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(54) **LIGHT EMITTING DIODE PACKAGE STRUCTURE FOR INCREASING HEAT-DISSIPATING AND LIGHT-EMITTING EFFICIENCY, AND METHOD FOR MANUFACTURING THE SAME**

LEUCHTDIODE-VERPACKUNGSSTRUKTUR ZUR ERHÖHUNG DER WÄRMEABLEITUNGS- UND LICHTEMISSIONSEFFIZIENZ, UND VERFAHREN ZUR HERSTELLUNG DERSELBEN

STRUCTURE DE BOÎTIER DE DIODE ÉLECTROLUMINESCENTE POUR AUGMENTER L'EFFICACITÉ DE DISSIPATION DE LA CHALEUR ET L'EFFICACITÉ D'ÉMISSION LUMINEUSE, ET SON PROCÉDÉ DE FABRICATION

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(56) References cited:
EP-A2- 0 335 683
DE-A1-102007 010 882
US-A1- 2002 004 251
US-A1- 2005 151 149
US-A1- 2007 170 454
US-A1- 2008 023 711
US-A1- 2008 099 770
US-A1- 2009 166 657

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a light emitting diode (LED) package structure and a method for manufacturing the same, in particular, to an LED package structure for increasing heat-dissipating and light-emitting efficiency and a method for manufacturing the same.

2. Description of Related Art

[0002] The invention of the lamp greatly changed the style of building construction and the living style of human beings, allowing people to work during the night. Without the invention of the lamp, we may stay in the living conditions of ancient civilizations.

[0003] Various lamps such as incandescent bulbs, fluorescent bulbs, power-saving bulbs and etc. have been intensively used for indoor illumination. These lamps commonly have the disadvantages of quick attenuation, high power consumption, high heat generation, short working life, high fragility, and being not recyclable. Further, the rapid flow of electrons (about 120 per second) through the electrodes of a regular fluorescent bulb causes an unstable current at the onset of lighting a fluorescent bulb, resulting in a flash of light that is harmful to the sight of the eyes. In order to eliminate this problem, a high frequency electronic ballast may be used. When a fluorescent or power-saving bulb is used with high frequency electronic ballast, it saves about 20% of the consumption of power and eliminates the problem of flashing. However, the high frequency electronic ballast is not detachable when installed in a fluorescent or power-saving bulb, the whole lamp assembly becomes useless if the bulb is damaged. Furthermore, because a fluorescent bulb contains a mercury coating, it may cause pollution to the environment when thrown away after damage. Hence, LED lamp or LED tube is created in order to solve the above-mentioned questions of the prior lamp. US 2008/0023711 A1, US 2005/0151149 A1, US 2007/0170454 A1, US 2002/0004251 A1, US 2008/0099770 A1 and US 2009/0166657 A1 disclose various known LED packages.

SUMMARY OF THE INVENTION

[0004] In view of the aforementioned issues, the present invention provides an LED package structure for increasing heat-dissipating and light-emitting efficiency and a method for manufacturing the same. Because a Ni/Pd alloy is formed on the bottom side of solidified solder ball or solder glue, the solidified solder ball or solder glue cannot react with a chip-placing pad of a substrate body to form an IMC (Intermetallic Compound) that is brittle during reflow process.

[0005] To achieve the above-mentioned objectives, the present invention provides an LED package structure for increasing heat-dissipating and light-emitting efficiency, including: a substrate unit, an alloy unit, a light-emitting unit, a conductive unit, a light-reflecting unit and a package unit. The substrate unit has a substrate body, at least one first conductive pad, at least one second conductive pad and at least one chip-placing pad, and the at least one first conductive pad, the at least one second conductive pad and the at least one chip-placing pad are formed on a top surface of the substrate body. The substrate body has a circuit substrate, a heat-dissipating layer disposed on a bottom surface of the circuit substrate, and an insulative reflecting layer disposed on the top surface of the circuit substrate to expose the at least one first conductive pad, the at least one second conductive pad and the at least one chip-placing pad. The alloy unit has at least one Ni/Pd alloy formed on the at least one chip-placing pad. The light-emitting unit has at least one LED chip positioned on the at least one Ni/Pd alloy of the alloy unit by solidified solder ball or solder glue. The conductive unit has at least two conductive wires, and the at least one LED chip is electrically connected to the at least one first conductive pad through one of the at least two conductive wires, and the at least one LED chip is electrically connected to the at least one second conductive pad through the other conductive wire. The light-reflecting unit has an annular reflecting gel body surroundingly coated on the top surface of the insulative reflecting layer, wherein the annular reflecting gel body surrounds the at least one LED chip to form a gel position limiting space. The package unit has a light-transmitting package gel body formed on the top surface of the substrate body in order to cover the light-emitting unit and the conductive unit, wherein the position of the light-transmitting package gel body is limited in the gel position limiting space.

[0006] To achieve the above-mentioned objectives, the present invention provides a method for manufacturing an LED package structure for increasing heat-dissipating and light-emitting efficiency, including: -providing a substrate unit that has a substrate body, at least one first conductive pad, at least one second conductive pad and at least one chip-placing pad, wherein the at least one first conductive pad, the at least one second conductive pad and the at least one chip-placing pad are formed on a top surface of the substrate body, and the substrate body has a circuit substrate, a heat-dissipating layer disposed on a bottom surface of the circuit substrate, and an insulative reflecting layer disposed

on the top surface of the circuit substrate to expose the at least one first conductive pad, the at least one second conductive pad and the at least one chip-placing pad; - forming at least one Ni/Pd alloy on the at least one chip-placing pad; - placing at least one LED chip on the at least one Ni/Pd alloy via solder ball or solder glue; -solidifying the solder ball or solder glue to form a solidified solder ball or solder glue, wherein the at least one LED chip is positioned on the at least one Ni/Pd alloy by the solidified solder ball or solder glue; - electrically connecting the at least one LED chip between the at least one first conductive pad and the at least one second conductive pad through at least two conductive wires, wherein the at least one LED chip is electrically connected to the at least one first conductive pad through one of the at least two conductive wires, and the at least one LED chip is electrically connected to the at least one second conductive pad through the other conductive wire; - surroundingly coating an annular reflecting gel body on the top surface of the insulative reflecting layer, wherein the annular reflecting gel body surrounds the at least one LED chip to form a gel position limiting space ; and -forming a light-transmitting package gel body on the top surface of the substrate body in order to cover the at least one LED chip and the at least two conductive wires, wherein the position of the light-transmitting package gel body is limited in the gel position limiting space.

[0007] Therefore, because the Ni/Pd alloy is formed on the bottom side of the solidified solder ball or solder glue, the solidified solder ball or solder glue cannot react with the chip-placing pad of the substrate body to form an IMC (Intermetallic Compound) that is brittle during reflow process. Hence, when the LED chip is disposed on the solidified solder ball or solder glue by reflow process, the soldering intensity (joint intensity) between the solidified solder ball or solder glue and the chip-placing pad of the substrate body can be strengthened. In addition, the alloy unit has another two Ni/Pd alloys (or two Ni/Pd/Au alloys) that are respectively formed on the top surface of the first conductive pad and the top surface of the second conductive pad, so that the conductive unit such as two gold wires are respectively electrically bonded to the one Ni/Pd alloys on the first conductive pad and another Ni/Pd alloys on the second conductive pad.

