

Description

Title of Invention: LED LEADFRAME PACKAGE, LED PACKAGE USING THE SAME, AND METHOD OF MANUFACTURING THE LED PACKAGE

Technical Field

- [1] The present invention relates to a light emitting diode (LED) lead frame package, a LED package using the LED lead frame package, and a method of manufacturing the LED package, and more particularly, to a LED lead frame package, which can be easily manufactured at reduced manufacturing costs, an LED package using the LED lead frame package, and a method of manufacturing the LED package.

Background Art

- [2] A light emitting diode (LED) is a semiconductor illuminating apparatus which has various advantages as compared to conventional illuminating apparatuses. For example, an LED has a long life span, has a compact size, small power consumption, and no quicksilver pollution. Accordingly, LEDs are frequently used as new illuminating apparatuses instead of conventional illuminating apparatuses.
- [3] In order to improve light output of an LED package, a convex lens structure is usually introduced on an outer optical layer of the LED package. In conventional LED packages, the convex lens structure is manufactured in advance and then mounted on the conventional LED packages. Due to this additional manufacture of the convex lens structure and an assembly process thereof, additional manufacturing process and an assembling device therefor are required. Moreover, when mounting the convex lens structure manufactured beforehand onto the conventional LED packages, an undesired air layer may be formed between the convex lens structure and a sealing layer that is already formed on the LED package. Also, according to the conventional art, when forming a sealing layer on a LED die to protect the LED die, it is difficult to form a convex curvature in an external surface of the sealing layer. Accordingly, the manufacture yield of the method of manufacturing a LED package according to the conventional art is relatively low, and the production costs thereof are high.
- [4] In order to provide a white LED for emitting white light, a phosphor layer is usually coated directly on a blue LED die or a ultraviolet (UV) LED die. For example, when a blue LED die is used, light having various wavelengths generated in a phosphor material may be mixed with one another or the light having various wavelengths may be mixed with blue excitation light emitted from the blue LED die, thereby emitting white light. However, when the LED die is directly coated with a phosphor layer, since the LED die and the phosphor layer are very near to each other, light emitted from the

phosphor material proceeds to the LED die and is absorbed by the LED die.

- [5] Thus, disposing a transparent spacer between the LED die and the phosphor layer has been suggested so that light emitted from the phosphor layer is incident to the LED die or a substrate near the LED die, thereby reducing the probability of light absorption. FIG. 1 illustrates an example of the above technique disclosed in U.S. Patent No. 5,959,316. Referring to FIG. 1, a LED die 60 is mounted on a substrate 62, and a phosphor layer 66 is separated away from the LED die 60 via a spacer 64 covering the LED die 60. Also, a protection layer 68 is formed outside the phosphor layer 66. However, also in this structure, light emitted from the phosphor layer 66 may be incident to the LED die 60 and onto the substrate 62 and thus be absorbed thereby without being hardly disturbed.

Disclosure of Invention

Technical Problem

- [6] The present invention provides a light emitting diode (LED) lead frame package and a LED package using the LED lead frame package, which can be easily manufactured at reduced manufacturing costs.

Solution to Problem

- [7] The present invention also provides an LED package in which light emitted from a phosphor material is incident to a LED die and is absorbed thereby, thereby reducing light absorption loss.
- [8] The present invention also provides a method of manufacturing a LED package in which a LED package is easily manufactured at reduced manufacturing costs.
- [9] According to an aspect of the present invention, there is provided a lead frame package comprising:
- [10] a heat dissipation base;
- [11] a plurality of electrodes disposed around the heat dissipation base;
- [12] an insulation support portion that surrounds the heat dissipation base and the plurality of electrodes to fix the heat dissipation base and the plurality of electrodes;
- [13] at least two ring-shaped protrusions formed along circumferential outlines on an upper surface of the insulation support portion; and
- [14] at least one ring-shaped groove formed between the at least two ring-shaped protrusions.
- [15] According to an aspect of the present invention, there is provided a light emitting diode (LED) package comprising the above-mentioned lead frame package.
- [16] For example, the LED package comprises:
- [17] at least one LED die attached on a bottom surface of the heat dissipation base;
- [18] a plurality of wires electrically connecting the at least one LED die and the plurality

