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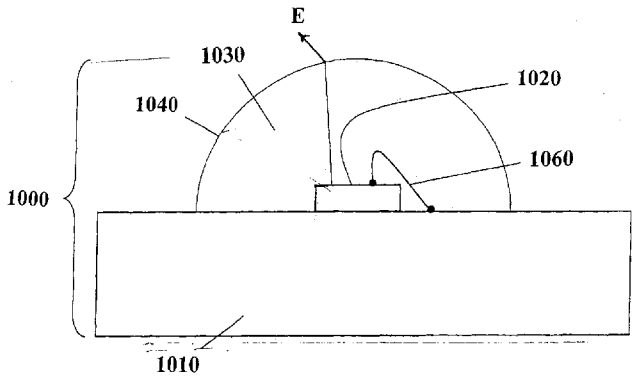

FIG. 10

(57) Abstract: A light emitting diode device includes a substrate (1060), one or more light emitting diode chips (1020) on the substrate (1060) configured to emit electromagnetic radiation, and a lens (1030) configured to encapsulate the light emitting diode chips (1020) having a surface (1040) with a micro-roughness structure. The micro-roughness structure functions to improve the light extraction of the electromagnetic radiation and to direct the electromagnetic radiation outward from the lens (1030).

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LED DEVICE WITH A LIGHT EXTRACTING ROUGH STRUCTURE AND MANUFACTURING METHODS THEREOF

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation-in-part of US Application Serial No. 12/558,476 filed on 09/11/2009, which claims the priority of Taiwan Application Serial Number 98115567 filed on 05/11/2009.

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

[0002] This invention relates to an light emitting diode device having a light extracting rough structure and manufacturing methods thereof, wherein the light extracting rough structure has a micron-scaled roughness to improve light extraction efficiency and uniformity of the light emitting diode.

2. DESCRIPTION OF RELATED ART

[0003] In a conventional LED device, there is a lens structure which is disposed on the LED. However, total reflection effect reduces light extraction efficiency in the LED structure. FIG. 1 is a schematic diagram showing a conventional LED device. As shown in FIG. 1, a LED 110 is encapsulated by a lens 120. When the light is emitted from the LED, there are two phenomena. If the angle of incidence is smaller than the critical angle, the light transmits through the surface 125 (shown by arrow A). If the angle of incidence is larger than the critical angle, the light reflects back to the lens. The total reflection reduces the light extraction efficiency of LED device.

BRIEF SUMMARY OF THE INVENTION

[0004] This invention provides a LED device having a light extracting rough structure and manufacturing methods thereof.

[0005] This invention provides a LED device which has a light extracting rough structure. The device includes a leadframe, one or more light emitting diode chips

disposed on and electrically connected to the leadframe, and a lens configured to encapsulate the one or more light emitting diode chips, the lens having a micro-roughness structure. This micro-roughness structure of the lens has a roughness between 0.1 μm and 50 μm. The device may include a protective layer made of transparent glue and located between the lens and the one or more light emitting diode chips to protect the one or more light emitting diode chips. *An alternate embodiment LED device includes a substrate, such as a semiconductor or ceramic material, rather than a leadframe.*

[0006] This invention also provides a manufacturing method to produce a light emitting diode device having a light extracting rough structure. The manufacturing method includes the steps: disposing one or more light emitting diode chips on a leadframe *(or a carrier)* and allowing the one or more light emitting diode chips to be electrically connected to the leadframe *(or to the carrier)* to form a semi-finished product; placing the semi-finished product inside a mold, the mold having been treated to have a micro-roughness structure in the inner surface, injecting a glue into the mold and curing the glue by heating, the glue forming a lens after curing, the lens encapsulating the one or more light emitting diode chips and having a surface including a micro-roughness structure, and retrieving the encapsulated light emitting diode chips and leadframe *(or the carrier)* from the mold. The micro-roughness structure has a roughness between 0.1 μm and 50 μm. Furthermore, before placing the semi-finished product inside the mold, a protective layer can be dispensed on the one or more light emitting diode chips to protect the one or more light emitting diode chips. The protective layer can be transparent glue or a glue mixed fluorescent bodies.

[0007] The invention also provides a manufacturing method to produce a light emitting diode device having a light extracting rough structure. The manufacturing method includes the steps: disposing one or more light emitting diode chips on a leadframe *(or a carrier)* and allowing the one or more light emitting diode chips to be electrically connected to the leadframe *(or the carrier)* to form a semi-finished product; placing the semi-finished product inside a mold; injecting a glue into the mold and curing the glue by heating, the glue forming a lens after curing, the lens encapsulating the one or more light emitting diode chips; retrieving the encapsulated light emitting diode chips and leadframe *(or the carrier)* from the mold; and roughening the surface of the lends to

form a micro-roughness structure. The micro-roughness structure of the lens has a roughness between 0.1μm and 50 μm. Furthermore, before placing the semi-finished product inside the mold, a protective layer can be dispensed on the one or more light emitting diode chips to protect the one or more light emitting diode chips. The protective layer can be transparent glue or a glue mixed with fluorescent bodies.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The advantages and features of the invention will be appreciated by learning the various embodiments and examples set forth below in conjunction with the accompanied drawings. The drawings should be regarded as exemplary and schematic, and are shown not to scale and should not be implemented exactly as shown. In addition, like reference numerals designate like structural elements in the drawings.

