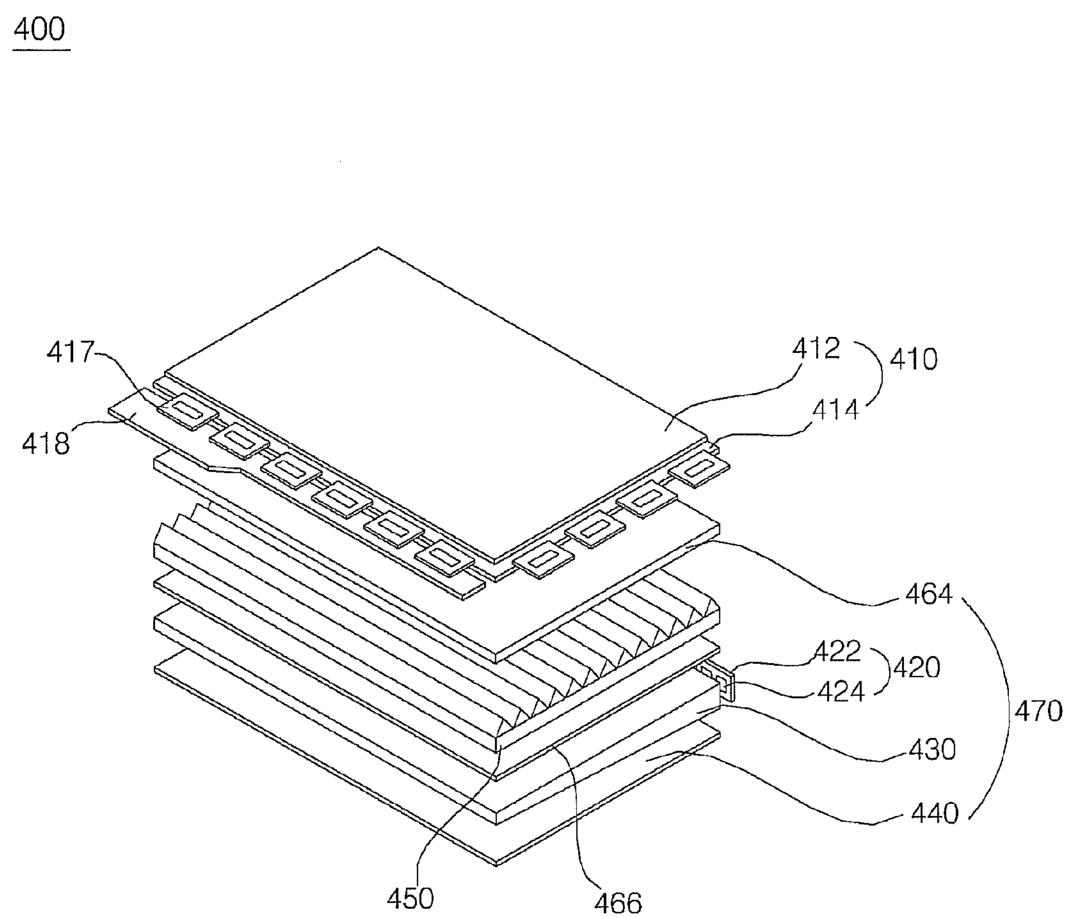
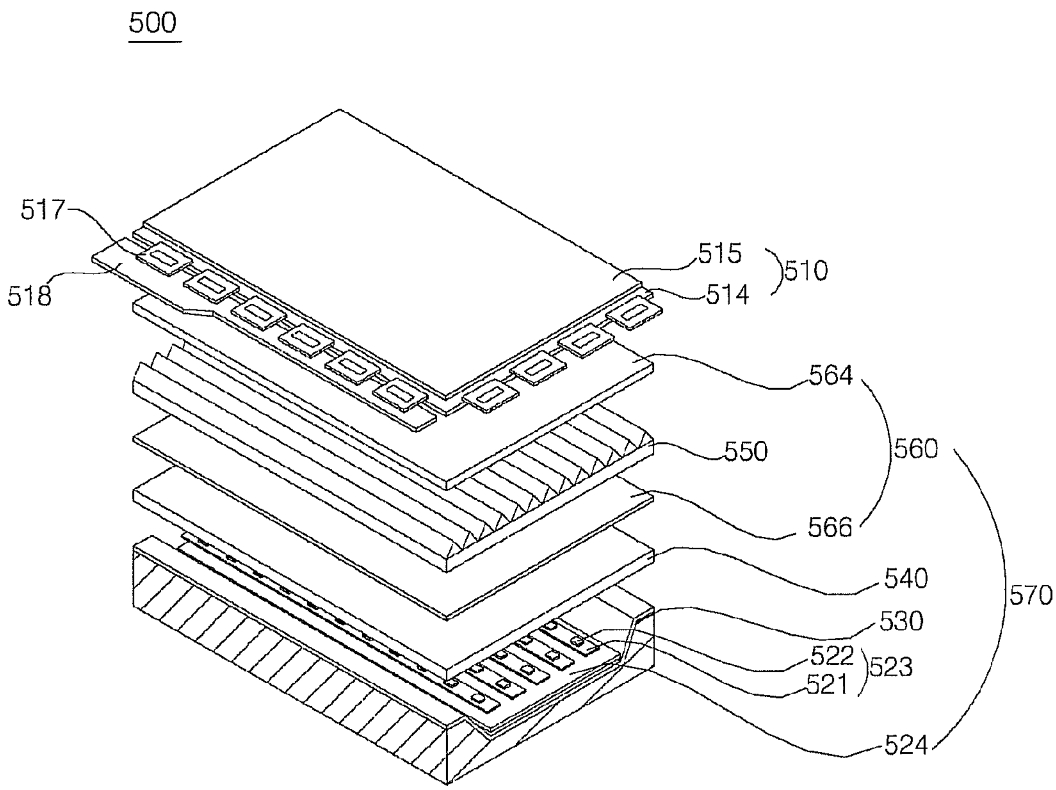


FIG. 14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LIGHT EMITTING DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the priority benefit of Korean Patent Application No. 10-2011-0091426, filed on Sep. 8, 2011 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

BACKGROUND

[0002] 1. Field

[0003] Embodiments relate to a light emitting device.

[0004] 2. Description of the Related Art

[0005] Generally, a light emitting diode (LED) as a light emitting device is a semiconductor device, which emits light in accordance with recombination of electrons and holes. Such an LED is widely used as a light source in optical communications, electronic appliances, etc.

[0006] The frequency (or wavelength) of light emitted from an LED is a function of the band gap of a material used in the LED. When a semiconductor material having a narrow band gap is used, low energy and thus long wavelength photons are generated. On the other hand, when a semiconductor material having a wide band gap is used, high energy and thus short wavelength photons are generated.

