

# US Patent & Trademark Office

## Patent Public Search | Text View

United States Patent Application Publication

20250267985

Kind Code

A1

Publication Date

August 21, 2025

Inventor(s)

JO; Sung Sik et al.

### LIGHT EMITTING DEVICE PACKAGE

#### Abstract

A light-emitting device package includes a frame including one side on which a first electrode is formed and the other side on which a second electrode is formed, an LED chip including a first conductive connection pad electrically connected to the first electrode and a second conductive connection pad electrically connected to the second electrode, a reflective member disposed on the frame, forming a cavity for accommodating the LED chip therein, and reflecting light emitted from the LED chip, and a wavelength conversion member filled in the cavity to cover the LED chip, wherein the reflective member includes a first side and a second side different from the first side, and a first height of the first side and a second height of the second side are formed to be different from each other.

**Inventors:** JO; Sung Sik (Yongin-si, KR), KIM; Pyeong Guk (Yongin-si, KR)

**Applicant:** LUMENS CO., LTD. (Yongin-si, KR)

**Family ID:** 1000008589702

**Assignee:** LUMENS CO., LTD. (Yongin-si, KR)

**Appl. No.:** 19/204443

**Filed:** May 09, 2025

#### Foreign Application Priority Data

KR 10-2021-0071417

Jun. 02, 2021

KR 10-2021-0117582

Sep. 03, 2021

#### Related U.S. Application Data

parent US division 17746877 20220517 parent-grant-document US 12328977 child US 19204443

## Publication Classification

**Int. Cl.:** **H10H20/831** (20250101); **H01L25/075** (20060101); **H10H20/814** (20250101);  
**H10H20/851** (20250101); **H10H20/857** (20250101)

**U.S. Cl.:**

**CPC** **H10H20/8312** (20250101); **H01L25/0753** (20130101); **H10H20/8142** (20250101);  
**H10H20/851** (20250101); **H10H20/857** (20250101);

---

## Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION [0001] This is a division of U.S. application Ser. No. 17/746,877, filed May 17, 2022, which claims the priority benefit under 35 U.S.C. § 119 to Korean Patent Application Nos. 10-2021-0071417, filed Jun. 2, 2021 and 10-2021-0117582, filed Sep. 3, 2021 in the Korean Intellectual Property Office, the disclosures of which are incorporated by reference herein in their entirety.

### BACKGROUND

#### 1. Field

[0002] An embodiment of the present disclosure relates to a light-emitting device package, and more particularly, to a light-emitting device package that may be used for display or lighting purposes.

#### 2. Description of the Related Art

[0003] A light-emitting diode (LED) refers to a type of semiconductor device capable of realizing light of various colors by forming a light-emitting source by forming a PN diode of a compound semiconductor. Such a light-emitting device has a long lifespan, may be miniaturized and lightweight, and may be driven at a low voltage. In addition, these LEDs are strong against shock and vibration, do not require warm-up time and complicated driving, and may be packaged after being mounted on a substrate or lead frame in various forms, so they may be modularized for various purposes and applied to a back light unit or various lighting apparatuses, etc.

[0004] On the other hand, in conventional light-emitting device packages applied to edge-type backlight units, which are an isotropic light-emitting type, color shading may occur between the light-emitting device packages because a directivity angle is narrow. In addition, in order to solve such the color shading, when intervals of light-emitting device packages are reduced by increasing the number of light-emitting device packages as before, costs are increased.

### SUMMARY

[0005] An objective of the embodiments of the present disclosure for solving the above problems is to provide a light-emitting device package capable of increasing a directivity angle and increasing light efficiency by exposing a side surface of a wavelength conversion member.

[0006] Additional aspects will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the presented embodiments of the disclosure.

[0007] One embodiment of the present disclosure provides a light-emitting device package including a frame including one side on which a first electrode is formed and the other side on which a second electrode is formed, an LED chip including a first conductive connection pad electrically connected to the first electrode and a second conductive connection pad electrically connected to the second electrode, a reflective member disposed on the frame, forming a cavity for accommodating the LED chip therein, and reflecting light emitted from the LED chip, and a

wavelength conversion member filled in the cavity to cover the LED chip, wherein the reflective member includes a first side and a second side different from the first side, and a first height of the first side and a second height of the second side are formed to be different from each other.

[0008] In one embodiment of the present disclosure, the first side may be made of a pair of sides facing each other among four sides of the reflective member, and the second side may be made of the remaining pair of sides among the four sides of the reflective member.

[0009] In one embodiment of the present disclosure, the second side may include an open area having the second height less than the first height of the first side.

[0010] In one embodiment of the present disclosure, an inner surface of the open area may have a stepped structure of two or more steps.

[0011] In one embodiment of the present disclosure, a portion of the inner surface of the open area may be formed of a curved surface.

[0012] In one embodiment of the present disclosure, the curved surface of the open area may have a parabolic shape profile concave toward an inside of the reflective member.

[0013] In one embodiment of the present disclosure, an imaginary extension surface extending from an upper surface of the LED chip may pass through a first area of the open area including the curved surface.

[0014] In one embodiment of the present disclosure, the second height may be equal to or less than half of the first height.

[0015] In one embodiment of the present disclosure, a length of the first side of the reflective member may be greater than a length of the second side thereof.

[0016] In one embodiment of the present disclosure, an inner surface of the first side may be made of an inclined surface having a constant inclination.