[0008] In order to further understand the techniques, means and effects, the present invention takes for achieving the prescribed objectives, the following detailed descriptions and appended drawings are hereby referred, such that, through which, the purposes, features and aspects of the present invention can be thoroughly and concretely appreciated; however, the appended drawings are provided solely for reference and illustration, without any intention that they be used for limiting the present invention, which is defined by the appended claims 1-7.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

FIG. 1 is a lateral, cross-sectional, schematic view of the LED package structure for increasing heat-dissipating and light-emitting efficiency according to a first illustrative example not defining, in itself, the present invention;
FIG. 2 is a lateral, cross-sectional, schematic view of the LED package structure for increasing heat-dissipating and light-emitting efficiency according to an embodiment of the present invention;
FIG. 3 is a lateral, cross-sectional, schematic view of the LED package structure for increasing heat-dissipating and light-emitting efficiency according to an other illustrative example not defining, in itself, the present invention;
FIG. 4 is a lateral, cross-sectional, schematic view of the LED package structure for increasing heat-dissipating and light-emitting efficiency according to a further illustrative example not defining, in itself, the present invention; and
FIG. 5 is a flowchart of the method for manufacturing an LED package structure for increasing heat-dissipating and light-emitting efficiency according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0010] Referring to FIG. 1, a first illustrative example not defining, in itself, the present invention provides an LED package structure for increasing heat-dissipating and light-emitting efficiency, including: a substrate unit 1, an alloy unit, a light-emitting unit 2, a conductive unit W and a package unit 4.

[0011] The substrate unit 1 has a substrate body 10, at least one first conductive pad 11a, at least one second conductive pad 11b and at least one chip-placing pad 11c, and the first conductive pad 11a, the second conductive pad 11b and the chip-placing pad 11c are formed on a top surface of the substrate body 10. In addition, the chip-placing pad 11c is disposed between the first conductive pad 11a and the second conductive pad 11b, and the first conductive pad 11a, the second conductive pad 11b and the chip-placing pad 11c can be copper foils or any conductive material. Furthermore, the substrate body 10 has a circuit substrate 100, a heat-dissipating layer 101 disposed on a bottom surface of the circuit substrate 100 and an insulative reflecting layer 102 disposed on the top surface of the circuit substrate 100 in order to expose the first conductive pad 11a, the second conductive pad 11b and the chip-placing pad 11c.

[0012] Moreover, the alloy unit has at least one Ni/Pd alloy M formed on the chip-placing pad 11c. In addition, the alloy unit has another two Ni/Pd alloys M1 (or two Ni/Pd/Au alloys) that are respectively formed on the top surface of the first conductive pad 11a and the top surface of the second conductive pad 11b, so that the conductive unit W such

as two gold wires are respectively electrically bonded to the one Ni/Pd alloys M1 on the first conductive pad 11a and another Ni/Pd alloys M1 on the second conductive pad 11b. In addition, the alloy unit has Au that can be blended into the Ni/Pd alloy M to form a Ni/Pd/Au alloy according to different requirements. In other words, the Ni/Pd alloy M can be replaced by the Ni/Pd/Au alloy.

[0013] Furthermore, the light-emitting unit 2 has at least one LED chip 20 (or many LED chips 20) positioned on the Ni/Pd alloy M of the alloy unit by solidified solder ball or glue B. For example, the LED chip 20 has a positive electrode P and a negative electrode N formed on a top surface thereof. Because the Ni/Pd alloy M is formed on the bottom side of the solidified solder ball or glue B, the solidified solder ball or glue B cannot react with the chip-placing pad 11c of the substrate body 10 to form an IMC (Intermetallic Compound) that is brittle during reflow process. Hence, when the LED chip 20 is disposed on the solidified solder ball or glue B by reflow process, the soldering intensity (joint intensity) between the solidified solder ball or glue B and the chip-placing pad 11c of the substrate body 10 can be strengthened.

[0014] Besides, the conductive unit W has at least two conductive wires Wa, and the LED chip 20 is electrically connected to the first conductive pad 11a and the second conductive pad 11b by the at least two conductive wires Wa, respectively. For example, the two conductive wires Wa are respectively connected between the positive electrode P of the LED chip 20 and the first conductive pad 11a and between the negative electrode N of the LED chip 20 and the second conductive pad 11b.

[0015] In addition, the package unit 4 has a light-transmitting package gel body 40 formed on the top surface of the substrate body 10 in order to cover the light-emitting unit 2 and the conductive unit W.

[0016] In the first illustrative example, the LED chip 20 can be a blue LED chip, and the light-transmitting package gel body 40 can be fluorescent gel. Hence, blue light beams (not shown) generated by the LED chips 20 (the blue LED chips) can pass through the light-transmitting package gel body 40 (the fluorescent gel) to generate white light beams (not shown) that are similar to the light source generate by sun lamp.

[0017] The measurement results of the LED package structure of the prior art are shown in the following table, for example the minimum value, maximum value and average value. The present disclosure provides an electric current of 700 milliampere (mA) for the first illustrative example of using the NiPdAu alloy or the NiPd alloy, and the relevant measurement results are shown in the following table:

Item	Min. value	Max. value	Average value	NiPdAu	NiPd
Luminous flux	569.748	647.311	620.645	660.659	678.645
Luminous efficiency	68.038	76.777	73.596	78.991	81.27
CIE x	0.3078	0.3207	0.3143	0.3138	0.3131
CIE y	0.3244	0.3511	0.3375	0.3435	0.3452
CCT	6000.4	6819.7	6370.8	6351.2	6373.3
Color render index	74.235	77.196	75.624	73.894	73.308

[0018] The unit of luminous flux is lumen; the unit of luminous efficiency is lumen/W; CIE x and CIE y respectively are x and y coordinates in xy chromaticity diagram of CIE (International Commission on Illumination); the unit of CCT (Correlated Color Temperature) is Kelvin (K); the unit of color render index is Rendering average (Ra).

[0019] In other words, the Ni/Pd alloy M or the Ni/Pd/Au alloy as an interface layer is formed between the solidified solder ball or glue B and the chip-placing pad 11c, so that not only the soldering intensity (joint intensity) between the solidified solder ball or glue B and the chip-placing pad 11c of the substrate body 10 can be strengthened, but also the heat-dissipating efficiency and the light-emitting efficiency are increased as shown in the above-mentioned table. For example, heat generated by the LED chip 20 can be transmitted to the chip-placing pad 11c of the substrate body 10 through the solidified solder ball or glue B and the Ni/Pd alloy M in sequence, so that the heat generated by the LED chip 20 can be dissipated quickly.

[0020] Referring to FIG. 2, an embodiment of the present invention provides an LED package structure for increasing heat-dissipating and light-emitting efficiency, including: a substrate unit 1, an alloy unit, a light-emitting unit 2, a conductive unit W, a light-reflecting unit 3 and a package unit 4.