[0009] FIG. 1 is a schematic diagram showing a conventional LED device;

[0010] FIG. 2 is a schematic diagram of a LED device having a light extracting rough structure according to an embodiment of the invention;

[0011] FIG. 3 is a schematic diagram of a LED device having a light extracting rough structure according to another embodiment of the invention;

[0012] FIG. 4A is a schematic enlarged diagram of part of the roughened surface in FIG. 2;

[0013] FIG. 4B is a schematic enlarged diagram of part of the roughened surface in FIG 3;

[0014] FIG. 5 is a manufacturing flow chart of a LED device according to an embodiment of the invention;

[0015] FIGS. 6 to 6D are schematic diagrams showing specific steps in the manufacturing process depicted in FIG 5;

[0016] FIG. 7 is a manufacturing flow chart of a LED device according to another embodiment of the invention;

[0017] FIGS. 8A and 8B are schematic diagrams showing the specific steps in part of the manufacturing process depicted in FIG 7;

[0018] FIG. 9 is a manufacturing flow chart of a LED device according to yet another embodiment of the invention; *and*

[0019] Figure 10 is a schematic cross sectional view of an alternate embodiment LED device.

DETAILED DESCRIPTION OF THE INVENTION

[0020] FIG. 2 is a schematic diagram showing a light emitting diode (LED) device 200 having a light extracting rough surface according to an embodiment of the invention. As shown in FIG. 2, the LED device 200 includes a leadframe 210, a LED 220 electrically connected to the leadframe 210, and a semi-spherical lens 230 configured to encapsulated the LED chip 220 and having a roughened surface 240. FIG. 3 is a schematic diagram showing a LED device 300 having a light extracting rough structure according to another embodiment of the invention. As shown in FIG. 3, the LED device 300 has a structure similar to that of the LED 200 in FIG. 2, except that while the lens 230 of the LED device 200 in FIG. 2 is semi-spherical, the lens 310 of the LED device 300 in FIG 3 is rectangular. Similarly, the lens 310 in FIG. 3 also has a roughened surface 320. The roughened surfaces 240 and 320 have micro-roughness structures having a roughness between 01. μm and 50 μm. The roughened surfaces 240 and 320 can improve the light extraction efficiency and uniformity of the LED devices 200 and 300, respectively. Specifically, as shown in FIG 2, when light is emitted from the LED chip 220, it is directed out of the LED device 200 by the roughened surface 240 of the semi-spherical lens 230 (as shown by arrow E in FIG. 2). Likewise, as shown in FIG. 3, when light emitted from the LED chip 220, it is directed out of the LED device 300 by the roughened surface 320 of the rectangular lens 310 (as shown by arrow E in FIG. 3). In addition, in FIGS. 2 and 3, the LED chip 220 can be electrically connected to the leadframe 210 via wire (not shown) but the connection is not limited to wire. In other embodiments, the LED chip 220 can be electrically connected to the leadframe 210 using flip-chip packaging. Further, although there is only one LED chip 220 shown in FIGS. 2 or 3, it will be appreciated that each of the LED devices 200 and 300 of the invention can actually include one or more LED chips 220.

[0021] FIG. 4A is a schematic enlarged diagram showing part of the roughened surface 240 in FIG. 2 (i.e. the portion circled as C). FIG 4B is a schematic enlarged diagram showing part of the roughened surface 320 in FIG. 3 (i.e. the portion circled as

D). It can be clearly seen in FIGS. 4A and 4B that the roughened surfaces 240 and 320 have irregularly jagged shapes. When the LED chip 220 emits light, these irregularly jagged shapes on the roughened surfaces can help reduce the total reflection occurring in the lens.

[0022] FIG. 5 is a manufacturing flow chart of a LED device according to an embodiment of the invention. As shown in FIG. 5, a LED chip is disposed on a leadframe in step 510 (the chip bounding step). In step 520, the LED chip is electrically connected to the leadframe via wire made of, for example, gold (Au) to form a semi-finished product of the LED device (the wire bonding step). In step 530, the semi-finished product is placed inside a treated (roughened) mold or template before a glue is injected into the mold or template and cured by heating, and then the finished product is retrieved from the mold or template (the glue injecting and encapsulating step).

