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Kim et al.

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(45) Date of Patent: Aug. 19, 2025

(54) **SURFACE EMITTING LASER PACKAGE HAVING A DIFFUSION PART HAVING GLASS AND POLYMER LAYERS AND LIGHT EMITTING DEVICE INCLUDING THE SAME**

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(73) Assignee: **LG INNOTEK CO., LTD.**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 904 days.

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(86) PCT No.: **PCT/KR2019/005696**

§ 371 (c)(1),
(2) Date: **Dec. 30, 2020**

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PCT Pub. Date: **Nov. 14, 2019**

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(30) **Foreign Application Priority Data**

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May 23, 2018 (KR) 10-2018-0058068
Aug. 27, 2018 (KR) 10-2018-0100264

(51) **Int. Cl.**
H01S 5/02257 (2021.01)
F21K 9/65 (2016.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H01S 5/02257*** (2021.01); ***F21K 9/65*** (2016.08); ***H01S 5/02208*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC H01S 5/02257; H01S 5/02208; H01S 5/02218; H01S 5/0236; H01S 5/183; H01S 5/423; F21K 9/65
See application file for complete search history.

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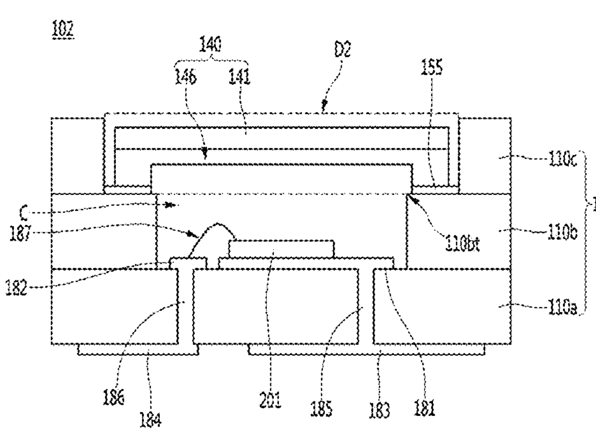
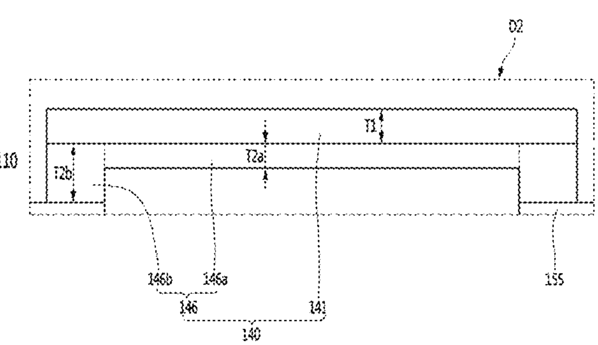
Primary Examiner — M. A. Golub-Miller
(74) *Attorney, Agent, or Firm* — Birch, Stewart, Kolasch & Birch, LLP

(57) **ABSTRACT**

The embodiment relates to a surface emitting laser package and a light emitting device including the same.
The surface-emitting laser package according to the embodiment may include a housing including a cavity, a surface-emitting laser device disposed in the cavity, and a diffusion unit disposed on the housing. The diffusion unit may include a polymer layer and a glass layer disposed on the polymer layer. The polymer layer may include a first polymer layer vertically overlapping the surface emitting laser device, and a second polymer layer not vertically overlapping the sur-
(Continued)





face emitting laser device. The thickness of the first polymer layer may be thinner than the thickness of the second polymer layer.

6 Claims, 33 Drawing Sheets

(51) **Int. Cl.**

H01S 5/02208	(2021.01)
H01S 5/02218	(2021.01)
H01S 5/0236	(2021.01)
H01S 5/183	(2006.01)
H01S 5/42	(2006.01)

(52) **U.S. Cl.**
CPC ***H01S 5/02218*** (2021.01); *H01S 5/0236* (2021.01); *H01S 5/183* (2013.01); *H01S 5/423* (2013.01)

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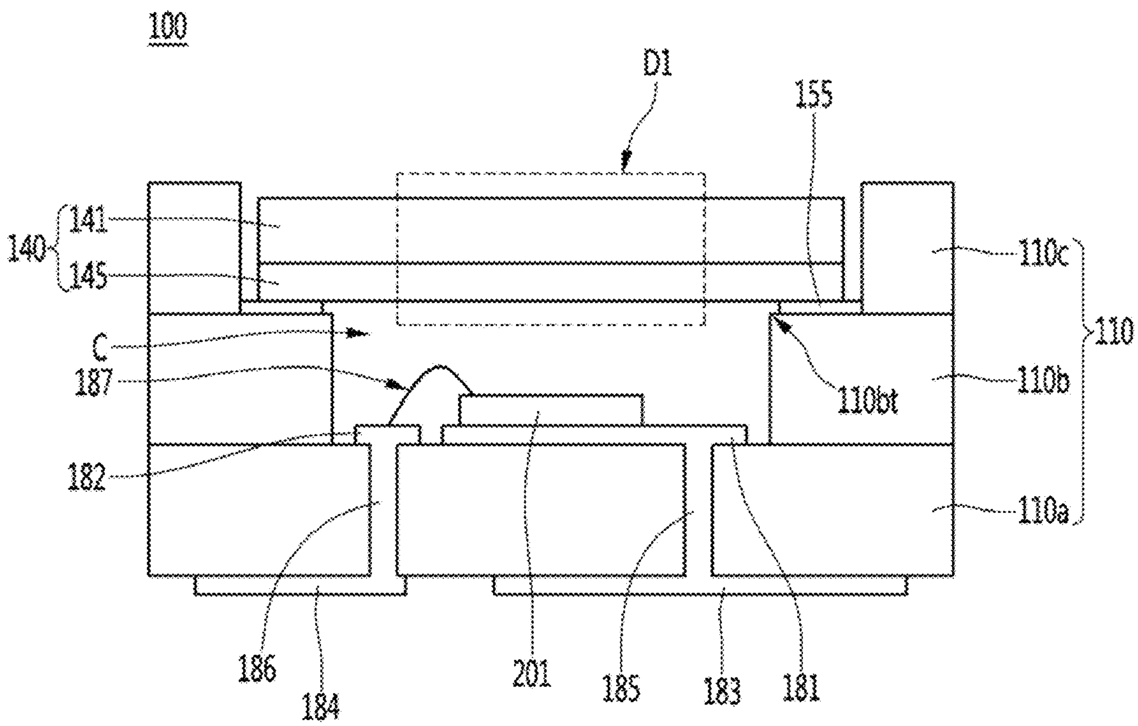
【Figure 1】


100
D1
155
140
141
145
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110
C
187
110bt
110b
182
110a
186
184
201
185
183
181

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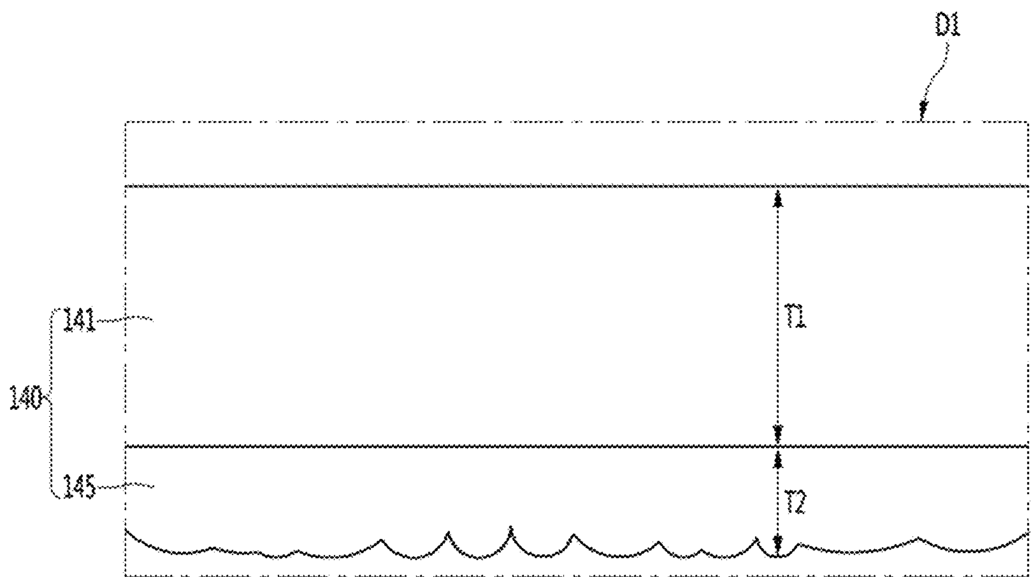

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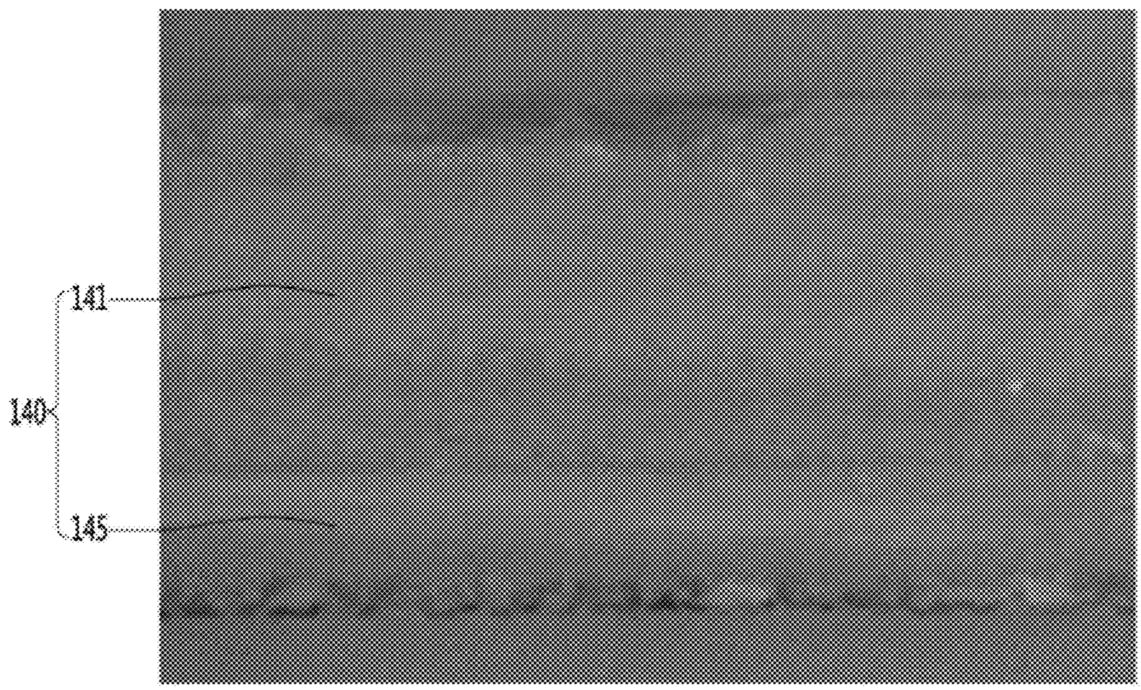

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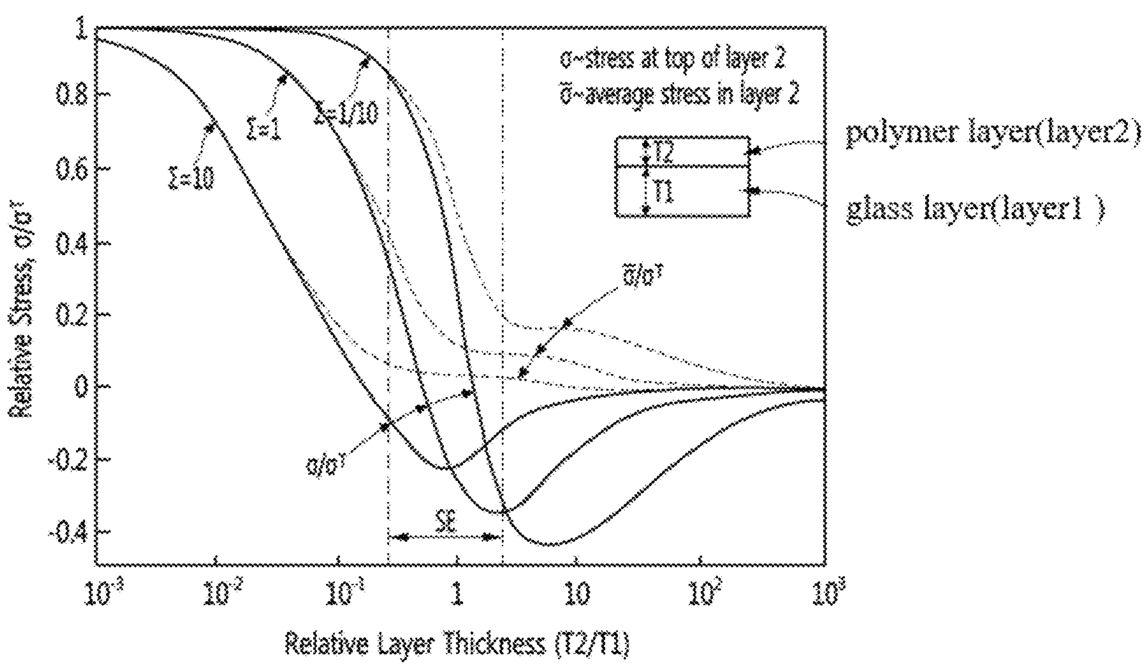
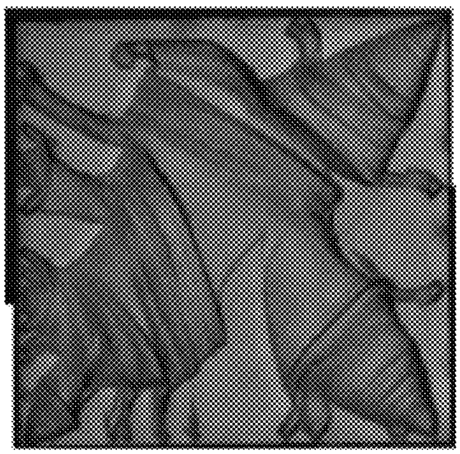
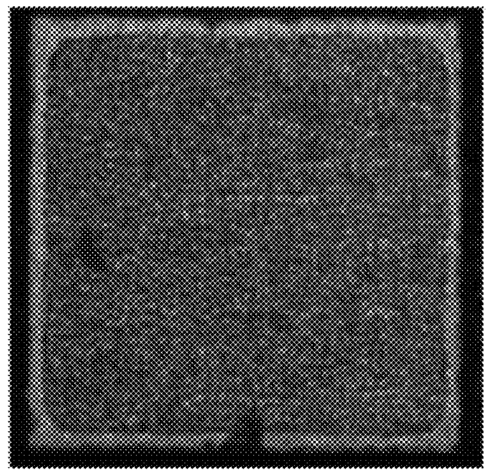


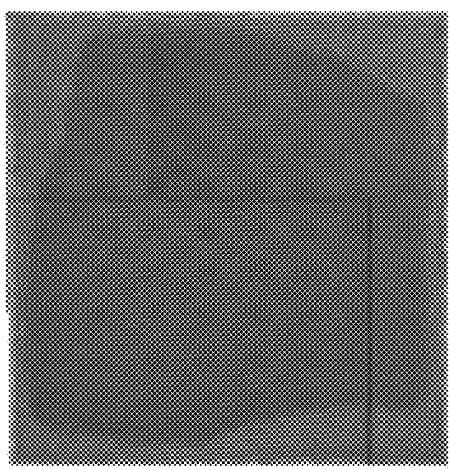
【Figure 5】



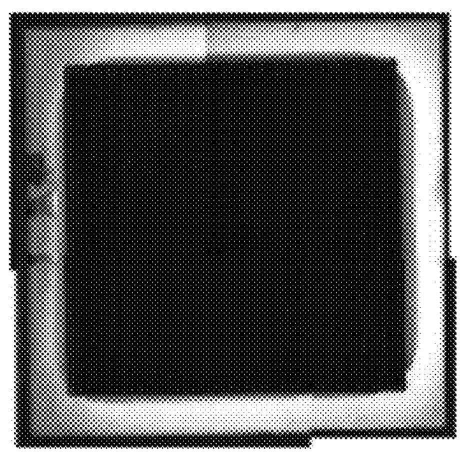
(a)



(c)



(b)



(d)

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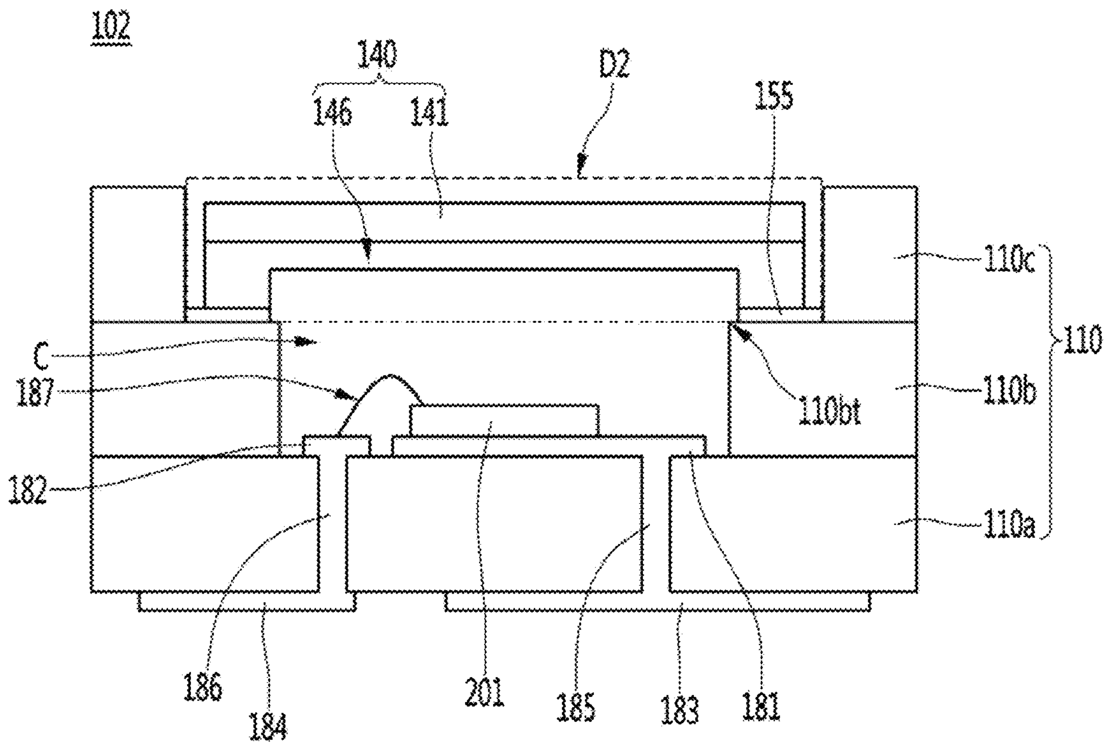
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182
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184
201
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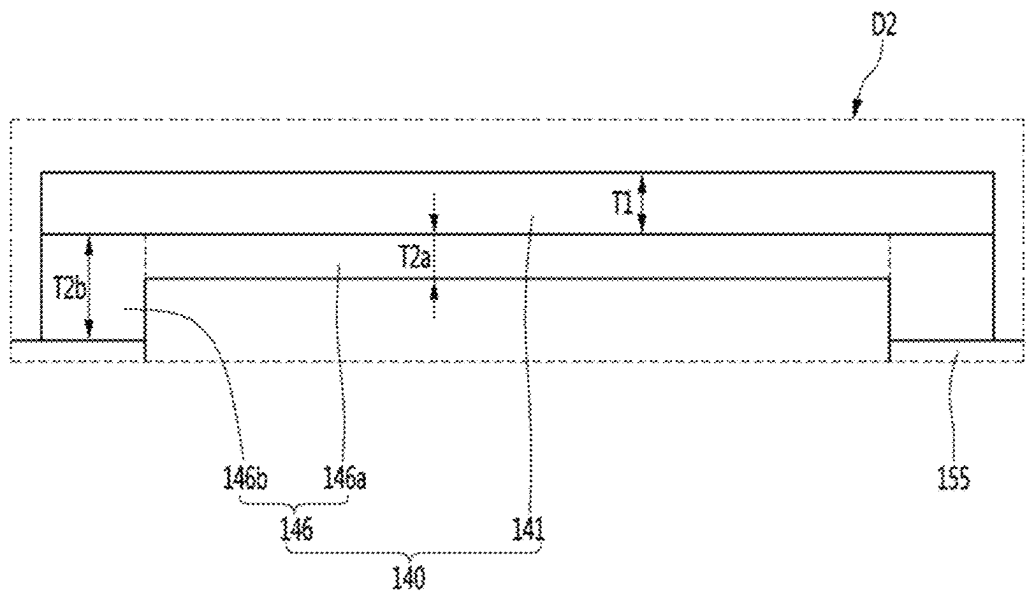
183
181

【Figure 7】



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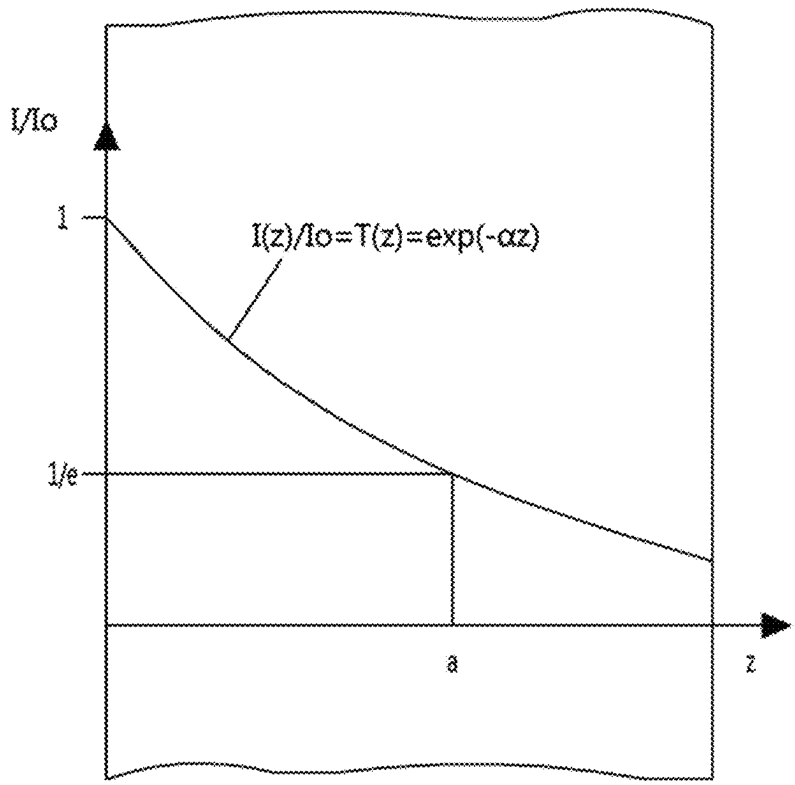

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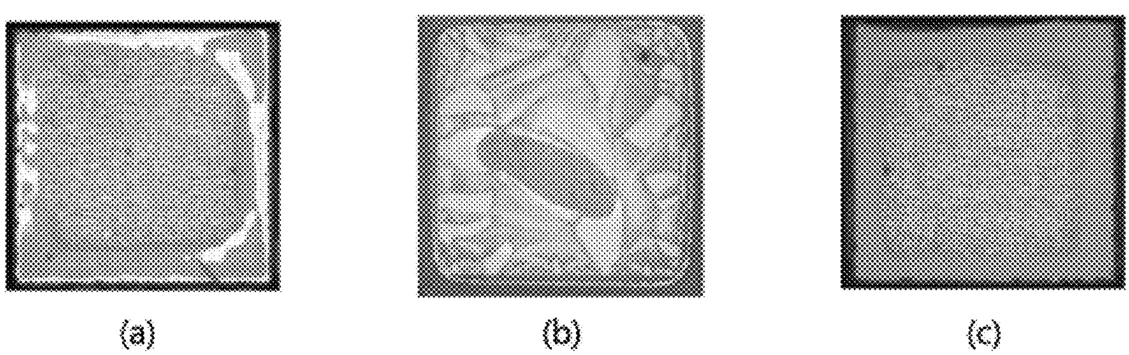