[0007] For example, an AlGaInP material generates light of a red wavelength. On the other hand, a silicon carbide (SiC) material or a Group-III nitride-based semiconductor, in particular, a GaN material generates light of a blue or ultraviolet wavelength.

[0008] Recently, light emitting devices are required to have high luminance so as to be used as light sources for illumination. In order to achieve such high luminance, research into manufacture of a light emitting device capable of achieving uniform current diffusion, and thus, enhancement in light emission efficiency, is being conducted.

SUMMARY

[0009] Embodiments provide a light emitting device.

[0010] In one embodiment, a light emitting device comprising a support member, a light emitting structure disposed on the support member, the light emitting structure comprising a first semiconductor layer comprises a first and second regions, a second semiconductor layer disposed on the second region, and an active layer between the first and second semiconductor layers, a first electrode disposed on the first semiconductor layer and a second electrode disposed on the second semiconductor layer, wherein the support member includes metal ions to convert light of a first wavelength emitted from the active layer into light of a second wavelength different from the first wavelength.

[0011] In another embodiment, a light emitting device comprising a support member and a light emitting structure disposed on the support member, the light emitting structure comprising a first semiconductor layer comprises a first and second regions, a second semiconductor layer disposed on the second region, and an active layer between the first and second semiconductor layers, a first electrode disposed on the first semiconductor layer, a second electrode disposed on the second semiconductor layer and a body comprising a first and second lead frames electrically connected to the light emitting device, and the body is provided with a cavity on the first and second lead frames, wherein the support member includes metal ions to convert light of a first wavelength emitted from the active layer into light of a second wavelength different from the first wavelength.

[0012] The light emitting device according to the embodiments includes the metal ions in the support member thereof to convert light of a given wavelength emitted from the light emitting structure and incident upon the support member into light of a wavelength different from the given wavelength. Thus, as for the light emitting device assembled in the light emitting device package, the phosphor may be dispensed with or a very small amount of the phosphor may be contained, thereby reducing the manufacturing cost of the light emitting device package.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Details of the embodiments will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

[0014] FIG. **1** is a perspective view of a light emitting device according to one embodiment;

[0015] FIG. **2** to FIG. **5** are perspective views of various embodiments of a second layer including metal ions of a support member in FIG. **1**;

[0016] FIG. **6** is a perspective view of a light emitting device package according to one embodiment;

[0017] FIG. **7** is a perspective view of a first embodiment of first and second lead frames of FIG. **6**;

[0018] FIG. **8** is a cross-sectional view illustrating a state in which a light emitting device is disposed on the first and second lead frames of FIG. **7**;

[0019] FIG. **9** is a perspective view of a second embodiment of first and second lead frames of FIG. **6**;

[0020] FIG. **10** is a cross-sectional view illustrating a state in which a light emitting device is disposed on the first and second lead frames of FIG. **9**;

[0021] FIG. **11** is a perspective view of an illumination device including a light emitting device according to one embodiment;

[0022] FIG. **12** is a cross-sectional view taken at a line A-A' of the illumination device of FIG. **11**;

[0023] FIG. **13** is a disassembled perspective view of a liquid crystal display device including a light emitting device according to one embodiment; and

[0024] FIG. **14** is a disassembled perspective view of a liquid crystal display device including a light emitting device according to another embodiment.

DETAILED DESCRIPTION OF EMBODIMENTS

[0025] Reference will now be made in detail to embodiments, examples of which are illustrated in the accompanying drawings. However, the present disclosure may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the disclosure to those skilled in the art. The present disclosure is defined only by the categories of the claims. In certain embodiments, detailed descriptions of device constructions or processes well known in the art may be omitted to avoid obscuring appreciation of the disclosure by a person of ordinary skill in the art. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[0026] Spatially-relative terms such as "below", "beneath", "lower", "above", or "upper" may be used herein to describe one element's relationship to another element as illustrated in the figures. It will be understood that spatially-relative terms are intended to encompass different orientations of the device in addition to the orientation depicted in the figures. For example, if the device in one of the figures is turned over, elements described as "below" or "beneath" other elements would then be oriented "above" the other elements. The exemplary terms "below" or "beneath" can, therefore, encompass both an orientation of above and below. Since the device may be oriented in another direction, the spatially-relative terms may be interpreted in accordance with the orientation of the device.

[0027] The terminology used in the present disclosure is for the purpose of describing particular embodiments only and is not intended to limit the disclosure. As used in the disclosure and the appended claims, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0028] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and the present disclosure, and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0029] In the drawings, the thickness or size of each layer is exaggerated, omitted, or schematically illustrated for convenience of description and clarity. Also, the size or area of each constituent element does not entirely reflect the actual size thereof.

[0030] When describing a configuration of a light emitting device in exemplary embodiments, angles and/or directions may be based on associated drawings. Unless a reference point with regard to angles and/or positional relationships are clearly expressed herein when describing a configuration of a light emitting device in exemplary embodiments, the reference point and/or positional relationships may be based on associated drawings.

[0031] Hereinafter, embodiments will be described in detail with reference to the drawings.

[0032] FIG. **1** is a perspective view of a light emitting device according to one embodiment of the invention.

[0033] Referring to FIG. **1**, a light emitting device **10** includes a support member **1** and a light emitting structure **6** disposed over the support member **1**.

[0034] The support member **1** may be made of a conductive or insulating substrate. For example, the support member **1** may be made of at least one of Al_2O_3, SiC, Si, GaAs, GaN, ZnO, Si, GaP, InP, Ge, and Ga_2O_3.

[0035] In this embodiment, the support member **1** is made of Al_2O_3. The present disclosure is not limited thereto.

[0036] The support member **1** may be subjected to a wet cleaning process so that impurities on a surface thereof are removed. The support member **1** may have a light-extraction pattern (not shown) formed at a surface thereof so as to enhance light extraction efficiency. The present disclosure is not limited thereto.

[0037] The support member **1** may include a material to facilitate heat discharge and thus allow the support member **1** to have improved thermal stability.

[0038] The support member **1** may include an anti-reflection layer (not shown) formed thereon called "an AR (anti-reflective) coating layer". The anti-reflection layer basically utilizes interference between light beams reflected from a plurality of interfaces. That is, the anti-reflection layer functions to shift the phases of light beams reflected from different interfaces such that differences between the phases of the reflected light beams are 180°, thus allowing the reflected light beams to be offset from each other and thereby reducing the intensity of the reflected light. The present disclosure is not limited thereto.

[0039] The support member **1** may convert a first light beam of a first wavelength emitted from the light emitting structure **6** into a second light beam of a second wavelength different from the first wavelength. The support member **1** may include a first layer **1*a*** adjacent to the light emitting structure **6**, a second layer **1*b*** adjacent to the first layer **1*a*** and capable to convert the first light beam into the second light beam, and a third layer **1*c*** adjacent to the second layer **1*b***.