[0017] Another embodiment of the present disclosure provides a light-emitting device package including a frame including one side on which a first electrode is formed and the other side on which a second electrode is formed, an LED chip including a substrate having an upper surface, a semiconductor laminate structure formed under the substrate, and a wavelength conversion member covering at least the upper surface of the substrate, wherein a first conductive connection pad electrically connected to the first electrode and a second conductive connection pad electrically connected to the second electrode are formed under the semiconductor laminate structure, a reflective member disposed on the frame, forming a cavity for accommodating the LED chip therein, and reflecting light emitted from the LED chip, and a light-transmitting member filled in the cavity to cover the LED chip, wherein the reflective member includes a first side and a second side different from the first side, and a first height of the first side is different from a second height of the second side.

[0018] In one embodiment of the present disclosure, the first side may be made of a pair of sides facing each other among four sides of the reflective member, and the second side may be made of the remaining pair of sides among the four sides of the reflective member.

[0019] In one embodiment of the present disclosure, the second side may include an open area having the second height less than the first height of the first side.

[0020] In one embodiment of the present disclosure, an inner surface of the open area may have a stepped structure of two or more steps.

[0021] In one embodiment of the present disclosure, a portion of the inner surface of the open area may be formed of a curved surface.

[0022] In one embodiment of the present disclosure, the curved surface of the open area may have a parabolic shape profile concave toward an inside of the reflective member.

[0023] In one embodiment of the present disclosure, an imaginary extension surface extending from an upper surface of the LED chip may pass through a first area of the open area including the curved surface.

[0024] In one embodiment of the present disclosure, the second height may be equal to or less than

half of the first height.

[0025] In one embodiment of the present disclosure, a length of the first side of the reflective member may be greater than a length of the second side thereof.

[0026] In one embodiment of the present disclosure, an inner surface of the first side may be made of an inclined surface having a constant inclination.

[0027] Other side surfaces, features and advantages other than those described above will become apparent from the following detailed description of the drawings, claims and disclosure.

---

## Description

### BRIEF DESCRIPTION OF THE DRAWINGS

[0028] The above and other aspects, features, and advantages of certain embodiments of the disclosure will be more apparent from the following description taken in conjunction with the accompanying drawings, in which:

[0029] FIG. 1 is a view schematically illustrating a light-emitting device package according to an embodiment of the present disclosure;

[0030] FIG. 2 is a side surface view of the light-emitting device package of FIG. 1;

[0031] FIG. 3 is a plan view of the light-emitting device package of FIG. 1;

[0032] FIG. 4 is a cross-sectional view taken along line IV-IV of FIG. 1;

[0033] FIG. 5 is a cross-sectional view taken along line V-V of FIG. 1;

[0034] FIG. 6 is a view for comparing part A and part B of FIG. 1;

[0035] FIG. 7 is a diagram schematically illustrating a light-emitting device package according to another embodiment of the present disclosure;

[0036] FIG. 8 is a view for explaining an LED chip according to another embodiment;

[0037] FIG. 9 is a diagram schematically illustrating a light-emitting device package according to another embodiment of the present disclosure;

[0038] FIG. 10 is a plan view of the light-emitting device package of FIG. 9;

[0039] FIG. 11 is a cross-sectional view taken along line XI-XI of FIG. 9; and

[0040] FIGS. 12 to 14 are views for explaining light-emitting device packages according to an optional embodiment of the present disclosure.

### DETAILED DESCRIPTION

[0041] Reference will now be made in detail to embodiments, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout. In this regard, the present embodiments may have different forms and should not be construed as being limited to the descriptions set forth herein. Accordingly, the embodiments are merely described below, by referring to the figures, to explain aspects. As used herein, the term “and/or” includes any and all combinations of one or more of the associated listed items. Expressions such as “at least one of,” when preceding a list of elements, modify the entire list of elements and do not modify the individual elements of the list.

[0042] Hereinafter, the following embodiments will be described in detail with reference to the accompanying drawings, and when described with reference to the drawings, the same or corresponding components are given the same reference numerals, and the overlapping description thereof will be omitted.

[0043] Since the present embodiments can apply various transformations, specific embodiments are illustrated in the drawings and described in detail in the detailed description. Effects and features of the present embodiments, and a method of achieving them will become clear with reference to the details described later in conjunction with the drawings. However, the present embodiments are not limited to the embodiments disclosed below and may be implemented in various forms.

[0044] In the following embodiments, terms such as first, second, etc. are used for the purpose of

distinguishing one component from other components without limiting meaning.

[0045] In the following examples, the singular expression includes the plural expression unless the context clearly dictates otherwise.

[0046] In the following embodiments, terms such as include or have means that the features or components described in the specification are present, and the possibility that one or more other features or components will be added is not excluded in advance.

[0047] In the following embodiments, when it is said that a part such as a unit, region, or component is on or on another part, it is not only when it is directly on the other part, but also another unit, region, component, etc. is interposed therebetween. cases are included.

[0048] In the following embodiments, terms such as connect or couple do not necessarily mean direct and/or fixed connection or coupling of two members unless the context clearly indicates otherwise, and does not exclude that another member is interposed between the two members.

[0049] It means that a feature or element described in the specification is present, and does not preclude the possibility that one or more other features or elements may be added.

