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Request for Examination

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(54) LIGHT EMITTING DIODE PACKAGE AND MANUFACTURING METHOD THEREOF

Abstract

The present invention discloses a light emitting diode package which has a plurality of high-power light emitting diodes mounted in a package form, and achieves excellent heat dissipation while maintaining high luminance, and a manufacturing method thereof. The present invention includes: a wiring part configured to control power and signal input and output to a plurality of light emitting diodes; a plurality of light emitting diodes mounted on the wiring part; a reflection cup part coupled to the wiring part to reflect light of the light emitting diodes; and a lens part disposed on the reflection cup part to irradiate light generated in the light emitting diodes to an outside.

Here, a heat sink is attached to a bottom surface of the wiring part on which the light emitting diodes are mounted to discharge heat generated from the light emitting diodes to the outside through the wiring part. The lens part is a Fresnel lens having various shapes, and the wiring part is a metal core PCB.

Main Figure

FIG. 3

Search Terms:

light emitting diode, package, red, green, blue

Specification

Brief Description of the Drawings

FIG. 1 is a view illustrating a related-art light emitting diode package.

FIG. 2 is a view illustrating a related-art light emitting diode package which has a plurality of light emitting diodes mounted in a single mold lens.

FIG. 3 is a view illustrating a high-power light emitting diode package according to the present invention.

FIG. 4 is a view illustrating an LED package shape manufactured by the present invention.

Explanation of Signs for Main Parts in the Drawings

300: LED package	301a: red LED chip
301b: green LED chip	301c: blue LED chip
311: reflection cup part	320: wiring part
322: silicon resin	330: lens part
350: heat sink	

Detailed Descriptions of the Invention

Objects of the Invention

Technical field to which the invention belongs and background art

The present invention relates to a light emitting diode package and a manufacturing method thereof, and more particularly, to a light emitting diode package which has a plurality of high-power light emitting diodes mounted in a package form, and is excellent in terms of high luminance and heat dissipation, and a manufacturing method thereof.

Typically, a light emitting diode refers to a diode that emits excessive energy as light when injected electrons and holes are recombined with each other, and includes a red light emitting diode which uses GaA, sP, etc., a green light emitting diode which uses GaP, etc., and a blue light emitting diode which uses a InGaN/AlGaIn double hetero structure.

These light emitting diodes are widely used in various fields such as number, characters display elements, signal light sensors, light sources for optical coupled devices due to their merits of low-voltage, low-power.

Four requirements should be met in order to manufacture good-quality light emitting diodes as follows.

The first requirement is good luminance, the second requirement is a long lifespan, the third requirement is thermal stability, and the fourth requirement is an operation at a low voltage.

Since luminance in such requirements is closely related to power consumption of devices, various methods are currently developing to increase luminance of light emitting diodes.

The basic structure of a light emitting diode is completed by growing a GaN buffer layer, a under GaN layer, an n-type dopant GaN layer, an active layer, and a P-type gallium nitride layer on a sapphire substrate in sequence.

A transparent metal (TM) layer is grown on the P-type gallium nitride layer to transmit light generated in the active layer to the outside.

The operating principle of the LED having the above-described structure is that when a voltage of a forward direction is applied to a semiconductor of a specific element, electrons and holes are recombined with each other while moving through a junction portion between a positive pole and a negative pole, and an energy level decreases due to the combination of electrons and holes, causing light to be emitted.

In addition, the LEDs are manufactured in very small sizes, typically 0.25 mm^2 , and have such a structure that they are mounted in an epoxy mold, a lead frame, and a PCB.

For the most commonly used LEDs, 5 mm (T 1 3/4) plastic packages or new types of packages are developing according to specific applications. Light emitted from the LEDs make wavelengths according to the mix of semiconductor chip components and these wavelengths determine colors of light.

According to the trend toward miniaturization and slimness of information communication devices, various components of devices, such as resistors, capacitors, noise filters, get miniaturized, and LEDs are made in the form of a surface mount device (SMD) in order to be directly mounted on a printed circuit board (PCB).