[0040] Each of the first and third layers **1*a*** and **1*c*** may be made of an Al_2O_3 substrate layer to transmit the first light beam and the second layer **1*b*** may include metal ions (not shown) to convert the first light beam into the second light beam.

[0041] The metal ions may include, for example, at least one of vanadium ions, chromium ions, titanium ions, and iron ions. The metal ions may include different metal ions from the above metal ions. The present disclosure is not limited thereto.

[0042] A ratio of the metal ions to an aluminum (Al) contained in an Al_2O_3 of the support member **1** may be in a range of 0.01% to 0.1%.

[0043] When the ratio is below 0.01%, the first light beam may be converted into the second light beam at a lower rate. When the ratio is above 0.1%, the manufacturing costs of the light emitting device may increase and, in addition, a first color of the first light beam may be converted to a second color of the second light beam more concentrated than the first color.

[0044] The second layer **1*b*** may be made of an Al_2O_3 substrate containing the metal ions implanted thereto using an ion implantation method. A location of the second layer **1*b*** may vary depending on at least one of heat and energy for implanting the metal ions using an ion implant device (not shown). The present disclosure is not limited thereto.

[0045] In this embodiment, the second layer **1*b*** is formed to be interposed between the first and third layers **1*a*** and **1*c***, although the support member **1** may consist of the second layer **1*b*** alone or may consist of the first and second layers **1*a*** and **1*b*** without the third layer **1*c***.

[0046] For example, when the second layer **1*b*** is an Al_2O_3 substrate and chromium ions are implanted thereto, the second light beam exhibits a red color. When the second layer **1*b*** is an Al_2O_3 substrate and vanadium ions are implanted thereto, the second light beam exhibits a purple color. When the second layer **1*b*** is an Al_2O_3 substrate and iron ions are implanted thereto, the second light beam exhibits a yellowish green color being a mixture of yellow and green colors.

[0047] For example, when the ratio of the chromium ions is below 0.01%, the second light beam exhibits a pink color less concentrated than the red color. On the other hand, when the ratio of the chromium ions is above 0.1%, the second light beam exhibits a red color more concentrated than the red color of the first light beam.

[0048] A thickness of the second layer **1***b* may be equal to or less than that of the support member **1**, although the present disclosure is not limited thereto.

[0049] Between the support member **1** and the light emitting structure **6**, there may be disposed a buffer layer **2** to reduce lattice mismatch between the member **1** and structure **6** and thus to allow a plurality of semiconductor layers to be reliably grown on the support member **1**.

[0050] The buffer layer **2** may be a single-crystal layer grown on the support member **1**. The single-crystal buffer layer **2** may improve crystallinity of the light emitting structure **6** grown thereon.

[0051] The buffer layer **2** may be formed as a stacked structure including AlN and/or GaN materials. For example, the stacked structure may include an AlInN/GaN structure, an InGaN/GaN structure, or an AlInGaN/InGaN/GaN structure, or the like.

[0052] A first semiconductor layer **3** of the light emitting structure **6** is formed on the support member **1** or the buffer layer **2**. When the first semiconductor layer **3** is realized as an N type semiconductor layer, the layer **3** may be made of a semiconductor material having, for example, a composition of $In_xAl_yGa_{1-x-y}N$ ($0 \leqq x \leqq 1$, $0 \leqq y \leqq 1$, and $0 \leqq x+y \leqq 1$) such as gallium nitride (GaN), aluminum nitride (AlN), aluminum gallium nitride (AlGaN), indium gallium nitride (InGaN), indium nitride (InN), indium aluminum gallium nitride (InAlGaN), aluminum indium nitride (AlInN) or the like which is doped with an N type dopant such as silicon (Si), germanium (Ge), tin (Sn), selenium (Se), tellurium (Te), etc.

[0053] The first semiconductor layer **3** is divided into first and second regions s**1** and s**2**. In the second region s**2**, there is disposed, on the first semiconductor layer **3**, an active layer **4** formed to have a single or multiple quantum well structure, a quantum-wire structure, a quantum dot structure or the like using a Group III-Group V compound semiconductor material.

[0054] When the active layer **4** has the quantum well structure, the quantum well structure may be a single or multiple quantum well structure including a well layer having a composition of $In_xAl_yGa_{1-x-y}N$ ($0 \leqq x \leqq 1$, $0 \leqq y \leqq 1$, and $0 \leqq x+y \leqq 1$) and a barrier layer having a composition of $In_aAl_bGa_{1-a-b}N$ ($0 \leqq a \leqq 1$, $0 \leqq b \leqq 1$, and $0 \leqq a+b \leqq 1$). The well layer may be made of a material having a smaller energy band gap than that of the barrier layer.

[0055] If the active layer **4** has a multiple quantum well structure, the respective well layers (not shown) and the respective barrier layers (not shown) may have different compositions, thicknesses and band gaps, although the disclosure is not limited thereto.

[0056] And an energy band gab of the well layer or barrier layer adjacent to the second semiconductor layer **5** has is larger than an energy band gap of the well layer or barrier layer adjacent to the first semiconductor layer **3**.

[0057] On and/or beneath the active layer **4**, there may be disposed an electrically conductive cladding layer (not shown) made of an AlGaN based semiconductor material and having a larger energy band gap than that of the active layer **4**.

[0058] In the second region s**2**, there is disposed, on the active layer **4**, a second semiconductor layer **5** which is realized as the P type semiconductor layer made of a semiconductor material having a composition of $In_xAl_yGa_{1-x-y}N$ ($0 \leqq x \leqq 1$, $0 \leqq y \leqq 1$, and $0 \leqq x+y \leqq 1$), such as gallium nitride (GaN), aluminum nitride (AlN), aluminum gallium nitride (AlGaN), indium gallium nitride (InGaN), indium nitride (InN), indium aluminum gallium nitride (InAlGaN), aluminum indium nitride (AlInN) or the like which is doped with a P type dopant such as magnesium (Mg), zinc (Zn), calcium (Ca), strontium (Sr), carbon (C), barium (Ba) or the like.

[0059] The first semiconductor layer **3**, the active layer **4** and the second semiconductor layer **5** may be formed using MOCVD (metal organic chemical vapor deposition), CVD (chemical vapor deposition), PECVD (plasma enhanced CVD), MBE (molecular beam epitaxy) or HVPE (hydride vapor phase epitaxy), etc. The present disclosure is not limited thereto.

[0060] A doping concentration of the N type and/or P type dopant in the first and/or second semiconductor layers **3** and **5** may be uniform or non-uniform. That is, a configuration of the semiconductor layers may be various. The present disclosure is not limited thereto.