[0050] In the drawings, the size of the components may be exaggerated or reduced for convenience of description. For example, since the size and thickness of each component shown in the drawings are arbitrarily indicated for convenience of description, the following embodiment is not necessarily limited to the illustrated bar.

[0051] FIG. 1 is a view schematically illustrating a light-emitting device package **10** according to an embodiment of the present disclosure, FIG. 2 is a side surface view of the light-emitting device package **10** of FIG. 1, and FIG. 3 is a plan view of the light-emitting device package **10** of FIG. 1. FIG. 4 is a cross-sectional view taken along line IV-IV of FIG. 1, FIG. 5 is a cross-sectional view taken along line V-V of FIG. 1, and FIG. 6 is a view for comparing part A and part B of FIG. 1.

[0052] Referring to FIGS. 1 to 6, a light-emitting device package **10** according to an embodiment of the present disclosure may include a frame **11**, an LED chip **100**, a reflective member **110** and a wavelength conversion member **120**.

[0053] The frame **11** may include one side on which a first electrode **R1** is formed and the other side on which a second electrode **R2** is formed. The first electrode **R1** and the second electrode **R2** may be formed symmetrically with respect to an electrode separation line. The frame **11** is electrically connected to the LED chip **100** by the first electrode **R1** and the second electrode **R2**, and may be made of a material having adequate mechanical strength to support the LED chip **100**.

[0054] Although the figure illustrates a case in which one LED chip **100** including a pair of first electrode **R1** and second electrode **R2** is mounted, the present disclosure is not limited thereto, and a plurality of LED chips **100** including a plurality of first electrodes **R1** and second electrodes **R2** may be mounted.

[0055] A metal substrate formed in a plate form or lead frame form with aluminum, copper, zinc, tin, lead, gold, silver, etc. may be applied to the frame **11**. Alternatively, a printed circuit board (PCB) on which a wiring layer is formed or a flexible printed circuit board (FPCB) formed of a flexible material may be applied to the frame **11**.

[0056] Alternatively, the frame **11** may be partially formed of a synthetic resin such as resin or glass epoxy or a ceramic material in consideration of thermal conductivity while being formed of metal, and may be formed of a material made of at least any one of epoxy mold compound (EMC), polyimide (PI), graphene, synthetic glass fiber, and combinations thereof in order to improve processability.

[0057] The LED chip **100** may include a substrate **101**, a semiconductor laminate structure **102**, a first conductive connection pad **103** and a second conductive connection pad **104**.

[0058] The substrate **101** may be a sapphire substrate having a light-emitting surface.

[0059] The semiconductor laminate structure **102** may be a gallium nitride-based semiconductor laminate structure formed on the substrate **101**. The semiconductor laminate structure **102** includes a first conductive semiconductor layer, an active layer, and a second conductive semiconductor

layer. At this time, although illustrated briefly in the drawings, parts of the second conductive semiconductor layer and the active layer are selectively removed, so that a part of the first conductive semiconductor layer is exposed, and the first conductive connection pad **103** may be connected through an exposed region. Also, the second conductive connection pad **104** is connected to the second conductive semiconductor layer.

[0060] The first conductive connection pad **103** may be electrically connected to the first electrode **R1**, and the second conductive connection pad **104** may be electrically connected to the second electrode **R2**.

[0061] The LED chip **100** may be any one of a blue LED, a red LED and a green LED, and may be an LED that generates light of various wavelengths or an ultraviolet LED. However, the present disclosure is not limited thereto, and any of various horizontal or vertical LEDs or various types of light-emitting devices on which signal transmission media such as bumps, wires or solders are installed may be applied.

[0062] The reflective member **110** is disposed on the frame **11**, forms a cavity accommodating the LED chip **100** therein, and may reflect light emitted from the LED chip **100**. The reflective member **110** may be formed to surround a side surface of the LED chip **100**, and may be made of a reflective material that reflects light emitted from the LED chip **100**. In another embodiment, the reflective member **110** may be formed of an absorbing material that absorbs light emitted from the LED chip **100**. Hereinafter, for convenience of description, a case in which the reflective member **110** is made of the reflective material will be mainly described.

[0063] The reflective member **110** may be a structure made of a molding resin material in which a reflective cup part having an open top to accommodate the LED chip **100** is formed. A base material of the reflective member **110** may be an organic or inorganic resin material. For example, the reflective member **110** may contain an organic or inorganic resin material such as silicone, epoxy, heat-resistant resin polyimide, phenol resin, melamine resin, unsaturated polyester resin, tritan, and the like.

[0064] The reflective member **110** may contain a light reflective material such as titanium oxide, silicon dioxide, titanium dioxide, zirconium dioxide, potassium titanate, alumina, aluminum nitride, boron nitride, mullite, chromium, white-based or metal-based substance, etc. in these resins. In addition, the reflective member **110** may further include boron nitride (BN), aluminum nitride (AlN), aluminum (Al), graphite, and the like. Through this, the reflective member **110** may improve heat dissipation performance.

[0065] The reflective member **110** includes a first side **111** having a first height **h1** and a second side **112** having a second height **h2**, and the second height **h2** may be less than the first height **h1**. The reflective member **110** may expose the wavelength conversion member **120** to be described later through the second side **112** formed at a lower level than the first side **111**. Through this, the light-emitting device package **10** of the present disclosure may radiate light emitted from the LED chip **100** to an upper portion of the LED chip **100**, and may also radiate light laterally through the second side **112** having the different height.