[0021] The difference between this embodiment and the first illustrative example is that: the embodiment further includes a light-reflecting unit 3 that has an annular reflecting gel body 30 surroundingly formed on the top surface of the substrate body 10 by coating. In addition, the annular reflecting gel body 30 surrounds the LED chip 20 to form a gel position limiting space 300 above the substrate body 10, and the position of the light-transmitting package gel body 40 is limited in the gel position limiting space 300.

[0022] Moreover, the annular reflecting gel body 30 has an arc shape formed on a top surface thereof. The annular

reflecting gel body 30 has a radius tangent T, and the angle θ of the radius tangent T relative to the top surface of the substrate body 10 is between 40° and 50°. The maximum height H of the annular reflecting gel body 30 relative to the top surface of the substrate body 10 is between 0.3 mm and 0.7 mm, and the width of a bottom side of the annular reflecting gel body 30 is between 1.5 mm and 3 mm. The thixotropic index of the annular reflecting gel body 30 is between 4 and 6, and the annular reflecting gel body 30 can be a white thermohardening reflecting body (opaque gel) mixed with inorganic additive.

[0023] Referring to FIG. 3, an other illustrative example not defining, in itself, the present invention provides an LED package structure for increasing heat-dissipating and light-emitting efficiency, including: a substrate unit 1, an alloy unit, a light-emitting unit 2, a conductive unit W and a package unit 4.

[0024] The substrate unit 1 has a substrate body 10, at least one first conductive pad 11a and at least one chip-placing pad 11c, and the first conductive pad 11a and the chip-placing pad 11c are formed on a top surface of the substrate body 10. In addition, the chip-placing pad 11c is adjacent to the first conductive pad 11a, and the first conductive pad 11a and the chip-placing pad 11c can be copper foils or any conductive material. Furthermore, the substrate body 10 has a circuit substrate 100, a heat-dissipating layer 101 disposed on a bottom surface of the circuit substrate 100 and an insulative reflecting layer 102 disposed on the top surface of the circuit substrate 100 in order to expose the first conductive pad 11a and the chip-placing pad 11c.

[0025] Moreover, the alloy unit has at least one Ni/Pd alloy M formed on the chip-placing pad 11c. In addition, the alloy unit has another Ni/Pd alloy M1 (or another Ni/Pd/Au alloy) that is formed on the top surface of the first conductive pad 11a, so that the conductive unit W such as a gold wire is electrically bonded to the Ni/Pd alloys M1 on the first conductive pad 11a. In addition, the alloy unit has Au that can be blended into the Ni/Pd alloy M to form a Ni/Pd/Au alloy according to different requirements. In other words, the Ni/Pd alloy M can be replaced by the Ni/Pd/Au alloy.

[0026] Furthermore, the light-emitting unit 2 has at least one LED chip 20 (or many LED chips 20) electrically positioned on the Ni/Pd alloy M of the alloy unit by solidified solder ball or glue B. For example, the LED chip 20 has a top electrode P and a bottom electrode N respectively formed on a top surface and a bottom surface thereof. Because the Ni/Pd alloy M is formed on the bottom side of the solidified solder ball or glue B, the solidified solder ball or glue B cannot react with the chip-placing pad 11c of the substrate body 10 to form an IMC (Intermetallic Compound) that is brittle during reflow process. Hence, when the LED chip 20 is disposed on the solidified solder ball or glue B by reflow process, the soldering intensity (joint intensity) between the solidified solder ball or glue B and the chip-placing pad 11c of the substrate body 10 can be strengthened.

[0027] Besides, the conductive unit W has at least one conductive wire Wa, and the LED chip 20 is electrically connected to the first conductive pad 11a by the conductive wire Wa. For example, the bottom electrode N is electrically connected to the chip-placing pad 11c by the solidified solder ball or glue B and the Ni/Pd alloy M, and the top electrode P is electrically connected to the first conductive pad 11a by the conductive wire Wa.

[0028] In addition, the package unit 4 has a light-transmitting package gel body 40 formed on the top surface of the substrate body 10 in order to cover the light-emitting unit 2 and the conductive unit W.

[0029] In the above illustrative example, the LED chip 20 can be a blue LED chip, and the light-transmitting package gel body 40 can be fluorescent gel. Hence, blue light beams (not shown) generated by the LED chips 20 (the blue LED chips) can pass through the light-transmitting package gel body 40 (the fluorescent gel) to generate white light beams (not shown) that are similar to the light source generate by sun lamp.

[0030] Referring to FIG. 4, a further illustrative example not defining, in itself, the present invention provides an LED package structure for increasing heat-dissipating and light-emitting efficiency, including: a substrate unit 1, an alloy unit, a light-emitting unit 2, a conductive unit W, a light-reflecting unit 3 and a package unit 4.

[0031] The difference between this further example and the second example is that: this further example further includes a light-reflecting unit 3 that has an annular reflecting gel body 30 surroundingly formed on the top surface of the substrate body 10 by coating. In addition, the annular reflecting gel body 30 surrounds the LED chip 20 to form a gel position limiting space 300 above the substrate body 10, and the position of the light-transmitting package gel body 40 is limited in the gel position limiting space 300.

[0032] Moreover, the annular reflecting gel body 30 has an arc shape formed on a top surface thereof. The annular reflecting gel body 30 has a radius tangent T, and the angle θ of the radius tangent T relative to the top surface of the substrate body 10 is between 40° and 50°. The maximum height H of the annular reflecting gel body 30 relative to the top surface of the substrate body 10 is between 0.3 mm and 0.7 mm, and the width of a bottom side of the annular reflecting gel body 30 is between 1.5 mm and 3 mm. The thixotropic index of the annular reflecting gel body 30 is between 4 and 6, and the annular reflecting gel body 30 can be a white thermohardening reflecting body (opaque gel) mixed with inorganic additive.

[0033] Referring to FIG. 5, the present invention provides a method for manufacturing an LED package structure for increasing heat-dissipating and light-emitting efficiency, including: providing a substrate unit 1 that has a substrate body 10 and at least one chip-placing pad 10c formed on a top surface of the substrate body 10 (the step S100); forming at least one Ni/Pd alloy M on the chip-placing pad 11c (the step S102); placing at least one LED chip 20 on the Ni/Pd alloy

M via solder ball or glue (the step S104); solidifying the solder ball or solder glue to form a solidified solder ball or solder glue B (for example using reflow process), wherein the LED chip 20 is positioned on the Ni/Pd alloy M by the solidified solder ball or solder glue B (the step S106); electrically connecting the LED chip 20 with the substrate body 10 (the step S108); and then forming a light-transmitting package gel body 40 on the top surface of the substrate body 10 in order to cover the light-emitting unit 3 and the conductive unit W (the step S110).

[0034] Hence, the first illustrative example and the embodiment of the present invention can be manufactured by the above-mentioned method. For example, in the first illustrative example, the two top electrodes (P, N) of the LED chip 20 are electrically connected to the first conductive pad 11a and the second conductive pad 11b by the at least two conductive wires Wa, respectively. In the above-described second illustrative example, the bottom electrode N of the LED chip 20 is electrically disposed on the Ni/Pd alloy M by the solidified solder ball or glue B, and the top electrode P of the LED chip 20 is electrically connected to the first conductive pad 11a by the conductive wire Wa.