[0061] Unlike the above-illustrated example, the first and second semiconductor layers **3** and **5** may be realized as P type and N type semiconductor layers respectively. In addition, an additional semiconductor layer may be formed thereon. Accordingly, the light emitting structure **6** may include at least one of an N-P junction, a P-N junction, an N-P-N junction, and a P-N-P junction.

[0062] In this embodiment, after the first semiconductor layer **3**, the active layer **4** and the second semiconductor layer **5** are formed, a mesa-etching is carried so that the first semiconductor layer **3** is exposed in the first region s**1**.

[0063] Then, in the first region s**1**, there is formed, on the first semiconductor layer **3**, a first electrode **7** in electrical contact therewith. A second electrode **8** is formed on the second semiconductor layer **5** to be in electrical contact therewith at an opposite side to the first electrode **7**.

[0064] At lease one of the first and second electrodes **7** and **8** may be made of at least one of cobalt (Co), copper (Cu), niobium (Nb), tin (Sn), indium (In), scandium (Sc), tantalum (Ta), vanadium (V), platinum (Pt), silicon (Si), silver (Ag), gold (Au), zinc (Zn), antimony (Sb), aluminum (Al), germanium (Ge), hafnium (Hf), lanthanum (La), magnesium (Mg), manganese (Mn), nickel (Ni), palladium (Pd), rhenium (Re), tungsten (W), ruthenium (Ru), molybdenum (Mo), iridium (Ir), rhodium (Rh), tantalum (Ta), zirconium (Zr) and titanium (Ti) or an alloy thereof. The present disclosure is not limited thereto.

[0065] At lease one of the first and second electrodes **7** and **8** may have a single layer structure or a multi-layer structure. The present disclosure is not limited thereto.

[0066] At least one of a light-transmissive electrode layer (not shown), a reflective electrode layer (not shown) and a wavelength conversion layer (not shown) may be formed between the light emitting structure **6** and the second electrode **8**, and/or between the first semiconductor layer **3** and the first electrode **7**. The present disclosure is not limited thereto.

[0067] The light-transmissive electrode layer may be electrically conductive and light-transmissive and uniformly diffuse electrical current applied from the second electrode **8** to the second semiconductor layer **5** therethrough, thereby preventing current concentration at a location beneath the second electrode **8**.

[0068] The light-transmissive electrode layer includes at lease one of ITO, IZO(In—ZnO), GZO(Ga—ZnO), AZO (Al—ZnO), AGZO(Al—Ga ZnO), IGZO(In—Ga ZnO), IrOx, RuOx, RuOx/ITO, Ni/IrOx/Au and Ni/IrOx/Au/ITO.

[0069] The wavelength conversion layer may be disposed on the second semiconductor layer **5** or the light-transmissive electrode layer and include a phosphor to convert or excite light emitted from the light emitting structure **6** into light of the same wavelength as that of the second light beam resulting from the conversion by the metal ions.

[0070] The wavelength conversion layer may be a coating film over the second semiconductor layer **5** or the light-transmissive electrode layer or may be a film containing the phosphor. The present disclosure is not limited thereto.

[0071] The reflective electrode layer may be made of at least one of aluminum (Al), silver (Ag) and copper (Cu). In case the light emitting device **10** is of a flip-chip type or a horizontal type, light beams emitted from the light emitting structure **6** advantageously have the same wavelength using the reflective electrode layer and the wavelength conversion layer.

[0072] FIG. **2** to FIG. **5** are perspective views of various embodiments of the second layer including the metal ions of the support member in FIG. **1**.

[0073] In FIG. **2** to FIG. **5**, the same elements are designated as the same reference numerals. Although the metal ions are shown as uniformly distributed in the rectangular second layer **1***b* in FIG. **2** to FIG. **5**, the metal ions may be non-uniformly distributed in the support member **1**. The metal ions may be distributed in at least one of the first and third layers **1***a* and **1***c*. The present disclosure is not limited thereto.

[0074] First, a second layer **1***b* as shown In FIG. **2** may include the same kind of first metal ions m**1**.

[0075] The first metal ions m**1** may be disposed between the first and third layers **1***a* and **1***c*. Further, the first metal ions m**1** may be disposed in at least one of the first and third layers **1***a* and **1***c*. The present disclosure is not limited thereto.

[0076] The first metal ions m**1** may convert first light beams of a first wavelength emitted from the light emitting structure **6** into second light beams of a second wavelength different from the first wavelength, thereby enabling light incident upon the support member **1** to exhibit a particular color including a white.

[0077] A second layer **1***b* as shown in FIG. **3** may be patterned and include first metal ions m**1**.

[0078] The second layer **1***b* is patterned such that light beams emitted therefrom include first light beams of a first wavelength emitted from the light emitting structure **6** and second light beams of a second wavelength different from the first wavelength.

[0079] That is, the support member **1** may emit the first light beams passing through the first, second and third layers **1***a*, **1***b* and **1***c* without any change and the second light beams resulting from the conversion by the metal ions m**1** of the second layer **1***b*, thereby rendering at least two colors.

[0080] To this end, the second layer **1***b* includes first stripe-shape patterned regions including the implanted metal ions m**1** and second stripe-shape patterned regions A**1** between the first stripe-shape patterned regions without the metal ions. In the second stripe-shape patterned regions A**1**, the first light beams emitted from the light emitting structure **6** propagate the second layer **1***b* without any change. In the second stripe-shape patterned regions A**1**, the second layer **1***b* may be the same Al_2O_3 substrate as the first and third layers **1***a* and **1***c*. It is noted that the patterned shape is not limited to the stripe shape. Any other patterned shapes are possible.

[0081] A second layer **1***b* shown in FIG. **4** may include a first layer **1***b*_**1** including first metal ions m**1** implanted therein and a second layer **1***b*_**2** including second metal ions m**2** implanted therein different from the first metal ions m**1**.

[0082] The first metal ions m**1** may convert first light beams of a first wavelength emitted from the light emitting structure **6** into second light beams of a second wavelength different from the first wavelength, while the second metal ions m**2** may convert at least one of the first and second light beams into third light beams of a third wavelength different from the first and second wavelengths.

[0083] The first and second layers **1***b*_**1** and **1***b*_**2** may be formed depending on at least one of energy and heat for implanting the metal ions using an ion implantation device during an ion implant process.

[0084] A second layer **1***b* shown in FIG. **5** may emit at least one of first light beams of a first wavelength emitted from the light emitting structure **6**, second light beams of a second wavelength converted from the first light beams, third light beams of a third wavelength converted from at least one of the first and second light beams, and fourth light beams being a mixture of the second and third light beams.

