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[Continued on next page]

(54) **Title**: LIGHT EMITTING ASSEMBLY AND METHOD FOR PREPARING THE SAME

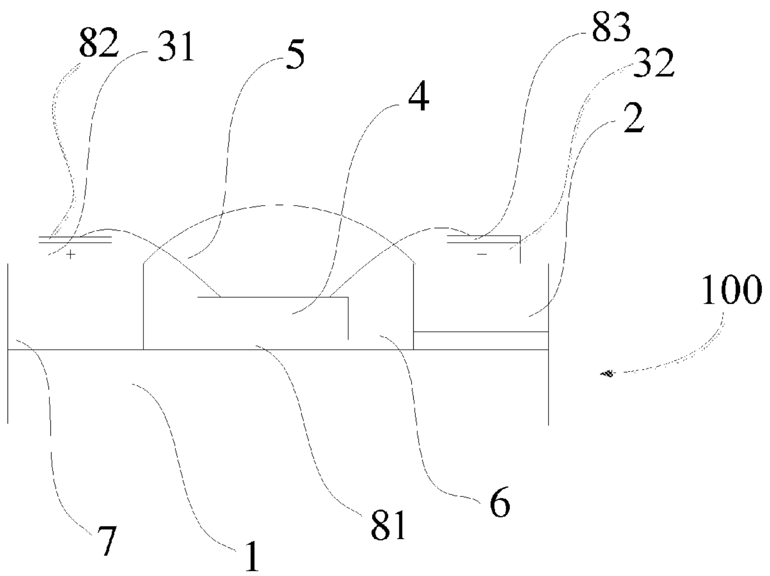

Fig. 1

(57) Abstract: A light emitting assembly and a method for preparing the light emitting assembly are provided. The light emitting assembly (100) includes: a copper heat sink (1); a ceramic substrate (2) having a mounting hole (6); a copper-oxygen eutectic layer (7) formed between the copper heat sink (1) and the ceramic substrate (2); a positive electrode (31) and a negative electrode (32) disposed on a surface of the ceramic substrate (2); an LED chip (4) disposed on the copper heat sink (1) and within the mounting hole (6), and electrically connected with the positive and negative electrodes (31, 32); and a fluorescent substance layer (5) covering the LED chip (4).

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LIGHT EMITTING ASSEMBLY AND METHOD FOR PREPARING THE SAME

CROSS REFERENCE TO RELATED APPLICATION

This application claims priority and benefits of Chinese Patent Application No. 201210559347.0, filed with State Intellectual Property Office, P. R. C. on December 21, 2012, the entire content of which is incorporated herein by reference.

FIELD

The present disclosure relates to the light emitting diode (LED) field, particularly to a light emitting assembly and a method for preparing the light emitting assembly.

BACKGROUND

The LED chip generally converts only about 15% to about 25% of the electric energy into light energy, and the remaining electric energy is converted into heat and dissipated. With the development of the LED chip manufacturing technology, the power of a single chip is increased. However, the heat generated is increased at the same time. If the heat cannot be removed in time, the temperature of the chip will increase, and the luminous efficiency and the service life of the chip may be reduced. Further, other performances such as coloration of the chip may be influenced by the temperature increasing. Therefore, there is a need to provide an LED chip having good heat dissipation performances.

SUMMARY

Embodiments of the present disclosure seek to solve at least one of the problems existing in the prior art to at least some extent, or to provide a consumer with a useful commercial choice.

Embodiments of a first broad aspect of the present disclosure provide a light emitting assembly. The light emitting assembly may include: a copper heat sink; a ceramic substrate having a mounting hole; a copper-oxygen eutectic layer formed between the copper heat sink and the ceramic substrate; a positive electrode and a negative electrode disposed on a surface of the ceramic substrate; an LED chip disposed on the copper heat sink and within the mounting hole, and electrically connected with the positive and negative electrodes; and a fluorescent substance layer covering the LED chip.