Accordingly, LED lamps which are used as display devices are developing in the form of a SMD. Such SMDs may simply replace existing lighting lamps and may be used as a lighting indicator, a character indicator, and an image indicator representing various colors.

As LEDs are widely used as described above, luminance required for lamps used in daily life, lamps for distress signals gradually increases, and recently, high-power light emitting diodes are widely used.

FIG. 1 is a view illustrating a related-art light emitting diode package.

As shown in FIG. 1, an LED package 100 is configured by forming molds for a red LED chip 101a, a green LED chip 101b, and a blue LED chip 101c independently.

That is, the red LED chip 101a, the green LED chip 101b, and the blue LED chip 101c are mounted on a wiring part 120 used for the LED package 100, and a red mold 110a, a green mold 110b, and a blue mold 110c are formed over the LED chips 101a, 101b, 101c, respectively.

Signal input and output terminals drawn out from the red LED chip 101a, the green LED chip 101b, and the blue LED chip 101c individually mounted are bonded onto the wiring part 120, and the bonded input and output terminals are electrically connected with connection pins 121 disposed under the wiring part 120 to be exposed to the outside of the wiring part 120.

The red LED chip 101a, the green LED chip 101b, and the blue LED chip 101c are electrically connected with the wiring part 120 by wire bonding, and the molds are formed by an epoxy resin.

Since the related-art light emitting diode package 100 having the above-described structure is operated by low power and the respective LED chips are

independently driven, the characteristics of monochromatic light corresponding to the respective LED chips are excellent.

FIG. 2 is a view illustrating a related-art LED package having a plurality of light emitting diodes mounted in a single mold lens. As shown in the drawing, a red LED chip 201a, a green LED chip 201b, a blue LED chip 201c are mounted in the single mold lens all together.

That is, the red LED chip 201a, the green LED chip 201b, the blue LED chip 201c are wire-bonded onto a wiring part 220, and a package mold 210 is formed over the wire-bonded LED chips 201a, 201b, 201c by an epoxy resin, thereby completing the LED package 200.

Since the LED chips 201a, 201b, 201c are disposed within a single mold, an electrical connection relationship between the wiring part 220 and the LED chips 201a, 201b, 201c is simpler than when molds are formed for the LED chips, respectively, and the number of connection pins 221 exposed under the wiring part 220 is smaller.

Since molding is performed on the entire three LED chips by a single epoxy, there is an advantage in implementing high-power light emitting diodes.

However, in the method of molding for the red LED chip, the green LED chip, and the blue LED chip, independently, in the related-art LED package as shown in FIG. 1, the plurality of LED chips should be mounted, respectively, in order to form the high-power light emitting diode package, which makes the package manufacturing process so complicated and causes a bulkiness issue.

In addition, the LED package has resistance components to the respective LED chips, and thus there are many thermal resistors, which cause problems of power loss and heat dissipation.

In the structure in which three LED chips are mounted in a single mold as described in FIG. 2, wire bonding should be performed to electrically connect the LED chips to the wiring part, respectively, which causes problems that the process is complicated and the volume increases to output high luminance.

In particular, since the plurality of LED chips are mounted within the single mold, more heat is generated but heat dissipation is more difficult to perform compared to the LED package where molds are independently formed.

Technical objects to be achieved by the invention

An object of the present invention is to provide a light emitting diode package which has a plurality of high-power light emitting diodes mounted in the form of a package and has a heat sink attached to the bottom surface of the package, thereby having excellent heat discharging functions and high luminance, and a manufacturing method thereof.

Constitution and operation of the invention

To achieve the above-described object and to solve the problem, a light emitting diode package according to the present invention may include:

- a wiring part configured to control power and signal input and output to a plurality of light emitting diodes;

- a plurality of light emitting diodes mounted on the wiring part;

- a reflection cup part coupled to the wiring part to reflect light of the light emitting diodes; and

- a lens part disposed on the reflection cup part to irradiate light generated in the light emitting diodes to an outside.

Here, a heat sink may be attached to a bottom surface of the wiring part on which the light emitting diodes are mounted to discharge heat generated from the light emitting diodes to the outside through the wiring part. The lens part may be a Fresnel lens having various shapes, and the wiring part may be a metal core PCB.