[0066] The first side **111** may be formed of a pair of sides facing each other among four sides of the reflective member **110**, and the second side **112** may be formed of the remaining pair of sides among the four sides of the reflective member **110**. For example, when the light-emitting device package **10** has a structure in which a length **L1** in one direction is greater than a length **L2** in the other direction as illustrated in the drawing, the first side **111** may be a pair of sides arranged in a long axis direction, and the second side **112** may be a pair of sides arranged in a short axis direction.

[0067] An inner surface of the first side **111** may be formed as an inclined surface with constant inclination. The first side **111** may reflect the light emitted from the LED chip **100** to the upper portion of the LED chip **100** through this inclination.

[0068] The total height of the second side **112** does not need to be less than the height of the first

side **111**, and as illustrated in the drawing, a predetermined area of the second side **112** may be less than the height of the first side **111** to form an open area **A**. In other words, the second side **112** may have the open area **A** having the second height **h2** less than the first height **h1** of the first side **111**. [0069] In this case, the second height **h2** may be equal to or less than half of the first height **h1**. When the open area **A** is viewed from a side surface of the light-emitting device package **10**, a central portion of the second side **112** may be formed in a concave groove structure (see FIG. 2). [0070] An inner surface of the open area **A** may be formed of a stepped structure of two or more steps. As an embodiment, a portion of the inner surface of the open area **A** may have a three-step structure including a curved surface. The open area **A** may effectively reflect the light emitted from the LED chip **100** in a lateral direction through the structure at least partially formed of the curved surface.

[0071] Specifically, the open area **A** of the second side **112** may include a first area **A1** having the curved surface, and a second area **A2** and a third area **A3** connected to both sides of the first area **A1**. The first area **A1** may have the curved surface as described above, and the curved surface may have a parabolic shape profile concave toward an inside of the reflective member **110**.

[0072] The first area **A1** may be disposed on the second area **A2** having a predetermined height. Through this, the first area **A1** having the curved surface is arranged at a position corresponding to the LED chip **100** having a certain thickness, and an imaginary extension surface **PA** extending from an upper surface of the LED chip **100** may pass through the first area **A1** of the open area **A** having the curved surface. Through this structure, the open area **A** may effectively reflect the light emitted from the LED chip **100** in the lateral direction as well.

[0073] The third area **A3** may be disposed on the first area **A1**, and may be formed in a stepped structure having a predetermined height. The wavelength conversion member **120** to be described later is a material filled and accommodated in the cavity of the reflective member **110**, and has initial fluidity. The third area **A3** may be formed as the stepped structure to prevent the wavelength conversion member **120** having this fluidity from overflowing from the second side **112** that is at a lower level than the first side **111** in height.

[0074] The wavelength conversion member **120** may be filled inside the cavity to cover the LED chip **100**. The wavelength conversion member **120** may be formed by a mixture of at least one phosphor and, for example, an encapsulant made of a resin powder. As an embodiment, when the LED chip **100** is a blue LED chip, the wavelength conversion member **120** may include red phosphor excited by blue light to emit red light and green phosphor emitting green light, or may include a yellow phosphor excited by blue light to emit yellow light.

[0075] If the side heights of the reflective member **110** are the same, the wavelength conversion member **120** may be formed to have an almost flat surface when filled in the cavity of the reflective member **110**. However, in the present disclosure, since the height of the second side **112** of the reflective member **110** is less than the height of the first side **111**, the wavelength conversion member **120** may have an externally convex curved surface rather than the flat surface.

Accordingly, a height of an uppermost end of the wavelength conversion member **120** may be formed to be greater than a height of an uppermost end of the reflective member **110**.

[0076] FIG. 7 is a diagram schematically illustrating a light-emitting device package **20** according to another embodiment of the present disclosure, and FIG. 8 is a view for explaining an LED chip **200** according to another embodiment.

[0077] Referring to FIGS. 7 and 8, a light-emitting device package **20** according to another embodiment of the present disclosure may include a frame **21**, an LED chip **200**, a reflective member **210** and a light-transmitting member **230**.

[0078] The light-emitting device package **20** according to another embodiment is formed in a chip size package (CSP) structure in which the LED chip **200** includes a wavelength conversion member **205** including phosphor.

[0079] The frame **21** may include one side on which a first electrode (not illustrated) is formed and

the other side on which a second electrode (not illustrated) is formed. The first electrode (not illustrated) and the second electrode (not illustrated) may be formed symmetrically with respect to an electrode separation line. The frame **21** is electrically connected to the LED chip **200** by the first electrode (not illustrated) and the second electrode (not illustrated), and may be made of a material having adequate mechanical strength to support the LED chip **200**.

[0080] The LED chip **200** may include a substrate, a semiconductor laminate structure, a first conductive connection pad, a second conductive connection pad and the wavelength conversion member **205**.

[0081] The substrate may be a sapphire substrate including a light-emitting surface.

[0082] The semiconductor laminate structure may be a gallium nitride-based semiconductor laminate structure formed on the substrate. The semiconductor laminate structure includes a first conductive semiconductor layer, an active layer, and a second conductive semiconductor layer. At this time, although illustrated briefly in the drawings, parts of the second conductive semiconductor layer and the active layer are selectively removed, so that a part of the first conductive semiconductor layer is exposed, and the first conductive connection pad may be connected through an exposed region. Also, the second conductive connection pad is connected to the second conductive semiconductor layer.