In some embodiments, the copper heat sink may be bonded with the ceramic substrate having a low thermal expansion coefficient by eutectic welding, thus a thermal expansion coefficient of the copper heat sink may be decreased. Therefore, a reliable bonding between the LED chip and the copper heat sink may be formed, which may reduce a thermal resistance of the light emitting assembly. In this way, a junction temperature of the LED chip may be reduced, so that both luminous efficiency and serve life of the light emitting assembly may be improved.

Embodiments of a second broad aspect of the present disclosure provide a method for preparing a light emitting assembly. The method may include: providing a copper heat sink and a ceramic substrate having a mounting hole; disposing the ceramic substrate on the copper heat sink and forming a copper-oxygen eutectic layer between the ceramic substrate and the copper heat sink by eutectic welding; providing a positive electrode and a negative electrode on a surface of the ceramic substrate; disposing an LED chip on the copper heat sink and within the mounting hole; electrically connecting the LED chip with the positive and negative electrodes; and covering the LED chip with a fluorescent substance layer.

With the method according to embodiments of the present disclosure, the copper heat sink may be bonded to the ceramic substrate having a low thermal expansion coefficient, thus the thermal expansion coefficient of the copper heat sink may be reduced. Therefore, a reliable bonding between the LED chip and the copper heat sink may be formed, which may reduce a thermal resistance of the light emitting assembly. In this way, a junction temperature of the LED chip may be reduced, so that both luminous efficiency and serve life of the light emitting assembly may be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects and advantages of embodiments of the present disclosure will become apparent and more readily appreciated from the following descriptions made with reference to the accompanying drawings, in which:

Fig.1 is a cross-sectional view of a light emitting assembly according to an embodiment of the present disclosure, and

Fig. 2 is a flow chart showing a method for preparing a light emitting assembly according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

Reference will be made in detail to embodiments of the present disclosure. The embodiments described herein are explanatory, illustrative, and used to generally understand the present disclosure. The embodiments shall not be construed to limit the present disclosure.

Various embodiments and examples are provided in the following description to implement different structures of the present disclosure. In order to simplify the present disclosure, certain elements and settings will be described. However, these elements and settings are only examples and are not intended to limit the present disclosure. In addition, reference numerals may be repeated in different examples in the disclosure. This repeating is for the purpose of simplification and clarity and does not refer to relations between different embodiments and/or settings. Furthermore, examples of different processes and materials are provided in the present disclosure. However, it would be appreciated by those skilled in the art that other processes and/or materials may be also applied. Moreover, a structure in which a first feature is “on” a second feature may include an embodiment in which the first feature directly contacts the second feature and may include an embodiment in which an additional feature is prepared between the first feature and the second feature so that the first feature does not directly contact the second feature.

Terms concerning attachments, coupling and the like, such as “connected” and “bonded”, refer to a relationship wherein structures are secured or attached to one another either directly or indirectly through intervening structures, as well as both movable or rigid attachments or relationships, unless expressly described otherwise.

In addition, terms such as "first" and "second" are used herein for purposes of description and are not intended to indicate or imply relative importance or significance.

A light emitting assembly according to embodiments of the present disclosure will be explained in detail below with reference to Fig. 1.

According to an embodiment of the present disclosure, a light emitting assembly 100 is provided. As shown in Fig. 1, the light emitting assembly 100 may include: a copper heat sink 1; a ceramic substrate 2 having a mounting hole 6; a copper-oxygen eutectic layer 7 formed between the copper heat sink 1 and the ceramic substrate 2; a positive electrode 31 and a negative electrode 32 disposed on a surface of the ceramic substrate 2; an LED chip 4 disposed on the copper heat sink 1 and within the mounting hole 6, and electrically connected with the positive and negative electrodes 31, 32; and a fluorescent substance layer 5 covering the LED chip 4.