- of electrodes; and
- [19] a sealing layer structure that is formed to cover the LED die and comprises at least one layer having a convex external surface,
- [20] wherein an edge of the at least one layer of the sealing layer structure is extended to corresponding one of the at least two ring-shaped protrusions.
- [21] According to another aspect of the present invention, there is provided a method of manufacturing an LED package, the method comprising:
- [22] providing a lead frame package comprising: a heat dissipation base; a plurality of electrodes disposed around the heat dissipation base; an insulation support portion that surrounds the heat dissipation base and the plurality of electrodes to fix the heat dissipation base and the plurality of electrodes; at least two ring-shaped protrusions formed along circumferential outlines on an upper surface of the insulation support portion; and at least one ring-shaped groove formed between two of the at least two ring-shaped protrusions,
- [23] attaching at least one LED die on a bottom surface of the heat dissipation base; electrically connecting the LED die and the plurality of electrodes; and
- [24] forming at least one layer that has a convex external surface, to cover the LED die,
- [25] wherein an edge of the at least one layer of the sealing layer structure is extended to corresponding one of the at least two ring-shaped protrusions.

Brief Description of Drawings

- [26] The above and other features and advantages of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:
- [27] FIG. 1 is a cross-sectional view illustrating an example of a white light emitting diode (LED) according to the conventional art;
- [28] FIG. 2 is a perspective view of a LED lead frame package structure according to an embodiment of the present invention;
- [29] FIG. 3 is a top plan view illustrating the LED lead frame package of FIG. 2;
- [30] FIG. 4 is a perspective view showing the arrangement of a heat dissipation base and a plurality of electrodes of the LED lead frame package illustrated in FIG. 2, not an insulation support portion, according to an embodiment of the present invention;
- [31] FIG. 5 is a cross-sectional view illustrating the LED lead frame package structure of FIG. 2;
- [32] FIG. 6 is a cross-sectional view illustrating a structure of an LED package according to an embodiment of the present invention;
- [33] FIG. 7 is a cross-sectional view illustrating a structure of an LED package according to another embodiment of the present invention; and

- [34] FIGS. 8 and 9 are cross-sectional views schematically illustrating the principle of a method of manufacturing an LED package, according to an embodiment of the present invention.

Best Mode for Carrying out the Invention

- [35] The present invention will now be described more fully with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown. Like reference numerals in the drawings denote like elements, and sizes of elements are exaggerated for convenience and clarity of description.
- [36] FIG. 2 is a perspective view of a structure of a light emitting diode (LED) lead frame package 20 according to an embodiment of the present invention. Referring to FIG. 2, the LED lead frame package 20 includes a heat dissipation base 2, four electrodes 1 arranged around the heat dissipation base 2, and an insulation support portion 3 that surrounds the heat dissipation base 2 and the plurality of electrodes 1 to fix the heat dissipation base 2 and the plurality of electrodes 1. In the present embodiment, the LED lead frame package 20 includes four electrodes 1; however the present invention is not limited thereto, and the LED lead frame package 20 may include one or more electrodes 1. The insulation support portion 3 may be formed of an insulating plastic material such as poly phthal amide (PPA).
- [37] FIG. 3 is a top plan view of the LED lead frame package 20 of FIG. 2. Referring to FIG. 3, the LED lead frame package 20 includes, for the four identical metal electrodes 1 that are arranged in a radial direction. The four electrodes 1 may be respectively arranged at 90 degree around a center axis of the heat dissipation base 2 and protrude in a radial direction from the center axis of the heat dissipation base 2. FIG. 4 is a perspective view schematically illustrating the arrangement of the heat dissipation base 2 and the four electrodes 1, not the insulation support portion 3. Referring to FIG. 4, upper surfaces of the four electrodes 1 are at the same height of a highest point of the heat dissipation base 2. Also, as illustrated in FIGS. 2 through 4, a first end portion of the electrodes 1 may face a lateral circumference of the heat dissipation base 2, and a second end portion of the electrode 1 may be disposed to protrude from an outer wall of the insulation support portion 3. The upper surfaces of the electrodes 1 may be coated with, for example, a highly reflective material such as silver or aluminum.
- [38] Also, referring to FIG. 4, the heat dissipation base 2 may have a reflective cup 10 having a cavity form. A bottom surface of the reflective cup 10 may be coated with a highly reflective material such as silver or aluminum. An upper surface of the reflective cup 10 is at the highest point of the heat dissipation base 2. That is, the upper surface of the reflective cup 10 may be formed at the same height as the upper surface of the electrodes 1.