[0023] FIGS. 6A to 6D are schematic diagrams showing specific steps in the manufacturing process in FIG. 5. FIG. 6A illustrates the specific steps 510 and 520 depicted in FIG. 5. As shown in FIG. 6A, a LED chip 620 is disposed on a leadframe 610 and is electrically connected to the leadframe 610 via wire 630 so as to form a LED semi-finished product. FIGS. 6B and 6D illustrate the specific step 630 depicted in FIG. 5. As shown in FIGS. 6B to D, the semi-finished product (composed of leadframe 610, LED chip 620, and wire 630) of FIG. 6A is placed inside a treated (roughened) mold or template 640. The mold or template has an irregularly jagged inner surface 650 (as shown in the enlarged portion circled in FIG. 6B). After the mold or template 640 is roughened, the jagged inner surface 650 can have a micro-roughness structure having a roughness between 0.1μm and 5μm. Next, as shown in FIG. 6C, a glue *(or a polymer)* such as epoxy or silicone is injected into the mold or template 640, and the glue is heated to cure. Finally, as shown in FIG. 6D, the final product is allowed to separate from the mold or template 640. The final product is composed of leadframe 610, LED chip 620, wire 630, and lens 660, wherein the lens 660 is cured by heating the glue. The lens has an irregularly jagged surface 670 (as shown in the enlarged portion circled in FIG. 6D) resulted from the jagged inner surface 650 of the mold or template 640. The jagged surface 670 also has a micro-roughness structure between 0.1 μm and 50 μm. The jagged inner surface 650 of the mold or template 640 is formed by using one of sand blasting,

chemical etching, and electrochemical etching so that the jagged inner surface 650 has the micro-roughness structure having a roughness between 0.1 μm and 50 μm.

[0024] FIG. 7 is a manufacturing flow chart of a LED device according to another embodiment of the invention. As shown in FIG. 7, a LED chip is disposed on a leadframe in step 710 (the chip bonding step). In step 720, the LED chip is electrically connected to the leadframe via wire made of, for example, gold (Au) (the wire bonding step). In step 730, a glue dispensing process is performed, wherein transparent glue optionally containing fluorescent bodies is coated over the LED chip and the wire so as to completely encapsulate the LED chip and partially encapsulates the wire (the glue dispensing step) to form a semi-finished product of the LED device. The transparent glue used in step 730 can be configured as a protective layer for the LED chip and wire. The transparent glue can also be configured to secure the carrier layer of the fluorescent bodies when the LED device needs different types of fluorescent bodies to emit light with different wavelengths. The transparent glue can be silicone. In step 740, the semi-finished product is placed inside a treated (roughened) mold or template before the glue is injected into the mold or template and heated, and then when the glue is cured after heating, the final product is retrieved from the mold or template (the glue injecting and encapsulating step). The manufacturing flow chart depicted in FIG. 7 is similar to that in FIG. 5, except that in FIG. 7 the LED chip and wire are coated with the transparent glue optionally containing the fluorescent bodies (i.e. the glue dispensing step).

[0025] FIG. 8A is a schematic diagram showing the specific steps 710 to 730 depicted in FIG. 7, FIG. 8B shows the semi-finished product depicted in FIG. 6B is placed inside the mold or template 640. As compared to FIG. 6A, the semi-finished product of the LED device of FIG. 8A can be composed of leadframe 610, LED chip 620, wire 630, and protective layer 810 (and/or carrier layer) optionally containing fluorescent bodies. In FIG. 7, all the steps but step 730 are similar to those in FIG. 5. This means that step 710 corresponds to step 510; step 720 corresponds to step 520; and step 740 corresponds to step 530 (as shown in FIGS. 6C and 6D); hence, these steps will not be described here for brevity. Although FIGS. 6A and 8A show that each LED device has only one LED chip 620, it is understood that the LED device of the invention can actually include one or more LED chips 620.

[0026] In other embodiments of the invention, the treated (roughened) mold or template may not be required. FIG. 9 is a manufacturing flow chat of a LED device according to yet another embodiment of the invention. As shown in FIG. 9, a LED chip is disposed on a leadframe in step 910 (the chip bonding step). In step 920, the LED chip is electrically connected to the leadframe via wire made of, for example, gold (Au) to form a semi-finished product of the LED device (the wire bonding step). In step 930, a glue dispensing process is performed, wherein transparent glue optionally containing fluorescent bodies is coated over the LED chip and wire so as to completely encapsulate the wire (the glue dispensing step). However, step 930 is not necessary and can be omitted in other embodiments. In step 940, the semi-finished product of the LED device is placed inside a mold or template having no treated inner surface before a lens having no jagged surface is formed by using the above mentioned curing-by-heating step, and then the final product is retrieved from the mold or template (the glue injecting and encapsulating step). Finally, in step 950, the surface of the lens is roughened by a method such as etching or imprinting, thereby forming a lens surface with an irregularly jagged shape (the surface roughening step). After being roughened, the surface of the lens has a micro-roughness structure having a roughness between 0.1 μm and 50 μm. The etching method can be performed to achieve the desired roughness, for example, by etching the surface of the lens with methylbenzene at about room temperature to about 60°C for about 30 seconds to about 1 hour. On the other hand, the imprinting method can be performed to achieve the desired roughness, for example, by selectively printing silicone on the surface of the lens and curing it at about 150°C for about 30 minutes.