[0085] To this end, the second layer **1***b* shown in FIG. **5** may include a first layer **1***b*_**1** including first stripe-shape patterned regions A**1** without any metal ions to transmit the first light beams and second stripe-shape patterned regions between the first stripe-shape patterned regions A**1** having first metal ions m**1** to convert the first light beams; and a second layer **1***b*_**2** including third stripe-shape patterned regions A**2** without any metal ions corresponding to the first stripe-shape patterned regions A**1** respectively and fourth stripe-shape patterned regions having second metal ions m**2** corresponding to the second stripe-shape patterned regions respectively. It is noted that the patterned shape is not limited to the stripe shape. Any other patterned shapes are possible.

[0086] FIG. **6** is a perspective view of a light emitting device package according to one embodiment.

[0087] FIG. **6** is a perspective view illustrating a partial inner configuration of the light emitting device package **100** in a see-through manner. In this embodiment, the light emitting device package **100** is of a top-emitting type. However, the light emitting device package **100** may be of a side-emitting type. The present disclosure is not limited thereto.

[0088] Referring to FIG. **6**, the light emitting device package **100** includes the light emitting device **10** and a body **20** to seat the light emitting device **10** therein.

[0089] The body **20** may include first body portions **22** extending in a first direction (now shown) and second body portions **24** extending in a second direction (now shown) perpendicular to the first direction. The first and second body portions **22** and **24** may be integrated with each other, and may be formed using an injection molding process or an etching process, etc. The present disclosure is not limited thereto.

[0090] The first and second body portions **22** and **24** may be made of at least one selected from among a resin such as polyphthalamide (PPA), silicon (Si), aluminum (Al), aluminum nitride (AlN), AlO_x, a liquid crystal polymer such as photosensitive glass (PSG), polyamide 9T (PA9T), syndiotactic polystyrene (SPS), a metal, sapphire (Al_2O_3), beryllium oxide (BeO), ceramics, and a Printed Circuit Board (PCB).

[0091] The top shape of the body **20** may be triangular, rectangular, polygonal, circular, or the like depending on application and design of the light emitting device package **100**.

[0092] The first and second body portions **22** and **24** form a cavity s to seat the light emitting device **10** therein. The cavity s may be formed to have a cross-section in a shape of a cup, concave vessel, etc. Each of the first and second body portions **22** and **24** forming the cavity s may have an inner side surface sloped relative to a bottom of the body **20**.

[0093] A top view of the cavity s may have a circular, rectangular, polygonal or elliptical shape, etc. The present disclosure is not limited thereto.

[0094] First and second lead frames **11** and **13** may be disposed on an inner bottom face of the body **20**. The first and second lead frames **11** and **13** may be made of an electrically conductive material such as a metal. For example, the lead frames **11** and **13** may be made of one or more selected from a group consisting of titanium (Ti), copper (Cu), nickel (Ni), gold (Au), chromium (Cr), tantalum (Ta), platinum (Pt), tin (Sn), silver (Ag), phosphorous (P), aluminum (Al), indium (In), palladium (Pd), cobalt (Co), silicon (Si), germanium (Ge), hafnium (Hf) ruthenium (Ru) and iron (Fe) and may include an alloy thereof.

[0095] The first and second lead frames **11** and **13** may be formed to have a single layer structure or a multi-layer structure. The present disclosure is not limited thereto.

[0096] The first and second lead frames **11** and **13** may respectively have first and second projections **12** and **14** formed thereon which is electrically connected to first and second electrodes (not shown) of the light emitting device **10** respectively.

[0097] Each of the first and second body portions **22** and **24** may have an inner side surface sloped relative to any one of the first and second lead frames **11** and **13** at a predetermined angle. Thus, the reflection angle of light emitted from the light emitting device **10** may be determined based on the slope angle of the inner side surfaces of the first and second body portions **22** and **24**, thereby adjusting the orientation angle of light to be extracted to the outside. The smaller the orientation angle of light, the greater the convergence of light emitted from the light emitting device **10** to the outside. On the contrary, the greater the orientation angle of light, the smaller the convergence of light emitted from the light emitting device **10** to the outside.

[0098] A number of the inner sloped side surfaces may be formed in the body **20**, although the present disclosure is not limited thereto.

[0099] The first and second lead frames **11** and **13** may be electrically connected to the first and second electrode and in turn be electrically connected to positive and negative electrodes or vice versa of an external power supply respectively, to supply electrical power to the light emitting device **10**.

[0100] In this embodiment, the light emitting device **10** is of a flip chip type. The first and second electrodes having opposite polarities are bonded to the first and second projections **12** and **14** respectively.

[0101] Adhesive members (not shown) may be disposed respectively between the first projection **12** and the first electrode **7** in FIG. **2** and between the second projection **14** and the second electrode **8** in FIG. **2**. This will be described later in detail.

[0102] An insulation dam **16** may be provided between the first and second lead frames **11** and **13** to prevent short circuit therebetween.

[0103] In this embodiment, the insulation dam has a flat upper surface, although the present disclosure is not limited thereto.

[0104] The body **20** may be provided with a cathode mark **17** which serves to identify polarities of the first and second lead frames **11** and **13**, thereby preventing misconnection of the first and second lead frames **11** and **13** to the external power supply.

[0105] For example, the light emitting device **10** may be a light emitting diode. The light emitting diode may be, for example, a color light emitting diode emitting red, green, blue, white light, etc. or may be a UV light emitting diode emitting ultra-violet light. The present disclosure is not limited thereto. One or more light emitting devices **10** may be mounted on the lead frames. The number and/or arrangement of the light emitting device **10** are not limited to the particulars.

[0106] The body **20** may include a resin material **18** filling the cavity s. Specifically, the resin material **18** may have a dual molded structure or a triple molded structure, although the present disclosure is not limited thereto.

[0107] The resin material **18** may take the form of a film, and may contain at least one of a phosphor and a light diffusing agent. Alternatively, the resin material **18** may be made of a transparent material not containing the phosphor and the light diffusing agent, although the present disclosure is not limited thereto.

[0108] FIG. **7** is a perspective view of a first embodiment of the first and second lead frames of FIG. **6**. FIG. **8** is a cross-sectional view illustrating a state in which a light emitting device is disposed on the first and second lead frames of FIG. **7**.

[0109] Referring to FIGS. **7** and **8**, the first frame **11** has the first projection **12** formed therefrom which is electrically connected to the first electrode **7** of the light emitting device **10**. The second frame **13** has the second projection **14** formed thereon which is electrically connected to the second electrode **8** of the light emitting device **10**.

[0110] The first and second electrodes **7** and **8** of the light emitting device **10** may have the same thickness as each other as shown in FIG. **1**. However, as the first and second electrodes **7** and **8** are disposed at different levels of the light emitting device **10**, the first and second projections corresponding to the first and second electrodes **7** and **8** respectively have different dimensions.