[0035] Furthermore, in accordance with the present invention, before forming the light-transmitting package gel body 40 on the top surface of the substrate body 10 (step S110), the method further includes: surroundingly coating liquid resin (not shown) on the top surface of the substrate body 10 (step S109A). In addition, the liquid resin can be coated on the substrate body 10 by any shapes according to different requirements (such as a circular shape, a square or a rectangular shape etc.). The thixotropic index of the liquid resin is between 4 and 6, the pressure of coating the liquid resin on the top surface of the substrate body 10 is between 350 kPa and 450 kPa, and the velocity of coating the liquid resin on the top surface of the substrate body 10 is between 5 mm/s and 15 mm/s. The liquid resin is surroundingly coated on the top surface of the substrate body 10 from a start point to a termination point, and the position of the start point and the position of the termination point are the same. Furthermore, after the step S109A, the method includes hardening the liquid resin to form an annular reflecting gel body 30, and the annular reflecting gel body 30 surrounding the LED chips 20 to form a gel position limiting space 300 above the substrate body 10 (step S109B). In addition, the liquid resin is hardened by baking, the baking temperature is between 120°C and 140°C, and the baking time is between 20 minute and 40 minute.

[0036] In conclusion, because the Ni/Pd alloy is formed on the bottom side of the solidified solder ball or solder glue, the solidified solder ball or solder glue cannot react with the chip-placing pad of the substrate body to form an IMC (Intermetallic Compound) that is brittle during reflow process. Hence, when the LED chip is disposed on the solidified solder ball or solder glue by reflow process, the soldering intensity (joint intensity) between the solidified solder ball or solder glue and the chip-placing pad of the substrate body can be strengthened. In addition, the alloy unit has another two Ni/Pd alloys (or two Ni/Pd/Au alloys) that are respectively formed on the top surface of the first conductive pad and the top surface of the second conductive pad, so that the conductive unit such as two gold wires are respectively electrically bonded to the one Ni/Pd alloys on the first conductive pad and another Ni/Pd alloys on the second conductive pad.

[0037] The above-mentioned descriptions merely represent solely the preferred embodiments of the present invention, without any intention or ability to limit the scope of the present invention, which is fully described only within the following claims. Various equivalent changes, alterations or modifications based on the claims of the present invention are all, consequently, viewed as being embraced by the scope of the present invention, which is defined by the following claims.

Claims

1. A light emitting diode (LED) package structure for increasing heat-dissipating and light-emitting efficiency, comprising:

   a substrate unit having a substrate body (10), at least one first conductive pad (11a), at least one second conductive pad (11b) and at least one chip-placing pad (11c), wherein the at least one first conductive pad (10a), the at least one second conductive pad (11b) and the at least one chip-placing pad (11c) are formed on a top surface of the substrate body (10), and the substrate body (10) has a circuit substrate (100), a heat-dissipating layer (101) disposed on a bottom surface of the circuit substrate (100), and an insulative reflecting layer (102) disposed on the top surface of the circuit substrate (100) to expose the at least one first conductive pad (11a), the at least one second conductive pad (11b) and the at least one chip-placing pad (11c);
   an alloy unit having at least one Ni/Pd alloy (M) formed on the at least one chip-placing pad (11c);
   a light-emitting unit (2) having at least one LED chip (20) positioned on the at least one Ni/Pd alloy (M) of the alloy unit through a solder ball or solder glue (B);
   a conductive unit having at least two conductive wires (Wa), wherein the at least one LED chip (20) is electrically connected to the at least one first conductive pad (11a) through one of the at least two conductive wires (Wa), and the at least one LED chip (20) is electrically connected to the at least one second conductive pad (11b) through the other conductive wire (Wa);

a light-reflecting unit having an annular reflecting gel body (30) surroundingly coated on the top surface of the insulative reflecting layer (102), wherein the annular reflecting gel body (30) surrounds the at least one LED chip (20) to form a gel position limiting space (300); and

a package unit having a light-transmitting package gel body (40) formed on the top surface of the substrate body (100) to cover the light-emitting unit (2) and the conductive unit (W), wherein the position of the light-transmitting package gel body (40) is limited in the gel position limiting space (300).

2. The LED package structure according to claim 1, wherein the annular reflecting gel body (40) has an arc shape formed on a top surface thereof, the annular reflecting gel body has a radius tangent and the angle of the radius tangent relative to the top surface of the substrate body (10) is between 40° and 50°, the maximum height of the annular reflecting gel body (40) relative to the top surface of the substrate body (10) is between 0.3 mm and 0.7 mm, the width of a bottom side of the annular reflecting gel body (40) is between 1.5 mm and 3 mm, the thixotropic index of the annular reflecting gel body (40) is between 4 and 6, and the annular reflecting gel body (40) is a white thermohardening reflecting body mixed with inorganic additive.

3. The LED package structure according to claim 1, wherein the at least one first conductive pad (11a), the at least one second conductive pad (11b) and the at least one chip-placing pad (11c) are copper foils.

4. The LED package structure according to claim 1, wherein the alloy unit has another two Ni/Pd alloys or two Ni/Pd/Au alloys (MI) that are respectively formed on the at least one first conductive pad (11a) and the at least one second conductive pad (11b).

5. The LED package structure according to claim 1, wherein the at least one LED chip (20) is a blue LED chip, and the light-transmitting package gel body (40) is fluorescent gel, wherein the at least one LED chip (20) has a positive electrode (P) and a negative electrode (N) formed on a top surface thereof, and the at least two conductive wires (Wa) are respectively electrically connected between the positive electrode (P) and the at least one first conductive pad (11a) and between the negative electrode (N) and the at least one second conductive pad (11b).

6. The LED package structure according to claim 1, wherein the alloy unit has Au blended into the at least one Ni/Pd alloy to form a Ni/Pd/Au alloy.

7. A method for manufacturing an LED package structure for increasing heat-dissipating and light-emitting efficiency, comprising:

providing (S100) a substrate unit having a substrate body (10), at least one first conductive pad (11a), at least one second conductive pad (11b) and at least one chip-placing pad (11c), wherein the at least one first conductive pad (11a), the at least one second conductive pad (11b) and the at least one chip-placing pad (11c) are formed on a top surface of the substrate body (10), and the substrate body (10) has a circuit substrate (100), a heat-dissipating layer (101) disposed on a bottom surface of the circuit substrate (100), and an insulative reflecting layer (102) disposed on the top surface of the circuit substrate (100) to expose the at least one first conductive pad (11a), the at least one second conductive pad (11b) and the at least one chip-placing pad (11c);

forming (S102) at least one Ni/Pd alloy (M) on the at least one chip-placing pad (11c);

placing (S104) at least one LED chip (20) on the at least one Ni/Pd alloy (M) via solder ball or solder glue (B);

solidifying (S106) the solder ball or solder glue (B) to form a solidified solder ball or solder glue (B), wherein the at least one LED chip (20) is positioned on the at least one Ni/Pd alloy (M) by the solidified solder ball or solder glue (B);

electrically connecting (S108) the at least one LED chip (20) between the at least one first conductive pad (11a) and the at least one second conductive pad (11b) through at least two conductive wires (Wa), wherein the at least one LED chip (20) is electrically connected to the at least one first conductive pad (11a) through one of the at least two conductive wires (Wa), and the at least one LED chip (20) is electrically connected to the at least one second conductive pad (11b) through the other conductive wire;

surroundingly coating (S109A,B) an annular reflecting gel body (30) on the top surface of the insulative reflecting layer (102), wherein the annular reflecting gel body (30) surrounds the at least one LED chip (20) to form a gel position limiting space (300); and

forming (S110) a light-transmitting package gel body (40) on the top surface of the substrate body (10) to cover the at least one LED chip (20) and the at least two conductive wires (Wa), wherein the position of the light-transmitting package gel body (40) is limited in the gel position limiting space (300).