[0027] *Referring to Figure 10 an alternate embodiment LED device 1000 includes a substrate 1010; at least one LED chip 1020 mounted to the substrate 1010 configured to emit electromagnetic radiation; a wire 1060 bonded to the LED chip 1020 and to the substrate 1010; and a lens 1030 encapsulating the LED chip 1020 having a roughened surface 1040 configured to increase the light extraction and direct the electromagnetic radiation outward. The lens 1030 can comprise a transparent polymer material, such as epoxy or silicone, formed with the roughened surface 1040 by molding or other suitable process, substantially as previously described. In addition, the lens 1030 can be semi-spherical in shape with a spherical surface substantially as previously*

described for LED device 200 (Figure 2), or polygonal in shape with a planar surface substantially as previously described for LED device 300 (Figure 3). As indicated by arrow E in Figure 10, the electromagnetic radiation emitted by the LED chip 1020 is directed outward from the lens 1030 at a different angle, rather than being reflected back towards the LED chip 1020 as with the prior art lens 120 (Figure 1) with a smooth surface.

[0028] *Still referring to Figure 10, the substrate 1010 functions as a mounting substrate, and also provides electrical conductors (not shown), electrodes (not shown) and electrical circuits (not shown) for electrically connecting the LED device 1000 to the outside world. The substrate 1010 can have a flat shape as shown, or can have a convex shape or a concave shape. In addition, the substrate 1010 can include a reflective layer (not shown) to improve increase the light reflection. The substrate 1010 can comprise Si, or another semiconductor material such as GaAs, SiC, GaP or GaN. Alternately, the substrate 1010 can comprise a ceramic material (e.g., AlN, Al_2O_3), sapphire, glass, a printed circuit board (PCB) material, a metal core printed circuit board (MCPCB), an FR-4 printed circuit board (PCB), a metal matrix composite, a silicon submount substrate, or any packaging substrate used in the art. Further, the substrate 1010 can comprise a single layer of metal or metal alloyed layers, or multiple layers such as Si, AlN, SiC, AlSiC, diamond, MMC, graphite, Al, Cu, Ni, Fe, Mo, CuW, CuMo, copper oxide, sapphire, glass, ceramic, metal or metal alloy. In any case, the substrate 1010 preferably has an operating temperature range of from about 60°C to 350°C.*

[0029] *The LED device 1000 can be fabricated using essentially the same manufacturing process shown in Figures 6A-6D or Figures 8A-8B. However, in the manufacturing process, a carrier takes the place of the leadframe 610 (Figure 6A). In addition, the carrier can include the previously described leadframe 210 (Figure 2) and substrate 1010 (Figure 10). For example, the carrier can be in the form of a wafer comprised of a plurality of substrates 1010. During the manufacturing process the carrier can be singulated into a plurality of LED devices 1000 each having a single substrate 1010.*

[0030] Although the foregoing invention has been described in the preferred embodiments in conjunction with the drawings for purposes of clarity of understanding, it

will be apparent to the person skilled in the art that certain changes and modification can be practiced within the scope of the appended claims. Accordingly, the present embodiments are to be considered as illustrative and not restrictive, and the invention is not to be limited to the details given herein, but may be modified within the scope and equivalents of the appended claims.

CLAIMS

1. A light emitting diode device having a light extracting rough structure, the device comprising:

a substrate;

at least one light emitting diode chip disposed on and electrically connected to the substrate; and

a lens on the substrate encapsulating the light emitting diode chip having a surface including a micro-roughness structure.

2. The light emitting diode device of claim 1 wherein the substrate comprises a semiconductor material.

3. The light emitting diode device of claim 1 wherein the substrate comprises a ceramic material.

4. A light emitting diode device comprising:

a substrate;

at least one light emitting diode chip mounted to the substrate configured to emit electromagnetic radiation; and

a polymer lens on the substrate encapsulating the light emitting diode chip, the polymer lens having a roughened surface comprising a plurality of jagged shapes configured to improve the light extraction of the electromagnetic radiation and to direct the electromagnetic radiation outward from the device.