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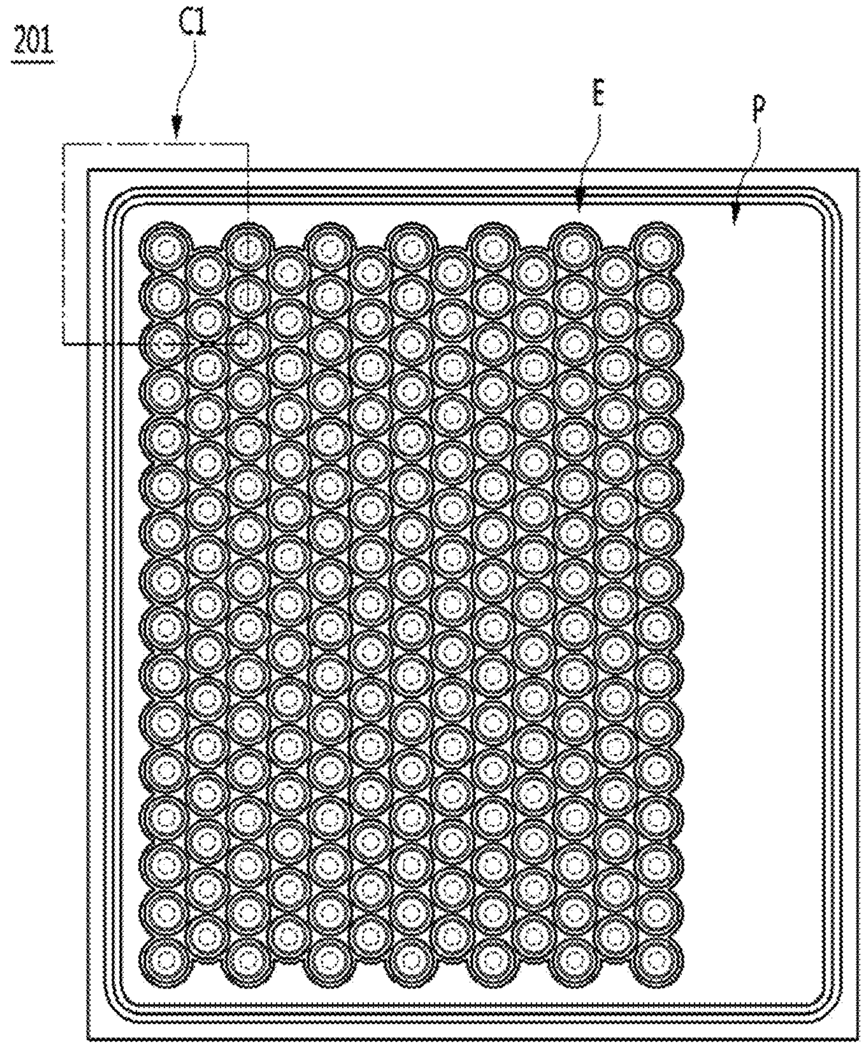

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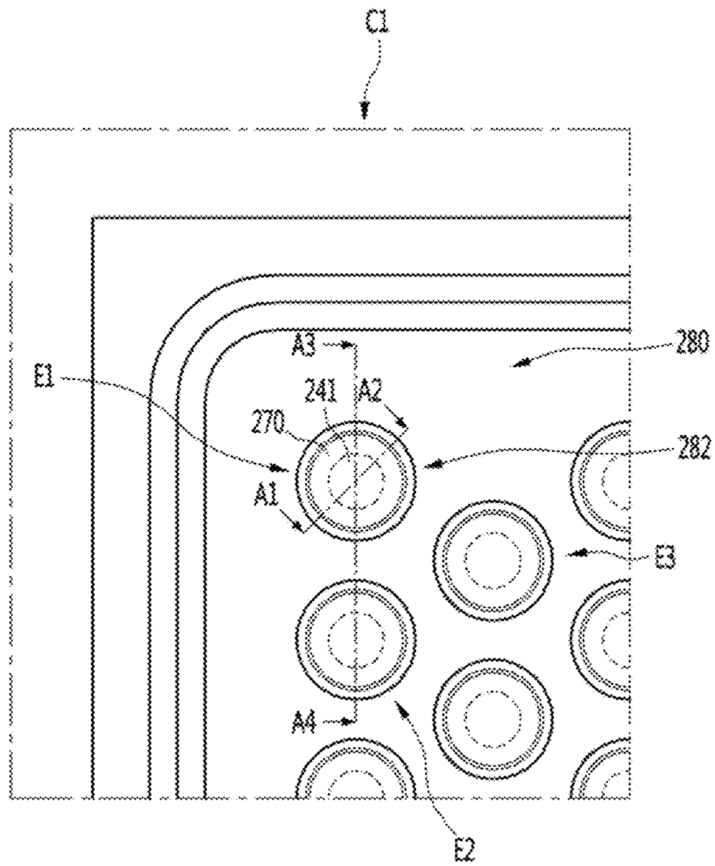

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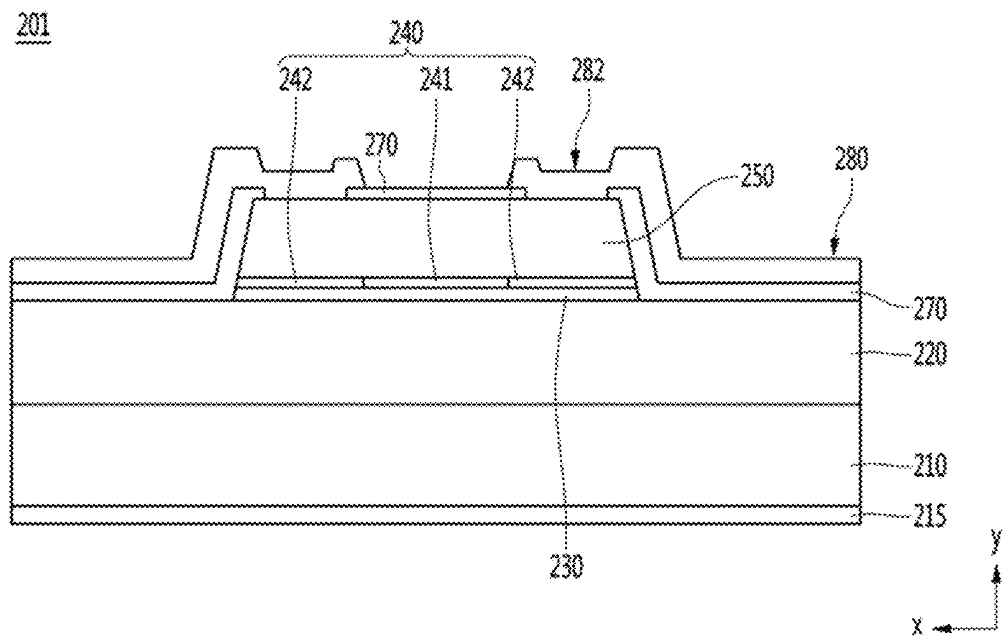

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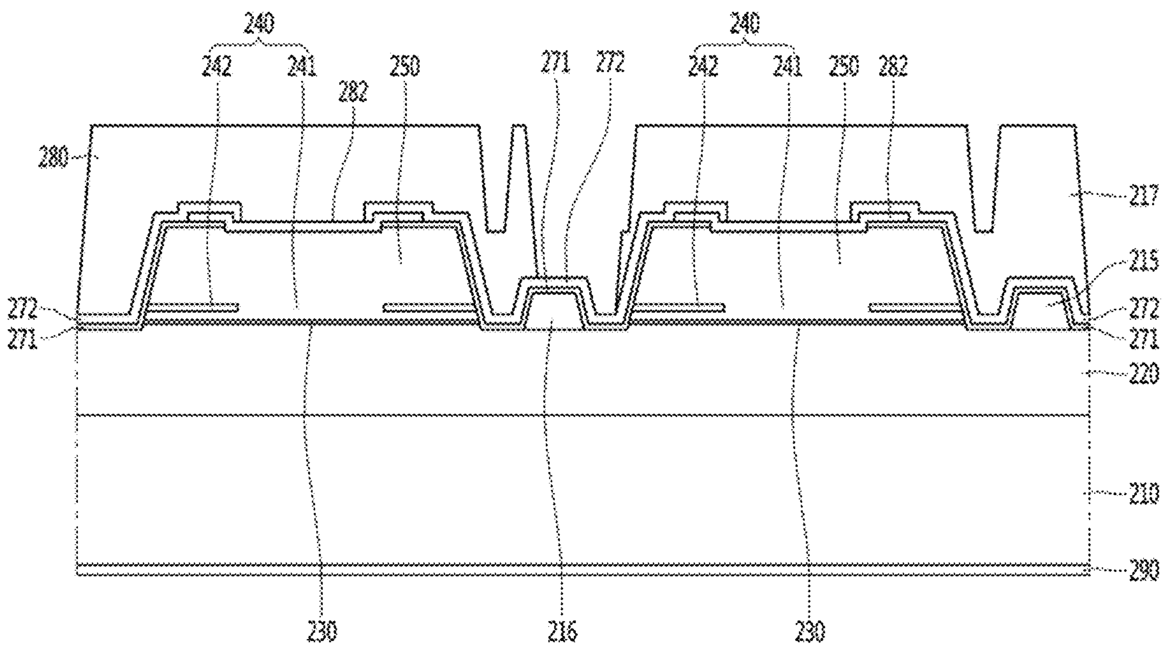

240
242
241
250
282
271
272
240
242
241
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280
217
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272
271
272
271
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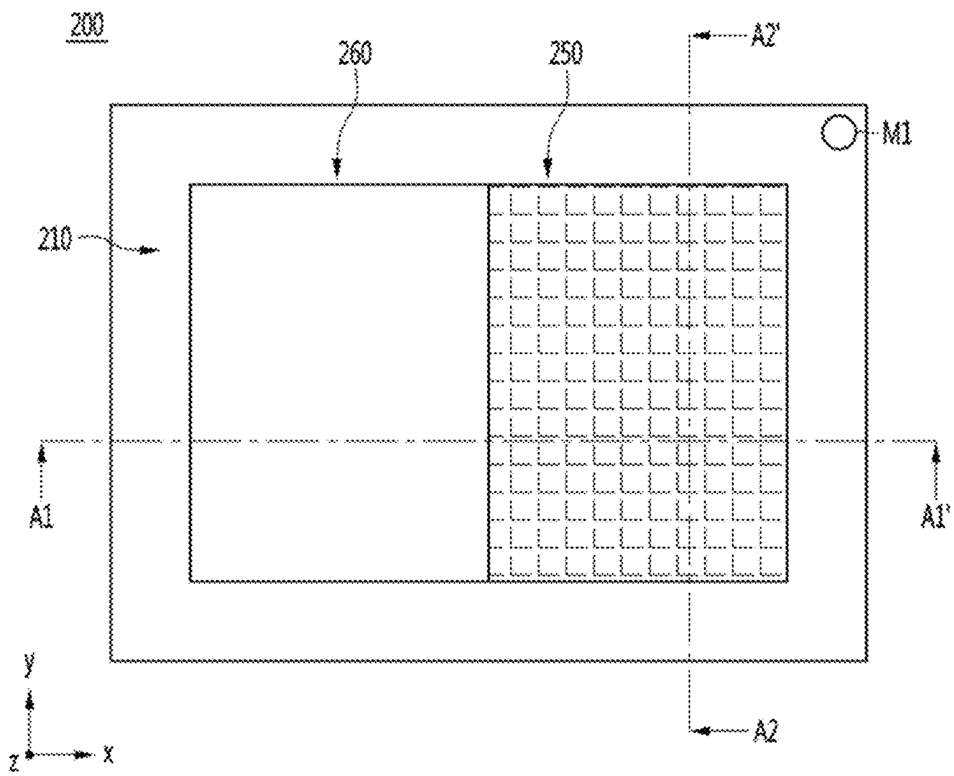
210
290
230
216
230

【Figure 14】



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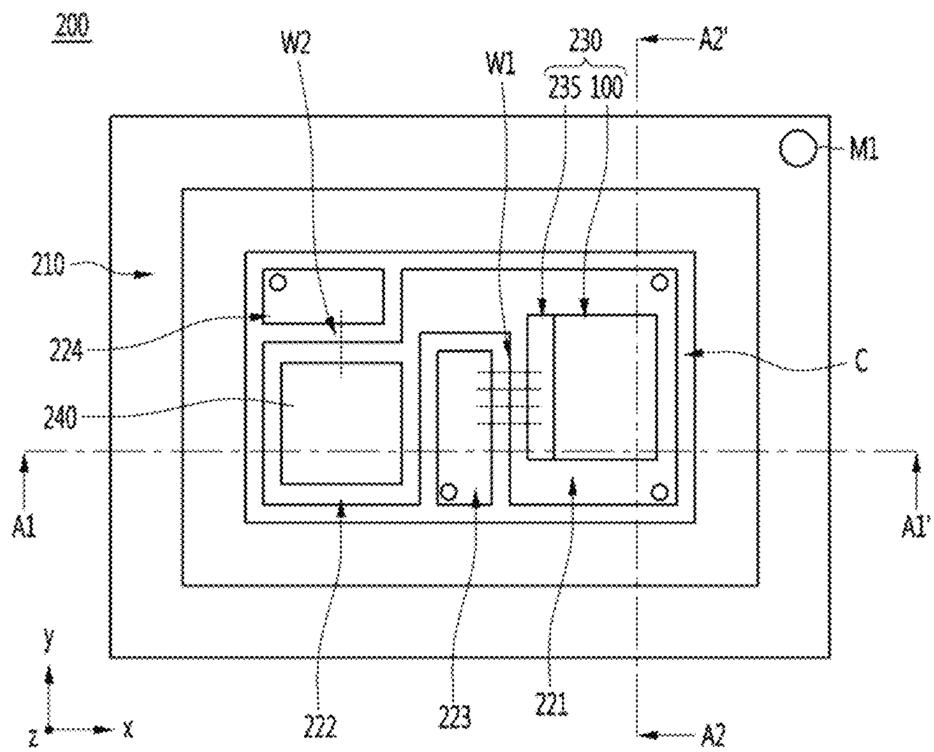
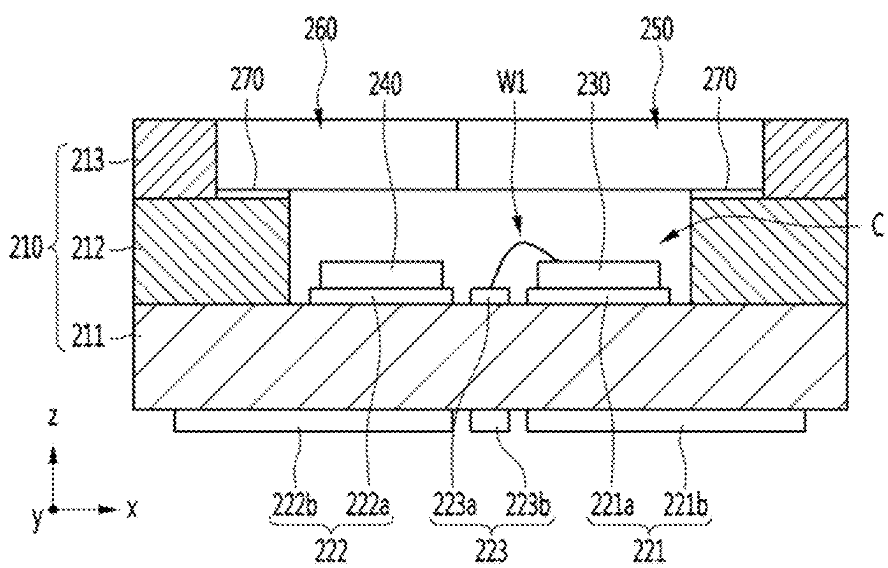
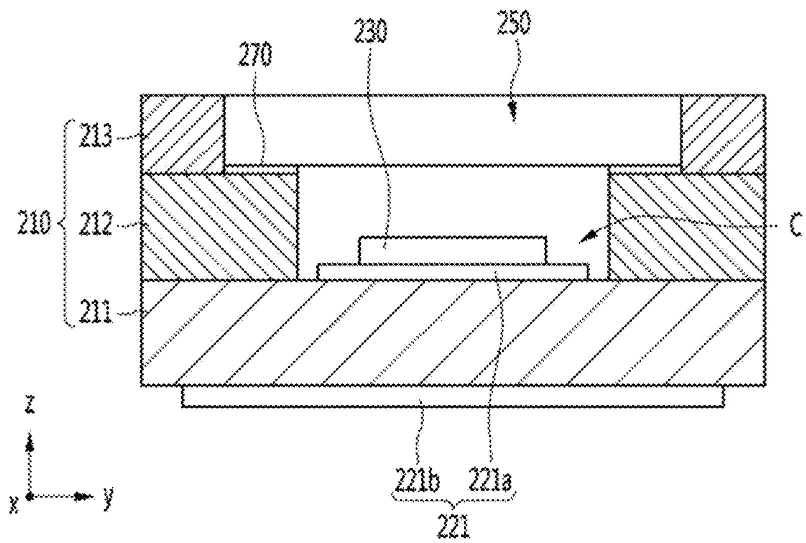


【Figure 16a】


260
250
270
240
W1
230
270
213
210
212
C
211
z
y
x
222b
222a
223a
223b
221a
221b
222
223
221

【Figure 16b】



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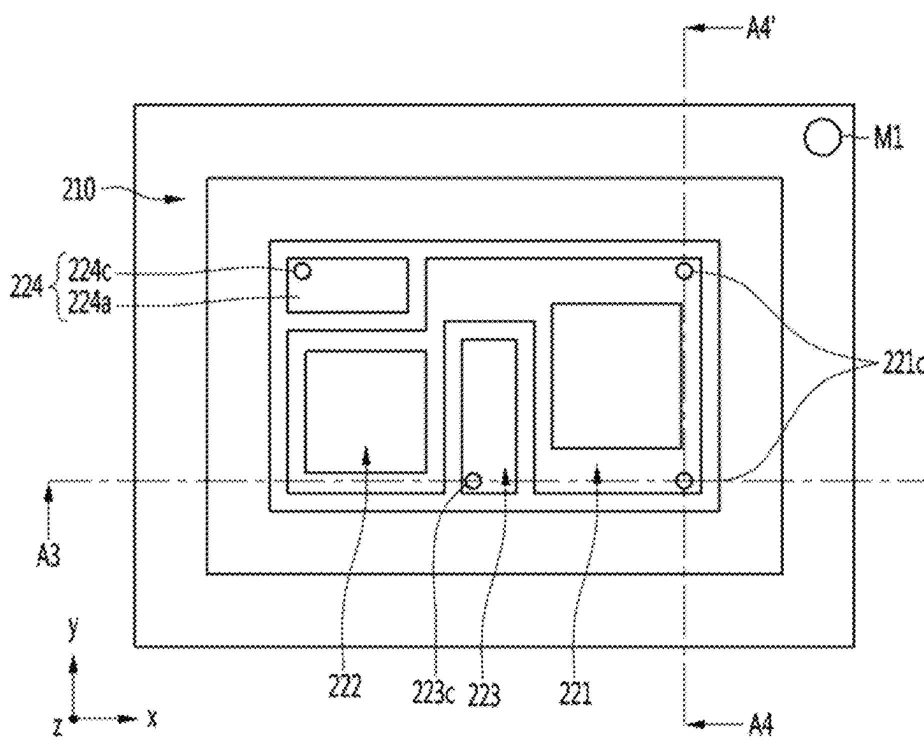
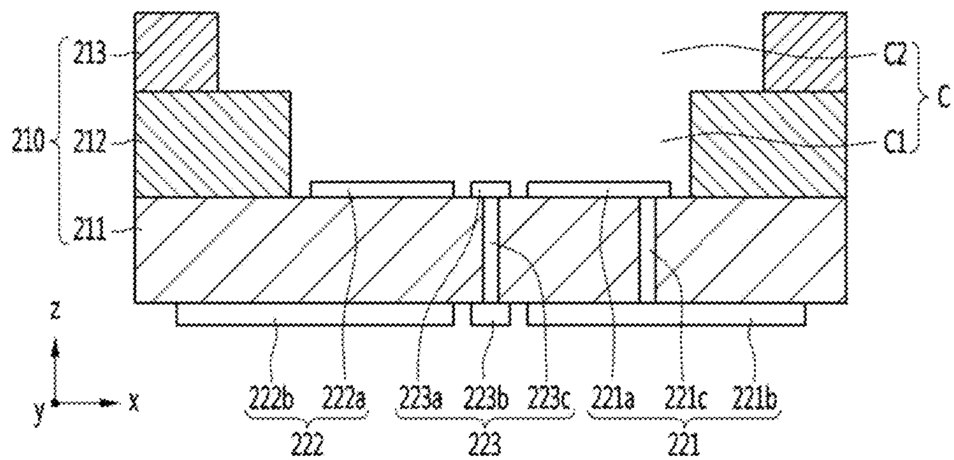
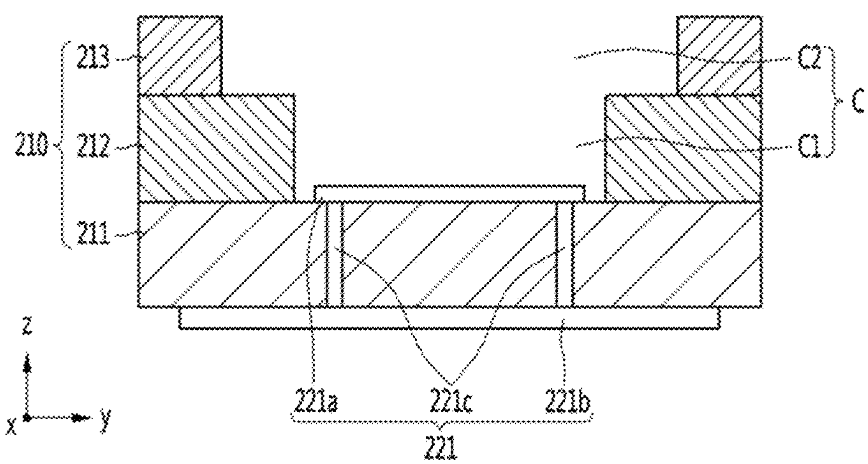


【Figure 18a】



【Figure 18b】



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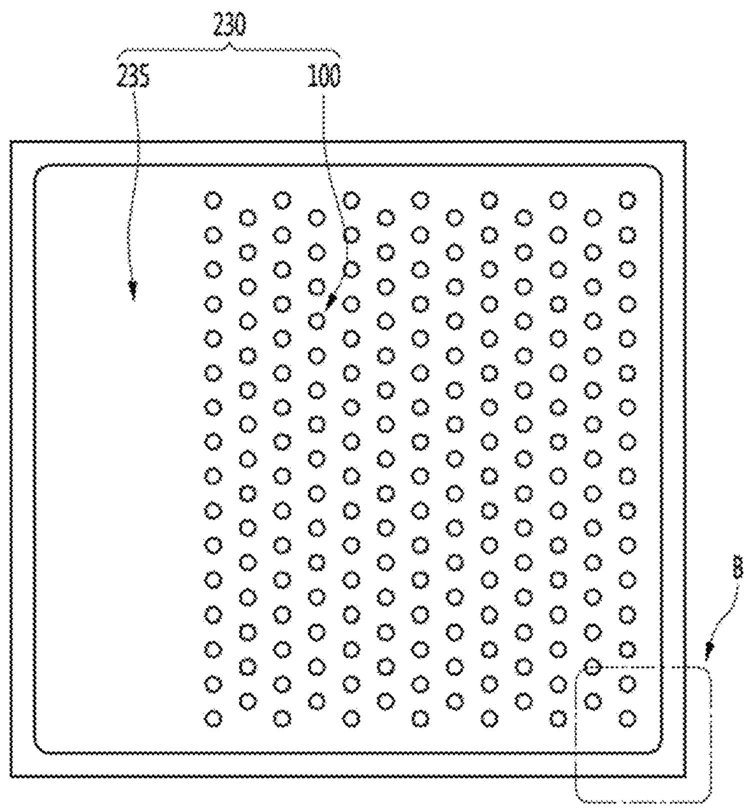

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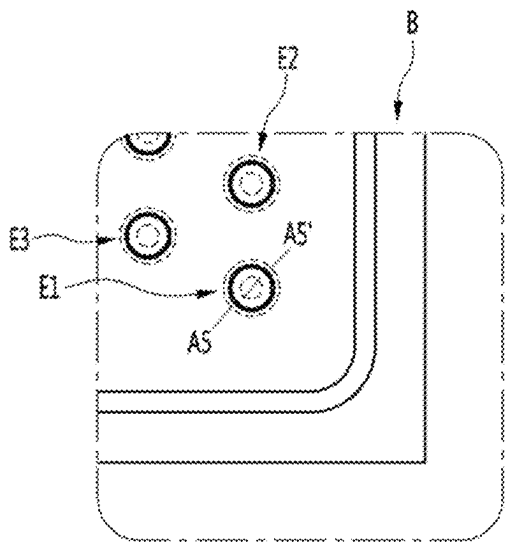