In some embodiments, the copper heat sink may 1 be made from copper having a high thermal conductivity. The copper heat sink 1 may be connected with the ceramic substrate 2 having a low thermal expansion coefficient via the copper-oxygen eutectic layer 7 (which may be formed by eutectic welding the copper heat sink 1 and the ceramic substrate 2) between the copper heat sink 1 and the ceramic substrate 2, thus a thermal expansion coefficient of the copper heat sink 1 may be reduced to be slightly higher than that of the ceramic substrate 2. Therefore the LED chip 4 may be disposed on a surface of the copper heat sink 1 directly. In addition, the adhesion between the LED chip 4 and the copper heat sink 1 may be increased.

In an embodiment of the present disclosure, the LED chip 4 may include a sapphire substrate (not shown) and electrodes (not shown) formed on the same side of the sapphire substrate.

In some embodiments of the present disclosure, the copper heat sink 1 may have a thickness of about 0.1 millimeters to about 100 millimeters.

In some embodiments, the ceramic substrate 2 may have a thickness of about 0.1 millimeters to about 2 millimeters. Alternatively, the ceramic substrate 2 may have a thickness of about 0.25 millimeters to about 0.63 millimeters.

In some embodiments, the copper-oxygen eutectic layer 7 may have a thickness of about 0.01 microns to about 100 microns. With the thicknesses of the copper heat sink 1, ceramic substrate 2 and copper-oxygen eutectic layer 7 mentioned above, the combination between the copper heat sink 1 and the ceramic substrate 2 may be improved.

In an embodiment of the present disclosure, a thickness of the ceramic 1 substrate may be greater than that of the LED chip 4. In this way, the light emitting assembly 100 according to embodiments of the present disclosure may have a larger concave structure, thus facilitating following steps for preparing the light emitting assembly 100, for example, filling the concave structure with a mixture of fluorescent powers and epoxy resin to form the fluorescent substance layer 5.

In some embodiments of the present disclosure, the positive and negative electrodes 31, 32 may be electrically connected with a power source (not shown). In one embodiment, the power source may include an isolated drive power supply. Then the light emitting assembly 100 according to embodiments of the present disclosure may be more safe and reliable.

In an embodiment of the present disclosure, the light emitting assembly 100 may further include a first nickel-gold alloy layer 81 between the copper heat sink 1 and the LED chip 4.

In an embodiment of the present disclosure, the light emitting assembly 100 may further include a second nickel-gold alloy layer 82 on a surface of the positive electrode 31 and a third nickel-gold alloy layer 83 on a surface of the negative electrode 32.

In some embodiments of the present disclosure, the mounting hole 6 in the ceramic substrate 2 may be formed by any suitable methods in related art, such as punching or cutting the ceramic substrate 2.

A method for preparing a light emitting assembly according to embodiments of the present disclosure may be described with reference to Fig. 2 in the following.

According to an embodiment of the present disclosure, there is provided a method for preparing a light emitting assembly. The method may include steps of: providing a copper heat sink and a ceramic substrate having a mounting hole; disposing the ceramic substrate on the copper heat sink and forming a copper-oxygen eutectic layer between the ceramic substrate and the copper heat sink by eutectic welding; providing a positive electrode and a negative electrode on a surface of the ceramic substrate; disposing an LED chip on the copper heat sink and within the mounting hole; electrically connecting the LED chip with the positive and negative electrodes; and covering the LED chip with a fluorescent substance layer.

Specifically, referring to Fig. 2, the method may include steps of:

Step S201: a copper heat sink and a ceramic substrate having a mounting hole are provided;

Step S202: the ceramic substrate is disposed on the copper heat sink and a copper-oxygen eutectic layer is formed between the ceramic substrate and the copper heat sink by eutectic welding;

Step S203: a positive electrode and a negative electrode are provided on a surface of the ceramic substrate;

Step S204: an LED chip is disposed on the copper heat sink and within the mounting hole;

Step S205: the LED chip is electrically connected with the positive and negative electrodes; and

Step S206: the LED chip is covered with a fluorescent substance layer.

In some embodiments of the present disclosure, the step S206 may include: a mixture including fluorescent powders and an epoxy resin is filled in the mounting hole, and the mixture is cured.