5. The light emitting diode device of claim 4 wherein the roughened surface comprises a spherical surface.

6. The light emitting diode device of claim 4 wherein the roughened surface comprises a planar surface.

7. The light emitting diode device of claim 4 wherein the substrate comprises a semiconductor material selected from the group consisting of Si, GaAs, SiC, GaP and GaN..

8. The light emitting diode device of claim 4 wherein the substrate comprises a ceramic material selected from the group consisting of AlN and Al_2O_3 .

9. The light emitting diode device of claim 4 wherein the jagged shapes have a roughness between 0.1 μm to 50 μm,

10. The light emitting diode device of claim 4 further comprising a transparent protective layer on the light emitting diode chip.

11. A method of manufacturing a light emitting diode device having a light extracting rough structure, the method comprising the following steps of:

disposing one or more light emitting diode chips on a substrate and allowing the one or more light emitting diode chips to be electrically connected to the substrate to form a semi-finished product;

placing the semi-finished product inside a mold, the mold having been treated to have a micro-roughness structure in the inner surface;

injecting a glue into the mold and curing the glue by heating, the glue forming a lens after curing, the lens encapsulating the one or more light emitting diode chips and having a micro-roughness structure in the surface; and

retrieving the encapsulated light emitting diode chips and the substrate from the mold.

12. The method of claim 11 wherein the micro-roughness structure in the inner surface of the mold has a roughness of between 0.1 μm and 50 μm.

13. The method of claim11 wherein treatment of the mold includes sand blasting, chemical etching or electrochemical etching.

14. The method of claim 11 wherein the surface of the micro-roughness structure of the lens has a roughness of between 0.1 μm to 50 μm.

15. The method of claim 11 further comprising forming a protective layer on the one or more light emitting diode chips before placing the semi finished product inside the mold.

16. The method of claim 11 wherein the substrate comprises a semiconductor material or a ceramic material.

17. The method of claim 11 wherein the substrate comprises a semiconductor material selected from the group consisting of Si, GaAs, SiC, GaP, GaN or AlN..

18. The method of claim 11 wherein the substrate comprises a ceramic material selected from the group consisting of AlN and Al_2O_3 .

19. The method of claim 11 wherein the micro-roughness structure comprises a plurality of jagged shapes.

20. The method of claim 11 wherein the substrate initially comprises a carrier comprising a plurality of substrates.

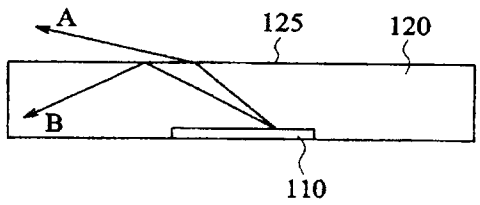

FIG. 1

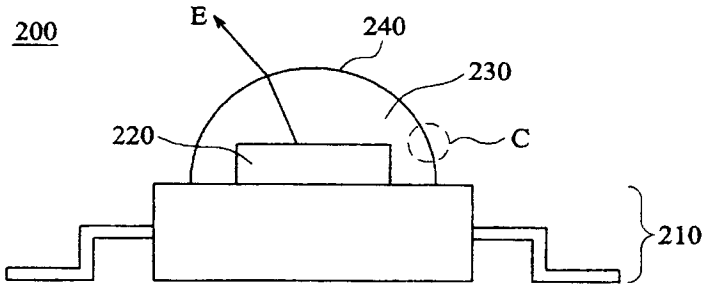

FIG. 2

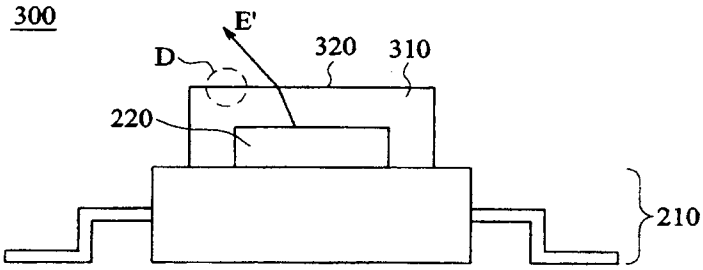

FIG. 3

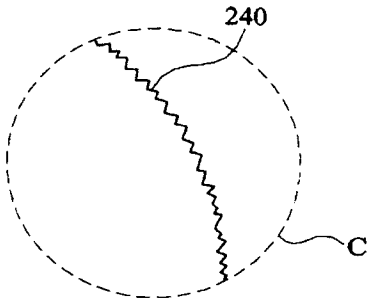

FIG. 4A

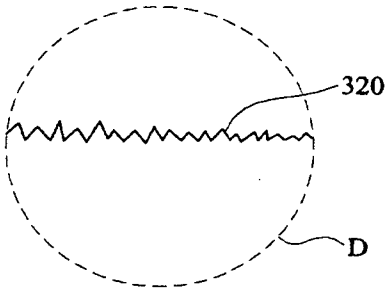

FIG. 4B

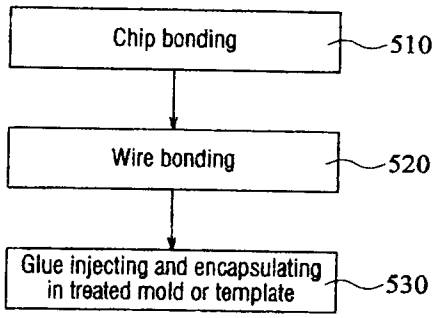
Chip bonding
510
Wire bonding
520
Glue injecting and encapsulating in treated mold or template
530