- [39] As illustrated in FIG. 4, the heat dissipation base 2 and the plurality of electrodes 1 are fixed by the insulation support portion 3 that surrounds them. To this end, the electrodes 1, the heat dissipation base 2, and the insulation support portion 3 may be integrally formed with a process such as an injection molding process.
- [40] FIG. 5 is a cross-sectional view illustrating the structure of the LED lead frame package 20 of FIG. 2. Referring to FIG. 5 and FIG. 2, the LED lead frame package 20 may further include at least two ring-shaped protrusions, namely, ring-shaped protrusions 11, 12, 13, and 14 that are formed along circumferential outlines on an upper surface of the insulation support portion 3 and at least one ring-shaped groove, namely, ring-shaped grooves 15, 16, and 17 that are respectively formed between two of the ring-shaped protrusions 11, 12, 13, and 14. The plurality of ring-shaped protrusions 11, 12, 13, and 14 and the plurality of ring-shaped grooves 15, 16, and 17 may be formed concentrically on the upper surface of the insulation support portion 3. As illustrated in FIG. 5, the plurality of ring-shaped protrusions 11, 12, 13, and 14 may be formed with sharp edges and inclined sidewalls.
- [41] The plurality of ring-shaped protrusions 11, 12, 13, and 14 and the plurality of ring-shaped grooves 15, 16, and 17 may be formed of the same PPA plastic as the insulation support portion 3, and may be a portion of the insulation support portion 3. For example, the plurality of ring-shaped protrusions 11, 12, 13, and 14 and the plurality of ring-shaped grooves 15, 16, and 17 may be formed on the upper surface of the insulation support portion 3 with a transfer molding process. Alternatively, the plurality of ring-shaped protrusions 11, 12, 13, and 14 and the plurality of ring-shaped grooves 15, 16, and 17 may also be formed during the injection molding process in which the plurality of electrodes 1, the heat dissipation base 2, and the insulation support portion 3 are integrally formed. In FIG. 5, four ring-shaped protrusions and three ring-shaped grooves are formed, but the number of ring-shaped protrusions and ring-shaped grooves may be selected variously according to embodiments of the present invention.
- [42] When the LED lead frame package 20 having the above-described structure including the plurality of ring-shaped protrusions 11, 12, 13, and 14 and the plurality of ring-shaped grooves 15, 16, and 17 is used in the manufacture of an LED package, sealing layers having a multilayer structure may be easily formed. FIG. 6 is a cross-sectional view illustrating a structure of an LED package 30 in which the LED lead frame package 20 is used, according to an embodiment of the present invention. Referring to FIG. 6, the LED package 30 includes a LED die 4 attached on a bottom surface of the heat dissipation base 2, a plurality of wires 6 that electrically connect the LED die 4 and the electrodes 1, a sealing layer 7 formed on the reflection cup 10 of the heat dissipation base 2 to cover the LED die 4, a phosphor layer 8 formed to cover the sealing layer 7, and an optical lens layer 9 formed to cover the phosphor layer 8.