[0083] The first conductive connection pad may be electrically connected to the first electrode, and the second conductive connection pad may be electrically connected to the second electrode.

[0084] The wavelength conversion member **205** may cover at least the upper surface of the substrate. The wavelength conversion member **205** may be formed by a mixture of at least one phosphor and, for example, an encapsulant made of a resin powder. As an embodiment, when the LED chip **200** is a blue LED chip, the wavelength conversion member **205** may include red phosphor excited by blue light to emit red light and green phosphor emitting green light, or may include a yellow phosphor excited by blue light to emit yellow light.

[0085] A molding method for forming the wavelength conversion member **205** may be adopted in various ways. In particular, a transfer molding method in which resin powder and phosphor are mixed, softened at high temperature and high pressure to form a gel or liquefied, and press-fitted into a cavity of a heated mold to form a tablet may be advantageously used. Alternatively, a molding method for flattening the upper surface of the wavelength conversion member **205** using screen printing or a squeeze method may also be an alternative. The wavelength conversion member **205** may be formed to surround a side surface as well as an upper surface of the flip-type LED chip **200**.

[0086] The reflective member **210** is disposed on the frame **21**, forms a cavity accommodating the LED chip **200** therein, and may reflect light emitted from the LED chip **200**. The reflective member **210** may be formed to surround the side surface of the LED chip **200**, and may be made of a reflective material that reflects light emitted from the LED chip **200**.

[0087] The reflective member **210**, like the reflective member **110** according to an embodiment, has a first side **211** and a second side **212** different from the first side **211**, a first height of the first side **211** and a second height of the second side **212** may be different from each other. Here, the light-emitting device package **20** of the present disclosure may radiate light emitted from the LED chip **200** to the upper portion of the LED chip **200**, and may also radiate light in a lateral direction through the second side **212** having a different height.

[0088] The first side **211** may be formed of a pair of sides facing each other among four sides of the reflective member **210**, and the second side **212** may be formed of the remaining pair of sides among the four sides of the reflective member **210**. For example, when the light-emitting device package **20** has a structure in which a length in one direction is greater than a length in the other direction as illustrated in the drawing, the first side **211** may be a pair of sides arranged in a long axis direction, and the second side **212** may be a pair of sides arranged in a short axis direction.

[0089] An inner surface of the first side **211** may be formed as an inclined surface with constant



inclination. The first side **211** may reflect the light emitted from the LED chip **200** to the upper portion of the LED chip **200** through this inclination.

[0090] The total height of the second side **212** does not need to be less than the height of the first side **211**, and as illustrated in the drawing, a predetermined area of the second side **212** may be less than the height of the first side **211** to form an open area A. In other words, the second side **212** may have the open area A having the second height less than the first height of the first side **211**. Through this, the reflective member **210** may expose the light-transmitting member **230** to be described later through the open area A.

[0091] The light-transmitting member **230** may be filled inside the cavity to cover the LED chip **200**. The light-transmitting member **230** may be made of a transmissive material that transmits light emitted from the LED chip **200**. The light-transmitting member **230** may be an organic or inorganic resin material. For example, the reflective member **230** may contain an organic or inorganic resin material such as silicone, epoxy, heat-resistant resin polyimide, phenol resin, melamine resin, unsaturated polyester resin, tritan, and the like.

[0092] If the side heights of the reflective member **210** are the same, the light-transmitting member **230** may be formed to have an almost flat surface when filled in the cavity of the reflective member **210**. However, in the present disclosure, since the height of the second side **212** of the reflective member **210** is less than the height of the first side **211**, the light-transmitting member **230** may have an externally convex curved surface rather than the flat surface. Accordingly, a height of an uppermost end of the light-transmitting member **230** may be formed to be greater than a height of an uppermost end of the reflective member **210**.

[0093] FIG. **9** is a diagram schematically illustrating a light-emitting device package **30** according to another embodiment of the present disclosure, FIG. **10** is a plan view of the light-emitting device package **30** of FIG. **9**, and FIG. **11** is a cross-sectional view taken along line XI-XI of FIG. **9**.

[0094] Referring to FIGS. **9** to **11**, in a light-emitting device package **30** according to another embodiment of the present disclosure, a reflective member **310** has a plurality of cavities corresponding to a plurality of LED chips **300**, and hereinafter, for convenience of description, a case in which two cavities C1 and C2 are provided and two LED chips **300A** and **300B** are mounted will be mainly described. In addition, since the light-emitting device package **30** is the same as or similar to the above-described embodiment except that it includes two cavities C1 and C2, overlapping descriptions will be omitted.

[0095] The light-emitting device package **30** according to the present disclosure may include a frame **31**, an LED chip **300**, a reflective member **310** and a light-transmitting member **320**.

[0096] The frame **31** may be formed to have a long shape in one direction, and two LED chips **300A** and **300B** may be mounted along a long axis direction of the frame **31**. To this end, two pairs of first electrodes R1 and R3 and second electrodes R2 and R4 may be arranged along the long axis direction in the frame **31**. The frame **31** is electrically connected to each of the two LED chips **300A** and **300B** by the two pairs of first electrodes R1 and R3 and second electrodes R2 and R4, and may be manufactured with material having adequate mechanical strength to support the LED chip **300**.

[0097] The LED chip **300** may include a substrate **301**, a semiconductor laminate structure **302**, a first conductive connection pad **303** and a second conductive connection pad **304**.