In some embodiments of the present disclosure, the method may further include a step of oxidizing a surface of the copper heat sink on which the ceramic substrate is to be disposed before the eutectic welding. In one embodiment, the oxidizing step may be performed for about 10 minutes to about 60 minutes under a condition of: a temperature of about 500 Celsius degree to about 1000 Celsius degree and an oxygen content of about 50 ppm to about 1000 ppm.

In some embodiments of the present disclosure, the eutectic welding may be performed by heating the ceramic substrate and the copper heat sink for about 10 minutes to about 60 minutes at a temperature of about 1065 Celsius degree to about 1080 Celsius degree under a presence of nitrogen.

In an embodiment of the present disclosure, the method may further include a step of forming a first nickel-gold alloy layer between the copper heat sink and the LED chip.

In some embodiments, the method may further include steps of: forming a second nickel-gold alloy layer on a surface of the positive electrode, and forming a third nickel-gold alloy layer on a surface of the negative electrode.

The mounting hole may be formed during the molding process of the ceramic substrate, or formed by punching or cutting the ceramic substrate after the ceramic substrate is formed, without particular limits in the present disclosure.

It should be noted that, methods for forming the positive and negative electrodes, forming the LED chip and forming the first, second and third nickel-gold alloy layers are known to those having ordinary skill in the art, any suitable methods capable of forming these components may be applied in the present disclosure. By way of example and without limits, the positive and negative electrodes may be formed on the ceramic substrate by screen printing; the LED chip may be welded on the copper heat sink and within the mounting hole; and the first, second and third nickel-gold alloy layers may be formed by conventional deposition methods, like physic vapor deposition (PVD).

In some embodiments, the step S205 may be performed by using a gold wire to connect the LED chip with the positive and negative electrodes, without particular limits in the present disclosure.

Embodiments of the present disclosure will be described below in detail with reference to the following examples.

EXAMPLE 1

A ceramic substrate having a thickness of 0.1 millimeters was punched and cut by a laser to form a mounting hole in the ceramic substrate.

A copper sheet having a thickness of 0.1 millimeters was oxidized for 60 minutes at a temperature of 800 Celsius degree under an oxygen content of 100 ppm.

The ceramic substrate was disposed on the copper sheet and heated for 30 minutes at a temperature of 1072 Celsius degree in the presence of nitrogen, and then cooled to room temperature.

Positive and negative copper electrodes were disposed on a surface of ceramic substrate by screen printing, and then the ceramic substrate was sintered for 10 minutes at a temperature of 800 Celsius degree in the presence of nitrogen.

A first Ni-Au layer was deposited on a surface of copper sheet in the mounting hole, and second and third Ni-Au layers were deposited on surfaces of the positive and negative copper electrodes respectively.

A LED chip having a power of 2 W was welded on the first Ni-Au layer by a solid phase crystallization process.

The LED chip was connected with the positive and negative electrodes via gold wires.

A mixture of fluorescent powders and an epoxy resin was filled in the mounting hole to cover the LED chip with a fluorescent substance layer, thus obtaining a light emitting assembly.

The positive and negative electrodes of the resulted light emitting assembly were connected to an isolated drive power supply, obtaining a product A1.

EXAMPLE 2

A ceramic substrate having a thickness of 2 millimeters was punched and cut by a laser to form a mounting hole in the ceramic substrate.

A copper sheet having a thickness of 100 millimeters was oxidized for 60 minutes at a temperature of 800 Celsius degree under an oxygen content of 100 ppm.

The ceramic substrate was disposed on the copper sheet and heated for 30 minutes at a temperature of 1072 Celsius degree in the presence of nitrogen, and then cooled to room temperature.

A copper layer was formed on a surface of ceramic substrate by PVD. A layer of photosensitive printing ink was covered on the copper layer, then exposed and developed to expose a predetermined part of the copper layer. Finally the photosensitive printing ink was removed, and then the remaining part of the copper layer was removed by immersing the copper layer into a copper etching solution, thus forming positive and negative copper electrodes on a surface of the ceramic substrate.

A first Ni-Au layer was deposited on a surface of the copper sheet in the mounting hole, and second and third Ni-Au layers were deposited on surfaces of the positive and negative copper electrodes respectively.