- [43] The LED die 4 may be fixed on a bottom surface of the heat dissipation base 2 with, for example, a die adhesive material 5, that is, on the bottom surface of the reflection cup 10 of the heat dissipation base 2. Examples of the die adhesive material 5 are a silver paste and a solder. In the present embodiment, the LED package 30 includes one LED die 4 disposed on the bottom surface of the heat dissipation base 2; however the present invention is not limited thereto, and the LED package 30 can include a plurality of LED dies 4 disposed on the bottom surface of the heat dissipation base 2. For example, at least one selected from the group consisting of a UV LED, a blue LED, a green LED, and a red LED may be disposed on the bottom surface of the heat dissipation base 2.
- [44] The sealing layer 7, the phosphor layer 8, and the optical lens layer 9 constitute a multilayer sealing layer structure. For efficient light output, the sealing layer 7, the phosphor layer 8, and the optical lens layer 9 may have convex external surfaces. Also, in order to prevent that light emitted from the phosphor layer 8 is incident to the LED die 4 and absorbed by the LED die 4, an effective refractive index of the sealing layer 7 may be smaller than that of the phosphor layer 8 in a wavelength band of visible light.
- [45] The phosphor layer 8 emits visible light by being excited by UV light, blue light or green light. To this end, the phosphor layer 8 may be formed of a mixture in which a transparent material such as glass, polycarbonate (PC), poly(methyl methacrylate) (PMMA), or silicon resin is uniformly mixed with a phosphor material. Examples of the phosphor material include at least one type of phosphor material that emits visible light having different wavelengths by being excited by UV light, blue light or green light. For example, the phosphor material may be at least one selected from the group consisting of various types of phosphor materials emitting visible light having different wavelengths such as blue, green, yellow, orange, or red light. The green, yellow, orange, and red phosphor materials may partially absorb blue light or green light at least or completely absorb UV light to emit light spectrums having peak wavelengths in the green, yellow, orange, and red color wavelength ranges. Also, the blue phosphor material may emit a light spectrum having a peak wavelength in a blue color range by completely absorbing UV light.
- [46] The LED package 30 emitting white light may be provided by using the phosphor layer 8. For example, when the LED die 4 emits blue light in a wavelength range of 450 nm to 480 nm, the phosphor layer 8 may be excited by blue light to emit light having a yellow peak wavelength. Then the yellow light and residual blue light are mixed, thereby forming white light. Also, the phosphor layer 8 may include various types of phosphor materials that emit light of various wavelengths by being excited by light having an excitation wavelength emitted from the LED die 4. In this case, white

light is emitted as the light of various wavelengths are mixed. For example, when the LED die 4 emits near-UV rays in a range of 380 nm to 450 nm, the phosphor layer 8 may include blue, green, and red phosphor materials that respectively emit light having blue, green, and red peak wavelengths by being excited by the near-UV rays. Then as the blue, green and red lights are mixed, white light is formed.