[0098] The substrate **301** may be a sapphire substrate having a light-emitting surface, and may be formed of zinc oxide (ZnO), gallium nitride (GaN), silicon carbide (SiC), aluminum nitride (AlN), etc. in addition to sapphire.

[0099] The semiconductor laminate structure **302** may be a gallium nitride-based semiconductor laminate structure formed on the substrate **301**. The semiconductor laminate structure **302** includes a first conductive semiconductor layer, an active layer and a second conductive semiconductor layer. At this time, although illustrated briefly in the drawings, parts of the second conductive semiconductor layer and the active layer are selectively removed, so that a part of the first

conductive semiconductor layer is exposed, and the first conductive connection pad **303** may be connected through an exposed region. Also, the second conductive connection pad **304** is connected to the second conductive semiconductor layer.

[0100] The light-emitting device package **30** according to the present disclosure may include the plurality of LED chips **300**, and the plurality of LED chips **300** may be two or more. The first conductive connection pad **303** may be electrically connected to the first electrodes **R1** and **R3**, and the second conductive connection pad **304** may be electrically connected to the second electrodes **R2** and **R4**. Although the drawing illustrates that the first electrodes **R1** and **R3** and the second electrodes **R2** and **R4** are arranged to intersect along the long axis direction of the frame **31**, the present disclosure is not limited thereto, depending on how electrical wirings are connected, the second electrodes **R2** and **R4** may be disposed in a central region of the frame **31**, and the first electrodes **R1** and **R3** may be disposed in an outer region.

[0101] The LED chip **300** may emit at least one of ultraviolet light, blue light, green light, and red light, and may emit light of a short wavelength such as ultraviolet light or blue light.

[0102] The reflective member **310** is disposed on the frame **31**, and forms two cavities **C1** and **C2** accommodating two LED chips **300A** and **300B** therein, respectively, and may reflect light emitted from the two LED chips **300A** and **300B**. Specifically, the reflective member **310** may include a body **311** disposed on the frame **31** to form an internal space, and a partition wall **313** separating the internal space of the body **311**.

[0103] The body **311** may be disposed along a periphery of the frame **31** to form the internal space on the frame **31**. The body **311** may be made of a reflective material that reflects light emitted from the plurality of LED chips **300**. As another embodiment, the body **311** may be made of an absorbing material that absorbs light emitted from the plurality of LED chips **300**. Hereinafter, for convenience of explanation, a case where the body **311** is made of the reflective material will be mainly described.

[0104] The body **311** may be a structure of a molding resin material having an open top to accommodate the plurality of LED chips **300** in the internal space. In this case, the reflective member **310** may separate the internal space of the body **311** by using the partition wall **313** to form a first cavity **C1** and a second cavity **C2** accommodating the LED chip **300** therein, respectively. The partition wall **313** may be made of the same material as the body **311**, and for example, the body **311** and the partition wall **313** may be integrally manufactured using a single molding.

[0105] The reflective member **310** may contain a light reflective material such as titanium oxide, silicon dioxide, titanium dioxide, zirconium dioxide, potassium titanate, alumina, aluminum nitride, boron nitride, mullite, chromium, white-based or metal-based substance in these resins. In addition, the reflective member **310** may further include boron nitride (BN), aluminum nitride (AlN), aluminum (Al), graphite, and the like. Through this, the reflective member **310** may improve heat dissipation performance.

[0106] Specifically, the body **311** of the reflective member **310** may include a first side **311A** having a first height **h1** and a second side **311B** having a second height **h2**, and the second height **h2** may be less than the first height **h1**. The body **311** of the reflective member **310** may expose the light-transmitting member **320** to be described later through the second side **311B** formed at a lower level than the first side **311A**. Through this, the light-emitting device package **30** of the present disclosure may radiate light emitted from the LED chip **300** to an upper portion of the LED chip **300**, and also radiate light in a lateral direction through the second side **311B** having a different height.

[0107] The first side **311A** may be formed of a pair of sides facing each other among four sides of the body **311**, and the second side **311B** may be formed of the remaining pair of sides among the four sides of the body **311**. For example, when the light-emitting device package **30** has a structure in which a length **L1** in one direction is greater than a length **L2** in the other direction as illustrated

in the drawing, the first side **311A** may be a pair of sides arranged in a long axis direction, and the second side **311B** may be a pair of sides arranged in a short axis direction.

[0108] An inner surface of the first side **311A** may be formed as an inclined surface with constant inclination. The first side **311A** may reflect the light emitted from the LED chip **300** to the upper portion of the LED chip **300** through this inclination.

[0109] The total height of the second side **311B** does not need to be less than the height of the first side **311A**, and as illustrated in the drawing, a predetermined area of the second side **311B** may be less than the height of the first side **311A** to form an open area A. In other words, the second side **311B** may have the open area A having the second height  $h_2$  less than the first height  $h_1$  of the first side **311A**. In this case, the second height  $h_2$  may be equal to or less than half of the first height  $h_1$ . When the open area A is viewed from a side surface of the light-emitting device package **30**, a central portion of the second side **311B** may be formed in a concave groove structure (see FIG. 2).

[0110] An inner surface of the open area A may be formed of a stepped structure of two or more steps. As an embodiment, a portion of the inner surface of the open area A may have a three-step structure including a curved surface. The open area A may effectively reflect the light emitted from the LED chip **300** in the lateral direction through the structure at least partially formed of the curved surface.