A LED chip having a power of 2 W was welded on the first Ni-Au layer by a solid phase crystallization process.

The LED chip was connected with the positive and negative electrodes via gold wires.

A mixture of fluorescent powders and an epoxy resin was filled in the mounting hole to cover the LED chip with a fluorescent substance layer, thus obtaining a light emitting assembly.

The positive and negative electrodes of the resulted light emitting assembly were connected to an isolated drive power supply, obtaining a product A2.

COMPARATIVE EXAMPLE 1

A ceramic substrate was punched and cut by a laser to form a mounting hole in the ceramic substrate.

A first electrode was formed on a first surface of the ceramic substrate by printing, and then the ceramic substrate was sintered for 10 minutes at a temperature of 800 Celsius degree in the presence of nitrogen, then cooled to room temperature.

A second surface of the ceramic substrate was bonded with a copper heat sink via a heat conductive rubber.

A second electrode was formed on the second surface of the ceramic substrate by screen printing, and then the ceramic substrate was sintered for 10 minutes at a temperature of 800 Celsius degree in the presence of nitrogen.

A first Ni-Au layer was deposited on a surface of copper heat sink in the mounting hole, and second and third Ni-Au layers were deposited on surfaces of the first and second copper electrodes respectively.

A LED chip having a power of 2 W was welded on the first Ni-Au layer by a solid phase crystallization process.

The LED chip was connected with the first and second electrodes via gold wires.

A mixture of fluorescent powders and an epoxy resin was filled in the mounting hole to cover the LED chip with a fluorescent substance layer, thus obtaining a light emitting assembly.

The first and second electrodes of the resulted light emitting assembly were connected to an isolated drive power supply, obtaining a product B1.

COMPARATIVE EXAMPLE 2

A circuit was formed on a first surface of a direct bond copper (DBC) plate having a mounting hole by a process including steps of: film-posting, exposing, developing and etching.

A first Ni-Au layer was deposited in the mounting hole, and second and third Ni-Au layers were deposited on positive and negative electrodes formed on the DBC plate.

A LED chip having a power of 2 W was welded on a first surface of the DBC plate via a solid phase crystallization process.

A second surface of the DBC plate was connected to a copper heat sink via eutectic soldering.

The LED chip was connected with the positive and negative electrodes via gold wires.

A retaining wall was formed on the DBC plate, and then a mixture of fluorescent powders and an epoxy resin was filled in the retaining wall to cover the LED chip with a fluorescent substance layer.

The positive and negative electrodes were connected with an isolated drive power supply, forming a product B2.

Tests

Reliability

Each of the products A1, A2, B1 and B2 was subjected to the following process: cooling in ice-water solution (0 Celsius degree) for 5 minutes, then heating in boiled water (100 Celsius degree) for 5 minutes. The process was repeated for several times. The results are shown in Table 1.

Junction temperature Tj

A temperature measuring point of a thermocouple (K type) was placed on a heat dissipating pad, and a temperature of the heat dissipating pad Tc was measured. The junction temperature Tj was calculated according to an equation Tj=Rjc • P+Tc (Rjc represents a thermal resistance parameter of the LED chip, and P represents a power for heat converting). The results are shown in Table 1.

Table 1

	A1	A2	B1	B2
Process repeating time	＞100	＞100	50	＞100
Tj (Celsius degree)	52	53	52	122

As indicated in Table 1, the light emitting assembly according to embodiments of the present disclosure has better thermal shock resistances and reliability. In addition, the light emitting assembly according to embodiments of the present disclosure has a Tj of lower than 60 Celsius degree, therefore obtaining a higher luminous efficiency and a longer service life. In comparison, product B1 has a lower reliability, while product B2 has a lower luminous efficiency and shorter service life.