- [47] According to the current embodiment of the present invention, the sizes of the sealing layer 7, the phosphor layer 8, and the optical lens layer 9 and curvature of upper surfaces thereof may be easily adjusted with the plurality of ring-shaped protrusions 11, 12, 13, and 14 and the plurality of ring-shaped grooves 15, 16, and 17. As illustrated in FIG. 6, an edge of the sealing layer 7 is extended to the ring-shaped protrusion 11, and an edge of the phosphor layer 8 is extended to the ring-shaped protrusion 12, and an edge of the optical lens layer 9 is extended to the ring-shaped protrusion 13. As the edges of the sealing layer 7, the phosphor layer 8, and the optical lens layer 9 are defined to the ring-shaped protrusions 11, 12, and 13, respectively, the sizes of the sealing layer 7, the phosphor layer 8, and the optical lens layer 9 may be easily defined. Also, by adjusting the amounts of the material of the sealing layer 7, the phosphor layer 8, and the optical lens layer 9 defined to the corresponding ring-shaped protrusions 11, 12, and 13, the curvature of the upper surfaces of the sealing layer 7, the phosphor layer 8, and the optical lens layer 9 may be easily determined.
- [48] Hereinafter, a method of manufacturing the LED package 30 as described above will be described in detail. First, the LED lead frame package 20 including the heat dissipation base 2, the plurality of electrodes 1 disposed around the heat dissipation base 2, the insulation support portion 3 that surrounds the heat dissipation base 2 and the plurality of electrodes 1 to fix the same, the plurality of ring-shaped protrusions 11, 12, 13, and 14 formed on the upper surface of the insulation support portion 3, and the plurality of ring-shaped grooves 15, 16, and 17 respectively formed between two of the plurality of ring-shaped protrusions 11, 12, 13, and 14 is manufactured using, for example, an injection molding process. Then, at least one LED die 4 is attached on a bottom surface of the heat dissipation base 2 with the die adhesive material 5, and the LED die 4 and the plurality of electrodes 1 are electrically connected to each other via a plurality of wires 6.
- [49] Next, a liquid transparent resin material is filled in the reflection cup 10 of the heat dissipation base 2 to cover the LED die 4. For example, the liquid transparent resin material may be a silicon resin. The liquid transparent resin material may be provided to a sufficient amount while being defined within the ring-shaped protrusion 11. Then an external surface of the liquid transparent resin material is formed convex due to surface tension within an upper sharp edge of the ring-shaped protrusion 11. For example, as illustrated in FIG. 8, when a transparent resin material 18 is provided with

a sufficient amount within the ring-shaped protrusion 11, a convex external surface is formed by surface tension. A curvature of the convex external surface may be determined by the amount of the transparent resin material 18. Even if too much of the transparent resin material 18 is used and thus the transparent resin material 18 overflows the ring-shaped protrusion 11, the transparent resin material 18 may be defined within the ring-shaped protrusion 12 again as illustrated in FIG. 9. When the external surface of the transparent resin material reaches a desired curvature in this manner, the liquid transparent resin material 18 is hardened by heat or UV ray irradiation, thereby forming the sealing layer 7. Accordingly, the size and curvature of the sealing layer 7 may be easily defined.

[50] Then, another liquid transparent resin material to which a phosphor material is uniformly mixed is formed over the sealing layer 7 to cover the sealing layer 7. For example, a mixture in which a liquid silicon resin and a phosphor material are uniformly mixed may be formed over the sealing layer 7. The mixture is defined to the ring-shaped protrusion 12, and has a convex external surface within a sharp upper edge of the ring-shaped protrusion 12 due to surface tension. After the external surface of the mixture reaches a desired curvature, the liquid mixture is hardened by heat or UV ray irradiation, thereby forming the phosphor layer 8.

[51] Finally, another liquid transparent resin material is formed over the phosphor layer 8 to cover the phosphor layer 8. For example, the liquid transparent resin material may be a silicon resin. The liquid transparent resin material over the phosphor layer 8 is defined to the third ring-shaped protrusion 13 and has a convex external surface within a sharp upper edge of the third ring-shaped protrusion 13 due to surface tension. Then, the liquid transparent resin material over the phosphor layer 8 is hardened to form the optical lens layer 9. In this manner, the sealing layer 7, the phosphor layer 8, and the optical lens layer 9 may be formed to have desired sizes and desired external surface curvatures.

[52] FIG. 7 is a cross-sectional view illustrating a structure of an LED package 40 according to another embodiment of the present invention. Unlike the LED package 30 illustrated in FIG. 6, the LED package 40 of FIG. 7 includes two sealing layers, namely, first and second sealing layers 7 and 7a, under the phosphor layer 8. That is, the second sealing layer 7a that is transparent is further formed between the phosphor layer 8 and the first sealing layer 7. The rest of the structure of the LED package 40 of FIG. 7 is the same as that of the LED package 30 illustrated in FIG. 6. Thus, the description of the rest of the structure of the LED package 40 will be omitted.