In addition, the Fresnel lens may have a center formed in a convex lens shape and may have concavo-convex portions symmetric to each other with reference to the convex lens. The heat sink may be formed in a concavo-convex shape to have an extended surface area, the reflection cup part may be made of any one material of Cu, Al, or polycarbonate, and a reflection coating treatment by Ag may be performed on a surface of an inner area of the reflection cup part in which the light emitting diode is mounted.

In addition, a method for manufacturing a light emitting diode package according to the present invention may include the steps of:

- mounting a plurality of light emitting diodes on a wiring part which is made of metal;

- mounting a reflection cup part on the wiring part on which the light emitting diodes are mounted to reflect light;

- performing a molding operation on an opened inside of the reflection cup part in which the light emitting diode is mounted; and

- attaching a lens onto the reflection cup part on which the molding operation is performed.

Here, a heat sink may further be included on a bottom surface of the wiring part to which the lens is attached, and the LED chips mounted on the wiring part may be mounted by selecting any one of wire bonding or flip-chip bonding.

The present invention can maximize luminance by mounting the plurality of high-power light emitting diodes in a package form, and achieves excellent heat dissipation by attaching the heat sink to the bottom surface of the package.

In addition, by mounting the plurality of LED chips in a single package, the manufacturing process is simplified.

Hereinafter, preferred embodiments of the present invention will be described based on the accompanying drawings.

FIG. 3 is a view illustrating a high-power light emitting diode package according to the present invention.

As shown in FIG. 3, the high-power light emitting diode package is mainly divided into a light emitting diode part 301a, 301b, 301c, a lens part 330, and a wiring part 320.

The light emitting diode part 301a, 301b, 301c is a structure in which red LED chips 301a, green LED chips 301b, blue LED chips 301c emitting red, blue, and green light, respectively, are combined. Although three LED chips 301a, 301b, 301c are illustrated in FIG. 3, a plurality of LED chips may be used to correspond to Fresnel lenses of various shapes as shown in FIG. 4.

The lens part 330 is configured with Fresnel lenses, and the Fresnel lens has a convex lens structure that has a low height at the center thereof, and the convex lens has concavo-convex shapes on the left and right thereof to be symmetric to each other, and the height of the concavo-convex shape is similar to the height of the convex lens.

The Fresnel lens having the above-described structure has the advantage that the height is lower than in a related-art LED lens structure formed by molding, and the same light luminance is maintained.

The wiring part 320 is formed by a metal core printed circuit board (PCB) and has the LED chips 301a, 301b, 301c mounted thereon and is electrically connected therewith.

The metal core PCB of the wiring part 320 is used for a large area that has a plurality of chips mounted thereon, and may apply an electric current to cause the chips to operate while electrically connecting terminals of the mounted chips.

In addition, the wiring part 320 is made of metal and is excellent in terms of heat dissipation as high heat generated from the mounted LED chips 301a, 301b, 301c is discharged to the outside through the wiring part 320.

In order to enhance the heat dissipation effect of the wiring part 320, a heat sink 350 formed in a concavo-convex shape to increase a heat dissipation surface area may be attached or may be integrally formed with the wiring part 320.

A reflection cup part 311 is disposed to enhance light efficiency of the LED chips 301a, 301b, 301c mounted on the wiring part 320, and the reflection cup part 311 serves to enhance light efficiency of the LED chips 301a, 301b, 301c mounted on the wiring part 320 while supporting the lens part 330.

The reflection cup part 311 is made of copper (Cu), aluminum (Al), polycarbonate (PC), and a reflection coating film made of Ag metal is formed on an inner side surface of the reflection cup part 311, that is, areas that light generated from the LED chips 301a, 301b, 301c directly contacts.

When the reflection cup part 311 is attached to the wiring part 320 on which the LED chips 301a, 301b, 301c are mounted, a silicon resin 322 fills to maximize external

quantum efficiency by filling with a material of the same refractive index, while protecting a flip chip or wire bonding.

The plurality of light emitting diodes, the lens part 330 which includes Fresnel lenses having various shapes, and the wiring part 320 which has the plurality of light emitting diodes mounted thereon to generate high light output, and is capable of dissipating generated heat to the outside rapidly are assembled into a single module structure.