Patentansprüche

1. Eine LED (Light Emitting Diode) - Packungsstruktur, aufweisend:

   eine Substrateinheit mit einem Substratkörper (10), mindestens eine erste leitfähige Kontaktstelle (11a), mindestens eine zweite leitfähige Kontaktstelle (11b) und mindestens eine Chipplatzierungs-Kontaktstelle (11c), wobei die mindestens eine erste leitfähige Kontaktstelle (10a), die mindestens eine zweite leitfähige Kontaktstelle (11b) und die mindestens eine Chipplatzierungs-Kontaktstelle (11c) auf einer oberen Oberfläche des Substratkörpers (10) ausgebildet sind und der Substratkörper (10) ein Schaltkreis-Substrat (100) und eine isolierende reflektierende Schicht (102) hat, die auf der oberen Oberfläche des Schaltkreis-Substrats (100) angeordnet sind, so dass die mindestens eine erste leitfähige Kontaktstelle (11a), die mindestens eine zweite leitfähige Kontaktstelle (11b) und die mindestens eine Chipplatzierungs- Kontaktstelle (11c) freigelegt sind;
   eine Legierungseinheit mit mindestens einer Ni / Pd-Legierung (M), die auf der mindestens einen Chipplatzierungs- Kontaktstelle (11c) ausgebildet ist;
   eine lichtemittierende Einheit (2) mit mindestens einem LED-Chip (20), der auf der mindestens einen Ni / Pd-Legierung (M) der Legierungseinheit durch eine Lotkugel oder einen Lotkleber (B) positioniert ist;
   eine leitfähige Einheit mit mindestens zwei leitfähigen Drähten (Wa), wobei der mindestens eine LED-Chip (20) über einen der mindestens zwei leitfähigen Drähte (Wa) mit der mindestens einen ersten leitfähigen Kontaktstelle (11a) elektrisch verbunden ist, und der mindestens eine LED-Chip (20) durch den anderen leitenden Draht (Wa) elektrisch mit der mindestens einen zweiten leitenden Kontaktstelle (11b) verbunden ist;
   eine lichtreflektierende Einheit mit einem ringförmigen reflektierenden Gelkörper (30), der umgebend auf der oberen Oberfläche der isolierenden reflektierenden Schicht (102) aufgebracht ist, wobei der ringförmige reflektierende Gelkörper (30) den wenigstens einen LED-Chip (20) zur Bildung eines Gelpositions-Begrenzungsraums (300) umgibt; und
   eine Verpackungseinheit mit einem lichtdurchlässigen Gehäuse-Gelkörper (40), der auf der oberen Oberfläche des Substratkörpers (100) ausgebildet ist, um die lichtemittierende Einheit (2) abzudecken, wobei die Position des lichtdurchlässigen Gehäuse-Gelkörpers (40) in dem Gelpositions-Begrenzungsraum (300) begrenzt ist.

2. Die LED-Packungsstruktur gemäß Anspruch 1, wobei der ringförmige reflektierende Gelkörper (40) eine Bogenform aufweist, die auf einer oberen Oberfläche desselben ausgebildet ist, wobei der ringförmige reflektierende Gelkörper eine Radiustangente hat und der Winkel der Radiustangente relativ zu der oberen Oberfläche des Substratkörpers (10) zwischen 40° und 50° liegt, wobei die maximale Höhe des ringförmigen reflektierenden Gelkörpers (40) relativ zu der oberen Oberfläche des Substratkörpers (10) zwischen 0,3 mm und 0,7 mm beträgt, die Breite einer unteren Seite des ringförmigen reflektierenden Gelkörpers (40) zwischen 1,5 mm und 3 mm beträgt, der thixotrope Index des ringförmigen reflektierenden Gelkörpers (40) zwischen 4 und 6 liegt, und der ringförmige reflektierende Gelkörper (40) ein weißer wärmehärtender reflektierender Körper, gemischt mit anorganischem Additiv, ist.

3. Die LED-Packungsstruktur gemäß Anspruch 1, wobei die mindestens eine erste leitfähige Kontaktstelle (11a), die mindestens eine zweite leitfähige Kontaktstelle (11b) und die mindestens eine Chipplatzierungs- Kontaktstelle (11c) Kupferfolien sind.

4. Die LED-Packungsstruktur gemäß einem der Ansprüche 1 bis 3, wobei die Legierungseinheit zwei weitere Ni / Pd-Legierungen oder zwei Ni / Pd / Au-Legierungen (M1) hat, die jeweils auf der mindestens einen ersten leitfähigen Kontaktstelle (11a) und der mindestens einen zweiten leitfähigen Kontaktstelle (11b) ausgebildet sind.

5. Die LED-Packungsstruktur gemäß Anspruch 1, wobei der mindestens eine LED-Chip (20) ein blauer LED-Chip ist und der lichtdurchlässige Packungs-Gelkörper (40) Fluoreszenzgel ist, wobei der mindestens eine LED-Chip (20) eine positive Elektrode (P) und eine negative Elektrode (N) hat, die auf einer oberen Oberfläche desselben ausgebildet sind, und die mindestens zwei leitfähigen Drähte (Wa) jeweils zwischen der positiven Elektrode (P) und der mindestens einen ersten leitfähigen Kontaktstelle (11a) und zwischen der negativen Elektrode (N) und der mindestens einen zweiten leitenden Kontaktstelle (11b) elektrisch verbunden sind.

6. Die LED-Gehäusestruktur gemäß Anspruch 1, wobei die Legierungseinheit Au hat, das in die mindestens eine Ni / Pd-Legierung eingemischt ist, um eine Ni / Pd / Au-Legierung zu bilden.