FIG. 5

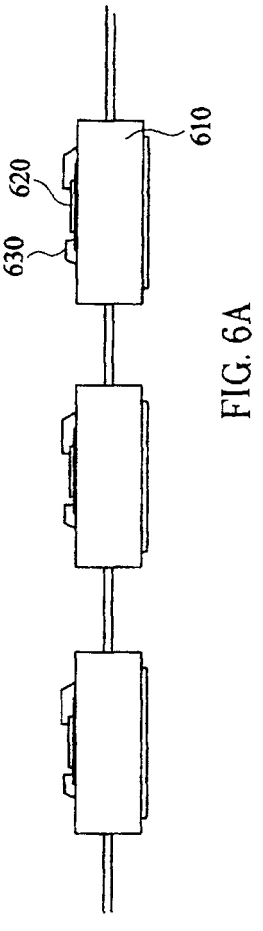

FIG. 6A

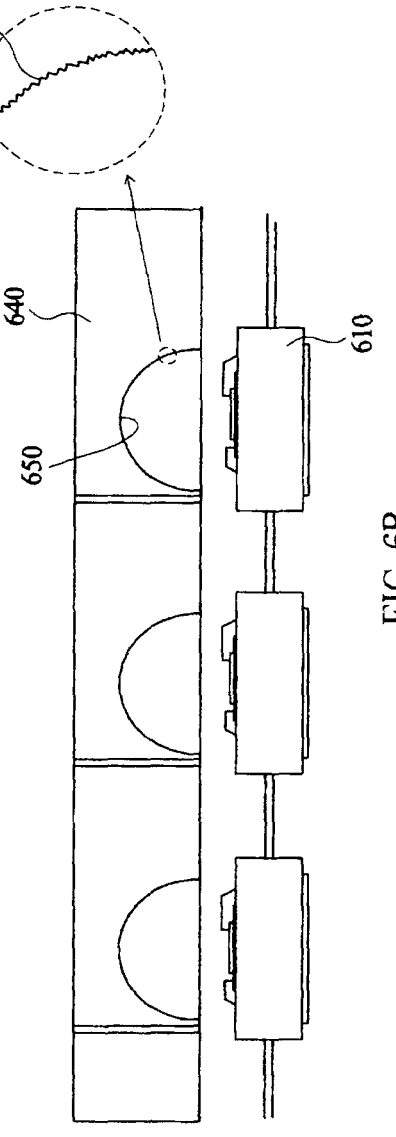

FIG. 6B

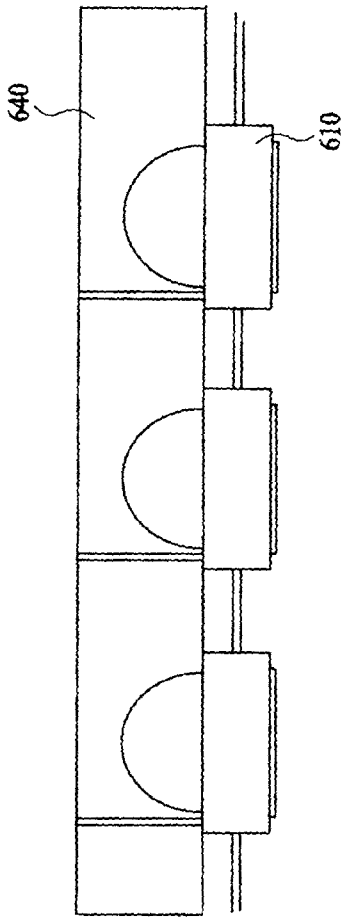

FIG. 6C

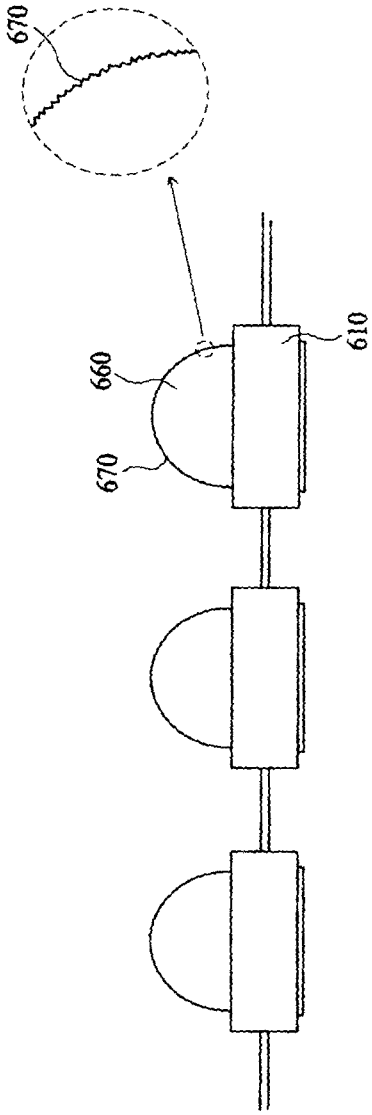

FIG. 6D

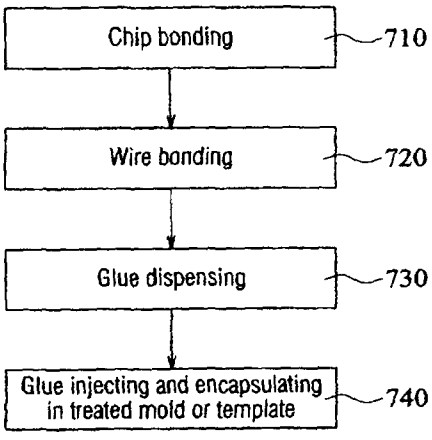
Chip bonding
710
Wire bonding
720
Glue dispensing
730