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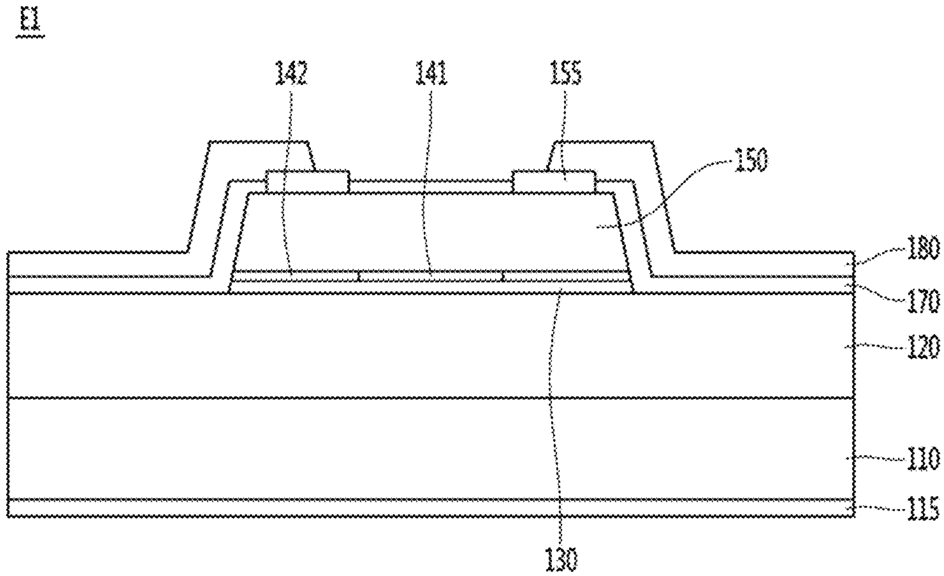

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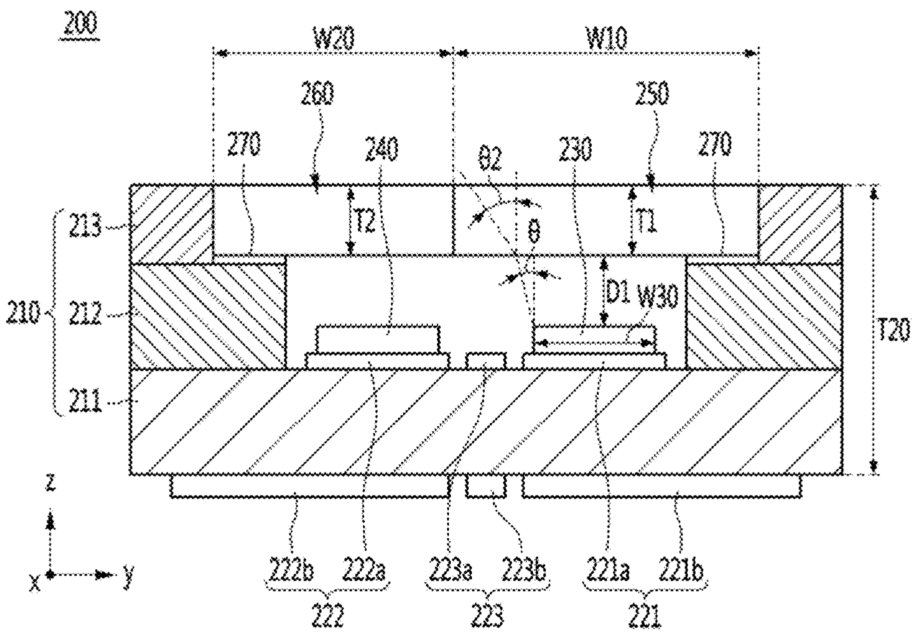
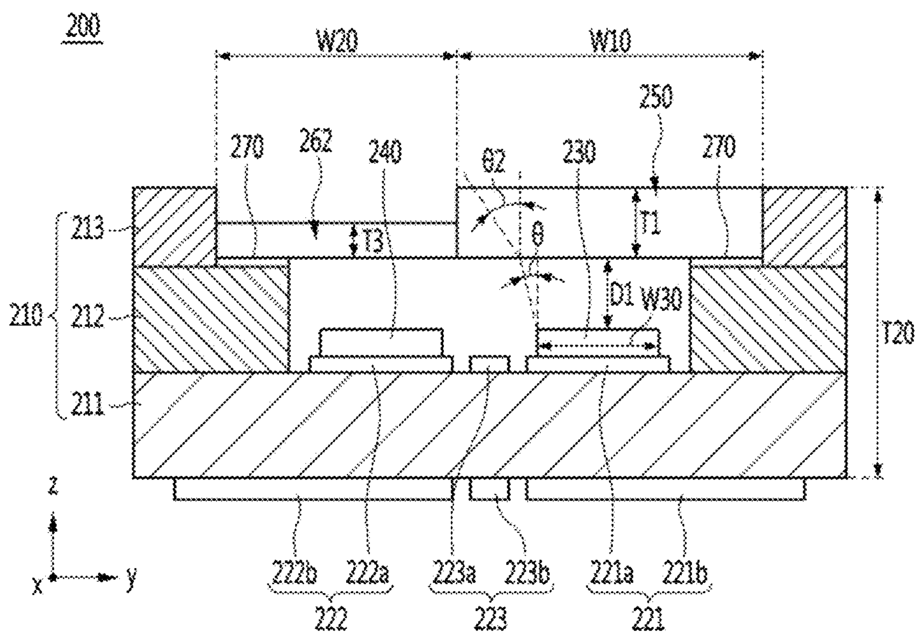
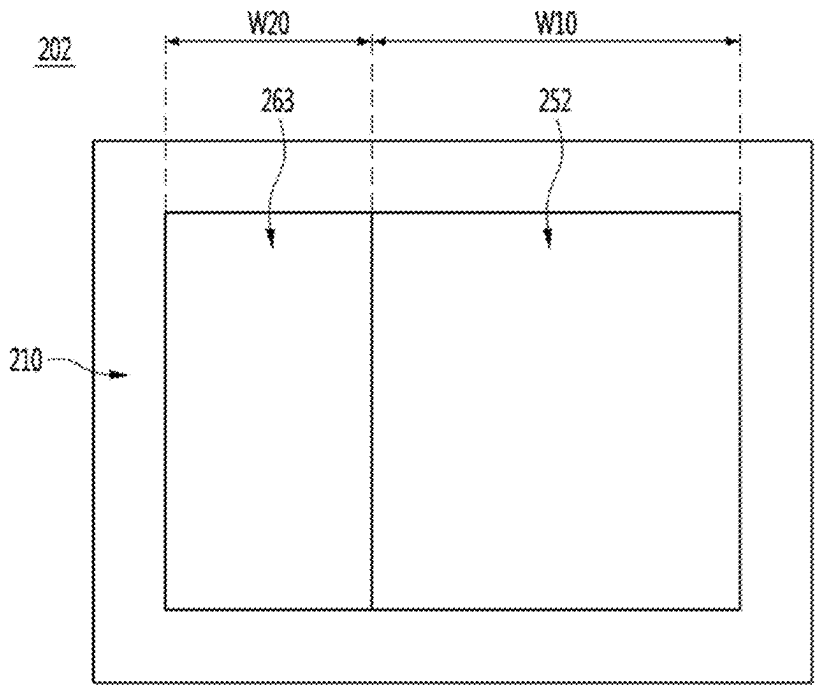


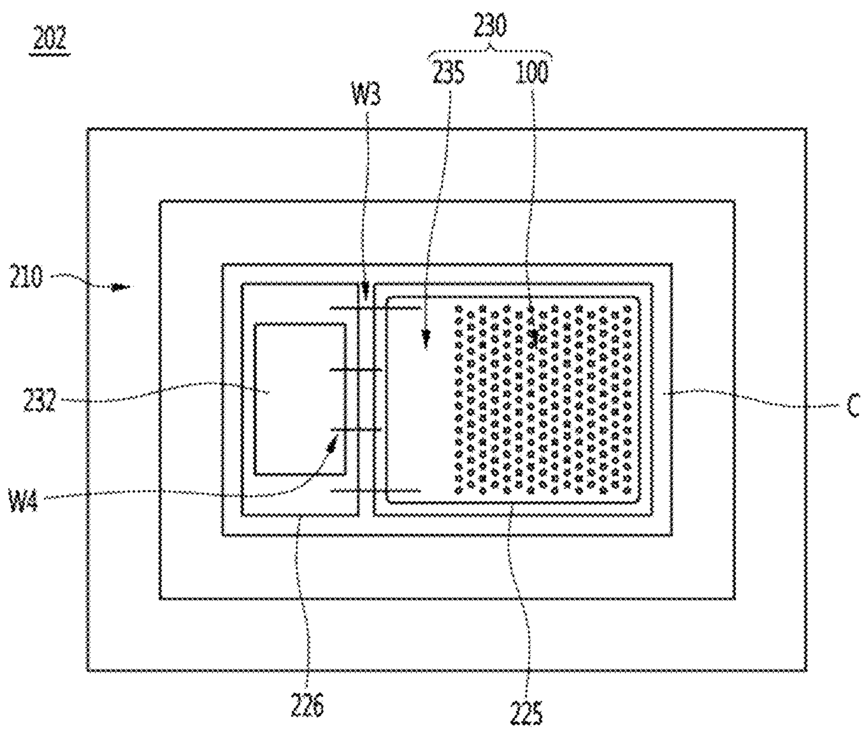
【Figure 22b】


200
W20
W10
250
270
262
240
θ2
230
270
213
T3
θ
T1
D1
W30
210
212
T20
211
z
x
y
222b
222a
223a
223b
221a
221b
222
223
221

【Figure 23a】



【Figure 23b】



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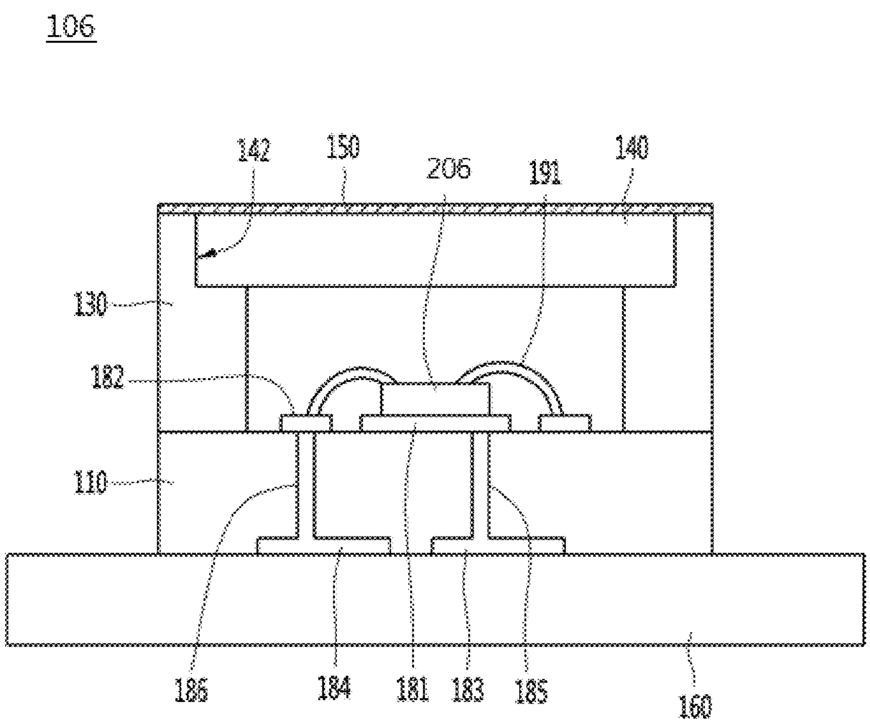

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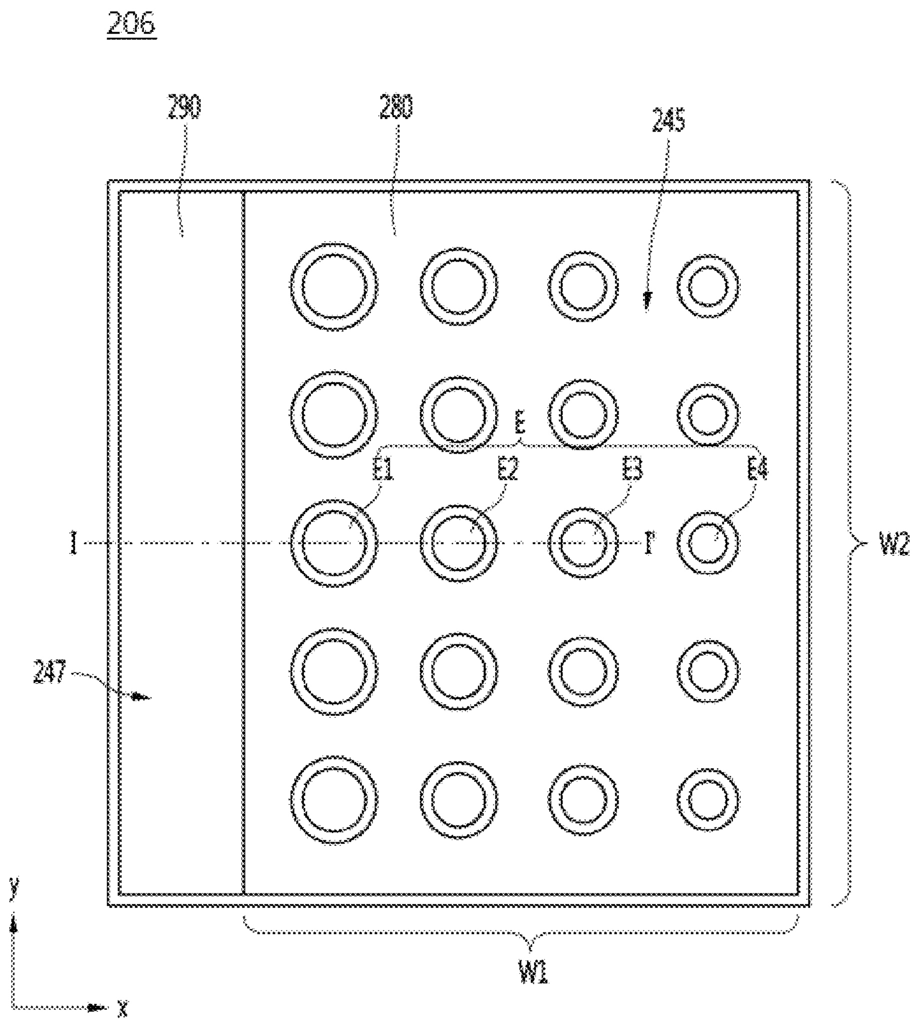

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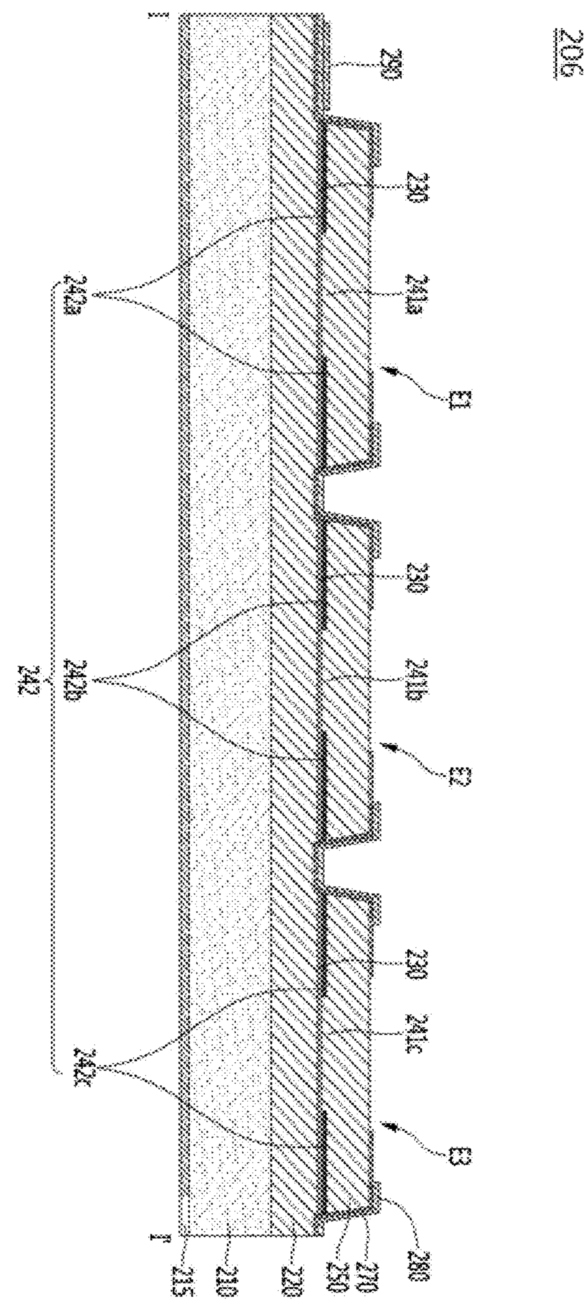
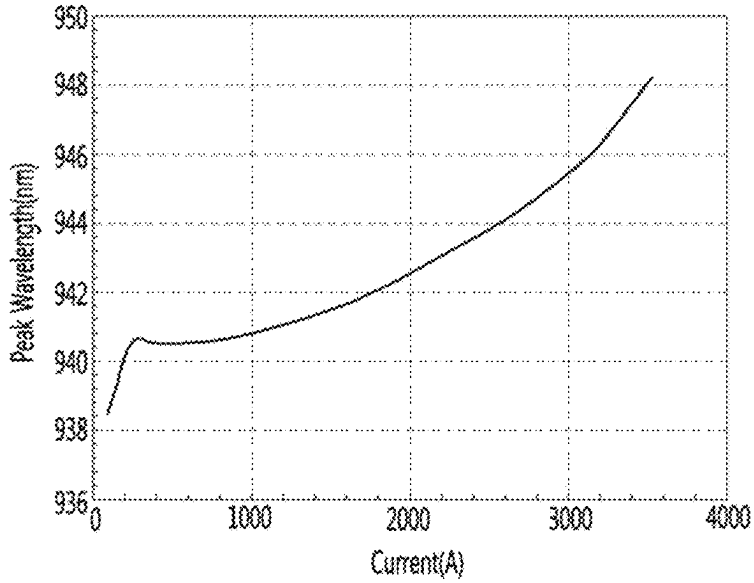
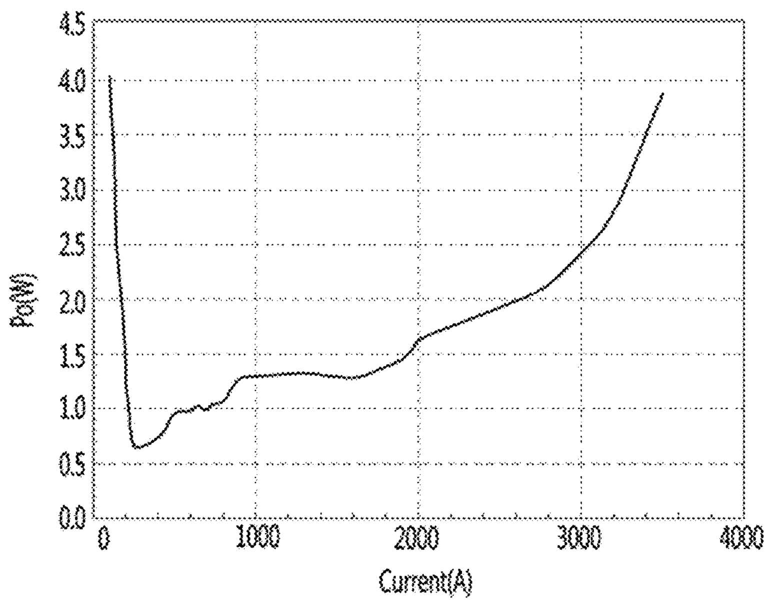

206
I
290
230
242a
241a
E1
230
242
242b
241b
E2
230
241c
242c
E3
I'
215
210
220
250
270
280

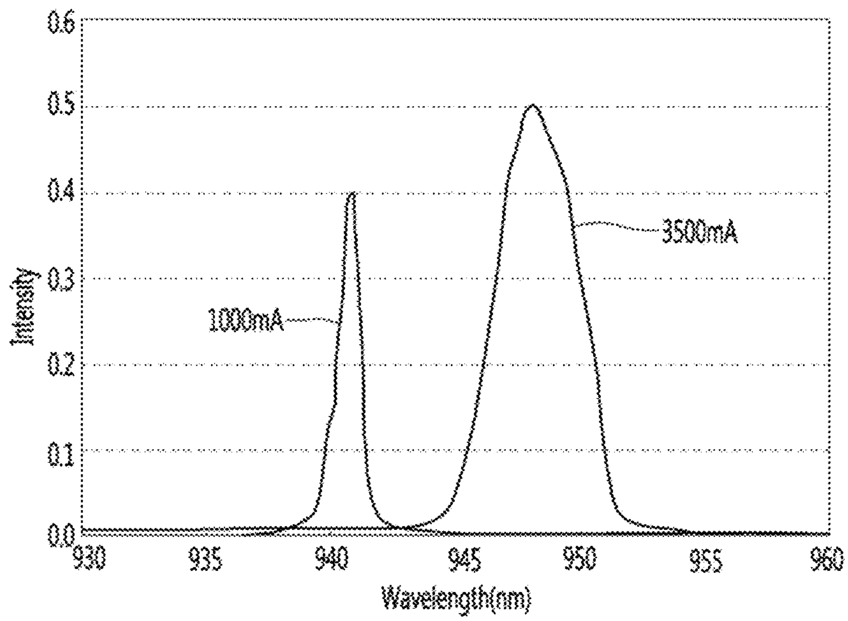
【Figure 27a】



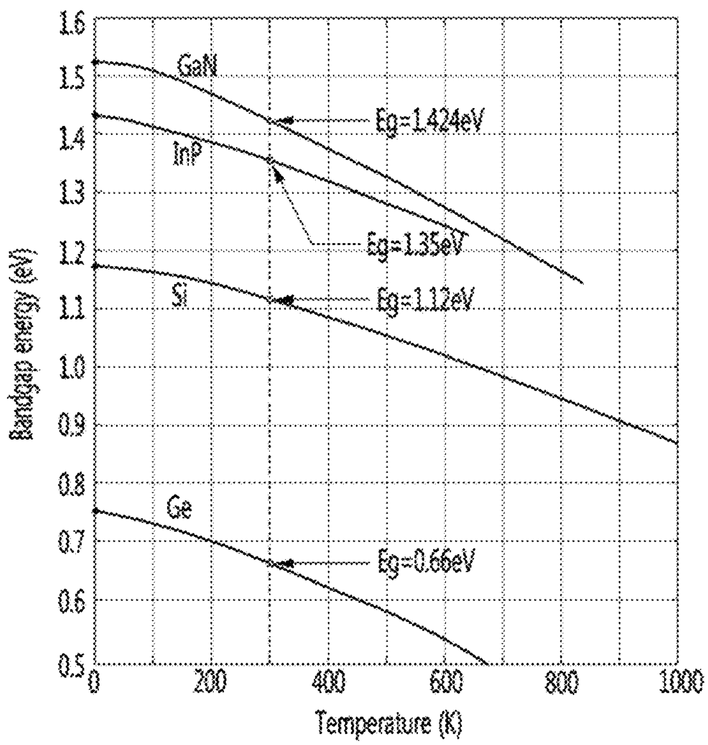
【Figure 27b】



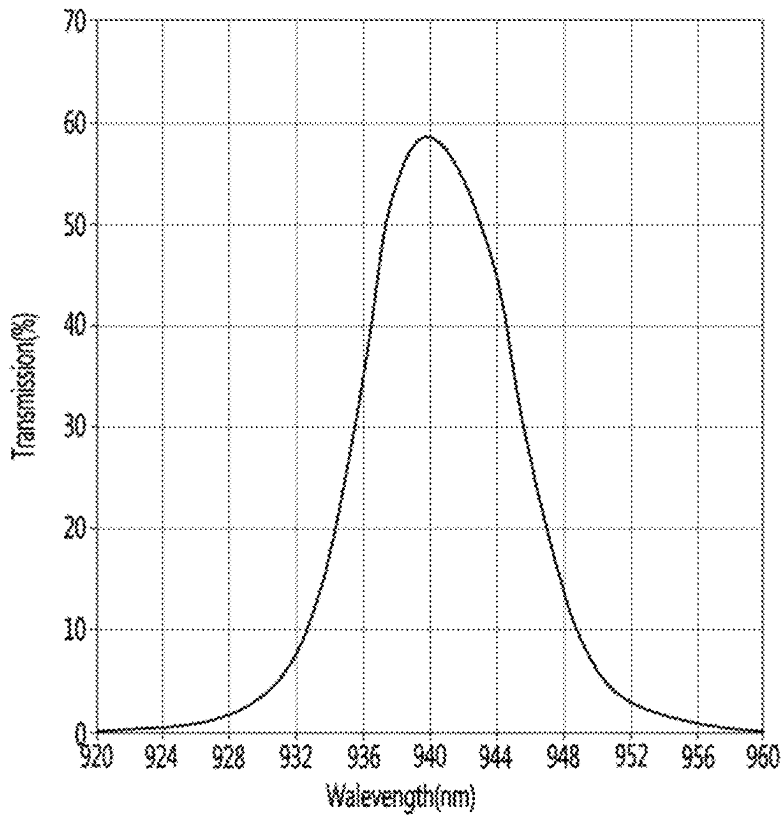
【Figure 27c】


0.6
0.5
0.4
0.3
0.2
0.1
0.0
Intensity
1000mA
3500mA
930
935
940
945
950
955
960
Wavelength(nm)