7. Ein Verfahren zum Herstellen einer LED-Packungsstruktur, aufweisend:

   Bereitstellen (S100) einer Substrateinheit mit einem Substratkörper (10), mindestens einer ersten leitfähigen

Kontaktstelle (11a), mindestens einer zweiten leitfähigen Kontaktstelle (11b) und mindestens einer Chipplatzierungs-Kontaktstelle (11c), wobei die mindestens eine erste leitfähige Kontaktstelle (11a), die mindestens eine zweite leitfähige Kontaktstelle (11b) und die mindestens eine Chipplatzierungs-Kontaktstelle (11c) auf einer oberen Oberfläche des Substratkörpers (10) ausgebildet sind, und der Substratkörper (10) ein Schaltkreis-Substrat (100) und eine isolierende reflektierende Schicht (102) aufwiest, die auf der oberen Oberfläche des Schaltkreissubstrats (100) angeordnet sind, so dass die mindestens eine erste leitfähige Kontaktstelle (11a), die mindestens eine zweite leitfähige Kontaktstelle (11b) und die mindestens eine Chipplatzierungs- Kontaktstelle (11c) freigelegt werden;

Bilden (S102) mindestens einer Ni / Pd-Legierung (M) auf der mindestens einen Chipplatzierungs- Kontaktstelle (11c);

Platzieren (S104) mindestens eines LED-Chips (20) auf der mindestens einen Ni / Pd-Legierung (M) durch eine Lotkugel oder einen Lotkleber (B);

Verfestigen (S106) der Lotkugel oder des Lotklebers (B), um eine verfestigte Lotkugel oder Lotkleber (B) zu bilden, wobei der mindestens eine LED-Chip (20) auf der wenigstens einen Ni / Pd-Legierung (M) durch die verfestigte Lotkugel oder den Lotkleber (B) positioniert ist;

elektrisches Verbinden (S108) des mindestens einen LED-Chips (20) zwischen der mindestens einen ersten leitfähigen Kontaktstelle (11a) und der mindestens einen zweiten leitfähigen Kontaktstelle (11b) über mindestens zwei leitende Drähte (Wa), wobei der mindestens eine LED-Chip (20) elektrisch mit der mindestens einen ersten leitfähigen Kontaktstelle (11a) über einen der mindestens zwei leitenden Drähte (Wa) verbunden ist, und der mindestens eine LED-Chip (20) elektrisch mit der mindestens einen zweiten leitfähigen Kontaktstelle (11b) durch den anderen leitenden Draht elektrisch verbunden ist;

umgebendes Beschichten (S109A, B) eines ringförmigen reflektierenden Gelkörpers (30) auf der oberen Oberfläche der isolierenden reflektierenden Schicht (102), wobei der ringförmige reflektierende Gelkörper (30) den mindestens einen LED-Chip (20) umgibt, um einen Gelpositions-Begrenzungsraum (300) auszubilden; und

Bilden (S110) eines lichtdurchlässigen Gehäuse-Gelkörpers (40) auf der oberen Oberfläche des Substratkörpers (10), um den mindestens einen LED-Chip (20) zu bedecken, wobei die Position des lichtdurchlässigen Gehäuse-Gelkörpers (40) in dem Gelpositions-Begrenzungsraum (300) begrenzt ist.

Revendications

1. Structure de boîtier de diode électroluminescente (LED) destinée à accroître la dissipation de la chaleur et l'efficacité d'émission de la lumière, comprenant :

une unité substrat qui présente un corps de substrat (10), au moins une première plage conductrice (11a), au moins une seconde plage conductrice (11b) et au moins une plage de placement de puce (11c), dans lequel la ou les premières plages conductrices (10a), la ou les secondes plages conductrices (11b), et la ou les plages de placement de puce (11c), sont formées sur la surface supérieure du corps de substrat (10), et le corps de substrat (10) présente un substrat de circuit (100), une couche de dissipation de la chaleur (101) disposée sur la surface inférieure du substrat de circuit (100), et une couche réfléchissante isolante (102) disposée sur la surface supérieure du substrat de circuit (100) de façon à exposer la ou les premières plages conductrices (11a), la ou les secondes plages conductrices (11b), et la ou les plages de placement de puce (11c) ;

une unité alliage qui présente au moins un alliage de Ni / Pd (M) formé sur la ou les plages de placement de puce (11c) ;

une unité électroluminescente (2) qui présente au moins une puce de LED (20) positionnée sur le ou les alliages de Ni / Pd (M) de l'unité alliage par l'intermédiaire d'une bille de soudure ou d'une colle pour soudure (B) ;

une unité conduction qui présente au moins deux fils conducteurs (Wa), dans lequel la ou les puces de LED (20) sont connectées de manière électrique à la ou aux premières plages conductrices (11a) par l'intermédiaire de l'un des deux fils conducteurs (Wa) au moins, et la ou les puces de LED (20) sont connectées de manière électrique à la ou aux secondes plages conductrices (11b) par l'intermédiaire de l'autre fil conducteur (Wa) ;

une unité réflexion de la lumière qui présente un corps gélifié réfléchissant annulaire (30) déposé de manière à entourer la surface supérieure de la couche réfléchissante isolante (102), dans lequel le corps gélifié réfléchissant annulaire (30) entoure la ou les puces de LED (20) de façon à former un espace de limitation de la position du gel (300) ; et

une unité boîtier qui présente un corps gélifié de boîtier qui transmet la lumière (40) formé sur la surface supérieure du corps de substrat (100) de façon à couvrir l'unité électroluminescente (2) et l'unité conduction (W), dans lequel la position du corps gélifié de boîtier qui transmet la lumière (40) est limitée dans l'espace de limitation de la position du gel (300).

2. Structure de boîtier de LED selon la revendication 1, dans laquelle le corps gélifié réfléchissant annulaire (30) présente une forme arquée formée sur la surface supérieure de celui-ci, le corps gélifié réfléchissant annulaire présente une tangente de rayon et l'angle de la tangente de rayon par rapport à la surface supérieure du corps de substrat (10) est compris entre 40° et 50°, la hauteur maximum du corps gélifié réfléchissant annulaire (30) par rapport à la surface supérieure du corps de substrat (10) est comprise entre 0,3 mm et 0,7 mm, la largeur d'un côté inférieur du corps gélifié réfléchissant annulaire (30) est comprise entre 1,5 mm et 3 mm, l'indice thixotrope du corps gélifié réfléchissant annulaire (30) est compris entre 4 et 6, et le corps gélifié réfléchissant annulaire (30) est un corps réfléchissant thermodurcissable blanc mélangé à un additif inorganique.

3. Structure de boîtier de LED selon la revendication 1, dans laquelle la ou les premières plages conductrices (11a), la ou les secondes plages conductrices (11b), et la ou les plages de placement de puce (11c), sont des feuilles de cuivre.

4. Structure de boîtier de LED selon la revendication 1, dans laquelle l'unité alliage présente deux autres alliages de Ni / Pd, ou deux alliages de Ni / Pd / Au (M1), qui sont formés de manière respective sur la ou les premières plages conductrices (11a) et sur la ou les secondes plages conductrices (11b).

5. Structure de boîtier de LED selon la revendication 1, dans lequel la ou les puces de LED (20) sont des puces de LED bleues, et le corps gélifié de boîtier qui transmet la lumière (40) est un gel fluorescent, dans lequel la ou les puces de LED (20) présentent une électrode positive (P) et une électrode négative (N) formées sur la surface supérieure de celles-ci, et les deux fils conducteurs (Wa) au moins sont connectés respectivement de manière électrique entre l'électrode positive (P) et la ou les premières plages conductrices (11a), et entre l'électrode négative (N) et la ou les secondes plages conductrices (11b).