Glue injecting and encapsulating in treated mold or template
740

FIG. 7

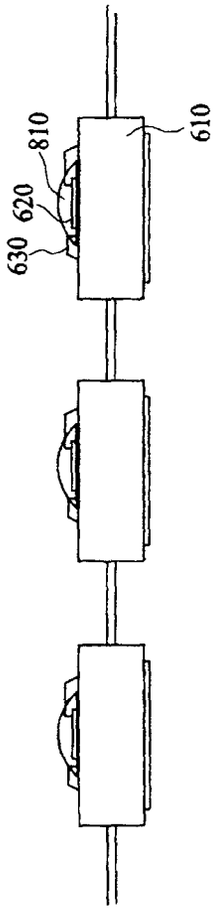

FIG. 8A

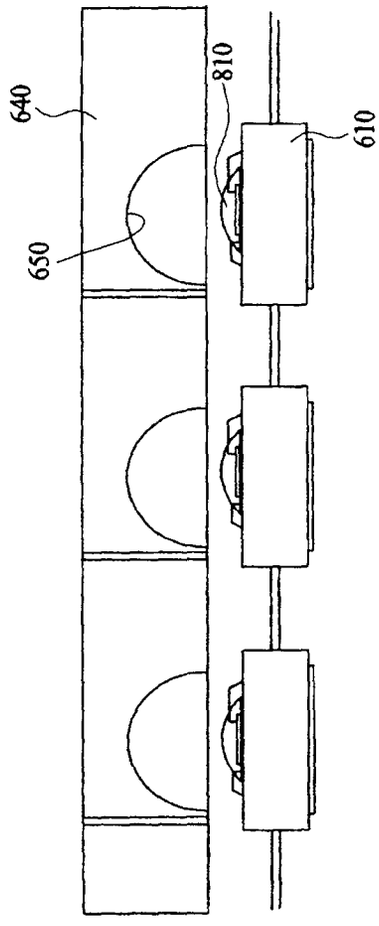

FIG. 8B

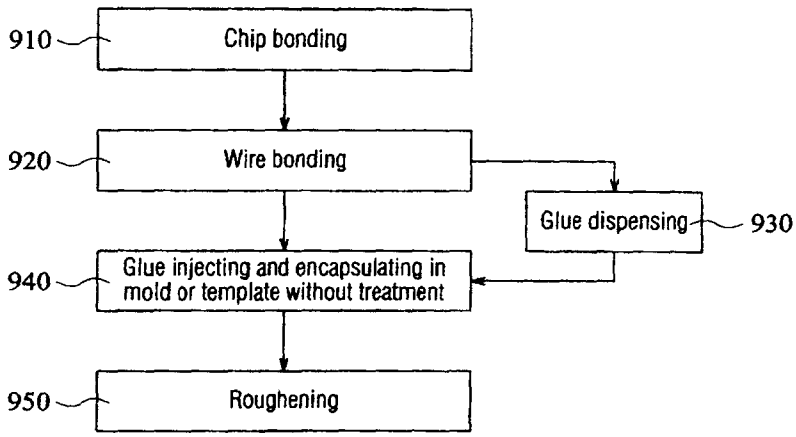
910
Chip bonding
920
Wire bonding
Glue dispensing
930
940
Glue injecting and encapsulating in mold or template without treatment
950
Roughening