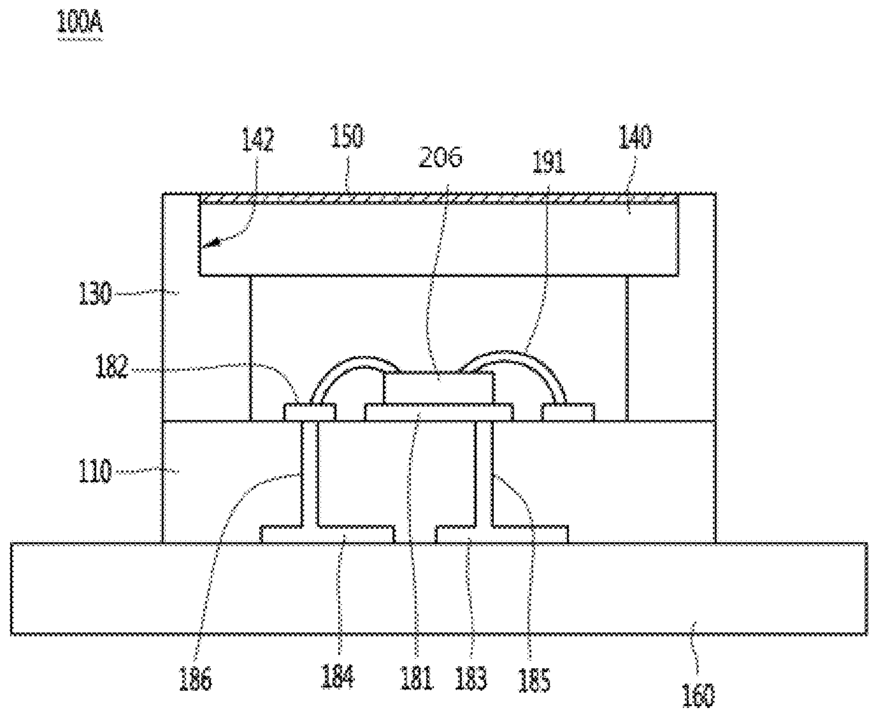
【Figure 28】


1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
Bandgap energy (eV)
GaN
InP
Si
Ge
Eg=1.424eV
Eg=1.35eV
Eg=1.12eV
Eg=0.66eV
0
200
400
600
800
1000
Temperature (K)

【Figure 29】


70
60
50
40
30
20
10
0
Transmission(%)
920
924
928
932
936
940
944
948
952
956
960
Walelength(nm)

【Figure 30】



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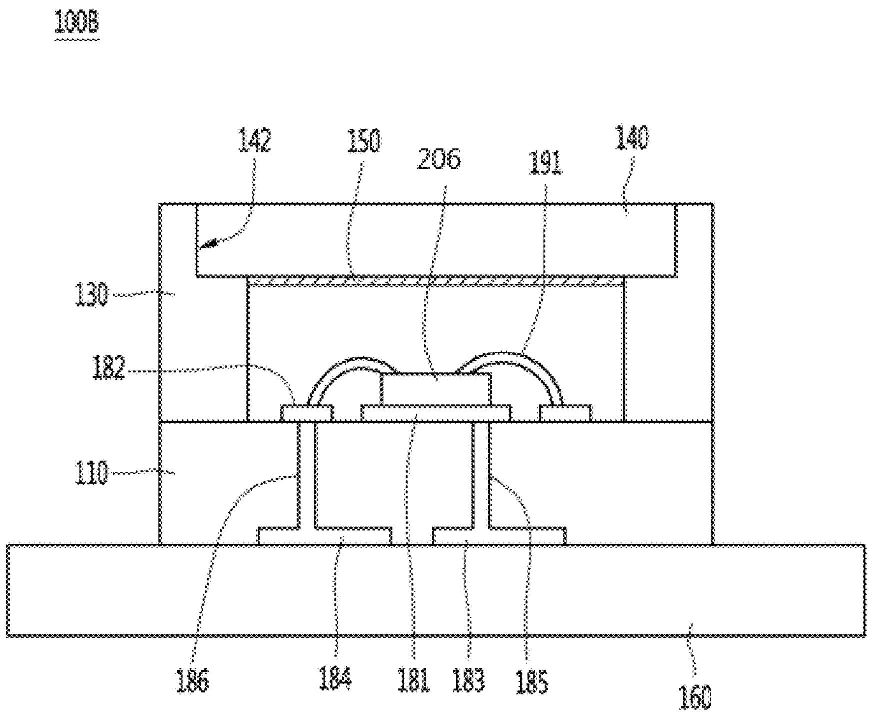

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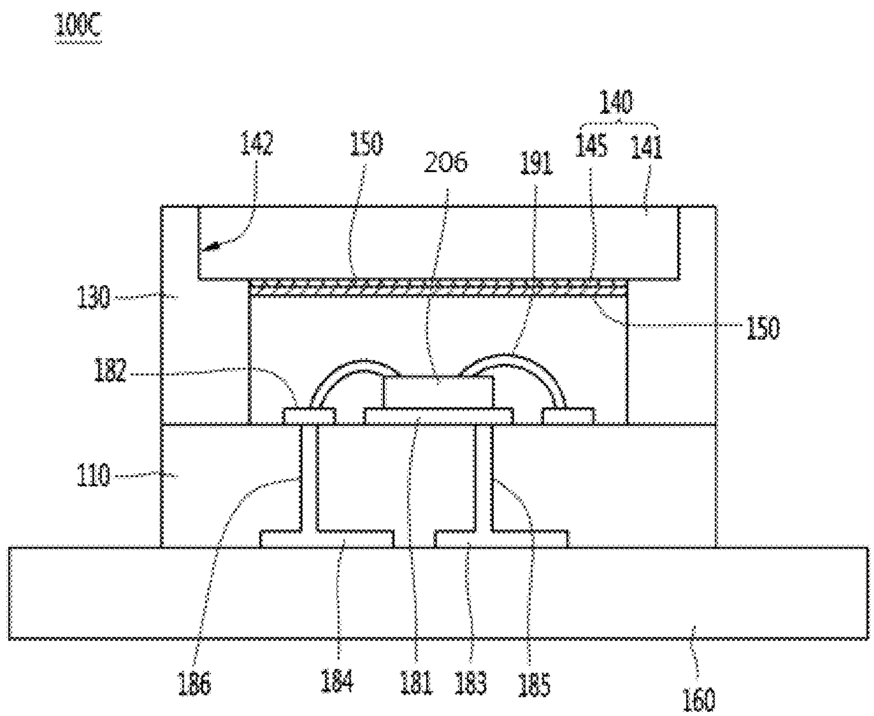
100C
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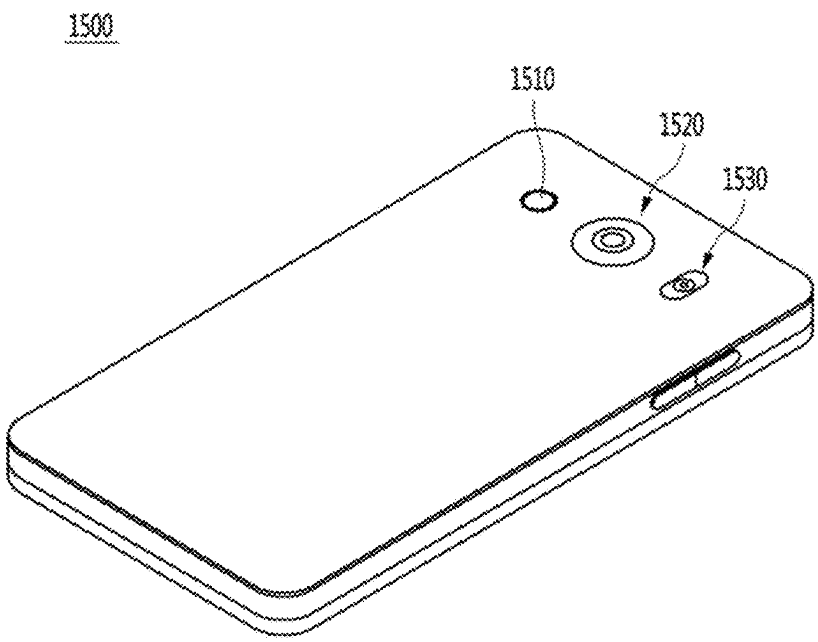
185
160

【Figure 33】



SURFACE EMITTING LASER PACKAGE HAVING A DIFFUSION PART HAVING GLASS AND POLYMER LAYERS AND LIGHT EMITTING DEVICE INCLUDING THE SAME

CROSS REFERENCE TO RELATED APPLICATIONS

This application is the National Phase of PCT International Application No. PCT/KR2019/005696, filed on May 13, 2019, which claims priority under 35 U.S.C. 119 (a) to Patent Application Nos. 10-2018-0054094, filed in the Republic of Korea on May 11, 2018, 10-2018-0058068, filed in the Republic of Korea on May 23, 2018, and 10-2018-0100264, filed in the Republic of Korea on Aug. 27, 2018, all of which are hereby expressly incorporated by reference into the present application.

TECHNICAL FIELD

The embodiment relates to a surface emitting laser package and a light emitting device including the same.

BACKGROUND ART

A semiconductor device including a compound such as GaN or AlGaN has many advantages, such as having a wide and easily adjustable band gap energy, and thus can be used in various ways as a light emitting device, a light receiving device, and various diodes.

In particular, light emitting devices such as light emitting diodes and laser diodes using a group III-V or II-VI compound semiconductor material of semiconductors can be implemented various colors such as blue, red, green, and ultraviolet light. In addition, it is possible to implement highly efficient white light rays by using fluorescent materials or by combining colors. In addition, it has advantages of low power consumption, semi-permanent life, fast response speed, safety and environmental friendliness compared to conventional light sources such as fluorescent lamps and incandescent lamps.

In addition, when light receiving devices such as photodetectors and solar cells are also manufactured using compound semiconductor materials of Groups III-V or II-VI of semiconductors, the development of device materials generates photocurrent by absorbing light in various wavelength ranges. By doing so, light in various wavelength ranges from gamma rays to radio wavelength ranges can be used. In addition, it has the advantages of fast response speed, safety, environmental friendliness, and easy control of device materials, so it can be easily used for power control or ultra-high frequency circuits or communication modules.

Accordingly, a light emitting diode backlight is replacing a cold cathode fluorescent lamp (CCFL) constituting a transmission module of an optical communication means and a backlight of a liquid crystal display (LCD) display device. Applications are expanding to white light emitting diode lighting devices that can replace fluorescent or incandescent bulbs, automobile headlights and traffic lights, and sensors that detect gas or fire.

In addition, applications can be extended to high-frequency application circuits, other power control devices, and communication modules. For example, in the conventional semiconductor light source device technology, there is a vertical-cavity surface emitting laser (VCSEL), which is used for optical communication, optical parallel processing, and optical connection. On the other hand, in the case of a laser diode used in such a communication module, it is designed to operate at a low current.

Surface emitting laser devices are being developed for communication and sensors. Surface emitting laser devices for communication are applied to optical communication systems.

The surface emitting laser device for sensors is applied to 3D sensing cameras that recognize human faces. For example, a 3D sensing camera is a camera capable of capturing depth information of an object, and has recently been in the spotlight in conjunction with augmented reality.

On the other hand, for sensing the depth of the camera module, a separate sensor is mounted, and it is divided into two types such as Structured Light (SL) method and ToF (Time of Flight) method.

In the structured light (SL) method, a laser of a specific pattern is radiated onto a subject, and the depth is calculated by analyzing the degree of deformation of the pattern according to the shape of the subject surface, and then combining it with a picture taken by an image sensor to obtain a 3D photographing result.

In contrast, the ToF method is a method in which a 3D photographing result is obtained by calculating the depth by measuring the time the laser reflects off the subject and returning it, and then combining it with the picture taken by the image sensor.

Accordingly, the SL method has an advantage in mass production in that the laser must be positioned very accurately, while the ToF technology relies on an improved image sensor, and it is possible to adopt either method or both methods in one mobile phone.

For example, a 3D camera called True Depth can be implemented in a front of a mobile phone in the SL method, and the ToF method can be applied in the rear thereof.

Such a surface emitting laser device can be commercialized as a surface emitting laser package. In a conventional surface emitting laser package, a diffusion part is disposed on the surface emitting laser device to diffuse the laser beam of the surface emitting laser device, and it is fixed by an adhesive member thereon.

However, even if the diffusion part is fixed by the adhesive member, a problem occurs in that the diffusion part is detached by impact. When the diffusion part is detached in this way, the laser beam emitted from the surface emitting laser device disposed under the diffusion part is exposed as it is. When the surface emitting laser package is applied to the field of facial recognition, there is a risk of blindness due to the exposure of the laser beam being transmitted to the user's eyes by the detachment and detachment of the diffusion part, so there is an issue of eye safety.

In particular, in the related art, the diffusion part includes a glass layer and a polymer layer. However, as the glass layer and the polymer layer have different coefficients of thermal expansion, there is a problem that peeling occurs in reliability tests such as a thermal shock or a thermal cycle test. The problem of delamination of the diffusion part causes a technical problem that cannot guarantee eye safety.

In addition, in the conventional high-power VCSEL package structure, a diffusion part is used to form a constant divergence angle. However, there is a risk that a person may become blind if the laser of the VCSEL is directly irradiated to the human eye when the diffusion part is separated by an impact during use in a vehicle or mobile. Accordingly, there is a need for a study on a semiconductor device package that can prevent a strong laser from being directly incident on a person while being applied to a vehicle or applied to an application field such as a movement of a person.

In addition, in the related art, as the application fields of semiconductor devices are diversified, high output and high voltage driving are required, as well as miniaturization of semiconductor device packages is strongly requested for miniaturization of products.

Meanwhile, the divergence angle may be measured by a radiance measurement method and an irradiance measurement method.

In addition, in the related art, when heat is generated due to over-operation or malfunction of the driving circuit for driving the surface emitting laser package, the wavelength band of light of the surface emitting laser device of the surface emitting laser package may be shifted to a longer wavelength range. Since such a long wavelength range may damage the user's eyes, a solution to this is required.

DISCLOSURE

Technical Problem

One of the technical problems of the embodiment is to provide a surface emitting laser package having excellent reliability and a light emitting device including the same.

In addition, one of the technical problems of the embodiment is to provide a surface emitting laser package and an optical module that are excellent in reliability and stability and can safely protect an element disposed therein from external impact.

In addition, one of the technical problems of the embodiment is to provide a compact surface emitting laser package and an optical module capable of driving high power and high voltage.

In addition, one of the technical problems of the embodiment is to provide a surface emitting laser package and an auto-focusing device capable of protecting the user's eyes.

The technical problem of the embodiment is not limited to the content described in this item, and includes what is understood through the description of the invention.

Technical Solution

The surface emitting laser package according to the embodiment may include a housing including a cavity, a surface emitting laser device disposed in the cavity, and a diffusion part disposed on the housing.

The diffusion part may include a polymer layer and a glass layer disposed on the polymer layer.

The polymer layer may include a first polymer layer vertically overlapping the surface emitting laser device, and a second polymer layer not vertically overlapping the surface emitting laser device.

The thickness T**2***a* of the first polymer layer may be thinner than the thickness T**2***b* of the second polymer layer.

The ratio (T**2***b*/T**1**) of thickness T**2***b* the of the second polymer layer **146***b* to the first thickness T**1** of the glass layer **141** may range from 0.12 to 3.0.

The embodiment may further include an adhesive member **155** between the housing and the polymer layer.

The thermal expansion coefficient of the adhesive member **155** may be in the range of 1 to 2 times the thermal expansion coefficient of the polymer layer **146**.

The surface emitting laser package according to the embodiment includes a housing including a cavity, a surface emitting laser device disposed in the cavity, and a diffusion part disposed on the housing. The diffusion part may include a polymer layer disposed on a housing on the surface emitting laser device and a glass layer disposed on the polymer layer.

A ratio (T**2**/T**1**) of the second thickness (T**2**) of the polymer layer to the first thickness (T**1**) of the glass layer may range from 0.12 to 3.0.

The embodiment may further include an adhesive member between the housing and the polymer layer.

The thermal expansion coefficient of the adhesive member **155** may be in the range of 1 to 2 times the thermal expansion coefficient of the polymer layer.

The surface emitting laser package according to the embodiment includes a body **210** including a cavity (C); a surface emitting laser device **230** disposed inside the cavity C; a light receiving device **240** disposed in the cavity C to be spaced apart from the surface emitting laser device **230** and configured to sense light emitted from the surface emitting laser device **230**; and diffusion parts **250** and **260** disposed on the body **210**, a transmissive part **250** and a reflective part **260**, wherein the transmissive part **250** is disposed on the surface emitting laser device **230**.

The reflective part **260** may be disposed on the light receiving device **240**. The second width W**20** of the reflective part **260** may be narrower than the first width W**10** of the transmissive part **250**. The reflective part **260** may not be overlapped with a divergence angle of the surface emitting laser device **230**.

In an embodiment, the second width W**20** of the reflective part **260** may be narrower than the first width W**10** of the transmissive part **250**.

The first width W**10** of the transmission part **250** may be wider than a divergence angle of the surface emitting laser device **230**.

The reflective part **260** may not be overlapped with a divergence angle of the surface emitting laser device **230**.

An embodiment includes a first electrode part **221** on which the surface emitting laser device is disposed; a second electrode part **222** on which the light receiving device **240** is disposed; a third electrode part **223** electrically connected to the surface emitting laser device by a first wire W**1**; and a fourth electrode part **224** electrically connected to the light receiving device **240** and the second wire W**2**.

In the embodiment, the first separation distance D**1** from the top surface of the surface emitting laser device **230** to the transmission part **250** may be in the range of 2/75 to ⅕ of the third horizontal width W**30** of the surface emitting laser device **230**.

The first horizontal width W**10** of the transmission part **250** may be in the range of 18/15 to 6 times the third horizontal width W**30** of the surface emitting laser device **230**.

The second horizontal width W**20** of the reflector **260** may range from 16/15 times to 4 times the horizontal width of the light receiving device **240**.

The thickness T**3** of the reflective part **262** may be thinner than the thickness T**1** of the transmissive part **250**.

The thickness T**3** of the reflective part **262** may range from 1/10 to ½ of the thickness T**1** of the transmissive part **250**.

The thickness T**3** of the reflective part **262** may be in the range of 1/75 to 1 times the third horizontal width W**30** of the surface emitting laser device **230**.

In addition, the surface emitting laser package according to the embodiment includes a body **210** including a cavity (C); a fifth electrode part **225** and a sixth electrode part **226** spaced apart from each other in the cavity C;

a surface emitting laser device **230** disposed on the fifth electrode part **225** and electrically connected to the sixth electrode part **226** and a third wire W3; a second light receiving device spaced apart from the surface emitting laser device **230** in the cavity C and disposed on the sixth electrode part **226** to detect light emitted from the surface emitting laser device **230**; and a diffusion part **252**, **263** disposed on the body **210** and including a second transmission part **252** and a third reflection part **263**; and the second transmission part **252** is disposed on the surface emitting laser device **230**, the third reflecting part **263** is disposed on the second light receiving device **232**, and the third reflection, and the portion **263** may not be overlapped with the divergence angle of the surface emitting laser device **230**.

The optical module according to the embodiment may include the surface emitting laser package.

In addition, the surface emitting laser package according to the embodiment includes a substrate; a surface emitting laser device disposed on the substrate; a housing disposed around the surface emitting laser device; a diffusion part disposed on the surface emitting laser device; and a wavelength limiting member disposed on the surface emitting laser device. The surface emitting laser device may emit light having a first wavelength band. The wavelength limiting member may block a wavelength of the light outside the first wavelength band.

In addition, the auto-focusing device according to the embodiment includes the surface emitting laser package; and a light-receiving unit receiving the reflected light of the light emitted from the surface emitting laser package.

Advantageous Effects

According to the embodiment, there is a technical effect of providing a surface emitting laser package having excellent reliability by preventing peeling of the diffusion part and a light emitting device including the same.

For example, the embodiment may control a ratio (T**2**/T**1**) of the second thickness T**2** of the polymer layer **145** as the second layer to the first thickness (T**1**) of the glass layer **141** as the first layer. Through this, even if the glass layer **141** and the polymer layer **145** have different coefficients of thermal expansion, relative stress can be controlled to be low. Therefore, the embodiment has a technical effect that can exhibit excellent performance in a reliability test such as a thermal shock or a heat cycle test.

In addition, in the embodiment, by controlling the first thickness T**2***a* of the first polymer layer **146***a* to be thinner than the second thickness T**2***b* of the second polymer layer **146***b*, it is vertically overlapped with the surface emitting laser device **201**. Optical properties may be improved by increasing the light transmittance of the first polymer layer **146***a*.

Also, at the same time, the second thickness T**2***b* of the second polymer layer **146***b* not vertically overlapping the surface emitting laser device **201** is thicker than the first thickness T**2***a* of the first polymer layer **146***a*. At the same time, by controlling the thickness ratio (T**2***b*/T**1**) of the glass layer **141** to the first thickness (T**1**) in the range of 0.12 to 3.0, there is a complex technical effect with excellent reliability against thermal stress.

In addition, according to an embodiment, the coefficient of thermal expansion between the polymer layer **146** and the adhesive member **155** is minimized by controlling the coefficient of thermal expansion of the adhesive member **155** in a range of 1 to 2 times that of the polymer layer **146** so that there is a technical effect that can greatly improve the reliability.

In addition, according to the embodiment, there is a technical effect of providing a surface emitting laser package and an optical module having excellent reliability and stability.

In addition, according to the embodiment, it is possible to provide a compact surface emitting laser package and an optical module while being capable of driving high output and high voltage.

In addition, according to an embodiment, since a wavelength limiting member is provided on the expansion unit and the housing, there is a technical effect in that it is possible to block light having a second wavelength band emitted from the surface emitting laser device due to an abnormal operation so that the user's eyes are not damaged.

In addition, according to the embodiment, since the wavelength limiting member is attached to the housing as well as the diffusion part, the separation of the diffusion part is prevented, so that the light from the surface emitting laser device is directly provided to the outside, thereby preventing damage to the user's eyes.

The technical effects of the embodiments are not limited to the contents described in this item, and include those identified through the description of the invention.

DESCRIPTION OF DRAWINGS

FIG. **1** is a cross-sectional view of a surface emitting laser package according to a first embodiment.

FIG. **2** is an enlarged view of a first area in the surface emitting laser package according to the first embodiment.

FIG. **3** is a photograph of a diffusion part in the surface emitting laser package according to the first embodiment.

FIG. **4** is a relative stress data according to the relative thickness of the glass layer and the polymer layer in the diffusion part of the surface emitting laser package according to the first embodiment.

FIG. **5** is a photograph of a reliability test result in a surface emitting laser package according to a comparative example and an example.

FIG. **6** is a cross-sectional view of a surface emitting laser package according to a second embodiment.