[0111] Specifically, the open area A of the second side **311B** may include a first area **A1** having the curved surface, and a second area **A2** and a third area **A3** connected to both sides of the first area **A1**. The first area **A1** may have the curved surface as described above, and the curved surface may have a parabolic shape profile concave toward an inside of the reflective member **310**.

[0112] The first area **A1** may be disposed on the second area **A2** having a predetermined height. Through this, the first area **A1** having the curved surface is arranged at a position corresponding to the LED chip **300** having a certain thickness, and an imaginary extension surface **PA** extending from an upper surface of the LED chip **300** may pass through the first area **A1** of the open area A having the curved surface. Through this structure, the open area A may effectively reflect the light emitted from the LED chip **300** in the lateral direction as well.

[0113] The third area **A3** may be disposed on the first area **A1**, and may be formed in a stepped structure having a predetermined height. The light-transmitting member **320** to be described later is a material filled and accommodated in the first cavity **C1** and the second cavity **C2** of the reflective member **310**, and has initial fluidity. The third area **A3** may be formed as the stepped structure to prevent the light-transmitting member **320** having this fluidity from overflowing from the second side **311B** that is at a lower level than the first side **311A** in height.

[0114] Meanwhile, the partition wall **313** may separate the internal space formed by the body **311** to form the first cavity **C1** and the second cavity **C2** accommodating the LED chip **300**, respectively. The partition wall **313** may have the same height  $h_1$  as the first side **311A** of the body **311**. However, the present disclosure is not limited thereto, and as another embodiment, the height of the partition wall **313** may have the same height  $h_2$  as the open area A of the second side **311B**.

[0115] The partition wall **313** may include a first side surface **W1** and a second side surface **W2** that face each other. As an embodiment, each of the first side surface **W1** and the second side surface **W2** may be formed as an inclined surface having constant inclination, similarly to the inner surface of the first side **311A**. In another embodiment, each of the first side surface **W1** and the second side surface **W2** may be formed of a stepped structure of two or more steps. Specifically, each of the first side surface **W1** and the second side surface **W2** may be formed of a stepped structure having the same structure as the open area A of the second side **311B**.

[0116] The light-transmitting member **320** may be filled in the first cavity **C1** and the second cavity **C2** to cover the LED chip **300**. The light-transmitting member **320** may be formed of a light-transmitting resin layer, but is not limited thereto.

[0117] The light-transmitting member **320** may be formed by a mixture of at least one phosphor and, for example, an encapsulant made of a resin powder. As an embodiment, when the LED chip

**300** is a blue LED chip, the light-transmitting member **320** may include red phosphor excited by blue light to emit red light and green phosphor emitting green light, or may include a yellow phosphor excited by blue light to emit yellow light.

[0118] If the side heights of the reflective member **310** are the same, the light-transmitting member **320** may be formed to have an almost flat surface when filled in the cavity of the reflective member **310**. However, in the present disclosure, since the height of the second side **311B** of the reflective member **310** is less than the height of the first side **311A**, the light-transmitting member **320** may have an externally convex curved surface rather than the flat surface. Accordingly, a height of an uppermost end of the light-transmitting member **320** may be formed to be greater than a height of an uppermost end of the reflective member **310**.

[0119] In one embodiment, the light-transmitting member **320** may be filled with the same light-transmitting material in the first cavity **C1** and the second cavity **C2**, but is not limited thereto, may be filled with materials to which different types of phosphor are added so that different colors of light are emitted. In another embodiment, the light-transmitting member **320** may be filled with a material in which phosphor is added to only one of the first cavity **C1** and the second cavity **C2**, if necessary.

[0120] FIGS. **12** to **14** are views for explaining light-emitting device packages **30A**, **30B** and **30C** according to an optional embodiment of the present disclosure.

[0121] Referring to FIG. **12**, in a light-emitting device package **30A** according to an embodiment, phosphor, which is a wavelength conversion material, is not added to the light-transmitting member **320**, and a separate wavelength conversion member **340** including phosphor is further included.

[0122] The wavelength conversion member **340** is for converting the wavelength of light emitted from the LED chip **300**, and may be formed to cover or attach to an upper surface of the LED chip **300**. The wavelength conversion member **340** may cover the upper surface of at least one LED chip **300** disposed inside a first cavity **C1** and a second cavity **C2**. In addition, in the wavelength conversion member **340**, an outer edge of the wavelength conversion member **340** is preferably formed wider than an outer edge of the LED chip **300**, so that wavelength conversion for light reflected by a light reflecting surface of the reflective member **310** is possible.

[0123] Although the drawing illustrates the wavelength conversion member **340** in a form of being disposed on the upper surface of the LED chip **300**, it may be applied to other appropriate locations located on a light emission path, and the location of the wavelength conversion member **340** may be variously changed according to the structure of the light-emitting device package **30A**.

[0124] Referring to FIG. **13**, a light-emitting device package **30B** according to another embodiment may include a sealing member **350** covering a side surface of an LED chip **300**. The LED chip **300** may include a silver plating layer, but there is a problem in that the silver plating layer is discolored by exposure to external air. The sealing member **350** covers the side surface of the LED chip **300** to prevent the silver plating layer from being exposed to the outside, thereby preventing discoloration of the silver plating layer and securing reliability.