A process of manufacturing the light emitting diode package according to the present invention as described above will be described hereinbelow.

The plurality of light emitting diodes 301a, 301b, 301c, that is, the red LED chip 301a, the green LED chip 301b, and the blue LED chip 301c, are mounted on the wiring part 320.

In this case, the red LED chip 301a is suitable for wire bonding rather than flip-chip bonding due to its red luminescence, and therefore, electrodes of the red LED chips 301a are caused to electrically contact circuit terminals on the wiring part 320.

The green LED chips 301b, the blue LED chips 301c directly contact circuit terminals on the wiring part 320 by flip chip bonding.

When the LED chips 301a, 301b, 301c are mounted on the wiring part 320 as described above, the reflection cup part 311 is coupled with the wiring part to support the Fresnel lenses to be mounted while enhancing light reflectance of the LEDs.

The reflection cup part 311 has a structure in which areas where the LED chips 301a, 301b, 301c are mounted are opened, and the LED chips 301a, 301b, 301c mounted on the wiring part 320 are positioned in the open areas.

When the reflection cup part 311 is coupled to the wiring part 320, molding is performed on the LED chips 301a, 301b, 301c surrounded by the reflection cup part 311 by injecting a silicon resin 322.

Since the high-power LED chips 301a, 301b, 301c are mounted, molding is performed by using the silicon resin 322, so that deformation caused by deterioration of molding by a general epoxy resin, or yellowing can be prevented.

When molding is performed on the LED chips 301a, 301b, 301c by the silicon resin 322, the lens part 330 which includes the Fresnel lenses having a plano-convex lens structure is coupled with the reflection cup part 311, and the coupled lens part 330 is bonded to the silicon resin 322 molded on the LED chips 301a, 301b, 301c and the reflection cup part 311 with a constant force.

When the lens part 330 is coupled with the reflection cup part 311, the lens part 330 may be coupled by using a heat-resistant adhesive on the reflection cup part 311.

After the lens part 330 is coupled with the reflection cup part 311, pins are arranged along the edge of the lens part 330 to couple the lens part 330 to fix the entire LED package 300.

When the lens part 330 is coupled to the reflection cup part 311 as described above, the LED package 300 is completed by attaching a heat sink 350 having a

concavo-convex shape to the bottom surface of the wiring part 320 of the LED package 300 to discharge high heat generated from the high-power LED chips to the outside of the LED package 300.

Accordingly, without molding directly after the plurality of high-power light emitting diodes are directly arranged on the wiring part 320, the reflection cup part 311, the Fresnel lens 330 and the heat sink 350 are coupled, thereby having a single module structure.

That is, the high-luminance LED package 300 can be implemented by the plurality of light emitting diodes, and the heat sink 350 is attached to rapidly discharge high heat generated by high power to the outside of the LED package 300.

FIG. 4 is a view illustrating an LED package shape manufactured according to the present invention.

As shown in FIG. 4, FIG. 4 is a top view illustrating the shape of the lens part attached to the LED package of FIG. 3.

The lens part uses the Fresnel lens that has a low height and various shapes, and has a linear shape, a circular shape, a hexagonal shape, a square shape, and is used to manufacture various types of packages having LED chips mounted thereon.

A plurality of high-power light emitting diodes arranged in various shapes may be mounted in the form of a single package, and may be manufactured to be assembled in a single module shape.

An LED package where the Fresnel lenses are packaged in a linear shape may be used for backlight, and an LED package in which the Fresnel lenses are packaged in a circular shape may be used for signal lights, car headlights, and interior lightings.

The Fresnel lenses arranged in a square shape or hexagonal shape may be used for various lighting components used in daily life, such as lightings, marine signal lights, emergency lights, stadium lights, search lights.

Accordingly, the present invention can package the plurality of high-power light emitting diodes as described above, and can rapidly discharge high heat generated therefrom to the outside, and therefore, may be used as a high-luminance LED package module.

By packaging and configuring the plurality of light emitting diodes as described above, the manufacturing process is simplified and costs are reduced.