6. Structure de boîtier de LED selon la revendication 1, dans lequel l'unité alliage présente de l'Au mélangé dans le ou les alliage de Ni / Pd, de façon à former un alliage de Ni / Pd / Au.

7. Procédé destiné à fabriquer une structure de boîtier de LED destinée à accroître la dissipation de la chaleur et l'efficacité d'émission de la lumière,, comprenant les étapes consistant à :

fournir (S100) une unité substrat qui présente un corps de substrat (10), au moins une première plage conductrice (11a), au moins une seconde plage conductrice (11b) et au moins une plage de placement de puce (11c), dans lequel la ou les premières plages conductrices (11a), la ou les secondes plages conductrices (11b), et la ou les plages de placement de puce (11c), sont formées sur la surface supérieure du corps de substrat (10), et le corps de substrat (10) présente un substrat de circuit (100), une couche de dissipation de la chaleur (101) disposée sur la surface inférieure du substrat de circuit (100), et une couche réfléchissante isolante (102) disposée sur la surface supérieure du substrat de circuit (100) de façon à exposer la ou les premières plages conductrices (11a), la ou les secondes plages conductrices (11b), et la ou les plages de placement de puce (11c) ;
former (S102) une unité alliage qui présente au moins un alliage de Ni / Pd (M) sur la ou les plages de placement de puce (11c) ;
placer (S104) au moins une puce de LED (20) sur le ou les alliage de Ni / Pd (M) par l'intermédiaire d'une bille de soudure ou d'une colle pour soudure (B) ;
solidifier (S106) la bille de soudure ou la colle pour soudure (B) de façon à former une bille de soudure ou une colle pour soudure (B) solidifiée, dans lequel la ou les puces de LED (20) sont positionnées sur le ou les alliage de Ni / Pd (M) par la bille de soudure ou par la colle pour soudure (B) solidifiée ;
connecter de manière électrique (S108) la ou les puces de LED (20) entre la ou les premières plages conductrices (11a) et la ou les secondes plages conductrices (11b) par l'intermédiaire de deux fils conducteurs (Wa) au moins, dans lequel la ou les puces de LED (20) sont connectées de manière électrique à la ou aux premières plages conductrices (11a) par l'intermédiaire de l'un des deux fils conducteurs (Wa) au moins, et la ou les puces de LED (20) sont connectées de manière électrique à la ou aux secondes plages conductrices (11b) par l'intermédiaire de l'autre fil conducteur ;
déposer un corps gélifié réfléchissant annulaire (30) de manière à entourer (S109A, B) la surface supérieure de la couche réfléchissante isolante (102), dans lequel le corps gélifié réfléchissant annulaire (30) entoure la ou les puces de LED (20) de façon à former un espace de limitation de la position du gel (300) ; et
former (S110) un corps gélifié de boîtier qui transmet la lumière (40) sur la surface supérieure du corps de substrat (10) de façon à couvrir la ou les puces de LED (20) et les deux fils conducteurs (Wa) au moins, dans lequel la position du corps gélifié de boîtier qui transmet la lumière (40) est limitée dans l'espace de limitation de la position du gel (300).

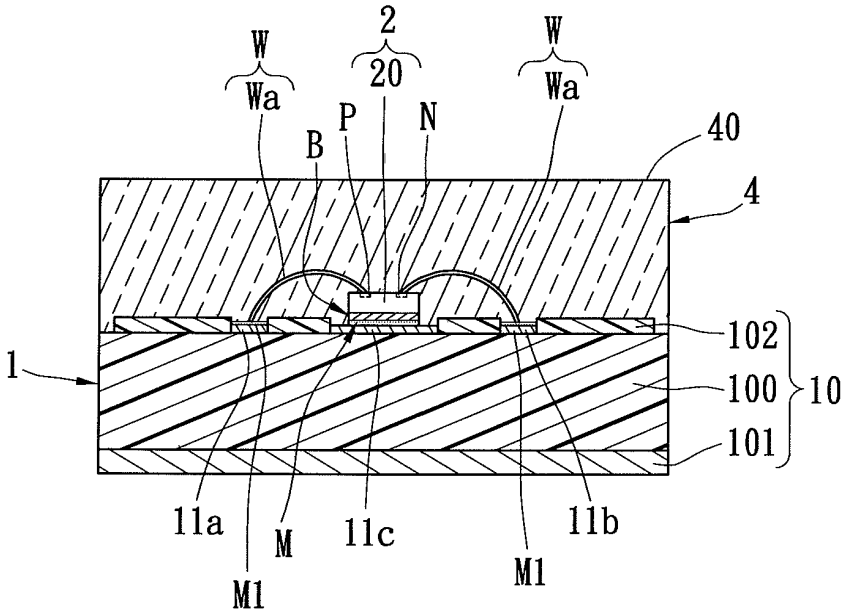
W
Wa
2
20
W
Wa
P
N
B
40
4
102
100
101
10
1
11a
M
11c
11b
M1
M1

FIG. 1

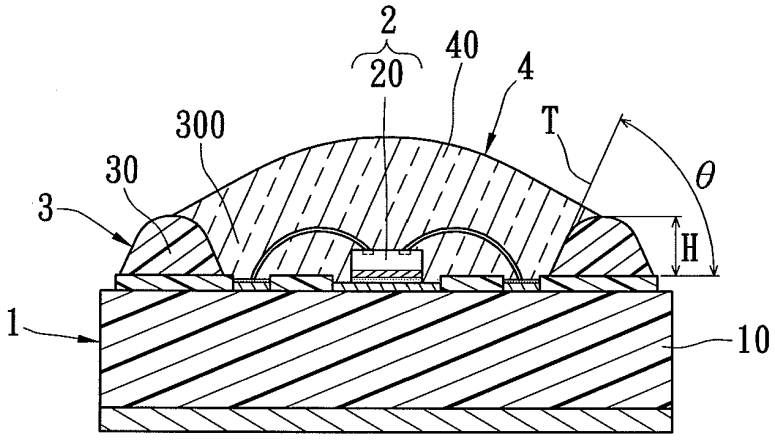
2
20
40
4
300
T
θ
30
3
H
1
10

FIG. 2

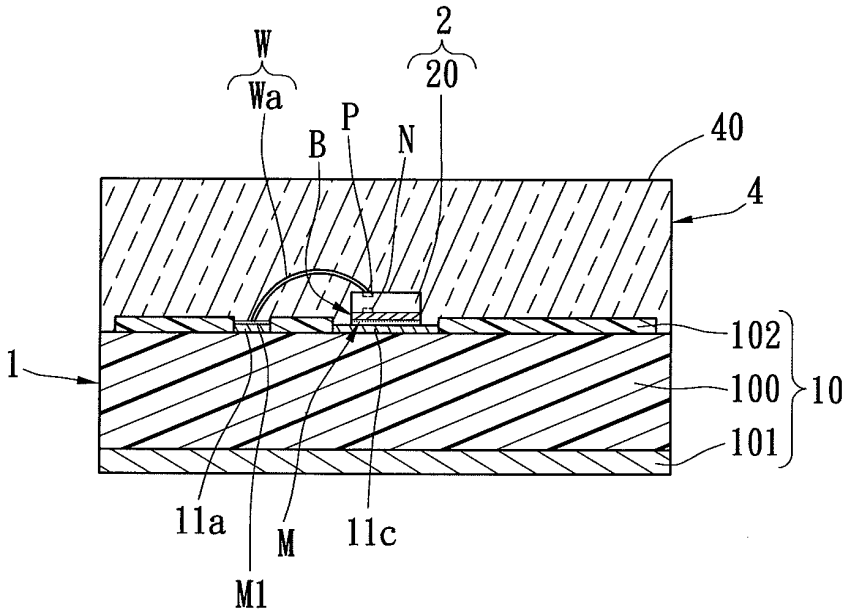
W
Wa
2
20
B
P
N
40
4
1
102
100
10
101
11a
M
11c
M1