[0111] The first projection **12** extends uprightly from an upper surface of the first lead frame **11** so as to have a first height d**1** and a first upper portion width w**1**.

[0112] The second projection **14** extends uprightly from an upper surface of the second lead frame **13** so as to have a second height d**2** and a second upper portion width w**2**.

[0113] In this embodiment, each of the first and second projections **12** and **14** is configured such that a lower portion thereof has the same width as an upper portion thereof. Alternatively, each of ratios of the first and second upper portions w**1** and w**2** respectively to first and second lower portion widths (not labeled) of the first and second projections **12** and **14** may be in a range of 0.2 to 1. The present disclosure is not limited thereto.

[0114] That is, the first and second upper portions w**1** and w**2** of at least one of the first and second projections **12** and **14** is 0.2 times to 1 times the first and second lower portion widths of the first and second projections **12** and **14**.

[0115] Since the first and second lower portion widths of the first and second projections **12** and **14** are larger than the first and second upper portions w**1** and w**2** thereof respectively, the light emitting device **10** may be stably disposed thereon.

[0116] The first and second upper portions w**1** and w**2** of the first and second projections **12** and **14** may be equal to or larger than widths (not labeled) of the first and second electrodes **7** and **8**. Thus, the light emitting device **10** may be stably disposed on the first and second projections **12** and **14**.

[0117] Nevertheless, in order to prevent short circuit between the first upper portion of the first projection **12** and the active layer **4** and/or the second semiconductor layer **5** of the light emitting device **10**, the first upper portion width w**1** must be smaller that a width of the first region s**1** of the first semiconductor layer **3**.

[0118] Accordingly, a ratio of the second upper portion width w**2** to the first upper portion width w**1** may be in a range of 1 to 2.

[0119] That is, the first upper portion width w**1** of the first projection **12** is 1 times to 2 times the second upper portion width w**2** of the second projection **14**.

[0120] Since, as mentioned above, the first and second electrodes **7** and **8** are disposed at different levels of the light emitting device **10**, a ratio of the first height d**1** to the second height d**2** may be in a range of 1 to 5.

[0121] That is, the first height d**1** of the first projection is 1 times to 5 times the second height d**2** of the second projection **14**.

[0122] Nevertheless, as the second electrode **8** is disposed on the second semiconductor layer **5**, the second upper portion width w**2** may be equal to the first upper portion width w**1**. Otherwise, if the second upper portion width w**2** is two or more times lager than the first upper portion width w**1**, light emission efficiency of the light emitting device **10** may be reduced.

[0123] If the ratio of the first height d**1** to the second height d**2** is smaller than 1, it is difficult for the first projection **12** to be electrically connected to the first electrode **7**. On the other hand, if the ratio of the first height d**1** to the second height d**2** is larger than 5, a vertical length (not labeled) of the second electrode **8** should be larger, leading to a deterioration in electrical stability of the light emitting device **10**.

[0124] The first and second projections **12** and **14** may be spaced substantially the same distance from a center between facing-away sides of the first and second lead frames **11** and **13**. The first and second projections **12** and **14** may be disposed in a symmetrical relationship with each other. The present disclosure is not limited thereto.

[0125] Top shapes of the first and second projections **12** and **14** may respectively correspond to those of the first and second electrodes **7** and **8**. The present disclosure is not limited thereto.

[0126] Adhesive members pa may be respectively disposed between the first projection **12** and the first electrode **7** and between the second projection **14** and the second electrode **8**.

[0127] The adhesive members pa may respectively serve to electrically connect the first projection **12** to the first electrode **7** and the second projection **14** to the second electrode **8**. To this end, each of the adhesive members pa may be formed of at least one of a bonding ball, an adhesive paste and an adhesive film containing at least one of silver (Ag) and gold (Au).

[0128] Since there are formed respective attachments between the first projection **12** and the first electrode **7** and between the second projection **14** and the second electrode **8** using the adhesive members pa, short circuit between the first electrode **7** and the second projection **14** and between the second electrode **8** and the first projection **12** may be advantageously prevented.

[0129] FIG. **9** is a perspective view of a second embodiment of the first and second lead frames of FIG. **6**. FIG. **10** is a cross-sectional view illustrating a state in which a light emitting device is disposed on the first and second lead frames of FIG. **9**.

[0130] In referring to FIG. **9** and FIG. **10**, descriptions of the same configurations as in FIG. **7** and FIG. **8** will be eliminated or be briefly addressed.

[0131] Referring to FIG. **9** and FIG. **10**, the first and second projections **12** and **14** respectively have first and second grooves **12***a* and **14***a* formed in the upper portions thereof to receive portions of the first and second electrodes **7** and **8** respectively.

[0132] The first and second upper portion widths w**1** and w**2** of the first and second projections **12** and **14** may respectively be larger than the widths (not labeled) of the first and second electrodes **7** and **8**. Ratios of first and second groove widths wh**1** and wh**2** of the first and second grooves **12***a* and **14***a* respectively to the widths (not labeled) of the first and second electrodes **7** and **8** may be in a range of 1 to 1.1, so that the portions of the first and second electrodes **7** and **8** are respectively inserted into the first and second grooves **12***a* and **14***a*.

[0133] Ratios of first and second depths bh**1** and bh**2** of the first and second grooves **12***a* and **14***a* respectively to thicknesses (not labeled) of the first and second electrodes **7** and **8** may be in a range of 0.3 to 0.7. If the ratios are below 0.3, the portions of the first and second electrodes **7** and **8** may not be securely inserted into the first and second grooves **12***a* and **14***a*, respectively. On the other hand, if the ratios are above 0.7, the portions of the first and second electrodes **7** and **8** may be securely inserted into the first and second grooves **12***a* and **14***a* respectively, but there may occur cracks at the first and second semiconductor layers **3** and **5** and further the adhesive members may be bonded to the first and second semiconductor layers **3** and **5**, leading to reduction of electrical current flow therein.

[0134] In accordance with the light emitting device package **100** of this embodiment, when assembling a flip chip type light emitting device **10** on the first and second lead frames **11** and **13**, the first and second electrodes **7** and **8** are just bonded to the first and second projections **12** and **14** respectively using the respective adhesive members pa, thereby achieving a simple manufacturing process of the light emitting device package **100**.

[0135] Moreover, when assembling the light emitting device package **100** of this embodiment, an alignment mark (not shown) used in disposing the light emitting device on the lead frames may be formed on the first and/or second lead frames **11** and **13** and/or the upper surfaces or side surfaces of the first and second projections **12** and **14**. A formation position of the alignment mark is not limited thereto.