Effect of the Invention

As described above, the present invention can maximize luminance by mounting the plurality of high-power light emitting diodes in a package form, and achieves excellent heat dissipation and high-luminance by attaching the heat sink to the bottom surface of the package.

In addition, by mounting the plurality of LED chips in a single package, the manufacturing process is simplified.

The present invention is not limited to the above-described embodiments, and various changes can be made by those skilled in the art without departing from the scope of the claims.

(57) Claims

Claim 1

A light emitting diode package comprising:
a wiring part configured to control power and signal input and output to a plurality of light emitting diodes;
a plurality of light emitting diodes mounted on the wiring part;
a reflection cup part coupled to the wiring part to reflect light of the light emitting diodes; and
a lens part disposed on the reflection cup part to irradiate light generated in the light emitting diodes to an outside.

Claim 2

The light emitting diode package of claim 1, wherein a heat sink is attached to a bottom surface of the wiring part on which the light emitting diodes are mounted to discharge heat generated from the light emitting diodes to the outside through the wiring part.

Claim 3

The light emitting diode package of claim 1, wherein the lens part is a Fresnel lens having various shapes.

Claim 4

The light emitting diode package of claim 1, wherein the wiring part is a metal core PCB.

Claim 5

The light emitting diode package of claim 3, wherein the Fresnel lens has a center formed in a convex lens shape and has concavo-convex portions symmetric to each other with reference to the convex lens.

Claim 6

The light emitting diode package of claim 2, wherein the heat sink is formed in a concavo-convex shape to have an extended surface area.

Claim 7

The light emitting diode package of claim 1, wherein the reflection cup part is made of any one material of Cu, Al, or polycarbonate.

Claim 8

The light emitting diode package of claim 1, wherein a reflection coating treatment by Ag is performed on a surface of an inner area of the reflection cup part in which the light emitting diode is mounted.

Claim 9

A method for manufacturing a light emitting diode package, the method comprising the steps of:

mounting a plurality of light emitting diodes on a wiring part which is made of metal;

mounting a reflection cup part on the wiring part on which the light emitting diodes are mounted to reflect light;

performing a molding operation on an opened inside of the reflection cup part in which the light emitting diode is mounted; and

attaching a lens onto the reflection cup part on which the molding operation is performed.

Claim 10

The method of claim 9, wherein a heat sink is further included on a bottom surface of the wiring part to which the lens is attached.

Claim 11

The method of claim 9, wherein the LED chips mounted on the wiring part are mounted by selecting any one of wire bonding or flip-chip bonding.