FIG. **7** is an enlarged view of a second area in the surface emitting laser package according to the second embodiment.

FIG. **8** is light absorption data according to a thickness in a polymer layer of a diffusion part in the surface emitting laser package according to the second embodiment.

FIG. **9** is a photograph of a reliability test result in a surface emitting laser package according to Comparative Examples 2, 3, and third embodiment;

FIG. **10** is a plan view of a surface emitting laser device according to an embodiment.

FIG. **11** is an enlarged view of a region C**1** of the surface emitting laser device according to the embodiment shown in FIG. **10**.

FIG. **12** is a cross-sectional view taken along line A**1**-A**2** of the surface emitting laser device according to the embodiment shown in FIG. **11**.

FIG. **13** is another cross-sectional view of a surface emitting laser device according to an embodiment.

FIG. **14** is a plan view of a surface emitting laser package according to a fourth embodiment.

FIG. **15** is a plan view in which a diffusion part and a reflector are omitted in the surface emitting laser package according to the fourth embodiment shown in FIG. **14**.

FIG. 16A is a cross-sectional view taken along line A1-A1' of the surface emitting laser package 200 according to the fourth embodiment shown in FIGS. 14 and 15.

FIG. 16B is a cross-sectional view taken along line A2-A2' of the surface emitting laser package 200 according to the fourth embodiment shown in FIGS. 14 and 15.

FIG. 17 is a plan view in which a light emitting device and a light receiving device are omitted in the surface emitting laser package according to the fourth embodiment shown in FIG. 16.

FIG. 18A is a cross-sectional view taken along line A3-A3' of the surface emitting laser package according to the fourth embodiment shown in FIG. 17;

FIG. 18B is a cross-sectional view taken along line A4-A4' of the surface emitting laser package according to the fourth embodiment shown in FIG. 17;

FIG. 19 is a plan view of a surface emitting laser device in a surface emitting laser package according to an embodiment.

FIG. 20 is a partially enlarged view of a region B of the surface emitting laser device in the surface emitting laser package according to the embodiment shown in FIG. 19.

FIG. 21 is a cross-sectional view taken along line A5-A5' of a first emitter of the surface emitting laser device of the surface emitting laser package according to the embodiment shown in FIG. 20;

FIG. 22A is a detailed cross-sectional view of the surface emitting laser package according to the fourth embodiment shown in FIG. 16A and a first wire is omitted.

FIG. 22B is a view in which the thickness of the reflective portion is thinner than the thickness of the transmission portion in the surface emitting laser package according to the fourth embodiment shown in FIG. 22A.

FIG. 23A is a plan view of a surface emitting laser package according to a fifth embodiment.

FIG. 23B is a view in which a second transmission part and a third reflection part are omitted in the surface emitting laser package according to the fifth embodiment shown in FIG. 23A.

FIG. 24 is a cross-sectional view illustrating a surface emitting laser package according to a sixth embodiment.

FIG. 25 is a plan view of a surface emitting laser device according to a sixth embodiment.

FIG. 26 is a cross-sectional view taken along line I-I' of the surface emitting laser device according to the sixth embodiment shown in FIG. 25.

FIG. 27 shows a state in which the peak wavelength of light is shifted according to the current.

FIG. 28 shows a change in bandgap energy according to temperature.

FIG. 29 shows the peak wavelength according to the wavelength of the wavelength limiting member.

FIG. 30 is a cross-sectional view illustrating a surface emitting laser package according to a seventh embodiment.

FIG. 31 is a cross-sectional view illustrating a surface emitting laser package according to an eighth embodiment.

FIG. 32 is a cross-sectional view illustrating a surface emitting laser package according to a ninth embodiment.

FIG. 33 is a perspective view of a mobile terminal to which a surface emitting laser device is applied according to an embodiment.

MODE FOR INVENTION

Hereinafter, embodiments that can be implemented specifically for solving the above problems will be described with reference to the accompanying drawings.

In the description of the embodiment, what is described as being formed in "on or under" of each element includes both elements that are in direct contact with each other or that one or more other elements are arranged indirectly between the two elements. In addition, what is expressed as "on or under" may include not only an upward direction but also a downward direction based on one element.

In an embodiment, the surface emitting laser package may be referred to as a surface emitting laser package or a surface light emission laser package.

Hereinafter, the first to ninth embodiments will be described, but each embodiment is not independent from each other, and can be combined with each other within a range compatible with each other to solve the technical problem of the applied invention, and this will implement the technical effect of the applied invention

First Embodiment

FIG. 1 is a cross-sectional view showing a surface emitting laser package 100 according to a first embodiment, and FIG. 2 is an enlarged view of a first region D1 in the surface emitting laser package according to the first embodiment.

Referring to FIG. 1, the surface emitting laser package 100 according to the first embodiment may include a housing 110, a surface emitting laser device 201, and a diffusion part 140. For example, the surface emitting laser package 100 according to the first embodiment includes a housing 110 having a cavity C, a surface emitting laser device 201 disposed in the cavity C, and a diffusion part 140 disposed on the housing 110.

Hereinafter, a surface emitting laser package 100 according to a first embodiment will be described with reference to FIGS. 1 to 5.

In the surface emitting laser package 100 according to the embodiment, the housing 110 may support the surface emitting laser device 201 and the diffusion part 140 disposed thereon. The housing 130, the surface emitting laser device 201, and the diffusion part 140 may be modules modularized by a packaging process. One or a plurality of such modules may be mounted on a circuit board (not shown).

The housing 110 of the embodiment may include a material having excellent support strength, heat dissipation, insulation, and the like. The housing 110 may include a material having high thermal conductivity. In addition, the housing 110 may be made of a material having good heat dissipation properties so that heat generated from the surface emitting laser device 201 can be efficiently discharged to the outside.

In addition, the housing 110 may include an insulating material. For example, the housing 110 may include a ceramic material. The housing 110 may include a low temperature co-fired ceramic (LTCC) or a high temperature co-fired ceramic (HTCC). In addition, the housing 110 may be provided with a silicone resin, an epoxy resin, a thermosetting resin including a plastic material, or a high heat resistance material.

In addition, the housing 110 may include a metal compound. The housing 110 may include a metal oxide having a thermal conductivity of 140 W/mK or more. For example, the housing 110 may include aluminum nitride (AlN) or alumina (Al_2O_3). In addition, the housing 110 may include a conductive material. When the housing 110 is formed of a conductive material such as metal, an insulating member for electrical insulation may be provided between the housing

110 and the surface emitting laser device 201 or between the housing 110 and the first to sixth electrode parts 181 to 186 described later.

The housing 110 may have a square shape when viewed from above, but is not limited thereto.

With continued reference to FIG. 1, the housing 110 of the embodiment may include a single body or a plurality of bodies. For example, the housing 110 may include a first body 110*a*, a second body 110*b*, and a third body 110*c*. The second body 110*b* may be disposed on the first body 110*a*, and the third body 110*c* may be disposed on the second body 110*b*.

The first body 110*a* to the third body 110*c* may be made of the same material and formed integrally. Meanwhile, the first to third bodies 110*a* to 110*c* may be formed of different materials and may be formed by separate processes. For example, the second to third bodies 110*b* to 110*c* are made of the same material and are integrally formed, and the first body 110*a* is made of a material different from the second to third bodies 110*b* to 110*c*. In this case, the lower surfaces of the integrally formed second to third bodies 110*b* to 110*c* and the upper surfaces of the first body 110*a* may be adhered to each other by an adhesive member (not shown). For example, the adhesive member may include any one or more of an organic material, an epoxy resin, or a silicone resin.

Next, the surface emitting laser package 100 according to the embodiment may include a first electrode part 181 and a second electrode part 182. The first electrode part 181 and the second electrode part 182 may be disposed in the housing 110. Specifically, the first electrode part 181 and the second electrode part 182 may be disposed to be spaced apart from each other on the upper surface of the first body 110*a*.

In the embodiment, the surface emitting laser device 201 may be disposed on the first electrode part 181. The surface emitting laser device 201 may be disposed on a partial area of the first electrode part 181. The size of the first electrode part 181 may be larger than the size of the surface emitting laser device 201. For example, the surface emitting laser device 201 may have a square shape when viewed from above, but this is not limited thereto.

The surface emitting laser device 201 may be electrically connected to the second electrode part 182 by a predetermined wire 187.

In addition, the embodiment may include a third electrode part 183 and a fourth electrode part 184 disposed to be spaced apart from the lower side of the first body 110*a*, and also include a fifth electrode part 185 and a sixth electrode part 186 penetrating the first body 110*a*.

The fifth electrode part 185 may electrically connect the first electrode part 181 and the third electrode part 183, and the sixth electrode part 186 may be electrically connect the second electrode part 182 and the fourth electrode part 184.

In the embodiment, the housing 110 may include a mounting part 110*bt* on which the diffusion part 140 is disposed. For example, a part of the upper surface of the second body 110*b* may function as the mounting part 110*bt*.

The embodiment may include an adhesive member 155 disposed between the mounting part 110*bt* of the housing 110 and the diffusion part 140. The adhesive member 155 can be formed by a material having excellent adhesion, moisture resistance, insulation, and support strength. For example, the adhesive member 155 may include one or more of an organic material, an epoxy resin, or a silicone resin.

Accordingly, the embodiment may provide a surface emitting laser package having excellent reliability by preventing detachment from the housing of the diffusion part and a light emitting device including the same.

Next, FIG. 2 is an enlarged view of a first area D1, for example, a diffusion part 140 in the surface emitting laser package 100 according to the first embodiment, and FIG. 3 is a picture of the diffusion part 140 of the surface emitting laser package according to the first embodiment.

Referring to FIG. 2, in the embodiment, the diffusion part 140 has a glass layer 141 having a first thickness T1 and a polymer layer 145 disposed on the glass layer 141 having a second thickness T2. Although the polymer layer 145 is shown to be disposed under the glass layer 141 in FIG. 2, the polymer layer 145 may be disposed above the glass layer 141 in the manufacturing process by a printing process. According to FIG. 2, the polymer layer 145 may include a pattern including a curved surface, and the pattern may be regular or irregular. In addition, the pattern may not be present at a portion where the adhesive member 155 to be described later is in contact, and may be formed on a relatively flat surface than the pattern.

As described above, in the related art, since the glass layer and the polymer layer constituting the diffusion part have different coefficients of thermal expansion, they are used in reliability tests such as thermal shock or thermal cycle test and there is a technical problem that cannot guarantee eye safety due to the delamination of the diffusion part.

FIG. 4 is a relative stress ($\sigma/\sigma T$) data according to the relative thickness ratio (T2/T1) between the glass layer 141 and the polymer layer 145, which are adjacent layers in the diffusion part 140 of the surface emitting laser package according to the first embodiment.

The embodiment can control the thickness ratio (T2/T1) of the first layer, the glass layer 141 and the second layer, the polymer layer 145, so that even if they have different coefficients of thermal expansion, there are technical effects that can show performance in that embodiment is excellent in reliability tests such as thermal shock or thermal cycle test.

For example, referring to FIG. 4, in the embodiment, the ratio thickness (T2/T1) of the second thickness T2 of the polymer layer 145 as the second layer 2 compared to the first thickness T1 of the glass layer 141 as the first layer 1 may be controlled to be 0.12 to 3.0 (first range SE). Through this, the relative stress is controlled to a low range of $-0.4<\sigma/\sigma T<0.8$, so even if the glass layer 141 and the polymer layer 145 have different coefficients of thermal expansion, there is a technical effect in that excellent performance can represent in reliability tests such as thermal shock or thermal cycle test.

In this case, σ is a stress at the top of the second layer of the polymer layer 145, and $\overline{\sigma}$ is the average stress in the second layer of the polymer layer 145 (average stress in layer 2). In FIG. 4, the Σ value may have a value such as 10, 1, or 1/10 depending on the material.

Table 1 below shows reliability test result data in the surface emitting laser packages (Experimental Examples 1 to 3) according to Comparative Example 1 (reliability tests were conducted with 5 samples each).

In addition, FIG. 5 is a photograph of the reliability test results in the surface emitting laser package according to Comparative Example 1 and Experimental Examples. Specifically, FIG. 5 (*a*) is a photograph of Comparative Example 1, and FIGS. 5 (*b*) to 5 (*d*) are photographs of the Experimental Examples 1~3.

TABLE 1

	Glass layer thickness (T1) + polymer layer thickness (T2) (mm) [T2/T1]	Starting state	200 cycle	350 cycle	500 cycle	750 cycle
Comparative Example 1	0.7 + 0.08 [8/70 = 0.1143]	OK(5)	NG(2)	NG(5)	NG(5)	NG(5)
Experimental Example 1	0.28 + 0.08 [8/28 = 0.286]	OK(5)	OK(5)	OK(5)	OK(5)	OK(5)
Experimental Example 2	0.2 + 0.1 [10/20 = 0.5]	OK(5)	OK(5)	OK(5)	OK(5)	OK(5)
Experimental Example 3	0.4 + 0.05 [5/40 = 0.125]	OK(5)	OK(5)	OK(5)	OK(5)	OK(5)

Referring to Table 1 and FIG. **5**, in Comparative Example 1, total interface peeling occurred in the all five Diffuser raw materials from the 200 cycle. However, in Experimental Examples 1~**3** according to embodiment, excellent reliability was exhibited without interfacial peeling even up to 7500 cycles.

According to an embodiment, the thickness ratio (T**2**/T**1**) of the second thickness T**2** of the polymer layer **145**, which is the second layer, to the first thickness T**1** of the glass layer **141**, which is the first layer, is a first range SE. By controlling thickness ratio to 0.12 to 3.0, the relative stress is controlled to be low, so that even if the glass layer **141** and the polymer layer **145** have different coefficients of thermal expansion, there is a technical effect in that the embodiment can show excellent performance in the same reliability during thermal shock test or thermal cycle test, etc.

In addition, according to an embodiment, the thickness ratio (T**2**/T**1**) of the second thickness T**2** of the polymer layer **145**, which is the second layer, to the first thickness T**1** of the glass layer **141**, which is the first layer, can be controlled as the first range (SE) such as 0.125 to 1.0.

In addition, according to an embodiment, the thickness ratio (T**2**/T**1**) of the second thickness T**2** of the polymer layer **145**, which is the second layer, to the first thickness T**1** of the glass layer **141**, which is the first layer, can be controlled to be 0.125 to 0.5 (first range SE).

In addition, in the embodiment, the first thickness T**1** of the glass layer **141** can be controlled to be about 50 to 300 μm, and in the embodiment, the second thickness T**2** of the polymer layer **145** can be controlled to be about 50 to 150 μm.

In the embodiment, the relative stress can be controlled to be low by controlling the thickness ratio (T**2**/T**1**) of the second thickness T**2** of the polymer layer **145**, which is the second layer, to the first thickness T**1** of the glass layer **141**, which is the first layer. Through this, even if the glass layer **141** and the polymer layer **145** have different coefficients of thermal expansion, there is a technical effect in that the embodiment can exhibit excellent performance in reliability tests such as thermal shock or thermal cycle test.

Second Embodiment

Next, FIG. **6** is a cross-sectional view of a surface emitting laser package **102** according to a second embodiment, and FIG. **7** is an enlarged view of a second area D**2** in the surface emitting laser package according to the second embodiment. FIG. **8** is light absorption data according to the thickness of the polymer layer **146** of the diffusion part in the surface emitting laser package **102** according to the second embodiment.

The second embodiment can adopt the technical features of the first embodiment, and the main features of the second embodiment will be described below.

The surface emitting laser package **102** according to the second embodiment includes a housing **110** including a cavity C, a surface emitting laser device **201** disposed in the cavity C, and a diffusion part **140** disposed on the housing **110**.

The diffusion part **140** includes a polymer layer **146** disposed on the housing **110** on the surface emitting laser device **201** and a glass layer **141** disposed on the polymer layer **146**.

Referring to FIG. **7**, the polymer layer **146** includes a first polymer layer **146*a*** vertically overlapping with the surface emitting laser device **201** and a second polymer layer **146*b*** not vertically overlapping the surface emitting laser device **201**. A first thickness T**2*a*** of the first polymer layer **146*a*** may be thinner than a second thickness T**2*b*** of the second polymer layer **146*b***.

FIG. **8** is light transmission data according to the thickness z of the polymer layer **146** in the surface emitting laser package **102** according to the second embodiment, and the degree of light absorption can be known.

For example, in FIG. **8**, the horizontal axis represents the thickness z of the polymer layer **146**, the vertical axis represents the light transmittance (I/I0) data, and a represents the absorption constant (4πλ).

Referring to FIG. **8**, it can be seen that as the thickness z of the polymer layer **146** increases, the light transmittance (I/I0) of the vertical axis decreases exponentially as the light absorption increases.

Referring back to FIG. **7**, in the second embodiment, the first thickness T**2*a*** of the first polymer layer **146*a*** is controlled to be thinner than the second thickness T**2*b*** of the second polymer layer **146*b***. Optical properties may be improved by increasing the light transmittance in the first polymer layer **146*a*** vertically overlapping the light emitting laser device **201**.

Also, at the same time, the second thickness T**2*b*** of the second polymer layer **146*b*** not vertically overlapping the surface emitting laser device **201** is thicker than the first thickness T**2*a*** of the first polymer layer **146*a***. At the same time, by controlling the thickness ratio (T**2*b***/T**1**) of the glass layer **141** to the first thickness T**1** in the range of 0.12 to 3.0, there is a complex technical effect with excellent reliability against thermal stress.

Also, referring to FIG. **7**, in the second embodiment, the coefficient of thermal expansion (unit, ppm/° C.) of the adhesive member **155** may be controlled in a range of 1 to 2 times than the coefficient of thermal expansion of the polymer layer **146**. Through this, reliability can be greatly improved by minimizing the coefficient of thermal expansion between the polymer layer **146** and the adhesive member **155**.

For example, in the second embodiment, the coefficient of thermal expansion (unit, ppm/° C.) of the adhesive member **155** is controlled to be about 70 to 80 (ppm/° C.), and the coefficient of thermal expansion of the polymer layer **146** is controlled to be about 50 to 60. Through this, the thermal expansion coefficient of the adhesive member **155** is controlled to be in the range of 1 to 2 times than the thermal expansion coefficient of the polymer layer **146**, so that the reliability between the polymer layer **146** and the adhesive member **155** can be greatly improved by minimizing the thermal expansion. In an embodiment, the material of the polymer layer may be a polyurethane acrylate series, but is not limited thereto.

Table 2 below shows reliability test result data for the surface emitting laser packages according to Comparative Example 2, Comparative Example 3, and Second Experimental example, and FIG. **9** is a surface emitting laser according to Comparative Example 2, Comparative Example 3, and Second Embodiment. This is a picture of the reliability test result on the package.

TABLE 2

	No of Bonding surface of the Diffusion part	Starting state	200 cycle	350 cycle	500 cycle	750 cycle	1000 cycle
Comparative Example 2	Same	OK(5)	OK(5)	OK(5)	OK(5)	NG(5)	NG(5)
Comparative Example 3	Same	OK(5)	OK(5)	NG(5)	NG(5)	NG(5)	NG(5)
Experimental Example 4	Same	OK(5)	OK(5)	OK(5)	OK(5)	OK(5)	OK(5)

Table 2 shows data from the reliability test results in the surface emitting laser package (Experimental Example 4) according to Comparative Example 2 and Comparative Example 3 and Second Embodiment (reliability tests were conducted with 5 samples each). In addition, FIG. **9** (*a*) is a photograph of Comparative Example 2, FIG. **9** (*b*) is a photograph of Comparative Example 3, and FIG. **9** (*c*) is a photograph of Experimental Example 4.

In Comparative Example 2, from the 750 cycle, all five Diffuser raw materials were completely separated from the interface. In particular, in Comparative Example 3, from 350 cycles, all five of the diffuser raw materials were completely separated from the interface. On the other hand, in Experimental Example 4 according to the second embodiment, excellent reliability was exhibited without interfacial peeling even up to 1,000 cycles.

In the second embodiment, the coefficient of thermal expansion of the adhesive member **155** may be controlled in a range of 1 to 2 times that of the polymer layer **146**. Through this, the embodiment has a technical effect that can greatly improve reliability by minimizing the coefficient of thermal expansion between the polymer layer **146** and the adhesive member **155**.

Next, the surface emitting laser device **201** will be described with reference to FIGS. **10** to **12**.

FIG. **10** is a plan view of a surface emitting laser device according to an embodiment, and FIG. **11** is an enlarged view of a region C1 of the surface emitting laser device according to the embodiment shown in FIG. **10**.

FIG. **12** is a cross-sectional view taken along line A**1**-A**2** of the surface emitting laser device according to the embodiment shown in FIG. **11**.

Referring to FIGS. **10** to **12**, the surface emitting laser device **201** according to the embodiment may include a light emitting portion E and a pad portion P. As shown in FIG. **10**, the light emitting portion E may be a region in which a laser beam is emitted as a region including a plurality of light emitting emitters E**1**, E**2**, and E**3**. For example, the light emitting portion E may include tens to hundreds of light emitting emitters. The pad portion P may be a region not disposed on the light emitting emitters E**1**, E**2**, and E**3**.

The surface emitting laser device **201** according to the embodiment may include a second electrode **282**. That is, in each of the light emitting emitters E**1**, E**2**, and E**3**, the second electrode **282** may be disposed in a region other than the region corresponding to the aperture **241**. For example, the second electrode **282** may be disposed in the second region of the second reflective layer **250**. The first region of the second reflective layer **250** is surrounded by the second region and may be equal to or larger than the size of the opening **241**. Accordingly, the beam generated by the emission layer **230** may pass through the opening **241** and be emitted to the outside through the opening defined by the second electrode **282**.

Referring to FIG. **12**, the surface emitting laser device **201** according to the embodiment includes at least one of a first electrode **215**, a substrate **210**, a first reflective layer **220**, a light emitting layer **230**, an oxide layer **240**, and a second reflective layer **250**, the passivation layer **270**, and the second electrode **282**.

The oxide layer **240** may include an opening **241** and an insulating region **242**. The opening **241** may be a passage area through which current flows. The insulating region **242** may be a blocking region that blocks the flow of current. The insulating region **242** may be referred to as an oxide layer or an oxidation layer. The oxide layer **240** may be referred to as a current confinement layer because the oxide layer **240** limits the flow or density of the current so that the more concentrated laser beam is emitted.

The surface emitting laser device **201** according to the embodiment may further include a pad electrode **280**. The pad electrode **280** may be disposed in a region other than the pad portion P, that is, except the light emitting portion E. The pad electrode **280** may be electrically connected to the second electrode **282**. The first electrode **282** and the pad electrode **280** may be formed integrally or may be formed separately.

In the drawings of the embodiment, the direction of the x-axis may be a direction parallel to the length direction of the substrate **210**, and the y-axis may be a direction perpendicular to the x-axis.

The surface emitting laser device **201** according to the embodiment provides a substrate **210**. The substrate **210** may be a conductive substrate or a non-conductive substrate. A metal having excellent electrical conductivity may be used as the conductive substrate. Since heat generated during the operation of the surface emitting laser device **201** must be sufficiently dissipated, a GaAs substrate or a metal substrate having high thermal conductivity may be used as the conductive substrate, or a silicon (Si) substrate may be used. As the non-conductive substrate, an AlN substrate, a sapphire (Al_2O_3) substrate, or a ceramic-based substrate may be used.

The surface emitting laser device **201** according to the embodiment provides a first electrode **215**. The first electrode **215** may be disposed under the substrate **210**. The first electrode **215** may be formed of a conductive material and may be disposed in a single layer or multiple layers. For example, the first electrode **215** may be a metal, and includes at least one of aluminum (Al), titanium (Ti), chromium (Cr), nickel (Ni), copper (Cu), and gold (Au). Thus, it is formed in a single-layer or multi-layered structure, thereby improving the electrical properties and increasing the light output.

The surface emitting laser device **201** according to the embodiment provides a first reflective layer **220**. The first reflective layer **220** may be disposed on the substrate **210**. When the substrate **210** is omitted to reduce the thickness, the lower surface of the first reflective layer **220** may contact the upper surface of the first electrode **215**.

The first reflective layer **220** may be doped with a first conductivity type dopant. For example, the first conductivity-type dopant may include an n-type dopant such as Si, Ge, Sn, Se, and Te.

The first reflective layer **220** may include a gallium-based compound, for example, AlGaAs, but is not limited thereto. The first reflective layer **220** may be a Distributed Bragg Reflector (DBR). For example, the first reflective layer **220** may have a structure in which a first layer and a second layer including materials having different refractive indices are alternately stacked at least once or more.