Reference throughout this specification to “an embodiment,” “some embodiments,” or “one embodiment,” means that a particular feature, structure, material, or characteristic described in connection with the embodiment or example is included in at least one embodiment or example of the present disclosure. Thus, the appearances of the phrases such as “in some embodiments,” “in one embodiment,” or “in an embodiment,” in various places throughout this specification are not necessarily referring to the same embodiment or example of the present disclosure. Furthermore, the particular features, structures, materials, or characteristics may be combined in any suitable manner in one or more embodiments or examples.

Although explanatory embodiments have been shown and described, it would be appreciated by those skilled in the art that the above embodiments cannot be construed to limit the present disclosure, and changes, alternatives, and modifications can be made in the embodiments without departing from spirit, principles and scope of the present disclosure.

What is claimed is:

1. A light emitting assembly comprising:

a copper heat sink;

a ceramic substrate having a mounting hole;

a copper-oxygen eutectic layer formed between the copper heat sink and the ceramic substrate;

positive and negative electrodes disposed on a surface of the ceramic substrate;

an LED chip disposed on the copper heat sink and within the mounting hole, and electrically connected with the positive and negative electrodes; and

a fluorescent substance layer covering the LED chip.

2. The light emitting assembly according to claim 1, wherein the LED chip includes a sapphire substrate and electrodes formed on the same side of the sapphire substrate.

3. The light emitting assembly according to claim 1 or 2, wherein the copper heat sink has a thickness of about 0.1 millimeters to about 100 millimeters.

4. The light emitting assembly according any of claims 1-3, wherein the ceramic substrate has a thickness of about 0.1 millimeters to about 2 millimeters.

5. The light emitting assembly according any of claims 1-4, wherein the copper-oxygen eutectic layer has a thickness of about 0.01 microns to about 100 microns.

6. The light emitting assembly according to any of claims 1-5, wherein a thickness of the ceramic substrate is greater than that of the LED chip.

7. The light emitting assembly according to any of claims 1-6, wherein the positive and negative electrodes are electrically connected with a power source.

8. The light emitting assembly according to claim 7, wherein the power source includes an isolated drive power supply.

9. The light emitting assembly according to any of claims 1-8, further comprising

a first nickel-gold alloy layer between the copper heat sink and the LED chip.

10. The light emitting assembly according to any of claims 1-9, further comprising

a second nickel-gold alloy layer on a surface of the positive electrode, and

a third nickel-gold alloy layer on a surface of the negative electrode.

11. A method for preparing a light emitting assembly, comprising:

providing a copper heat sink and a ceramic substrate having a mounting hole;

disposing the ceramic substrate on the copper heat sink and forming a copper-oxygen eutectic layer between the ceramic substrate and the copper heat sink by eutectic welding;

providing a positive electrode and a negative electrode on a surface of the ceramic substrate;

disposing an LED chip on the copper heat sink and within the mounting hole;

electrically connecting the LED chip with the positive and negative electrodes; and

covering the LED chip with a fluorescent substance layer.

12. The method according to claim 11, wherein covering the LED chip with a fluorescent substance layer comprises:

filling the mounting hole with a mixture including fluorescent powders and epoxy resin, and curing the mixture.

13. The method according to claim 11 or 12, further comprising:

oxidizing a surface of the copper heat sink on which the ceramic substrate is to be disposed before the eutectic welding.

14. The method according to claim 13, wherein the oxidizing is performed for about 10 minutes to about 60 minutes under a condition of: a temperature of about 500 Celsius degree to about 1000 Celsius degree and an oxygen content of about 50 ppm to about 1000 ppm.

15. The method according to any of claims 11-14, wherein the eutectic welding is performed by

heating the ceramic substrate and the copper heat sink for about 10 minutes to about 60 minutes at a temperature of about 1065 Celsius degree to about 1080 Celsius degree under a presence of nitrogen.

16. The method according to any of claims 11-15, further comprising:

forming a first nickel-gold alloy layer between the copper heat sink and the LED chip.

17. The method according to any of claims 11-16, further comprising:

forming a second nickel-gold alloy layer on a surface of the positive electrode, and forming a third nickel-gold alloy layer on a surface of the negative electrode.