FIG. 9

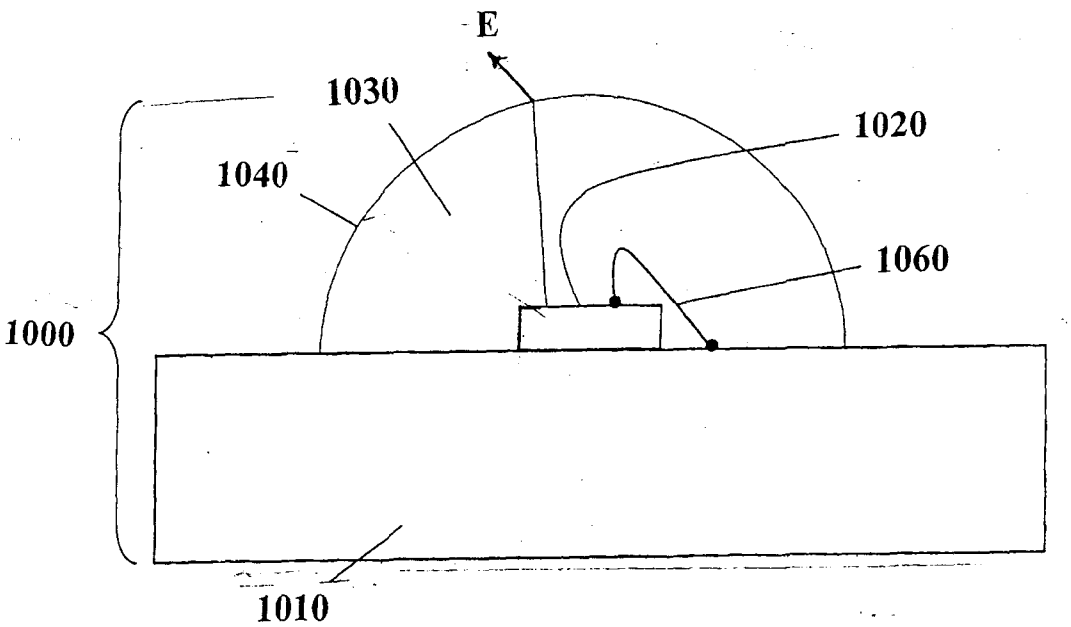

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2012/001093

A. CLASSIFICATION OF SUBJECT MATTER

see extra sheet

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:F21, 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)

CPRSABS, TWABS, CNABS, MOABS, HKABS, VEN, CNKI: LED? diode? lens?? jag??? rough???? coarse???? uneven???? surface?

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	US2012086035A1 (SEMILEDS OPTOELECTRONICS CO LTD) 12 Apr. 2012 (12.04.2012) claims 1-20	1-20
X	US2010283065A1 (SEMILEDS OPTOELECTRONICS CO LTD) 11 Nov. 2010 (11.11.2010) description paragraphs [0021]-[0028], figures 1-9	1-20
X	CN2829097Y (HONGQI SCIENCE & TECHNOLOGY CO LTD) 18 Oct. 2006 (18.10.2006) description pages 3-4, fig.2	1-20
X	CN101471416A (CREE INC) 01 Jul. 2009 (01.07.2009) description pages 4-10, figures 1-8	1-20

☒ 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

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"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
12 Nov. 2012 (12.11.2012)	**29 Nov. 2012 (29.11.2012)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer LU, Ping Telephone No. (86-10)62085879

Form PCT/ISA /210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2012/001093

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN101794856A (SONY CORP) 04. Aug 2010 (04.08.2010) description pages 2-7, figures 1-9B	1-20
X	CN101937964A (SHENZHEN CITY UNILUMIN TECHNOLOGY DEV CO LTD) 05 Jan. 2011 (05.01.2011) description pages 1-2, figures 1-3	1-20

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2012/001093

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
US2012086035A1	12.04.2012	US2012092852A1	19.04.2012
		KR20120016272A	23.02.2012
		TW201041192A	16.11.2010
		CN102257643A	23.11.2011
		WO2010131090A1	18.11.2010
		US2010283065A1	11.11.2010
US2010283065A1	11.11.2010	US2012086035A1	12.04.2012
		US2012092852A1	19.04.2012
		KR20120016272A	23.02.2012
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		WO2010131090A1	18.11.2010
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		EP2071642A2	17.06.2009
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		US2010193821A1	05.08.2010
		JP2010177501A	12.08.2010
		US8158997B2	17.04.2012
CN101937964A	05.01.2011	None	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2012/001093

A. CLASSIFICATION OF SUBJECT MATTER

F21V5/00 (2006.01) i

H01L33/00 (2006.01) i

F21Y101/02 (2006.01) n