For example, the first reflective layer **220** may include a plurality of layers disposed on the substrate **210**. Each layer may contain a semiconductor material having a composition formula of $AlxGa_{(1-x)}As$ ($0<x<1$), and when Al in each layer increases, the refractive index of each layer decreases, and when Ga increases, the refractive index of can be increased. The thickness of each layer may be λ, λ may be a wavelength of light generated from the light emitting layer **230**, and n may be a refractive index of each layer with respect to the light of the above-described wavelength. Here, λ may be 650 to 980 nanometers (nm), and n may be the refractive index of each layer. The first reflective layer **220** having such a structure may have a reflectance of 99.999% for light having a wavelength of about 940 nanometers.

The thickness of the layer in each of the first reflective layers **220** may be determined according to a respective refractive index and a wavelength **2** of light emitted from the light emitting layer **230**.

The surface emitting laser device **201** according to the embodiment may include a light emitting layer **230**. The emission layer **230** may be disposed on the first reflective layer **220**. Specifically, the emission layer **230** may be disposed on the first reflective layer **220**. The emission layer **230** may be disposed between the first reflective layer **220** and the second reflective layer **250**.

The emission layer **230** may include an active layer and at least one or more cavities. For example, the emission layer **230** may include an active layer, a first cavity disposed below the active layer, and a second cavity disposed above the active layer. The light emitting layer **230** of the embodiment may include both the first cavity and the second cavity, or may include only one of the two.

The active layer may include any one of a single well structure, a multiple well structure, a single quantum well structure, a multi quantum well (MQW) structure, a quantum dot structure, or a quantum wire structure.

The active layer may include a quantum well layer and a quantum barrier layer using a group III-V or VI compound semiconductor material. The quantum well layer may be formed of a material having an energy band gap smaller than the energy band gap of the quantum barrier layer. The active layer may be formed in a 1 to 3 pair structure such as InGaAs/AlxGaAs, alGaInP/GaInP, AlGaAs/AlGaAs, AlGaAs/GaAs, GaAs/InGaAs, but is not limited thereto. The active layer may not be doped with a dopant.

The first cavity and the second cavity may be formed of $AlyGa_{(1-y)}As$($0<y<1$), but are not limited thereto. For example, the first cavity and the second cavity may each include a plurality of layers of $AlyGa_{(1-y)}As$.

The surface emitting laser device **201** according to the embodiment may provide an oxide layer **240**. The oxide layer **240** may include an insulating region **242** and an opening **241**. The insulating region **242** may surround the opening **241**. For example, the opening **241** may be disposed on the first area (center area) of the emission layer **230**, and the insulating region **242** may be disposed on the second area (edge area) of the emission layer **230**. The second area may surround the first area.

The opening **241** may be a passage area through which current flows. The insulating region **242** may be a blocking region that blocks the flow of current. The insulating region **242** may be referred to as an oxide layer or an oxide layer.

The surface emitting laser device **201** according to the embodiment may include a second reflective layer **250**. The second reflective layer **250** may be disposed on the oxide layer **240**.

The second reflective layer **250** may include a gallium-based compound, for example, AlGaAs, and the second reflective layer **250** may be doped with a second conductivity type dopant. The second conductivity-type dopant may be a p-type dopant such as Mg, Zn, Ca, Sr, Ba, or the like. Meanwhile, the first reflective layer **220** may be doped with a p-type dopant, and the second reflective layer **250** may be doped with an n-type dopant.

The second reflective layer **250** may also be a Distributed Bragg Reflector (DBR). For example, the second reflective layer **250** may have a structure in which a plurality of layers including materials having different refractive indices are alternately stacked at least once or more.

The second reflective layer **250** having such a structure may have a reflectance of 99.9% for light having a wavelength of about 940 nanometers.

The second reflective layer **250** may be formed by alternately stacking layers, and the number of pairs of layers in the first reflective layer **220** may be greater than the number of pairs of layers in the second reflective layer **250**. As described above, the reflectance of the first reflective layer **220** is 99.999%, which may be greater than the reflectance of 99.9% of the second reflective layer **250**.

In an embodiment, the second reflective layer **250** may include a plurality of layers disposed on the emission layer **230**. Each layer may be formed of a single layer or a plurality of layers.

The surface emitting laser device **201** according to the embodiment may provide a passivation layer **270**. The passivation layer **270** may surround a portion of the light emitting structure. Some regions of the light emitting structure may include, for example, the light emitting layer **230**, the oxide layer **240**, and the second reflective layer **250**. The passivation layer **270** may be disposed on the upper surface of the first reflective layer **220**. The passivation layer **270** may be disposed on the edge region of the second reflective layer **250**. When the light emitting structure is partially mesa etched, a part of the top surface of the first reflective layer **220** may be exposed, and a partial region of the light emitting structure may be formed. The passivation layer **270** may be disposed around a portion of the light emitting structure and on the exposed top surface of the first reflective layer **220**.

The passivation layer **270** may protect the light emitting structure from the outside and may block an electrical short between the first reflective layer **220** and the second reflective layer **250**. The passivation layer **270** may be formed of an inorganic material such as SiO_2, but is not limited thereto.

The surface emitting laser device **201** according to the embodiment may provide a second electrode **282**. The second electrode **282** may be electrically connected to the pad electrode **280**. The second electrode **282** may contact a portion of the upper surface of the second reflective layer **250**.

The second electrode **282** and the pad electrode **280** may be made of a conductive material. For example, the second electrode **282** and the pad electrode **280** are platinum (Pt), aluminum (Al), titanium (Ti), chromium (Cr), nickel (Ni), tungsten (W), copper (Cu), gold (Au) and may be formed in a single-layer or multi-layered structure.

(Flip Chip Type Surface Emitting Laser Device)

Next, FIG. **13** is another cross-sectional view of a surface emitting laser device according to an embodiment.

The surface emitting laser device according to the embodiment can be applied to the flip-chip type surface emitting laser device as shown in FIG. **13**.

In addition to the vertical type, the surface emitting laser device according to the embodiment may have a flip chip type in which the first electrode **215** and the second electrode **282** face the same direction as shown in FIG. **13**.

For example, in the flip-chip type surface emitting laser device shown in FIG. **13**, the first electrode parts **215** and **217**, the substrate **210**, the first reflective layer **220**, the active region **230**, and the aperture region **240**, the second reflective layer **250**, the second electrode parts **280** and **282**, the first passivation layer **271**, the second passivation layer **272**, and the non-reflective layer **290** may be included. In this case, the reflectivity of the second reflective layer **250** may be designed to be higher than that of the first reflective layer **220**.

In this case, the first electrode parts **215** and **217** may include a first electrode **215** and a first pad electrode **217**. The first electrode **215** may be electrically connected to the first reflective layer **220** exposed through a predetermined mesa process, and the first pad electrode **217** may be electrically connected to the first electrode **215**.

The first electrode parts **215** and **217** may be made of a conductive material, and may be, for example, metal. For example, the first electrode **215** includes at least one of aluminum (Al), titanium (Ti), chromium (Cr), nickel (Ni), copper (Cu), and gold (Au), and has a single layer or multilayer structure. The first electrode **215** and the first pad electrode **217** may include the same metal or different metals.

When the first reflective layer **220** is an n-type reflective layer, the first electrode **215** may be an electrode for the n-type reflective layer.

The second electrode parts **280** and **282** may include a second electrode **282** and a second pad electrode **280**, and the second electrode **282** is electrically connected on the second reflective layer **250**, the second pad electrode **280** may be electrically connected to the second electrode **282**.

When the second reflective layer **250** is a p-type reflective layer, the second electrode **282** may be a p-type electrode.

The second electrode (see FIGS. **4** and **8**) according to the above-described embodiment may be applied equally to the second electrode **282** of the flip-chip type surface emitting laser device.

The first insulating layer **271** and the second insulating layer **272** may be made of an insulating material, for example, nitride or oxide. For example, it may include at least one of polyimide, silica (SiO_2), or silicon nitride (Si_3N_4).

Fourth Embodiment

FIG. **14** is a plan view of a surface emitting laser package **200** according to a fourth embodiment, and FIG. **15** is a top view of the surface emitting laser package according to the fourth embodiment shown in FIG. **14** while a transmissive part **250** and a reflective part **260** are omitted. The transmissive part **250** and the reflective part **260** may be referred to as a diffusion part, but the present disclosure is not limited thereto.

First, referring to FIG. **14**, the surface emitting laser package **200** according to the fourth embodiment may include a body **210**, a transmission part **250**, and a reflection part **260**. In the drawings of the embodiment, a ground may be defined by an x-axis and a y-axis, and a normal direction perpendicular to the ground (xy plane) may be the z-axis. In the embodiment, the horizontal width of the body **210** in the x-axis direction on the surface may be greater than the horizontal width in the y-axis direction, but is not limited thereto. An index mark M1 is formed on the body **210** so that the positions of the transmitting part **250** and the reflecting part **260** can be easily identified. The cross-sectional lines **A1-A1'** and **A2-A2'** in FIGS. **14** and **15** will be described with reference to FIGS. **16**A and **16**B. The body **210** may be referred to as a substrate, but is not limited thereto.

Referring to FIGS. **14** and **15**, the surface emitting laser package **200** according to the fourth embodiment includes a body **210** including a cavity C, and a surface emitting laser device **230** disposed inside the cavity C, a light receiving device **240** disposed in the cavity C to be spaced apart from the surface emitting laser device **230** and detecting light emitted from the surface emitting laser device **230**, and a transmissive part **250** disposed on the upper body **210** and a reflective part **260** disposed on the light receiving device **240**. The transmissive part **250** and the reflective part **260** may be referred to as a diffusion part.

Referring to FIG. **15**, the surface emitting laser device **230** may include a light emitting part **100** and a pad part **235**.

In addition, the embodiment may include a single or a plurality of electrode parts disposed at the bottom of the cavity C between the surface emitting laser device **230** and the light receiving device **240**.

For example, the embodiment may include a first electrode part **221** on which the surface emitting laser device **230** is disposed, and a third electrode part **223** electrically connected to the surface emitting laser device **230** by a first wire W1, a second electrode part **222** on which the light receiving device **240** is disposed, and a fourth electrode part **224** electrically connected to the light receiving device **240** by a second wire W2. The second electrode part **222** may extend from the first electrode part **221** to be integrally formed, but is not limited thereto.

In the embodiment, the laser emitted from the surface-emitting laser device **230** is diffused through the transmission unit **250** and the light-receiving device **240** may sense light reflected from the package, and the amount of light detected by measuring the degree of change, whether or not the transmission part **250** is attached or detached can be precisely controlled.

In this case, in the embodiment, the transmissive part **250** may be disposed in a beam divergence range of the surface-emitting laser device **230** and a reflective part **260** may be disposed in other areas. Through this, light reflected and totally reflected inside the package may be reflected inside without sending it to the outside through the reflector **260**. In addition, on the contrary, light incident from the outside of the package to the inside of the package may be reflected through the reflecting unit **260** so as not to be incident inside. Through this, the embodiment has a technical effect of providing a surface-emitting laser package and an optical assembly having excellent reliability and stability by remarkably improving the photo-sensing performance of the light-receiving device **240**.

Next, the surface emitting laser package **200** according to the fourth embodiment will be described in more detail with reference to FIGS. **16**A and **16**B.

FIG. **16**A is a cross-sectional view of the surface emitting laser package **200** according to the fourth embodiment shown in FIGS. **14** and **15** along line A**1**-A**1**', and FIG. **16**B is a cross-sectional view taken along line A**2**-A**2**' of the surface emitting laser package **200** according to a fourth embodiment shown in FIGS. **14** and **15**.

Referring to FIGS. **16**A and **16**B, a surface emitting laser package **200** according to a fourth embodiment includes a body **210** including a cavity C, and a surface emitting laser device **230** disposed inside the cavity C, a light receiving device **240** disposed in the cavity C to be spaced apart from the surface emitting laser device **230** and detecting light emitted from the surface emitting laser device **230**, and a transmissive part **250** disposed on the body **210** on the surface emitting laser device **230** and a reflective part **260** disposed on the light receiving device **240**.

In the embodiment, the body **210** may be formed of a single layer or a plurality of layers. For example, the body **210** may be formed as a single-layered substrate, or may include a first substrate **211**, a second substrate **212** and a third substrate **213** as shown.

The body **210** may include a material having high thermal conductivity. Accordingly, the body **210** may be provided with a material having good heat dissipation characteristics so that heat generated by the surface emitting laser device **230** can be efficiently discharged to the outside. For example, the body **210** may include a ceramic material. The body **210** may include a low temperature co-fired ceramic (LTCC) or a high temperature co-fired ceramic (HTCC).

In addition, the body **210** may include a metal compound. The body **210** may include a metal oxide having a thermal conductivity of 140 W/mK or more. For example, the body **210** may include aluminum nitride (AlN) or alumina (Al_2O_3).

In addition, the body **210** may include a resin-based insulating material. The body **210** may be provided with a silicone resin, an epoxy resin, a thermosetting resin including a plastic material, or a high heat resistance material.

In addition, the body **210** may include a conductive material. For example, when the body **210** is made of a conductive material, such as metal, an insulating layer (not shown) for electrical insulation between the body **210** and the surface emitting laser device **230** may be provided therebetween.

Accordingly, according to the embodiment, there is a technical effect of providing a surface emitting laser package and an optical module having excellent heat dissipation characteristics while being capable of driving high output and high voltage.

The first substrate **211**, the second substrate **212**, and the third substrate **213** may have the same material of the body **210** or may include at least one differently.

Next, in an embodiment, a single or a plurality of electrode parts may be disposed on the body **210**. For example, referring to FIG. **15**, in the embodiment, a first electrode part **221**, a second electrode part **222**, a third electrode part **223**, and a fourth electrode part **224** can be placed on the body **210**.

For example, in an embodiment, a first electrode part **221** on which the surface emitting laser device **230** is disposed, and a third electrode part **223** electrically connected to the surface emitting laser device **230** by a first wire W**1**, a second electrode part **222** on which the light receiving device **240** is disposed, and a fourth electrode part **224** electrically connected to the light receiving device **240** by a second wire W**2** (see FIG. **15**).

The first to fourth electrode parts **221** to **224** may be formed of a conductive metal material. For example, the first to fourth electrode parts **221** to **224** may be at least one of Cu, ag, Ni, Cr, Ti, al, Rh, Pd, Ir, Ru, Mg, Zn, Pt, au, Hf or an alloy of two or more of them and may be a single layer or a multilayer.

Referring back to FIGS. **16**A and **16**B together, the first electrode part **221** may include a first upper electrode **221***a* disposed on the body **210** and a first lower electrode **221***b* disposed under the body **210**. A surface emitting laser device **230** may be disposed on the first upper electrode **221***a*. The first lower electrode **221***b* may be formed larger than the first upper electrode **221***a* to improve electrical conductivity and heat dissipation efficiency.

In addition, the second electrode part **222** may include a second upper electrode **222***a* disposed on the body **210** and a second lower electrode **222***b* disposed under the body **210**. The light receiving device **240** may be disposed on the second upper electrode **222***a*. The second lower electrode **222***b* may be formed larger than the second upper electrode **222***a* to improve conductivity and heat dissipation efficiency.

In addition, the third electrode part **223** may include a third upper electrode **223***a* disposed on the body **210** and a third lower electrode **223***b* disposed under the body **210**. The third upper electrode **223***a* may be electrically connected to the surface emitting laser device **230** by a first wire W**1**.

At this time, according to the embodiment, the third electrode part **223** is disposed between the first electrode part **221** and the second electrode part **222**, and the surface emitting laser device **230** is disposed thereon, and the light receiving device **240** is disposed on the second electrode part **222** to be spaced apart from the surface emitting laser device **230**. Since the beam divergence of the surface emitting laser device **230** can be secured to be a wide range and can minimize the area occupied by the light receiving device inside the package, it is possible to perform a high-sensitivity light sensing function and provide a compact surface emitting laser package and optical module.

Next, features of the electrode part in the embodiment will be described in more detail with reference to FIGS. **17** to **18**B.

FIG. **17** is a plan view of the surface emitting laser package according to the fourth embodiment shown in FIG. **16** while the surface emitting laser device **230** and the light receiving device **240** are omitted. FIG. **18**A is a cross-sectional view along line A**3**-A**3**' of the surface emitting laser package according to a fourth embodiment shown in FIG. **17**, and FIG. **18**B is a cross-sectional view along line A**4**-A**4**' of the surface emitting laser package according to the fourth embodiment shown in FIG. **17**.

Referring to FIGS. **18**A and **18**B, the first electrode part **221** includes a first upper electrode **221***a* disposed on the body **210**, and a first lower electrode **221***b* disposed under the body **210**, and a first connection electrode **221***c* electrically connecting the first upper electrode **221***a* and the first lower electrode **221***b*. The first connection electrode **221***c* may be a via electrode, but is not limited thereto.

The first upper electrode **221***a* may be electrically connected to the surface emitting laser device **230**. For example, the surface emitting laser device **230** may be disposed on the first upper electrode **221***a*.

Next, referring to FIG. **18**A, the second electrode part **222** includes a second upper electrode **222***a* disposed on the body **210** and a second lower electrode **222***b* disposed under the body **210**. Referring to FIG. **17**, the second electrode part **222** may be integrally formed extending from the first electrode part **221**, but is not limited thereto.

When the second electrode part **222** is integrally formed extending from the first electrode part **221**, the second upper electrode **222***a* and the second lower electrode **222***b* of the second electrode part **222** are electrically connected by the first connection electrode **221***c* of the first electrode part **221**.

In this case, the second upper electrode **222***a* may be electrically connected to the light receiving device **240**. For example, a light receiving device **240** may be disposed on the second upper electrode **222***a*.

Next, the third electrode part **223** includes a third upper electrode **223***a* disposed on the body **210**, a third lower electrode **223***b* disposed under the body **210** and a third connection electrode **223***c* electrically connecting the third upper electrode **223***a* and the third lower electrode **223***b*. The third upper electrode **223***a* may be electrically connected to the surface emitting laser device **230** through a first wire W**1**. The third connection electrode **223***c* may be a via electrode.

Referring to FIGS. **15** and **17**, a surface-emitting laser device **230** is disposed on a first electrode part **221**, and a light-receiving device **240** is spaced apart from the surface-emitting laser device **230** and is disposed on the second electrode part **222**. Through this, a wide beam divergence range of the surface-emitting laser device **230** can be secured, and an area occupied by the light-receiving device in the package can be minimized. Accordingly, the embodiment can provide a compact surface-emitting laser package and an optical assembly capable of performing a high-sensitivity light sensing function.

Next, referring to FIGS. **15** and **17**, the fourth electrode part **224** includes a fourth upper electrode **224***a* disposed on the body **210** and a fourth lower electrode (not shown) disposed under the body **210** and a fourth connection electrode **224***c* electrically connecting the fourth upper electrode **224***a* and the fourth lower electrode. The fourth upper electrode **224***a* may be electrically connected to the light receiving device **240** through a second wire W**2** (see FIG. **15**). The fourth connection electrode **224***c* may be a via electrode.

Meanwhile, referring to FIGS. **18**A and **18**B, a cavity C may be disposed in the body **210** of the embodiment, and a single cavity or a plurality of cavities may be disposed. For example, the body **210** of the embodiment may include a first cavity C**1** located on the second substrate **212** and a second cavity C**2** located on the third substrate **213**. The horizontal width of the second cavity C**2** may be larger than the horizontal width of the first cavity C**1**.

Referring to FIG. **16**A, a surface emitting laser device **230** and a light receiving device **240** may be disposed in the first cavity C**1**, and a transmitting part **250** and a reflecting part **260** may be disposed in the second cavity C**2**.

Next, with reference to FIGS. **19** to **21**, a description will be given of the surface emitting laser device **230** in the surface emitting laser package according to the embodiment.

FIG. **19** is a plan view of a surface emitting laser device **230** in a surface emitting laser package according to an embodiment, and FIG. **20** is a partial enlarged view of area B of a surface emitting laser device **230** in the surface emitting laser package according to the embodiment shown in FIG. **18**.

Referring to FIGS. **19** to **21**, the surface emitting laser device **230** according to the embodiment is illustrated for a vertical-cavity surface emitting laser (VCSEL), but is not limited thereto.

Referring to FIG. **19**, a surface emitting laser device **230** in a surface emitting laser package according to an embodiment may include a light emitting part **100** and a pad part **235**. Referring to FIGS. **19** and **20**, a plurality of light emitting emitters E**1**, E**2**, and E**3** may be disposed in the light emitting part **100**.

FIG. **21** is a cross-sectional view taken along line A**5**-A**5**' of the first emitter E**1** of the surface emitting laser device **230** of the surface emitting laser package according to the embodiment shown in FIG. **20**.

Referring to FIG. **21**, in the embodiment, the first emitter E**1** of the surface emitting laser device includes a first electrode **115**, a support substrate **110**, a first reflective layer **120**, a cavity region **130**, and an aperture. **141**, the insulating region **142**, the second reflective layer **150**, the second contact electrode **155**, the second electrode **180**, and the passivation layer **170**.

In an embodiment, the support substrate **110** may have excellent heat dissipation characteristics, and may be a conductive substrate or a non-conductive substrate. For example, the support substrate **110** may be provided with at least one selected from among conductive materials such as copper (Cu), gold (Au), nickel (Ni), molybdenum (Mo), copper-tungsten (Cu—W), a carrier wafer (eg, Si, Ge, alN), GaAs, ZnO, SiC, etc, but is not limited thereto.

In an embodiment, the first electrode **115** may be disposed under the support substrate **110**, and the first electrode **115** may be disposed in a single layer or in multiple layers of a conductive material.

The first reflective layer **120** may be provided with at least one of a group III-V or group II-VI compound semiconductor doped with a first conductivity type dopant. The second reflective layer **150** may be provided with at least one of a Group III-V or group II-VI compound semiconductor doped with a second conductivity type dopant.

For example, the first semiconductive layer **120** and the second reflective layer **150** may be one of a group including GaAs, GaAl, InP, InAs, and GaP. The first semiconductor layer **120** and the second reflective layer **150** can be provided as semiconductors having a composition formula of $Al_xGa_{1-x}As(0<x<1)/Al_yGa_{1-y}As(0<y<1)(y<x)$.

The cavity region **130** is disposed between the first reflective layer **120** and the second reflective layer **150**, a predetermined active layer (not shown) and a first cavity (not shown) disposed below the active layer, a second cavity (not shown) disposed above the active layer may be included. The cavity region **130** of the embodiment may include both the first cavity and the second cavity, or may include only one of the two.

In an embodiment, an insulating region **142** is disposed on the cavity region **130**, and an aperture **141** defined by the insulating region **142** may be positioned.

The insulating region **142** may be formed of an insulating layer, for example, aluminum oxide, and thus may function as a current insulating region, and an aperture **141** may be disposed in the central region. For example, in a predetermined AlGaAs layer, the insulating region **142** may be formed as the edge changes to Al_2O_3 by reacting with H_2O, and the central region not reacting with H_2O may become the aperture **141** made of AlGaAs.

The surface emitting laser device according to the embodiment may be mesa etched from the second reflective layer **150** in the region around the aperture **141** to the insulating region **142** and the cavity region **130**. In addition, a portion of the first reflective layer **120** may be mesa etched.

A second contact electrode **155** may be disposed on the second reflective layer **150**. The area of the second reflective layer **150** exposed by the second contact electrode **155** may correspond to the aperture **141**, which is a central area of the insulating region **142**. The contact electrode **155** may improve contact characteristics between the second reflective layer **150** and the second electrode **180**.

The passivation layer **170** may be disposed on a side surface and an upper surface of the mesa-etched light emitting structure and an upper surface of the first reflective layer **120**. The passivation layer **170** may be made of an insulating material, for example, a nitride or an oxide.

The second electrode **180** electrically contacts the exposed second contact electrode **155** and extends above the passivation layer **170** to receive current from the pad part **235**. The second electrode **180** may be made of a conductive material. For example, the second electrode **180** includes at least one of aluminum (Al), titanium (Ti), chromium (Cr), nickel (Ni), copper (Cu), and gold (Au) and it can be formed in a single-layer or multi-layer structure.

Referring back to FIG. **16**A, the light receiving device **240** employed in the surface emitting laser package according to the embodiment may be a photodetector for a monitor, and may receive incident light by applying a reverse bias voltage. The second upper electrode **222*a*** electrically connected to the light receiving device **240** may include a plurality of separated electrodes, which apply external power to the light receiving device **240** or an electrical signal detected by the light receiving device **240** can be transmitted to the outside.