FIG. 3

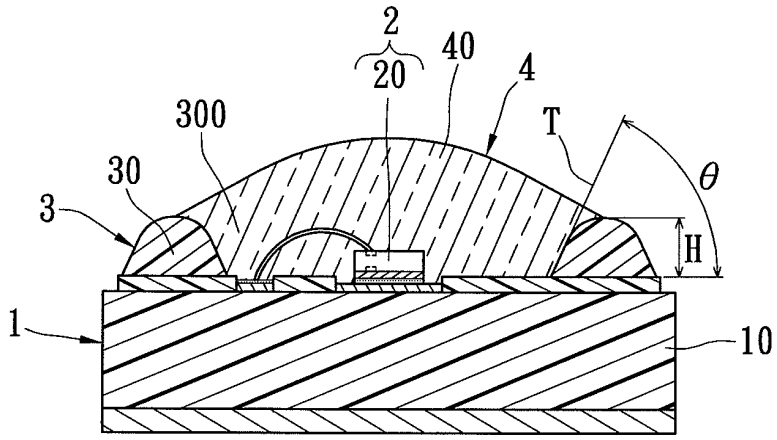
2
20
40
4
300
T
θ
30
3
H
1
10

FIG. 4

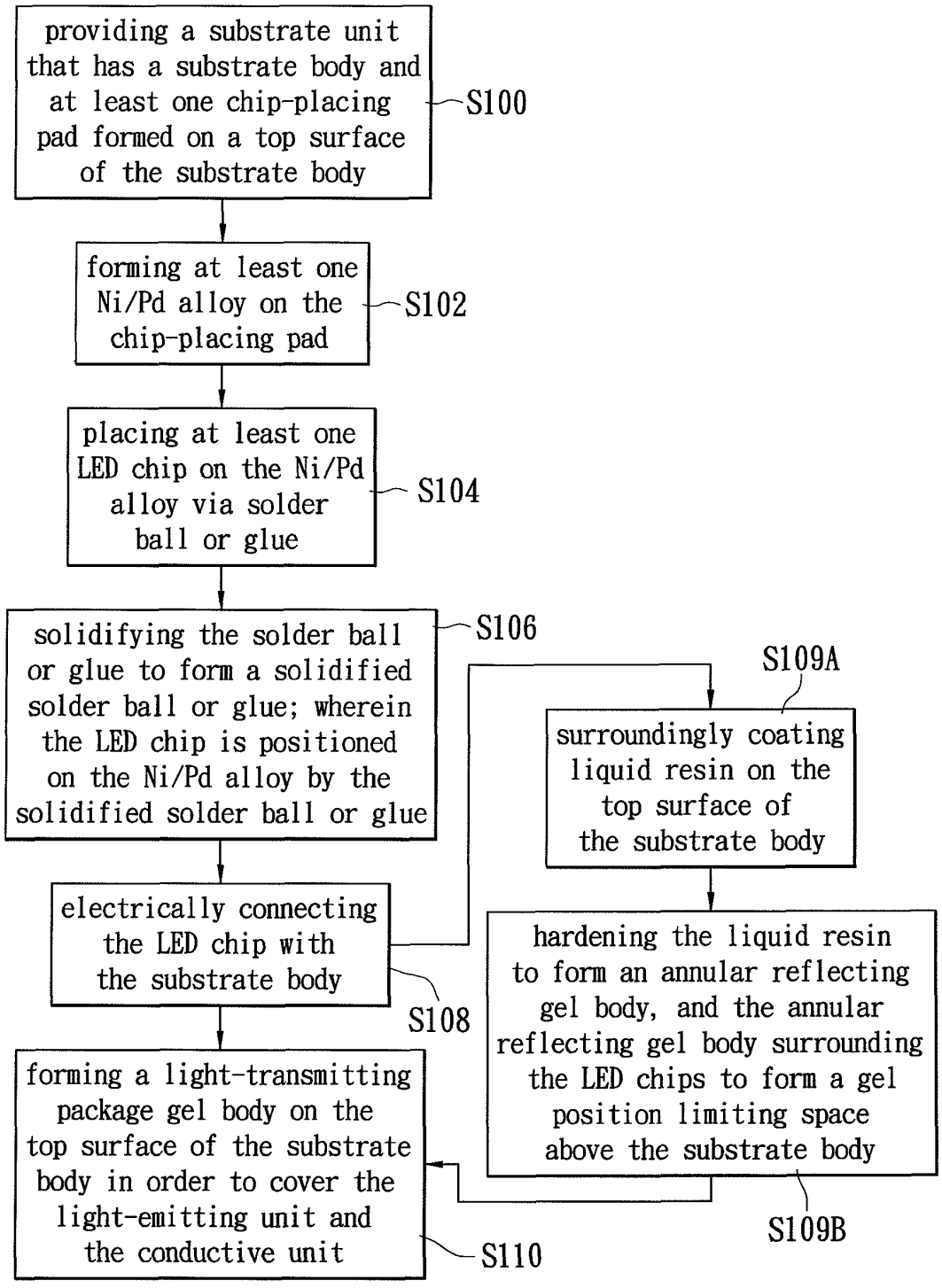
providing a substrate unit that has a substrate body and at least one chip-placing pad formed on a top surface of the substrate body
S100
forming at least one Ni/Pd alloy on the chip-placing pad
S102
placing at least one LED chip on the Ni/Pd alloy via solder ball or glue
S104
solidifying the solder ball or glue to form a solidified solder ball or glue; wherein the LED chip is positioned on the Ni/Pd alloy by the solidified solder ball or glue
S106
electrically connecting the LED chip with the substrate body
S108
S109A
surroundingly coating liquid resin on the top surface of the substrate body
hardening the liquid resin to form an annular reflecting gel body, and the annular reflecting gel body surrounding the LED chips to form a gel position limiting space above the substrate body
S109B
forming a light-transmitting package gel body on the top surface of the substrate body in order to cover the light-emitting unit and the conductive unit
S110

FIG. 5

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20080023711 A1 **[0003]**
- US 20050151149 A1 **[0003]**
- US 20070170454 A1 **[0003]**
- US 20020004251 A1 **[0003]**
- US 20080099770 A1 **[0003]**
- US 20090166657 A1 **[0003]**