[0125] The sealing member **350** has a certain height and may cover the side surface of the LED chip **300**. The sealing member **350** may be accommodated inside a cavity to surround a mounting area of the LED chip **300**, and may be formed to extend from the side surface of the LED chip **300** to a reflective member **310**.

[0126] Like the reflective member **310**, the sealing member **350** may contain a light reflective material such as titanium oxide, silicon dioxide, titanium dioxide, zirconium dioxide, potassium titanate, alumina, aluminum nitride, boron nitride, mullite, chromium, white-based or metal-based substance in resins. For example, the sealing member **350** may be a white silicone resin containing titanium oxide ( $\text{TiO}_2$ ) in an amount of 5% to 50%. The light-emitting device package **30B** according to the present disclosure may prevent thermal deterioration and discoloration of the LED chip **300** by using the sealing member **350**, and realize high reliability.

[0127] Referring to FIG. **14**, a light-emitting device package **30C** according to another embodiment

may include a diffusion member **360** that changes a direction of light emitted from a light-emitting surface of a LED chip **300** and diffuses it in a lateral direction. The diffusion member **360** may diffuse the light emitted from the LED chip **300** with uniform brightness.

[0128] The diffusion member **360** may include a plurality of irregular irregularities on a lower or upper surface. The light incident from the LED chip **300** may be diffused and scattered due to the irregularities. As an embodiment, the diffusion member **360** may be formed of an optically transparent resin such as polyethylene terephthalate (PET), polypropylene (PP), polycarbonate (PC), or polymethyl methacrylate (PMMA). In another embodiment, the diffusion member **360** may include a plurality of scattering particles therein, and the scattering particles may be formed of an acrylic resin, a styrene resin, or the like.

[0129] The diffusion member **360** may have a predetermined thickness and may be included in any one of a first cavity **322A** and a second cavity **322B**, and may uniformly diffuse incident light to form a uniform illuminance. In addition, the diffusion member **360** diffuses the light emitted from the LED chip **300** in a lateral direction, thereby further increasing the amount of light exposed in a lateral direction of the light-emitting device package **30C**.

[0130] The light-emitting device package according to the embodiments of the present disclosure having the above-described structure forms the open area by lowering a height of a portion of the side, so that the directivity angle to the open area and the amount of light may be increased. Through this, the light-emitting device package may be combined with a secondary optical system such as lenses and reflectors of lighting that requires light distribution in some directions, such as crosswalk light, street light, transmissive light, to secure efficient directional distribution.

[0131] The light-emitting device package according to the embodiments of the present disclosure may improve the uniformity of luminance between the light-emitting devices, and may improve stains at an edge portion of the light-emitting device package.

[0132] As such, the present disclosure has been described with reference to one embodiment shown in the drawings, but it is merely exemplary, and those skilled in the art will understand that various modifications and variations of the embodiments are possible therefrom. Accordingly, the true technical protection scope of the present disclosure should be determined by the technical spirit of the appended claims.

[0133] The light-emitting device package according to embodiments of the present disclosure forms the open area by lowering a height of a portion of the side, thereby increasing the directivity angle and the amount of light to the open area.

[0134] The light-emitting device package according to the embodiments of the present disclosure may improve the uniformity of luminance between the light-emitting devices, and may improve stains at an edge portion of the light-emitting device package.

[0135] It should be understood that embodiments described herein should be considered in a descriptive sense only and not for purposes of limitation. Descriptions of features or aspects within each embodiment should typically be considered as available for other similar features or aspects in other embodiments. While one or more embodiments have been described with reference to the figures, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope as defined by the following claims.

## Claims

1. A light-emitting device package comprising: a frame comprising one side on which a first electrode is formed and the other side on which a second electrode is formed; an LED chip comprising a substrate having an upper surface, a semiconductor laminate structure formed under the substrate, and a wavelength conversion member covering at least the upper surface of the substrate and a side surface of the semiconductor laminate structure, wherein a first conductive

connection pad electrically connected to the first electrode and a second conductive connection pad electrically connected to the second electrode are formed under the semiconductor laminate structure; a reflective member disposed on the frame, forming a cavity for accommodating the LED chip therein, and reflecting light emitted from the LED chip; and a light-transmitting member filled in the cavity to cover the LED chip, wherein the reflective member comprises a first side and a second side different from the first side, and a first height of the first side is different from a second height of the second side.

2. The light-emitting device package of claim 1, wherein the second side comprises an open area having the second height less than the first height of the first side.
  3. The light-emitting device package of claim 2, wherein the light-transmitting member is exposed through the open area.
  4. The light-emitting device package of claim 2, wherein an inner surface of the open area has a stepped structure of two or more steps.
  5. The light-emitting device package of claim 4, wherein a portion of the inner surface of the open area is formed of a curved surface.
  6. The light-emitting device package of claim 5, wherein an imaginary extension surface extending from an upper surface of the LED chip passes through a first area of the open area including the curved surface.
  7. The light-emitting device package of claim 1, wherein the second height is equal to or less than half of the first height.
  8. The light-emitting device package of claim 1, wherein a length of the first side of the reflective member is greater than a length of the second side thereof.
  9. The light-emitting device package of claim 1, wherein an inner surface of the first side is made of an inclined surface having a constant inclination.
  10. The light-emitting device package of claim 1, wherein a height of an uppermost end of the light-transmitting member is greater than a height of an uppermost end of the reflective member.
-