Next, technical features of the light emitting device package according to the embodiment will be described in more detail with reference to FIG. **22**A. FIG. **22**A is a detailed cross-sectional view of the surface emitting laser package **200** according to the fourth embodiment shown in FIG. **16**A while a first wire **W1** is omitted.

The surface-emitting laser package **200** according to the fourth embodiment may include a transmitting part **250** disposed on the surface-emitting laser device **230** and a reflecting part **260** disposed on the light-receiving device **240** while the transmitting part **250** and the reflecting part **260** may be disposed on the body **210**.

According to the embodiment, the laser emitted from the surface emitting laser device **230** is diffused through the transmission unit **250** and the light receiving device **240** senses the light reflected from the package inside. It is possible to precisely control whether the transmission part **250** is attached or detached by measuring the changes of the amount of the detected light.

The transmissive part **250** is disposed in a range of beam divergence from the surface emitting laser device **230**, and the reflective part **260** is disposed on the light receiving device **240** to reflect and totally reflect light inside the package. The light-sensing performance of the light receiving device **240** can be significantly improved by being reflected inside the light receiving device **240** through the reflection part **260**, and on the contrary, light incident from the outside of the package to the inside of the package is reflected in the reflection part **260**. So, the light-sensing performance in the light receiving device **240** can be remarkably improved because light incident from the outside of the package to the inside of the package is not incident inside.

There is a possibility that the transmitting part **250** and the reflecting part **260** may be separated from the body **210** in an extreme environment such as vibration or long-term use of the surface-emitting laser package. When the transmitting part **250** or the reflecting part **260** is separated, the strong laser emitted from the surface-emitting laser device **230** is directly irradiated to the outside without passing through the transmitting part **250** to damage the eyesight of the user, etc.

Accordingly, according to the embodiment, the transmitting part **250** and the reflecting part **260** may be disposed in the second cavity **C2** (see FIG. **18**A), and the adhesive layer **270** may be disposed on the exposed second substrate **212**. As a result, the bonding force between the transmitting part **250** or the reflecting part **260** and the second substrate **212** may be improved.

The adhesive layer **270** may include an organic material. For example, the adhesive layer **270** may include an epoxy-based resin or a silicone-based resin. In the embodiment, by improving the bonding force between the transmitting part **250**, the reflecting part **260** and the second substrate **212**, the surface-emitting laser device **230** and a laser package can provide a stable surface light emission that may not injure a person by strong light.

In an embodiment, the transmission unit **250** may function to expand a divergence angle of light emitted from the surface emitting laser device **230**. To this end, the transmission part **250** may include a micro lens, an uneven pattern, or the like.

In addition, the transmissive part **250** may include an anti-reflective function. For example, the transmissive part **250** may include an anti-reflective layer (not shown) disposed on one surface facing the surface emitting laser device **230**. For example, the transmissive part **250** may include an anti-reflective layer disposed on a lower surface facing the surface emitting laser device **230**. Through this, the non-reflective layer may prevent light incident from the surface emitting laser device **230** from being reflected from the surface of the transmitting part **250** and transmit it, thereby improving light loss due to reflection.

The anti-reflective layer may be formed of, for example, an anti-reflective coating film, and may be attached to the surface of the transmission part **250**. In addition, the anti-reflective layer may be formed on the surface of the transmission part **250** through spin coating or spray coating. For example, the anti-reflective layer may be formed as a single layer or multiple layers including at least one of a group including TiO_2, SiO_2, Al_2O_3, Ta_2O_3, ZrO_2, and MgF_2.

Referring to FIG. **14** for a moment, the first width of the body **210** in the x-axis direction may be larger than the second width in the y-axis direction, through which the transmitting part **250** and the reflecting part **260** are formed in the x-axis direction. By arrangement, it is possible to improve light diffusivity and ensure reliability. For example, the first width of the body **210** in the x-axis direction may be about 3.0 mm to 5.0 mm, and the second width in the y-axis direction may be about 2.0 mm to 3.0 mm, but is not limited thereto.

Referring back to FIG. **22**A, the thickness T**20** in the z-axis direction of the body **210** is secured to be about 1.0 mm to 2.0 mm, so that a highly reliable and compact light emitting device package can be implemented.

In this case, the third horizontal width W**30** in the y-axis direction of the surface emitting laser device **230** may be about 500 μm to 1,500 μm. The horizontal width of the surface emitting laser device **230** in the x-axis direction may also be the same as the third horizontal width W**30** in the y-axis direction, but is not limited thereto.

In the embodiment, since the light output is determined according to the number of emitters of the surface emitting laser device chip, the size of the surface emitting laser device may be different depending on the product. For example, at the mobile level recently, since a performance of about 1 W to 2 W is required for radiant power, the size of the surface emitting laser device may be about 500×500 μm to 1,500×1500 μm.

For example, in the embodiment, the third horizontal width W**30** of the surface emitting laser device **230** may be 500 μm to 1,500 μm, but is not limited thereto.

Next, the first separation distance D**1** from the top surface of the surface emitting laser device **230** to the transmission part **250** may range from 2/75 to about 1/5 of the third horizontal width W**30** of the surface emitting laser device **230**. For example, in an embodiment, the first separation distance D**1** from the top surface of the surface emitting laser device **230** to the transmission part **250** may be about 40 μm to 100 μm.

For example, the first separation distance D**1** from the top surface of the surface emitting laser device **230** to the transmission part **250** is about 2/75 or more of the third horizontal width W**30** of the surface emitting laser device **230**. For example, a minimum distance as first separation distance D**1** of about 40 μm or more may be secured in consideration of the first wire W**1** process. In addition, the first separation distance D**1** from the top surface of the surface emitting laser device **230** to the transmission part **250** is about 1/5 or less of the third horizontal width W**30** of the surface emitting laser device **230**. For example, the first separation distance may be about 100 μm or less such that a compact light emitting device package can be provided.

In addition, in the embodiment, the thickness T**1** of the transmitting part **250** can be about 200 μm to 1,000 μm in consideration of the beam divergence angle Θ and the divergence angle Θ in the surface emitting laser device **230**.

The thickness T**1** of the transmission part **250** is controlled to be about 200 μm or more, so that a sufficient range of laser emission can be secured. When the thickness T**1** of the transmission part **250** is less than 200 μm, there is a concern in that it is damaged during the manufacturing process or actual use. In addition, by designing the thickness T**1** of the transmission part **250** to be 1,000 μm or less, a compact surface emitting laser package may be implemented.

In the embodiment, the beam divergence angle θ in the surface emitting laser device **230** may be designed to be 0° or more. For example, if two apertures through which light is emitted from the surface emitting laser device **230** are formed, the beam divergence angle Q may be made close to 0°.

In addition, in the embodiment, the divergence angle θ range of the transmission part **250** may be greater than 0° to within 160° in consideration of the product.

In an embodiment, the measurement of the divergence angle may be performed by measuring a radiance or measuring an irradiance, but is not limited thereto.

Next, the embodiment may include a reflector **260** disposed on the light receiving device **240**. Through this, in the embodiment, the transmitting part **250** is disposed in the range of the beam divergence of the surface emitting laser device **230**, and the reflecting part **260** is disposed in the other areas, so that reflection and total reflection are performed inside the package. Light may be reflected inside without being sent to the outside through the reflector **260**, and on the contrary, light incident from the outside of the package to the inside of the package may be reflected through the reflector **260** so as not to be incident inside.

Accordingly, the embodiment has a technical effect of providing a surface emitting laser package and an optical assembly having excellent reliability and stability by remarkably improving the light-sensing performance in the light receiving device **240**.

Unlike the transmissive part **250**, the reflective part **260** may block light from inside/outside the package to be reflected inside/outside, and may be formed of a resin layer including A**1**, Ag powder or alloy powder thereof.

In the embodiment, the range of the first width W**10** of the transmission part **250** may be set to match the aperture of the surface emission laser device **230** and the divergence angle of the beam. Through this, the incidence rate to the transmitting part **250** of the outgoing light can be controlled to a level of almost 100%, and the incidence rate of the outgoing light to the reflecting part **260** can be controlled to a level of almost 0%.

Next, FIG. **22**B is a cross-sectional view of another embodiment of the surface emitting laser package according to the fourth embodiment shown in FIG. **22**A.

In an embodiment, the thickness T**3** of the second reflective part **262** may be formed to be thinner than the thickness T**1** of the transmitting part **250**. Through this, while securing the widest divergence angle that can be emitted from the transmitting part **250**, the light reflected from the second reflecting part **262** inside the package is reflected to the light receiving device **240** as much as possible, thereby improving the reliability of the light sensing performance. There is a technical effect that can provide an excellent surface emitting laser package and optical assembly.

In an embodiment, the thickness T**3** of the second reflective part **262** may range from 1/10 to 1/2 of the thickness T**1** of the transmissive part **250**. Since the thickness T**3** of the second reflecting part **262** is secured to be equal to or greater than 1/10 of the thickness T**1** of the transmitting part **250**, it can function as a reflecting part.

In particular, the thickness T**3** of the second reflective part **262** may be less than 1/2 of the thickness T**1** of the transmissive part **250**. Through this, the light output may be improved by increasing a ratio of light that may be transmitted upward of the second reflecting part **262**.

For example, the thickness T**3** of the second reflector **262** may be set to about 20 μm to about 500 μm. Since the thickness T**3** of the second reflective part **262** is secured to be 1/10 or more of the thickness T**1** of the transmission part **250**, for example, about 20 μm or more, it may function as a reflective part.

In addition, the thickness T3 of the second reflective part **262** may be less than ½ of the thickness T1 of the transmissive part **250**, for example, 500 μm or less. Through this, the light output may be improved by increasing a ratio of light that may be transmitted upward of the second reflecting part **262**.

Referring back to FIG. **22**A, the first horizontal width W**10** of the transmission part **250** may be larger than the second horizontal width W**20** of the reflective part **260**. Accordingly, the embodiment may increase the amount of light reflected by the light receiving device **240** and received.

The reflective part **260** may vertically overlap the light-receiving device **240**, but may not vertically overlap the third electrode part **223** or the surface emitting laser device **230**.

For example, the first horizontal width W**10** of the transmissive part **250** may be larger than the second horizontal width W**20** of the reflective part **260**. Accordingly, it is possible to provide a surface-emitting laser package and an optical assembly having excellent reliability of photo-sensing performance by increasing the likelihood that light totally reflected from the upper surface of the transmitting part **250** will also reach the light-receiving device **240**.

In an embodiment, the first horizontal width W**10** of the transmission part **250** may be in the range of 18/15 to 6 times the third horizontal width W**30** of the surface emitting laser device **230**. For example, the first horizontal width W**10** of the transmission part **250** may be about 1,800 μm to 3,000 μm. In this case, the third horizontal width W**30** of the surface emitting laser device **230** may be 500 μm to 1,500 μm, but is not limited thereto.

In the embodiment, the first horizontal width W**10** of the transmission part **250** is formed to be 18/15 times or more of the third horizontal width W**30** of the surface emitting laser device **230**, for example, about 1,800 μm or more such that first horizontal width W**10** may be secured to be wider than the divergence angle of the surface emitting laser device **230**.

In addition, in an embodiment, the first horizontal width W**10** of the transmission part **250** may be formed to be 6 times or less, for example, about 3,000 μm or less of the third horizontal width W**30** of the surface emitting laser device **230**. Accordingly, in the embodiment, by securing the area of the reflective unit **260**, the light-receiving device **240** may sense the light reflected from the inside of the package by the laser emitted from the surface emitting laser device **230**. Through this, the embodiment can more precisely control whether the transmission unit **250** is detached or not by measuring the degree of change in the amount of light detected.

In addition, in an embodiment, the second horizontal width W**20** of the reflector **260** may range from 16/15 to 4 times the horizontal width of the light receiving device **240**. For example, the second horizontal width W**20** of the reflecting part **260** may be about 1,600 μm to 2,000 μm, and the horizontal width of the light receiving device **240** may be about 500 μm to 1,500 μm, but is not limited thereto.

Accordingly, the horizontal width of the diffusion part including the transmission portion **250** and the reflection portion **260** may be about 3,400 μm to 5,000 μm, but is not limited thereto.

For example, in an embodiment, the second horizontal width W**20** of the reflector **260** may be formed to be 16/15 times or more of the horizontal width of the light receiving element **240**, for example, about 1,600 μm or more. Accordingly, an area of the reflective unit **260** may be secured so that the light receiving element **240** may detect light reflected from the inside of the package by the laser. Through this, the embodiment can more precisely control whether the transmission unit **250** is detached or not by measuring the degree of change in the amount of light detected.

In addition, in the embodiment, the second horizontal width W**20** of the reflective part **260** is formed to be less than 4 times the horizontal width of the light receiving device **240**, for example, about 2,000 μm or less, so that it may be prevented for the reflective part **260** from overlapping with a divergence angle of the surface emitting laser device **230**.

Referring back to FIG. **22**B, the thickness T**3** of the second reflecting part **262** may be set in a range of about 1/75 to about 1 times of the third horizontal width W**30** of the surface emitting laser device **230**. As the thickness T**3** of the second reflecting part **262** is formed to be about 1/75 or more of the third horizontal width W**30** of the surface emitting laser device **230**, it can function as a reflector and the proportion of transmitted lasers can be improved.

In addition, the thickness T**3** of the second reflecting part **262** may be formed to be less than about 1 times the third horizontal width W**30** of the surface emitting laser device **230**. Accordingly, the second reflecting part **262** may function as a reflecting part, and the thickness of the second reflecting unit **262** may be controlled to be thin to improve light output.

For example, the thickness T**3** of the second reflector **262** may be set to about 20 μm to about 500 μm. For example, the thickness T**3** of the second reflecting part **262** is formed to be about 1/75 or more of the third horizontal width W**30** of the surface emitting laser device **230**, for example, about 20 μm or more. As a result, the ratio of the laser that can be transmitted can be improved while functioning as a reflector.

In addition, the thickness T**3** of the second reflective part **262** may be about 1 times or less, for example, about 500 μm of the third horizontal width W**30** of the surface emitting laser device **230**. Accordingly, the second reflecting part **262** may function as a reflecting part, and the thickness of the second reflecting part **262** may be controlled to be thin to improve light output.

Fifth Embodiment

FIG. **23**A is a plan view of a surface emitting laser package **202** according to a fifth embodiment, and FIG. **23**B is a plan view of the surface emitting laser package **202** according to the fifth embodiment shown in FIG. **23**A while the second transmission part **252** and the third reflection part **263** are omitted.

The fifth embodiment can adopt the technical features of the fourth embodiment, and the main features of the fifth embodiment will be described below.

Referring to FIGS. **23**A and **23**B, a surface emitting laser package **202** according to the fifth embodiment includes a body **210** including a cavity C, and a fifth electrode part **225**, a sixth electrode part **226** disposed to be spaced apart from each other in the cavity C, a surface emitting laser device **230** disposed on the fifth electrode part **225** and electrically connected to the sixth electrode part **226** by a third wire W3, a second light receiving device **232** disposed on the sixth electrode part **226** to detect the light emitted from the surface emitting laser device **230** and spaced apart from the surface emitting laser device **230** in the cavity C, a second transmission part **252** disposed on the body **210** and above the surface emitting laser device **230**, and a third reflection part **263** disposed on the second light receiving device **232**. The second transmission part **252** and the third reflection part **263** may be referred to as a diffusion part.

The second light receiving device **232** may be electrically connected to the fifth electrode part **225** by a fourth wire W**4** to apply a reverse bias voltage.

According to the fifth embodiment, the second light receiving device **232** is disposed on the sixth electrode part **226** electrically connected to the surface emitting laser device **230** to provide a light sensing function in the second light receiving device **232**. And the third reflective part **263** is disposed on the second light receiving device **232**, thereby realizing high-performance photo-sensing performance, and providing a compact surface emitting laser package and an optical module.

Also, referring to FIG. **23**A, in the fifth embodiment, the first horizontal width W**10** of the second transmission part **252** in the first axial direction is formed larger than the second horizontal width W**20** of the third reflection part **263** in the first axial direction to increase the amount of light received by the second light receiving device **232**.

For example, the first horizontal width W**10** of the second transmission part **252** is formed larger than the second horizontal width W**20** of the third reflection part **263**, so that it is possible to provide a surface emitting laser package and an optical assembly having excellent reliability of light sensing performance by increasing the likelihood that light totally reflected from the upper side of the second transmission part **252** will also reach the second light receiving device **232**.

In addition, as shown in FIG. **22**B, in the fifth embodiment, the thickness of the third reflective portion **263** may be thinner than that of the second transmission portion **252**.

Accordingly, while securing the widest divergence angle that can be emitted from the second transmission unit **252**, the light reflected from the third reflection unit **263** inside the package may be reflected to the second light-receiving element **232** as much as possible. Accordingly, the embodiment has a technical effect of providing a surface-emitting laser package and an optical assembly having excellent reliability in light sensing performance.

According to the embodiment, there is a technical effect capable of providing a surface emitting laser package and an optical module having excellent reliability and stability.

In addition, according to the embodiment, it is possible to provide a compact surface emitting laser package and an optical module while being capable of driving high output and high voltage.

Sixth Embodiment

FIG. **24** is a cross-sectional view illustrating a surface emitting laser package according to a sixth embodiment.

Referring to FIG. **24**, the surface emitting laser package **106** according to the sixth embodiment may provide a substrate **110**.

The substrate **110** may support all components disposed on the substrate **110**. For example, the substrate **110** may support a surface emitting laser device **206**, a housing **130**, a diffusion part **140**, and a wavelength limiting member **150** disposed thereon. The surface emitting laser device **206**, the housing **130**, the diffusion part **140**, the wavelength limiting member **150**, and the substrate **110** may be modularized modules. One or a plurality of such modules may be mounted on the circuit board **160**.

The substrate **110** may include a material having high thermal conductivity. The substrate **110** may be made of a material having good heat dissipation properties so that heat generated by the surface emitting laser device **206** can be efficiently discharged to the outside. The substrate **110** may include an insulating material.

For example, the substrate **110** may include a ceramic material. The substrate **110** may include a low temperature co-fired ceramic (LTCC) or a high temperature co-fired ceramic (HTCC).

In addition, the substrate **110** may include a metal compound. The substrate **110** may include a metal oxide having a thermal conductivity of 140 W/mK or more. For example, the substrate **110** may include aluminum nitride (AlN) or alumina (Al_2O_3).

As another example, the substrate **110** may include a resin-based insulating material. The substrate **110** may be provided with a silicone resin, an epoxy resin, a thermosetting resin including a plastic material, or a high heat resistance material.

The substrate **110** may also include a conductive material. When the substrate **110** is made of a conductive material, for example, a metal, an insulating layer for electrical insulation between the substrate **110** and the surface emitting laser device **206** may be provided.

The surface emitting laser package **106** according to the sixth embodiment may provide a surface emitting laser device **206**.

The surface emitting laser device **206** may be disposed on the substrate **110**. The surface emitting laser device **206** may generate a laser beam and emit a laser beam in a direction perpendicular to the upper surface of the surface emitting laser device **206**. The surface emitting laser device **206** may emit a laser beam having an angle of view of 15° to 25° in an upward direction, for example. The surface emitting laser device **206** may include a plurality of emitters (E**1**, E**2**, E**3**, E**4** in FIG. **25**) emitting a circular beam. An example of the surface emitting laser device **206** will be described again later.

The surface emitting laser package **106** according to the sixth embodiment may provide a first electrode **181** and a second electrode **182**.

The first electrode **181** and the second electrode **182** may be disposed on the substrate **110**. The first electrode **181** and the second electrode **182** may be disposed on the substrate **110** to be spaced apart from each other.

One of the first electrode **181** and the second electrode **182** may be disposed around the surface emitting laser device **206**.

The surface emitting laser device **206** may be disposed on the first electrode **181**. In this case, the second electrode **182** may be disposed around the surface emitting laser device **206**.

The surface emitting laser device **206** may be provided on the first electrode **181**, for example, by a die bonding method. The surface emitting laser device **206** may be electrically connected to the second electrode **182**. For example, the surface emitting laser device **206** and the second electrode **182** may be electrically connected by a wire **191**. The surface emitting laser device **206** may be electrically connected to the second electrode **182** by a plurality of wires. The surface emitting laser device **206** may be electrically connected to the second electrode **182** by a wire **191**.

The number of wires connecting the surface emitting laser device **206** and the second electrode **182** and the connection location are selected by the size of the surface emitting laser device **206** or the degree of current diffusion required by the surface emitting laser device **206**.

The surface emitting laser package **106** according to the sixth embodiment may provide a first bonding part **183** and a second bonding part **184**.

The first bonding part **183** and the second bonding part **184** may be disposed under the substrate **110**. For example, first and second recesses spaced apart from each other are formed on the lower surface of the substrate **110**, a first bonding part **183** is disposed in the first recess, and a second bonding part **185** is disposed in the second recess.

For example, a lower surface of the first bonding part **183** and a lower surface of the second bonding part **184** may be electrically connected to each other by making contact with a signal line (not shown) of the circuit board **160**. The substrate **110** may be referred to as a first substrate, and the circuit board **160** may be referred to as a second substrate.

The first bonding part **183** and the second bonding part **184** may be disposed under the substrate **110** to be spaced apart from each other. The first bonding part **183** and the second bonding part **184** may have circular pads, but are not limited thereto.

The first bonding part **183** may be disposed on the lower surface of the substrate **110**. The first bonding part **183** may be electrically connected to the first electrode **181**. The first bonding part **183** may be electrically connected to the first electrode **181** through the first connection wiring **185**. For example, the first connection wiring **185** may be disposed in a first via hole provided in the substrate **110**. The first bonding part **183** and the first connection wiring **185** may be integrally formed using the same metal material.

The second bonding part **184** may be disposed on the lower surface of the substrate **110**. The second bonding part **184** may be electrically connected to the second electrode **182**. The second bonding part **184** may be electrically connected to the second electrode **182** through a second connection line **186**. For example, the second connection wiring **186** may be disposed in a second via hole provided in the substrate **110**. The second bonding part **184** and the second connection wiring **186** may be integrally formed using the same metal material.

For example, the first connection wiring **185** and the second connection wiring **186** may include tungsten (W), but are not limited thereto. Tungsten W is melted at a high temperature of 1000° C. or higher, injected into the first and second via holes, and then cured, thereby forming a first connection wiring **185** and a second connection wiring **186**. A part of tungsten W may be cured under the substrate **110** to form the first and second bonding parts **183** and **184**, but the embodiment is not limited thereto.

According to the sixth embodiment, driving power may be provided to the surface emitting laser device **206** through the circuit board **160**.

In the surface emitting laser package **106** according to the sixth embodiment described above, it was described based on the case of connection as the surface emitting laser device **206** is connected to the first electrode **181** in a die bonding method and the second electrode **182** is connected in a wire bonding method.

However, the manner in which driving power is supplied to the surface emitting laser device **206** may be variously modified and applied. For example, the surface emitting laser device **206** may be electrically connected to the first electrode **181** and the second electrode **182** by a flip chip bonding method. In addition, the surface emitting laser device **206** may be electrically connected to both the first electrode **181** and the second electrode **182** by wire bonding.

The surface emitting laser package **106** according to the sixth embodiment may provide a housing **130**. The housing **130** may be disposed on the substrate **110**. The housing **130** may be disposed along the peripheral area of the substrate **106**. For example, the substrate **110** may include a first region (a central region) and a second region (a peripheral region) surrounding the first region.

In this case, the surface emitting laser device **206** may be disposed on a part of the first area of the substrate **110**, and the housing **130** may be disposed on the second area of the substrate **120**. A second electrode **182** may be positioned between the first electrode **181** and the housing **130** on the substrate **110**. The housing **130** may be disposed around the surface emitting laser device **206**. The outer surface of the housing **130** may be aligned with the outer surface of the substrate **110** on a vertical line.

The height of the housing **130** may be greater than the height of the surface emitting laser device **206**. The housing **130** may include a material having high thermal conductivity. The housing **130** may be made of a material having good heat dissipation properties so that heat generated by the surface emitting laser device **206** can be efficiently discharged to the outside. The housing **130** may include an insulating material.

For example, the housing **130** may include a ceramic material. The housing **130** may include a low temperature co-fired ceramic (LTCC) or a high temperature co-fired ceramic (HTCC).

For example, the housing **130** may include a metal compound. The housing **130** may include a metal oxide having a thermal conductivity of 140 W/mK or more. For example, the housing **130** may include aluminum nitride (AlN) or alumina (Al_2O_3).