[0136] Furthermore, in accordance with the light emitting device package **100** of this embodiment, it is advantageous that a phosphor may not be contained in the resin material **18** since the light emitting device **10** in the package **100** as shown in FIG. **1** includes the metal ions. Alternatively, when the phosphor is contained in the resin material **18**, the amount of the phosphor in the resin material **18** may be advantageously reduced because the metal ions are contained in the second layer **1***b* of the support member **1** of the light emitting device **10**.

[0137] FIG. **11** is a perspective view of an illumination device including the light emitting device according to one embodiment. FIG. **12** is a cross-sectional view taken at a line A-A' of the illumination device of FIG. **11**.

[0138] Hereinafter, in order to describe the illumination device **300** in a more detailed manner, a length direction Z, a horizontal direction Y perpendicular to the length direction Z and a height direction X perpendicular to a plane formed by the directions Z and Y of the illumination device **300** will be referenced.

[0139] FIG. **12** illustrates a cross-section taken according to a plane formed by the directions Z and X and viewed in the horizontal direction Y.

[0140] Referring to FIG. **11** and FIG. **12**, the illumination device **300** includes a body **310**, a cover **330** coupled to the body **310**, and finishing caps **350** disposed at both ends of the body **310** respectively.

[0141] A light emitting device package array **340** is coupled to the body **310** at a lower face of the body **310**. Thus, the body **310** may be made of a metal material having excellent thermal conductivity and heat discharge rate to discharge heat generated from the light emitting device package array **340** from an upper face of the body **310**.

[0142] The light emitting device package array **340** may include a board **342** and a plurality of the light emitting device packages **344** disposed on the board **342**. Each of the light emitting device packages **344** may include a substrate (not shown) and a light emitting device (not shown) disposed on the substrate according to one embodiment.

[0143] The light emitting device packages **344** may be arranged on the board **342** in a plural-row or plural-color form to form the light emitting device package array. The light emitting device packages **344** may be spaced from each other by a regular interval or, if necessary, with varying intervals to adjust brightness, etc. of the illumination device **300**. The board **342** may be a PCB made of an FR4 material or may be a metal core PCB (MCPCB).

[0144] The cover **330** may be formed in a cylindrical shape to encompass the lower face of the body **310**, although the present disclosure is not limited thereto.

[0145] The cover **330** may protect the light emitting device package array **340** therein from external contaminants, etc.

[0146] The cover **330** may contain light diffusion particles to achieve anti-glare effects and/or uniform emission of light generated from the light emitting device package array **340**. At least one of the inner and outer surfaces of the cover **330** may be provided with a prism pattern. Also, a phosphor layer may be coated over at least one of the inner and outer surfaces of the cover **330**.

[0147] Since light generated from the light emitting device package array **340** is outwardly emitted through the cover **330**, the cover **330** should have high light transmittance and heat resistance sufficient to endure heat generated from the light emitting device package array **340**. To this end, the cover **630** may be made of polyethylene terephthalate (PET), polycarbonate (PC) or polymethylmethacrylate (PMMA).

[0148] The finishing caps **350** may be disposed at both ends of the body **310** and function to seal a power supply device (not shown). Each finishing cap **350** is provided with power pins **352**, so that the illumination device **300** in accordance with the illustrated embodiment may be directly connected to a terminal, which is provided for a conventional fluorescent lamp, without an additional connector.

[0149] FIG. **13** is a disassembled perspective view of a liquid crystal display device including the light emitting device according to one exemplary embodiment.

[0150] FIG. **13** illustrates an edge-light type liquid crystal display device **400**. The liquid crystal display device **400** may include a liquid crystal display panel **410** and a backlight unit **470** to supply light to the liquid crystal display panel **410**.

[0151] The liquid crystal display panel **410** may display an image using the light supplied from the backlight unit **470**. The liquid crystal display panel **410** may include a color filter substrate **412** and a thin film transistor substrate **414**, which are opposite each other with liquid crystals interposed therebetween.

[0152] The color filter substrate **412** may realize the color of an image displayed on the liquid crystal display panel **414**.

[0153] The thin film transistor substrate **414** is electrically connected to a PCB **418**, on which a plurality of circuit elements is mounted, by means of a drive film **417**. The thin film transistor substrate **414** may apply drive voltage provided by the PCB **418** to liquid crystals in response to a drive signal transmitted from the PCB **418**.

[0154] The thin film transistor substrate **414** may include thin film transistors and pixel electrodes in the form of thin films formed on another substrate made of a transparent material such as glass or plastic.

[0155] The backlight unit **470** includes a light emitting device package array **420** to emit light, a light guide plate **430** to change light emitted from the light emitting device package array **420** into planar light and to transmit the planar light to the liquid crystal display panel **410**, a plurality of films **450**, **466** and **464** to achieve brightness uniformity and improved vertical incidence of light emerging from the light guide plate **430**, and a reflective sheet **440** to reflect light emitted rearwards from the light guide plate **430** toward the light guide plate **430**.

[0156] The light emitting device package array **420** may include a plurality of light emitting device packages **424** and a PCB **422** on which the plurality of light emitting device packages **424** is mounted to form an array.

[0157] The light emitting device package array **420** may include a board **422** and a plurality of light emitting device packages **424** disposed on the board **442**. Each of the light emitting device packages **424** may include a substrate (not shown) and a light emitting device (not shown) disposed on the substrate according to one embodiment.

[0158] In this embodiment, the light emitting device may be the light emitting device in FIG. **1**. The present disclosure is not limited thereto.

[0159] Meanwhile, the backlight unit **470** may include a diffusion film **466** to diffuse light incident thereupon from the light guide plate **430** toward the liquid crystal display panel **410**, and a prism film **450** to condense the diffused light so as to enhance vertical light incidence. The backlight unit **470** may further include a protective film **464** to protect the prism film **450**.

[0160] FIG. **14** is a disassembled perspective view of a liquid crystal display device including a light emitting device according to another embodiment.

[0161] The same configuration as that illustrated in FIG. **13** and described with reference to FIG. **13** will not be repeatedly described in detail.

[0162] FIG. **14** illustrates a direct type liquid crystal display device **500** including a liquid crystal display panel **510** and a backlight unit **570** to supply light to the liquid crystal display panel **510**.

[0163] The liquid crystal display panel **510** is identical to that of FIG. **13** and, as such, no detailed description thereof will be given.

[0164] The backlight unit **570** may include a light emitting device package array **523**, a reflective sheet **524**, a lower chassis **530** in which the light emitting device package array **523** and reflective sheet **524** are accommodated, and a diffusion sheet **540** and a plurality of optical films **560**, which are disposed over the light emitting device package array **523**.

[0165] The light emitting device package array **523** may include a plurality of light emitting device packages **522**, and a PCB **521** on which the plurality of light emitting device packages **522** is mounted to form an array.