Figure

Figure 1

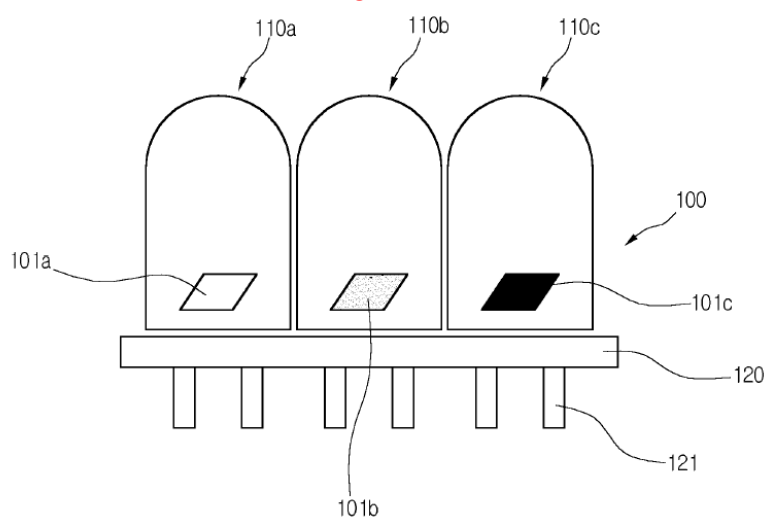


Figure 2

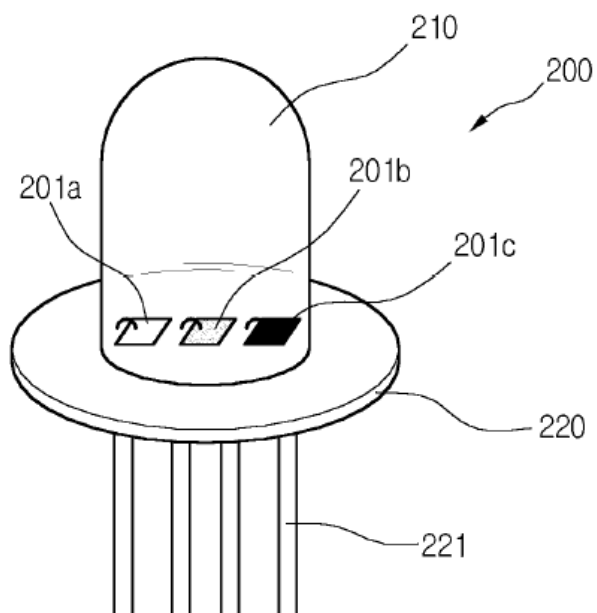


Figure 3

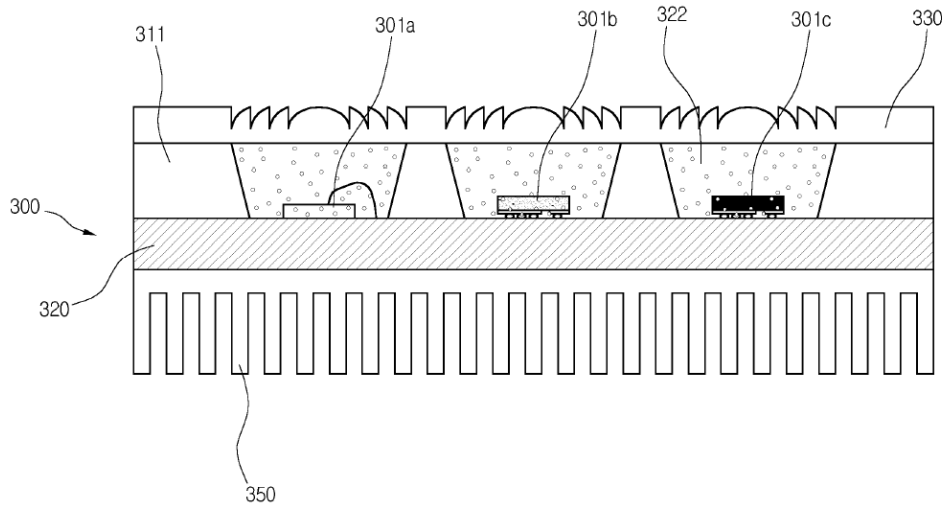
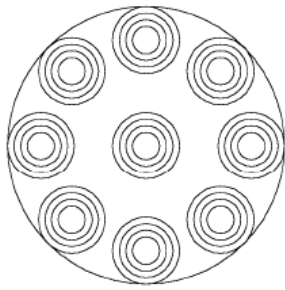


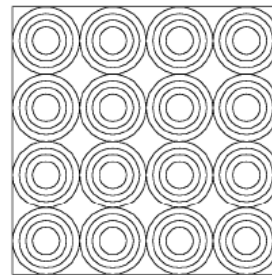
Figure 4



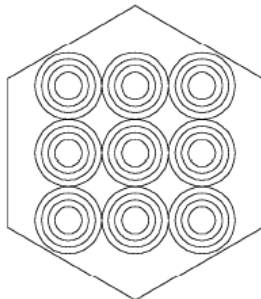
(a)



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VERIFICATION OF TRANSLATION

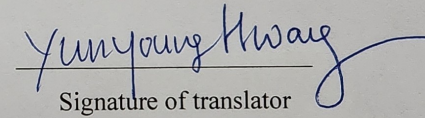
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hereby declare as follows:

1. I am a translator and am familiar with both the Korean and English languages.
2. I am the translator of the document attached hereto and certify to the best of my knowledge and belief that the attached document is an accurate and complete translation of the [R2-KR1020050012372A_Application_en-US].

Dated this 7th day of [October] 2024


Signature of translator