[53] Referring to FIG. 7, the first sealing layer 7, the second sealing layer 7a, the phosphor layer 8, and the optical lens layer 9 together form a multi-layer sealing layer structure. For efficient light output, the first sealing layer 7, the second sealing layer

7a, the phosphor layer 8, and the optical lens layer 9 may have convex external surfaces. Also, in order to prevent that light emitted from the phosphor layer 8 is incident to the LED die 4 and be absorbed by the LED die 4, an effective refractive index of the second sealing layer 7a is smaller than that of the phosphor layer 8 in a wavelength of visible light, and also smaller than that of the first sealing layer 7.

[54] As illustrated in FIG. 7, an edge of the first sealing layer 7 is extended to the ring-shaped protrusion 11, and an edge of the second sealing layer 7a is extended to the ring-shaped protrusion 12, and an edge of the phosphor layer 8 is extended to the ring-shaped protrusion 13, and an edge of the optical lens layer 9 is extended to the fourth ring-shaped protrusion 14. By defining the edges of the first sealing layer 7, the second sealing layer 7a, the phosphor layer 8, and the optical lens layer 9 to the plurality of ring-shaped protrusions 11, 12, 13, and 14, respectively, the sizes of the first sealing layer 7, the second sealing layer 7a, the phosphor layer 8, and the optical lens layer 9 may be easily defined. Also, by adjusting the amounts of material respectively provided to the first sealing layer 7, the second sealing layer 7a, the phosphor layer 8, and the optical lens layer 9 defined in the plurality of ring-shaped protrusions 11, 12, 13, and 14, the curvature of upper surfaces of the first sealing layer 7, the second sealing layer 7a, the phosphor layer 8, and the optical lens layer 9 may be easily determined.

[55] The sealing layer structure of the LED package 40 illustrated in FIG. 7 may be formed by using the above-described method of manufacturing the LED package 30. The difference between the LED packages 40 and 30 is that the second sealing layer 7a is formed before forming the phosphor layer 8 on the first sealing layer 7. That is, the first sealing layer 7 is first formed using the above-described method, and then a liquid transparent resin material is formed on the first sealing layer 7 to cover the first sealing layer 7. For example, the liquid transparent resin material may be a silicon resin. The liquid transparent resin material is formed to have a smaller effective refractive index than that of the first sealing layer 7. For example, an additive for adjusting an effective refractive index may be added to the silicon resin that is liquid. The liquid transparent resin material on the first sealing layer 7 is defined within the ring-shaped protrusion 12 and has a convex external surface in a sharp upper edge of the ring-shaped protrusion 12 due to surface tension. Then, by hardening the liquid transparent resin material on the first sealing layer 7 using heat or UV irradiation, the second sealing layer 7a may be formed. Next, in the same manner as described above, the phosphor layer 8 and the optical lens layer 9 are sequentially formed on the second sealing layer 7a. However, the material of the phosphor layer 8 is filled so as to be defined within the ring-shaped protrusion 13, and the material of the optical lens layer 9 is filled so as to be defined within the ring-shaped protrusion 14.

- [56] The first sealing layer 7, the second sealing layer 7a, the phosphor layer 8, and the optical lens layer 9 described above are sequentially formed using a liquid material but some of the layers may also be pre-made using separate processes.
- [57] For example, the phosphor layer 8 may be formed beforehand. In this case, the first sealing layer 7 is formed in the reflection cup 10 to cover the LED die 4. Then a liquid transparent resin for forming the second sealing layer 7a is provided within a concave inner portion of the phosphor layer 8 that is pre-made to have the concave inner portion and a convex external portion. Then the phosphor layer 8 in which the transparent resin material is filled is overturned and disposed on the first sealing layer 7, and then the transparent resin material is hardened by using heat or UV irradiation. Then the second sealing layer 7a is formed between the first sealing layer 7 and the phosphor layer 8, and the phosphor layer 8 may be tightly fixed on the first sealing layer 7. Then as described above, the optical lens layer 9 may be formed on the phosphor layer 8.
- [58] Alternatively, the phosphor layer 8 and the optical lens layer 9 may be pre-made. In this case, the pre-made phosphor layer 8 is fixed on the first sealing layer 7 as in the above-described manner. Then, the optical lens layer 9 which is pre-made may be attached on the phosphor layer 8. Also, only the optical lens layer 9 may be pre-made. In this case, the first sealing layer 7, the second sealing layer 7a, and the phosphor layer 8 are formed sequentially using a liquid material, and then the pre-made optical lens layer 9 is attached on the phosphor layer 8.
- [59] In order to manufacture a white light LED package, a multilayer sealing layer structure including the phosphor layer 8 as described above may be used. However, when manufacturing a color LED package emitting predetermined wavelength light, a LED die 4 emitting light of the wavelength may be attached on a bottom surface of the heat dissipation base 2, and only one transparent sealing layer may be formed on the LED die 4. For example, as illustrated in FIG. 8, one transparent resin material 18 may be defined within one of the first through fourth ring-shaped protrusions 11 through 14 and then hardened, thereby completing a color LED package.
- [60] While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, 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 of the present invention as defined by the following claims.