[0166] In particular, since each light emitting device package **522** may be provided at the light emitting surface thereof with a film made of an electrically conductive material and formed with a plurality of holes, it may be possible to dispense with a lens, and thus to realize a slim light emitting device package structure. Also, it may be possible to enhance light extraction efficiency. Thus, a backlight unit having a thinner structure may be realized.

[0167] The reflective sheet **524** reflects light generated by the light emitting device packages **522** toward the liquid crystal display panel **510**, to achieve an enhancement in light utilization efficiency.

[0168] Meanwhile, the light generated from the light emitting device package array **523** is incident upon the diffusion sheet **540**. The optical films **560** are disposed over the diffusion sheet **540**. The optical films **560** may include a diffusion film **566**, a prism film **550** and a protective film **564**.

[0169] The illumination device **300** and the display devices **400** and **500** may be included in a lighting system. A lighting device including a light emitting device package may be included in a lighting system.

[0170] The light emitting device according to the embodiments includes the metal ions in the support member thereof to convert light of a given wavelength emitted from the light emitting structure and incident upon the support member into light of a wavelength different from the given wavelength. Thus, as for the light emitting device assembled in the light emitting device package, the phosphor may be dispensed with or a very small amount of the phosphor may be used, thereby reducing the manufacturing costs of the light emitting device package.

[0171] Particular features, structures, or characteristics described in connection with the embodiment are included in at least one embodiment of the present disclosure and not necessarily in all embodiments. Furthermore, the particular features, structures, or characteristics of any specific embodiment of the present disclosure may be combined in any suitable manner with one or more other embodiments or may be changed by those skilled in the art to which the embodiments pertain. Therefore, it is to be understood that contents associated with such combination or change fall within the spirit and scope of the present disclosure.

[0172] Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and applications may be devised by those skilled in the art that will fall within the intrinsic aspects of the embodiments. More particularly, various variations and modifications are possible in concrete constituent elements of the embodiments. In addition, it is to be understood that differences relevant to the variations and modifications fall within the spirit and scope of the present disclosure defined in the appended claims.

What is claimed is:

1. A light emitting device comprising:
a support member;
a light emitting structure disposed on the support member, the light emitting structure comprising a first semiconductor layer comprises a first and second regions, a second semiconductor layer disposed on the second region, and an active layer between the first and second semiconductor layers;
a first electrode disposed on the first semiconductor layer; and
a second electrode disposed on the second semiconductor layer,
wherein the support member includes metal ions to convert light of a first wavelength emitted from the active layer into light of a second wavelength different from the first wavelength.

2. The light emitting device of claim **1**, wherein the support member comprises a first surface adjacent to the light emitting structure and a second surface opposite the first surface,
wherein the metal ions are disposed on at least one of the first or(and) second surfaces or are injected between the first and second surfaces.

3. The light emitting device of claim **1**, wherein the metal ions form at least one layer.

4. The light emitting device of claim **1**, wherein the metal ions comprise:
first metal ions to convert light of the first wavelength emitted from the active layer into light of the second wavelength different from the first wavelength; and
second metal ions to convert at least one of light of the first wavelength emitted from the active layer and light of the second wavelength into light of a third wavelength different from the first and second wavelengths.

5. The light emitting device of claim **4**, wherein the first and second metal ions are mixed to form a single layer, or respectively form first and second layers stacked one on top of the other.

6. The light emitting device of claim **1**, wherein the metal ions comprise at least one of vanadium ions, chromium ions, titanium ions, or(and) iron ions.

7. The light emitting device of claim **1**, wherein the support member comprises aluminum (Al),
wherein a ratio of the metal ions to the aluminum (Al) is in a range of 0.01% to 0.1%.

8. The light emitting device of claim **1**, further comprising:
a reflective electrode layer disposed on the second semiconductor layer or between the second electrode and the second semiconductor layer.

9. The light emitting device of claim **1**, further comprising:

a light-transmissive electrode layer disposed on the second semiconductor layer or between the second electrode and the second semiconductor layer.

10. A light emitting device package comprising:

a light emitting device comprising a support member and a light emitting structure disposed on the support member, the light emitting structure comprising a first semiconductor layer comprises a first and second regions, a second semiconductor layer disposed on the second region, and an active layer between the first and second semiconductor layers, a first electrode disposed on the first semiconductor layer, a second electrode disposed on the second semiconductor layer; and

a body comprising a first and second lead frames electrically connected to the light emitting device, and the body is provided with a cavity on the first and second lead frames,

wherein the support member includes metal ions to convert light of a first wavelength emitted from the active layer into light of a second wavelength different from the first wavelength.

11. The light emitting device package of claim **10**, wherein the first lead frame is formed a first projection and the first projection electrically connected to the first electrode, and

the second lead frame is formed a second projection and the first projection electrically connected to the second electrode.

12. The light emitting device package of claim **11**, wherein the width of an upper portion of the first projection is 1 times to 2 times the width of an upper portion of the second projection.

13. The light emitting device package of claim **11**, wherein the height of the first projection is 1 times to 5 times the height of the second projection.

14. The light emitting device package of claim **11**, wherein the width of an upper portion of at least one of the first and second projections is 0.2 times to 1 times the width of a lower portion.

15. The light emitting device package of claim **11**, wherein at least one of the first and second projections has a groove formed therein to receive a corresponding one of the first and second electrode.

16. The light emitting device package of claim **11**, further comprising:

adhesive members disposed respectively between the first projection and the first electrode and between the second projection and the second electrode,

wherein each of the adhesive members is formed of at least one of a bonding ball, an adhesive paste and an adhesive film containing at least one of silver (Ag) and gold (Au).

17. The light emitting device package of claim **10**, wherein the light emitting device comprises at least one of flip-chip type or a horizontal type.

18. The light emitting device package of claim **11**, further comprising:

a resin material filling the cavity,

wherein the resin material comprise transparent resin material.

19. The light emitting device package of claim **17**, wherein the transparent resin material comprises at least one of an epoxy material and a silicon material.

20. A lighting system comprising:

a substrate; and

a light emitting device package disposed on the substrate, comprises a light emitting device comprises a support member and a light emitting structure disposed on the support member, the light emitting structure comprising a first semiconductor layer comprises a first and second regions, a second semiconductor layer disposed on the second region, and an active layer between the first and second semiconductor layers, a first electrode disposed on the first semiconductor layer, a second electrode disposed on the second semiconductor layer, and a body comprises a first and second lead frames electrically connected to the light emitting device, and the body is provided with a cavity on the first and second lead frames,

wherein the support member includes metal ions to convert light of a first wavelength emitted from the active layer into light of a second wavelength different from the first wavelength, and

wherein the substrate comprises at least one of PCB, FPCB and MCPCB.

* * * * *