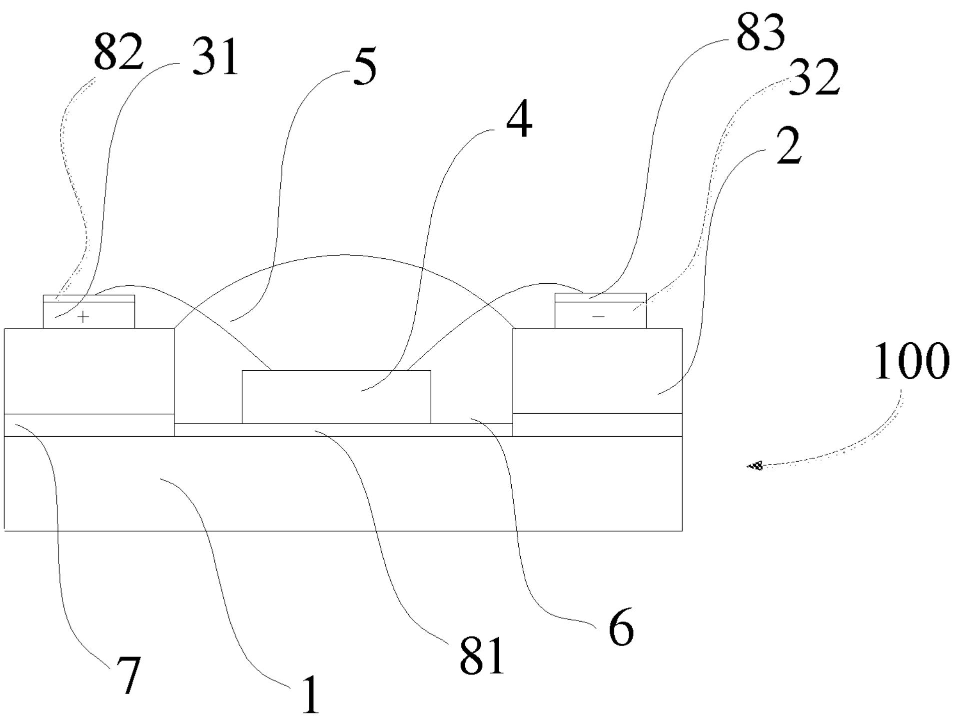

Fig. 1

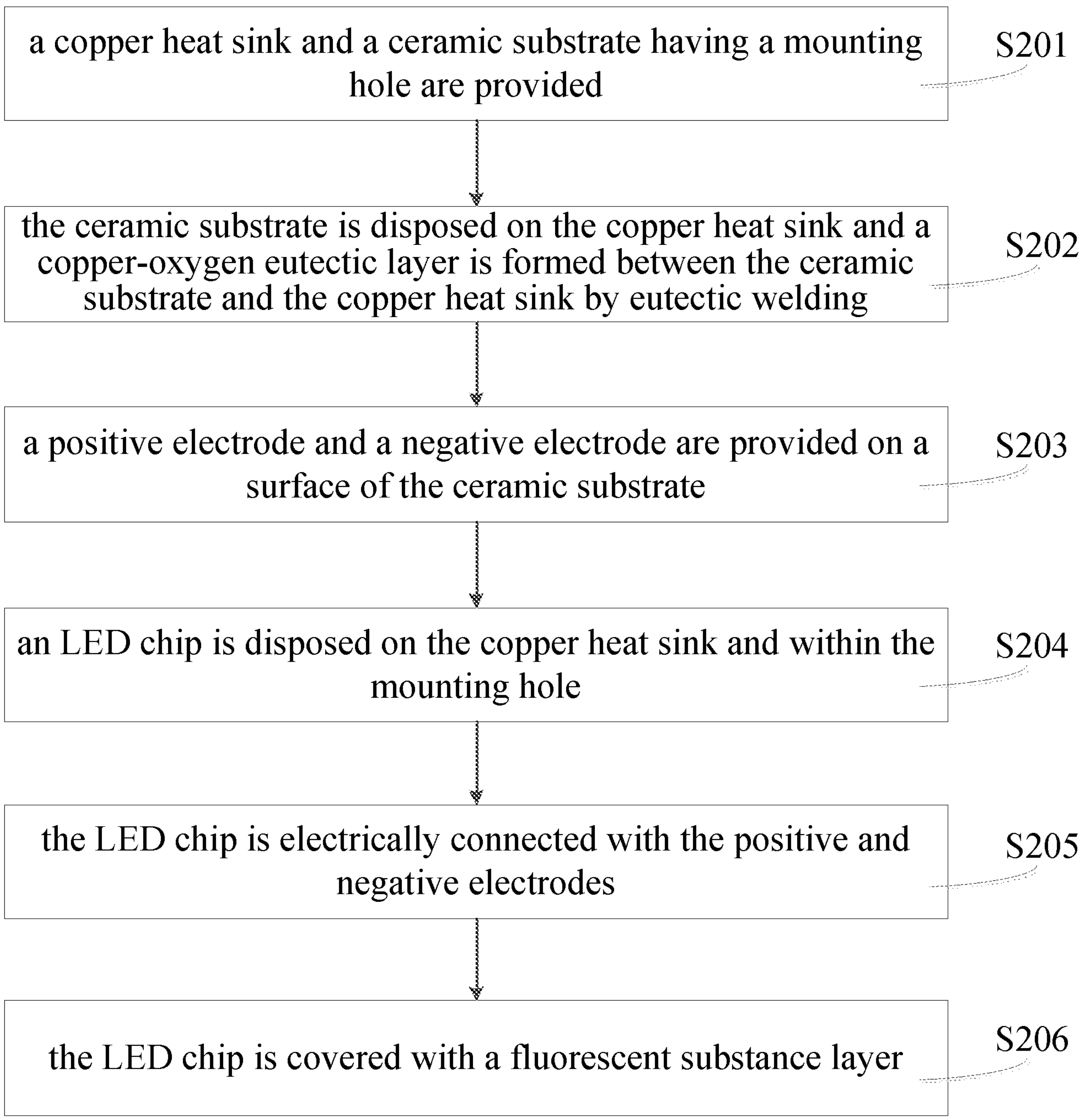
a copper heat sink and a ceramic substrate having a mounting hole are provided
S201
the ceramic substrate is disposed on the copper heat sink and a copper-oxygen eutectic layer is formed between the ceramic substrate and the copper heat sink by eutectic welding
S202
a positive electrode and a negative electrode are provided on a surface of the ceramic substrate
S203
an LED chip is disposed on the copper heat sink and within the mounting hole
S204
the LED chip is electrically connected with the positive and negative electrodes
S205
the LED chip is covered with a fluorescent substance layer
S206

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2013/088692

A. CLASSIFICATION OF SUBJECT MATTER

H01L 33/64 (2010.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CPRS,CNKI,EPODOC,WPI: led, light emitting diode, copper, cu, braze, oxygen, oxide, ceramic, alumina, eutectic, heat, thermal, conduct, dissipate, radiate, transfer, sink, fin

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2011149065 A1 (KYOCERA CORPORATION) 01 Dec. 2011 (01.12.2011) description, paragraphs 26,27,30,42,51,56,57; figures 2,3	1-17
Y	US 2006076571 A1 (HSIEH, M. et al.) 13 Apr. 2006 (13.04.2006) description, paragraphs 29,30,32,34,45,47; figures 1A,3C	1-17
Y	US 2010288537 A1 (HIGH CONDUCTION SCI CO LTD) 18 Nov. 2010 (18.11.2010) description, paragraph 30; figure 4	13-14
A	CN 2890611 Y (HUAHONG PHOTOELECTRON SHENZHEN CO LTD) 18 Apr. 2007 (18.04.2007) the whole document	1-17

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 Jan. 2014 (27.01.2014)	**06 Mar. 2014 (06.03.2014)**

Name and mailing address of the ISA/CN	Authorized officer
The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	ZHANG, Yue Telephone No. (86-10)62089115

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2013/088692

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
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