Claims

- [Claim 1] A lead frame package comprising:
a heat dissipation base;
a plurality of electrodes disposed around the heat dissipation base;
an insulation support portion that surrounds the heat dissipation base and the plurality of electrodes to fix the heat dissipation base and the plurality of electrodes;
at least two ring-shaped protrusions formed along circumferential outlines on an upper surface of the insulation support portion; and
at least one ring-shaped groove formed between the at least two ring-shaped protrusions.
- [Claim 2] The lead frame package of claim 1, wherein the insulation support portion is formed of poly phthal amide (PPA) plastic.
- [Claim 3] The lead frame package of claim 1, wherein the plurality of electrodes are disposed such that a first end portion of the electrodes faces a side of the heat dissipation base, and a second end portion of the electrodes protrudes from an outer wall of the insulation support portion.
- [Claim 4] The lead frame package of claim 1, wherein the heat dissipation base comprises a reflection cup, wherein a bottom surface of the reflection cup is coated with a reflective material.
- [Claim 5] The lead frame package of claim 1, wherein the at least two ring-shaped protrusions each comprise a sharp upper edge and inclined sidewalls.
- [Claim 6] The lead frame package of claim 1, wherein the heat dissipation base, the plurality of electrodes, and the insulation support portion are integrally formed with an injection molding process.
- [Claim 7] The lead frame package of claim 1, wherein the ring-shaped protrusions and the ring-shaped groove are formed on an upper surface of the insulation support portion with a transfer molding process.
- [Claim 8] A light emitting diode (LED) package comprising a lead frame package of one of claims 1 through 7.
- [Claim 9] The LED package of claim 8, wherein the LED package comprises:
at least one LED die attached on a bottom surface of the heat dissipation base;
a plurality of wires electrically connecting the at least one LED die and the plurality of electrodes; and
a sealing layer structure that is formed to cover the LED die and

comprises at least one layer having a convex external surface, wherein an edge of the at least one layer of the sealing layer structure is extended to corresponding one of the at least two ring-shaped protrusions.

- [Claim 10] The LED package of claim 9, wherein the LED die comprises at least one selected from the group consisting of a UV LED, a blue LED, a green LED, and a red LED.
- [Claim 11] The LED package of claim 9, wherein the sealing layer structure comprises at least one transparent sealing layer.
- [Claim 12] The LED package of claim 9, wherein the curvature of an upper surface of the at least one layer is determined by adjusting an amount of a material provided to the at least one layer of the sealing layer structure.
- [Claim 13] The LED package of claim 9, wherein the sealing layer structure comprises:
a first sealing layer that is transparent and is formed to directly cover the LED die;
a phosphor layer covering the first sealing layer; and
an optical lens layer covering the phosphor layer.
- [Claim 14] The LED package of claim 13, wherein an effective refractive index of the first sealing layer is smaller than an effective refractive index of the phosphor layer in a wavelength band of visible light.
- [Claim 15] The LED package of claim 13, wherein the sealing layer structure further comprises a second sealing layer that is transparent and is formed between the first sealing layer and the phosphor layer.
- [Claim 16] The LED package of claim 15, wherein an effective refractive index of the second sealing layer is smaller than an effective refractive index of the first sealing layer and an effective refractive index of the phosphor layer in a wavelength band of visible light.
- [Claim 17] The LED package of claim 16, wherein the phosphor layer is formed by uniformly mixing a phosphor material in glass, polycarbonate (PC), poly(methyl methacrylate) (PMMA), or silicon resin.
- [Claim 18] The LED package of claim 17, wherein the phosphor material emits visible light by being excited by UV light, blue light, or green light.
- [Claim 19] The LED package of claim 18, wherein the phosphor material comprises at least one phosphor material that emits visible light of different wavelengths by being excited by UV light, blue light, or green light.
- [Claim 20] A method of manufacturing an LED package, the method comprising:

providing a lead frame package comprising: a heat dissipation base; a plurality of electrodes disposed around the heat dissipation base; an insulation support portion that surrounds the heat dissipation base and the plurality of electrodes to fix the heat dissipation base and the plurality of electrodes; at least two ring-shaped protrusions formed along circumferential outlines on an upper surface of the insulation support portion; and at least one ring-shaped groove formed between two of the at least two ring-shaped protrusions,

attaching at least one LED die on a bottom surface of the heat dissipation base; electrically connecting the LED die and the plurality of electrodes; and

forming at least one layer that has a convex external surface, to cover the LED die,

wherein an edge of the at least one layer of the sealing layer structure is extended to corresponding one of the at least two ring-shaped protrusions.

[Claim 21]

The method of claim 20, wherein the forming of the sealing layer structure comprises:

providing a liquid transparent resin material over the heat dissipation base to cover the LED die; and

forming a first sealing layer by hardening the liquid transparent resin material, wherein the first sealing layer has a convex external surface formed by surface tension, within a sharp upper edge of a ring-shaped protrusion among the plurality of ring-shaped protrusions.

[Claim 22]

The method of claim 21, further comprising:

providing a liquid transparent resin material over the first sealing layer to cover the first sealing layer;

forming a second sealing layer by hardening the liquid transparent resin material on the first sealing layer;

providing a liquid transparent resin material over the second sealing layer to cover the second sealing layer,

wherein a phosphor material is uniformly mixed in the liquid transparent resin material;

forming a phosphor layer by hardening the liquid transparent resin material in which the phosphor material is mixed;

providing a liquid transparent resin material over the phosphor layer to cover the phosphor layer; and

forming an optical lens layer by hardening the liquid transparent resin

material on the phosphor layer.

[Claim 23]

The method of claim 22, wherein the second sealing layer has a convex external surface formed by surface tension within a sharp upper edge of another ring-shaped protrusion among the plurality of ring-shaped protrusions, the phosphor layer has a convex external surface formed by surface tension within a sharp upper edge of another ring-shaped protrusion among the plurality of ring-shaped protrusions, and the optical lens layer has a convex external surface formed by surface tension within a sharp upper edge of the another ring-shaped protrusion among the plurality of ring-shaped protrusions.

[Claim 24]

The method of claim 21, further comprising:

providing a liquid transparent resin material, in which a phosphor material is uniformly mixed, over the first sealing layer to cover the first sealing layer;

forming a phosphor layer by hardening the liquid transparent resin material in which the phosphor material is mixed;

providing a liquid transparent resin material over the phosphor layer to cover the phosphor layer; and

forming an optical lens layer by hardening the liquid transparent resin material on the phosphor layer.

[Claim 25]

The method of claim 24, wherein the phosphor layer has a convex external surface formed by surface tension within a sharp upper edge of another ring-shaped protrusion among the plurality of ring-shaped protrusions, and the optical lens layer has a convex external surface formed by surface tension within a sharp upper edge of another ring-shaped protrusion among the plurality of ring-shaped protrusions.