For example, the housing **130** may include a resin-based insulating material. Specifically, the housing **130** may be made of a silicone resin, an epoxy resin, a thermosetting resin including a plastic material, or a high heat resistance material.

The housing **130** may be made of a conductive material, such as a metal.

For example, the housing **130** may include the same material as the substrate **110**. When the housing **130** is formed of the same material as the substrate **110**, the housing **130** may be integrally formed with the substrate **110**.

In addition, the housing **130** may be formed of a material different from that of the substrate **110**. The substrate **110** may also be referred to as a housing. In this case, the substrate **110** may be referred to as a first housing and the housing **130** may be referred to as a second housing. Alternatively, the housing **130** may be referred to as a substrate. In this case, the substrate **110** may be referred to as a first substrate, and the housing **130** may be referred to as a second substrate.

According to the sixth embodiment, the substrate **110** and the housing **130** may be formed of a material having excellent heat dissipation properties. Accordingly, heat generated from the surface emitting laser device **206** can be effectively discharged to the outside.

According to the sixth embodiment, when the substrate **110** and the housing **130** are provided as separate components and are combined, an adhesive layer may be provided between the substrate **110** and the housing **130**.

For example, the adhesive layer may include an organic material. The adhesive layer may include an epoxy-based resin. In addition, the adhesive layer may include a silicone resin.

Meanwhile, a step may be provided in the upper region of the housing **130** in contact with the inner side. For example, a recess region **142** may be provided in an upper region of the housing **130**. For example, the width and/or depth of the recess region **142** may be provided in several hundreds of micrometers.

The surface emitting laser package **106** according to the sixth embodiment may provide a diffusion part **140**.

The diffusion part **140** may be disposed on the surface emitting laser device **206**. The diffusion part **140** may be disposed to be spaced apart from the surface emitting laser device **206**. The diffusion part **140** may be disposed in the recess region **142** of the housing **130**. The diffusion part **140** may be supported by the recess region **142** of the housing **130**.

An adhesive layer (not shown) may be provided between the diffusion part **140** and the recess region **142** of the housing **130**. For example, the adhesive layer may be provided on a lower surface and a side surface of the diffusion part **140** in contact with the inner surface of the recess region **142**. For example, the adhesive layer may include an organic material. The adhesive layer may include an epoxy-based resin. Alternatively, the adhesive layer may include a silicone resin.

The diffusion part **140** may expand the angle of view of the laser beam emitted from the surface emitting laser device **206**.

The diffusion part **140** may include an anti-reflective function. For example, the diffusion part **140** may include an anti-reflective layer disposed on one surface opposite to the surface emitting laser device **206**. The anti-reflective layer may be formed separately from the diffusion part **140**. The diffusion part **140** may include an anti-reflective layer disposed on a lower surface facing the surface emitting laser device **206**.

The non-reflective layer prevents the laser beam incident from the surface emitting laser device **206** from being reflected from the surface of the diffusion part **140** and transmits it into the diffusion part **140**, thereby improving light loss due to reflection.

The anti-reflective layer may be formed of, for example, an anti-reflective coating film and attached to the surface of the diffusion part **140**. The anti-reflective layer may be formed on the surface of the diffusion part **140** by spin coating or spray coating. For example, the anti-reflective layer may be formed as a single layer or multiple layers including at least one of a group including TiO_2, SiO_2, Al_2O_3, Ta_2O_3, ZrO_2, and MgF_2.

The surface emitting laser package **106** according to the sixth embodiment may provide a circuit board **160** including at least one signal line. The substrate **110** including the surface emitting laser device **206** may be mounted on the circuit board **160**. For example, the circuit board **180** may include first and second signal lines. In this case, the first bonding part **183** disposed under the substrate **106** is electrically connected to the first signal line of the circuit board **160** and disposed under the substrate to be connected to the first bonding part **183**. The second bonding part **184** spaced apart in the horizontal direction may be electrically connected to the second signal line of the circuit board **160**.

Meanwhile, as described above, the substrate **110** and the housing **130** may be manufactured by a wafer level package process. According to the sixth embodiment, the diffusion part **140** may also be attached to the housing **130** by a wafer level package process.

That is, after the surface emitting laser device **206** and the housing **130** are attached to the substrate **110** at a wafer level, and the diffusion part **140** is attached to the housing **130**, the substrate is cut by dicing or the like. A plurality of surface emitting laser packages in which the surface emitting laser device **206**, the housing **130**, and the diffusion part **140** are combined may be provided at the substrate **110**.

As described above, the surface emitting laser package **106** including the substrate **110**, the housing **130**, and the diffusion unit **140** may be manufactured by a wafer level package process. Accordingly, the outer surface of the substrate **110** and the outer surface of the housing **130** may be disposed on the same plane. That is, there is no step difference between the outer surface of the substrate **110** and the outer surface of the housing **130**.

In the sixth embodiment, there is no step difference between the outer surface of the substrate **110** and the outer surface of the housing **130**. Accordingly, it is possible to fundamentally prevent defects in which damage is caused by moisture permeation and external friction due to a stepped structure in the conventional surface emitting laser package.

According to the sixth embodiment, the substrate **110** and the housing **130** are manufactured by a wafer level package process, and the diffusion part **140** may be attached on the housing **130** in a separate process.

According to the sixth embodiment, the diffusion part **140** may be stably fixed to the housing **130** by an adhesive layer provided between the diffusion part **140** and the recess region **142** of the housing **130**.

Hereinafter, the surface emitting laser device **206** will be described in detail. FIG. **25** is a plan view of the surface emitting laser device according to the sixth embodiment, and FIG. **26** is a cross-sectional view taken along line I-I' of the surface emitting laser device according to the embodiment shown in FIG. **25**.

The surface emitting laser device **206** according to the sixth embodiment may emit light having, for example, a peak wavelength of 940 nm and a full width at half maximum (FWHM) of about 2 nm. This light may have, for example, a wavelength band of 940±2 nm, but is not limited thereto.

Referring to FIG. **25**, the surface emitting laser device **206** according to the sixth embodiment may include an emitting region **245** and a non-emitting region **247**. The non-emitting region **247** is an area in which a laser beam is not emitted, and, for example, a pad electrode **290** may be disposed. The light emitting region **245** is a region from which the laser beam is emitted, and, for example, a light emitting structure E may be disposed.

The light emitting structure E may include a plurality of emitters E**1**, E**2**, E**3**, and E**4**. Each emitter (E**1**, E**2**, E**3**, E**4**) may be disposed spaced apart from each other. The light emitting structure E may include a second electrode **280**. The emitting region **245** may include a first region and a second region. A plurality of first regions may be defined, and a region between the first regions may be defined as a second region. In this case, each emitter E**1**, E**2**, E**3**, and E**4** may be disposed in the first region, and the second electrode **280** may be disposed in the second region. Each emitter E**1**, E**2**, E**3**, E**4** may be surrounded by the second electrode **280**. The second electrode **280** may be integrally formed with the pad electrode **290**, but is not limited thereto. The second electrode **280** may extend from the pad electrode **290** to the emitting region **245** and be disposed in the emitting region **245**. As will be described later, the second electrode **280** may electrically connect a plurality of emitters E**1**, E**2**, E**3**, and E**4** to the pad electrode **290**.

Referring to FIG. **26**, the surface emitting laser device **206** according to the sixth embodiment includes a first electrode **215**, a substrate **210**, a first reflective layer **220**, a cavity region **230**, and an aperture **241**, an insulating region **242**, a second reflective layer **250**, a second electrode **280**, a passivation layer **270**, and a pad electrode **290**.

The cavity region **230** may include an active layer (not shown) and a cavity (not shown), which will be described in detail below. The insulating region **242** includes a first insulating region **242***a* disposed on the first emitter E**1**, a second insulating region **242***b* disposed on the second emitter E**2** and a third insulating region **242***c* disposed on the third emitter E**3**, but is not limited thereto.

<Substrate, First Electrode>

In the sixth embodiment, the substrate **210** may be a conductive substrate or a non-conductive substrate. When a conductive substrate is used, a metal having excellent electrical conductivity may be used. In addition, since it must be able to sufficiently dissipate heat generated during the operation of the surface-emitting laser device **206**, a GaAs substrate with high thermal conductivity, a metal substrate, or a silicon (Si) substrate may be used.

When a non-conductive substrate is used, an AlN substrate, a sapphire (Al_2O_3) substrate, or a ceramic-based substrate may be used.

In an embodiment, the first electrode **215** may be disposed under the substrate **210**, and the first electrode **215** may be disposed as a single layer or multiple layers of a conductive material. For example, the first electrode **215** may be a metal, and includes at least one of aluminum (Al), titanium (Ti), chromium (Cr), nickel (Ni), copper (Cu), and gold (Au). Thus, it is formed in a single-layer or multi-layer structure to improve electrical characteristics, thereby increasing light output.

<First Reflective Layer>

A first reflective layer **220** may be disposed on the substrate **210**.

The first reflective layer **220** may be doped with a first conductivity type dopant. For example, the first conductivity-type dopant may include an n-type dopant such as Si, Ge, Sn, Se, and Te.

In addition, the first reflective layer **220** may include a gallium-based compound, for example, AlGaAs, but is not limited thereto. The first reflective layer **220** may be a Distributed Bragg Reflector (DBR). For example, the first reflective layer **220** may have a structure in which a first layer and a second layer made of materials having different refractive indices are alternately stacked at least once or more.

The first layer and the second layer may include AlGaAs, and in detail, may be formed of a semiconductor material having a composition formula of $AlxGa_{(1-x)}As(0<x<1)$. Here, when Al in the first layer or the second layer increases, the refractive index of each layer decreases, and when Ga increases, the refractive index of each layer may increase.

The thickness of each of the first and second layers is λ, λ may be a wavelength of light generated in the cavity region **230**, and n may be a refractive index of each layer with respect to the light of the above-described wavelength. Here, λ may be 650 to 980 nm, and n may be the refractive index of each layer. The first reflective layer **220** having such a structure may have a reflectance of 99.999% for light in a wavelength region of about 940 nm.

The thicknesses of the first layer and the second layer may be determined according to each refractive index and the wavelength **2** of light emitted from the cavity region **230**.

<Cavity Area, Insulation Area, Aperture>

In the sixth embodiment, the cavity region **230**, the insulating region **242**, and the aperture **241** may be disposed on the first reflective layer **220**. Specifically, the cavity region **230** may be disposed on the first reflective layer **220**, and the insulating region **242** and the aperture **241** may be disposed on the cavity region **230**.

The cavity region **230** may include an active layer (not shown), a first cavity (not shown) disposed below the active layer, and a second cavity (not shown) disposed above the active layer. The cavity region **230** of the embodiment may include both the first cavity and the second cavity, or may include only one of the two.

The cavity region **230** may be disposed between the first reflective layer **220** and the second reflective layer **250**. An active layer may be disposed in the cavity region **230** of the embodiment, and the active layer may include any one of a single well structure, a multiple well structure, a single quantum well structure, a multi-quantum well (MQW) structure, a quantum dot structure, or the quantum wire structure.

The active layer may be formed in a pair structure such as a well layer and a barrier layer, for example, AlGaInP/GaInP, AlGaAs/AlGaAs, AlGaAs/GaAs, and GaAs/InGaAs using a compound semiconductor material of group III-V element, but is not limited thereto. The well layer may be formed of a material having an energy band gap smaller than that of the barrier layer.

The first cavity and the second cavity may be formed of $AlyGa_{(1-y)}As(0<y<1)$, but is not limited thereto.

In the sixth embodiment, the insulating region **242** and the aperture **241** may be disposed on the cavity region **230**.

For example, the first emitter E**1** includes a first insulating region **242***a* and a first aperture **241***a*, and the second emitter E**2** includes a second insulating region **242***b* and a second aperture **241***b*. In addition, the third emitter E**3** includes a third insulating region **242***c* and a third aperture **241***c*, and the fourth emitter E**4** includes a fourth insulating region (not shown) and a fourth aperture (not shown).

The insulating region **242** is an insulating layer made of an insulating material, for example, aluminum oxide, and may function as a current blocking layer. Each of the apertures **241***a*, **241***b*, and **241***c* positioned in the central region of each insulating region may be a non-insulating layer, that is, a conductive layer.

The insulating region **242** may surround the aperture **241**. The size of the aperture **241** may be adjusted by the insulating region **242**. For example, as the area of the insulating region **242** occupied on the cavity area **230** increases, the area of the aperture **241** may decrease.

For example, the first aperture **241***a* may be defined by the first insulating region **242***a* and for example, the second aperture **241***b* may be defined by the second insulating region **242***b*. Also, the third aperture **241***c* may be defined by the third insulating region **242***c*, and the fourth aperture may be defined by the fourth insulating region. Specifically, each insulating region **242** may include aluminum gallium arsenide. For example, in the insulating region **242**, as AlGaAs reacts with H_2O and the edge changes to aluminum oxide (Al_2O_3), the insulating region **242** may be formed. And since the central region is not reacted with H_2O, an aperture can be formed of AlGaAs.

In the sixth embodiment, a laser beam emitted from the cavity region **230** through the apertures **241***a*, **241***b*, and **241***c* may be emitted toward the upper region. In this case, the light transmittance of the apertures **241***a*, **241***b*, and **241***c* may be superior compared to the insulating regions **242***a*, **242***b*, and **242***c*.

<Second Reflective Layer>

The second reflective layer **250** may be disposed on the cavity region **230**.

The second reflective layer **250** may include a gallium-based compound, for example, AlGaAs, and the second reflective layer **250** may be doped with a second conductivity type dopant. For example, the second conductivity-type dopant may be a p-type dopant such as Mg, Zn, Ca, Sr, Ba, or the like. Meanwhile, the first reflective layer **220** may be doped with a p-type dopant, and the second reflective layer **250** may be doped with an n-type dopant.

The second reflective layer **250** may be a Distributed Bragg Reflector (DBR). For example, the second reflective layer **250** may have a structure in which a first layer (not shown) and a second layer (not shown) made of materials having different refractive indices are alternately stacked at least once or more.

The first layer and the second layer may include AlGaAs, and in detail, may be formed of a semiconductor material having a composition formula of $AlxGa_{(1-x)}As$ ($0<x<1$). Here, when Al increases, the refractive index of each layer decreases, and when Ga increases, the refractive index of each layer may increase. In addition, the thickness of each of the first layer and the second layer is λ, λ may be a wavelength of light emitted from the active layer, and n may be a refractive index of each layer with respect to light of the above-described wavelength.

The second reflective layer **250** having such a structure may have a reflectance of 99.9% for light in a wavelength region of 940 nm.

The second reflective layer **250** may be formed by alternately stacking third and fourth layers, and the number of pairs of the first and second layers in the first reflective layer **220** may be greater than the number of pairs of the third and fourth layers in the second reflective layer **250**. And as described above, the reflectance of the first reflective layer **220** is about 99.999%, which is greater than 99.9%, which is the reflectance of the second reflective layer **250**. For example, the number of pairs of the first layer and the second layer in the first reflective layer **220** may be 20 to 50 times, and the number of pairs of the third and fourth layers in the second reflective layer **250** may be up to 10 to 30 times.

<Passivation Layer, Second Electrode>

The passivation layer **270** is disposed on the side and top surfaces of the emitters E**1**, E**2**, E**3**, E**4**, and the top surface of the first reflective layer **220** exposed between the emitters E**1**, E**2**, E**3**, and E**4**. The passivation layer **270** is disposed on the side of each emitter (E**1**, E**2**, E**3**, E**4**) separated by a segment unit, and can protect and insulate each emitter (E**1**, E**2**, E**3**, E**4**). The passivation layer **270** may be made of an insulating material, for example, a nitride or an oxide.

The second electrode **280** may be disposed to be electrically connected to the second reflective layer **250**. That is, the second electrode **280** extends from the pad electrode **290** and contacts a part of the second reflective layer **250** through the passivation layer **270** surrounding each emitter E**1**, E**2**, E**3**, E**4**. The second electrode **280** may be disposed on the passivation layer **270**.

The second electrode **280** may be made of a conductive material, and may be, for example, a metal. For example, the second electrode **280** includes at least one of aluminum (Al), titanium (Ti), chromium (Cr), nickel (Ni), copper (Cu), and gold (Au), and has a single layer or multilayer structure.

As shown in FIG. **25**, the surface emitting laser device **206** may include a light emitting region **245** from which a laser beam is emitted, and a non-emitting region **247** in contact with the light emitting region **245** without the laser beam being emitted.

The non-emitting region **247** is an area in which the pad electrode **290** as a bonding pad for electrical connection with the outside is disposed, and no laser beam is generated in the non-emitting region **247**. The light emitting region **245** may include the light emitting structure E, and the light emitting structure E may include a plurality of emitters E**1**, E**2**, E**3**, and E**4**. A laser beam is generated in each of the plurality of emitters E**1**, E**2**, E**3**, and E**4**, and the generated laser beam may be emitted toward an upper direction. Accordingly, the emitting region **245** may be a region in which laser beams generated by the plurality of emitters E**1**, E**2**, E**3**, and E**4** are emitted.

While the surface emitting laser device **206** including the light emitting region **245** and the non-emitting region **247** has a square shape, the light emitting region **245** of the surface emitting laser device **206** may have a rectangular shape but, it is not limited thereto. The light emitting region **245** may have a first width W**1** in the x-axis direction (hereinafter referred to as a first direction) and a second width W**2** in the y-axis direction (hereinafter, referred to as a second direction). The second width W**2** may be larger than the first width W**1**. Accordingly, the emitting region **245** may have a rectangular shape that is longer in the second direction than in the first direction.

Referring back to FIG. **24**, the surface emitting laser package **106** according to the sixth embodiment may provide a wavelength limiting member **150**.

The wavelength limiting member **150** may be disposed on the diffusion part **140**. The wavelength limiting member **150** may be disposed on the housing **130**. The area (size) of the wavelength limiting member **150** may be larger than the area (size) of the diffusion part **140**. In this case, the wavelength limiting member **150** may be disposed on the housing **130** as well as the diffusion part **140**.

The wavelength limiting member **150** may contact the entire area of the upper surface of the diffusion part **140** and may contact the upper surface of the housing **130**. The wavelength limiting member **150** may be attached to the diffusion part **140** and the housing **130** using an adhesive (not shown). The adhesive material may include a silicone resin.

The wavelength limiting member **150** may have a thickness of 0.1 mm to 0.5 mm. The wavelength limiting member **150** may have a thickness of approximately 0.3 mm, but is not limited thereto. When the wavelength limiting member **150** is less than 0.1 mm, it may be difficult to block the wavelength. When the wavelength limiting member **150** exceeds 0.5 mm, absorption of light is increased, and the amount of light output from the wavelength limiting member **150** may decrease, thereby reducing light output efficiency.

The wavelength limiting member **150** may pass at least a wavelength band of light of the surface emitting laser device **206**. For example, when the surface emitting laser device **206** emits light in a wavelength band of 940±2 nm, the wavelength limiting member **150** may pass light in a wavelength band greater than the wavelength band of at least 940±2 nm.

As shown in FIG. **29**, the wavelength limiting member **150** may emit light having a peak wavelength of 940 nm and a half width (FWHM) of approximately 10 nm. Accordingly, the wavelength limiting member **150** may transmit light having a wavelength band of 940±5 nm, for example, and block light having a wavelength band out of the wavelength band of 940±5 nm. For example, when light having a peak wavelength of 948 nm is emitted from the surface emitting laser device **206**, any light is blocked by the wavelength limiting member **150** according to the sixth embodiment so that any light may be output through the wavelength limiting member **150**.

The peak wavelength of light allowed by the wavelength limiting member **150** may be the same as the peak wavelength of light emitted from the surface emitting laser device **206**. That is, a peak wavelength of light allowed by the wavelength limiting member **150** and a peak wavelength of light emitted from the surface emitting laser device **206** may be 940 nm. The half width (FWHM) of light allowed by the wavelength limiting member **150** may be equal to or greater than the half width of light emitted from the surface emitting laser device **206**. That is, the half width (FWHM) of light allowed by the wavelength limiting member **150** may be 1 to 3 times the half width of light emitted from the surface emitting laser device **206**. When the half width (FWHM) of light allowed by the wavelength limiting member **150** is less than 1 times the half width of light emitted from the surface emitting laser device **206**, the wavelength limiting member **150** is emitted from the surface emitting laser device **206** A part of the wavelength band of light is blocked so that the desired color light cannot be emitted.

When the half width (FWHM) of light allowed by the wavelength limiting member **150** is more than three times the half width of light emitted from the surface emitting laser device **206**, some wavelength bands out of the wavelength band of the light emitted from the surface emitting laser device **206** are also passed by the wavelength limiting member **150**, so that the performance of the wavelength limiting member **150** may be deteriorated.

The wavelength limiting member **150** may be, for example, a single layer or a filter or film having a multilayer structure. For example, the filter may be an infrared pass filter that transmits light having a wavelength band of 940±5 nm. For example, the film may be a multilayer thin film having different refractive indices. Such a multilayer thin film may be made of an insulating material, such as an organic material or an inorganic material. A thin film in which inorganic materials having different refractive indices are stacked may be formed, or a thin film in which organic materials and inorganic materials having different refractive indices are stacked may be formed.

A larger current may flow through the surface emitting laser device **206** due to malfunction or over-operation of the driving circuit that drives the surface emitting laser package **106**. For example, in normal operation, a current of, for example, 1000 mA may flow through the surface emitting laser device **206**. In an abnormal operation in which a malfunction or over-operation occurs, a current of, for example, 3000 mA may flow through the surface emitting laser device **206**. As described above, when a larger current flow through the surface emitting laser device **206** due to an abnormal operation, heat is generated in the surface emitting laser device **206**, and the wavelength band of light emitted from the surface emitting laser device **206** can be shifted by this heat. This may be due to changes in the band gap energy of the semiconductor material of the surface emitting laser device **206** by heat.

As shown in FIG. **28**, for example, the band gap energy of InP is 1.35 eV at room temperature (300K at 23° C. absolute temperature), but as the temperature increases, the band gap energy of InP may be less than 1.35 eV. Since the wavelength is inversely proportional to the bandgap energy, the inherent wavelength band of light of a semiconductor device made of InP may be shifted to a larger wavelength band as the temperature increases.

Other semiconductor materials, such as GaN, Si, and Ge, can also be changed in a similar manner to InP. That is, GaN, Si, and Ge may also shift the inherent wavelength band of light to a larger wavelength band.

Likewise, in the surface emitting laser device **206** according to the sixth embodiment, a unique wavelength band may be shifted to a larger wavelength band according to temperature. The inherent wavelength band of the surface emitting laser device **206** may be 940±2 nm.

FIG. **27** shows a state in which the peak wavelength of light is shifted according to the current. Specifically, FIG. **27**A shows a state in which the peak wavelength changes according to the current, FIG. **27**B shows a state in which the output power changes according to the current, and FIG. **27**C shows a state in which the wavelength and light intensity change according to the current.

As shown in FIG. **27**A, when, for example, 1000 mA flows through the surface emitting laser device **206** during normal operation, the surface emitting laser device **206** may emit light having a wavelength band of approximately 940±2 nm. When, for example, 3000 mA flows through the surface emitting laser device **206** during an abnormal operation, the surface emitting laser device **206** may emit light having a wavelength band of approximately 946±4 nm. From this, the temperature increases as the current increases due to an abnormal operation, and the band gap energy decreases as the temperature increases, so that the wavelength band of light of the surface emitting laser device **206** can be shifted to a larger wavelength band.

As shown in FIG. **27**B, as the current increases, the output power may also increase. For example, when 1000 mA flows through the surface emitting laser device **206** during normal operation, the output power Po output from the surface emitting laser device **206** may be 1.3 W. When 3000 mA flows through the surface emitting laser device **206** during an abnormal operation, the output power Po output from the surface emitting laser device **206** may be 2.5 W.

As shown in FIG. **27**C, as the current increases, not only the wavelength band is shifted, but also the intensity of light may be increased. The intensity of light has the same meaning as the output power shown in FIG. **27**B, and is a quantified (normalized) output power.

During normal operation, that is, when a current of 1000 mA flows through the surface emitting laser device **206**, light having a wavelength band of 940±2 nm from the surface emitting laser device **206** may be emitted with an intensity of 0.4. During an abnormal operation, that is, when a current of 3000 mA flows through the surface emitting laser device **206**, light having a wavelength band of 946±4 nm in the surface emitting laser device **206** may be emitted with an intensity of 0.5. From this, a larger current flows through the surface emitting laser device **206** during abnormal operation, and heat is generated in the surface emitting laser device **206** by this current, so that not only the wavelength band of light is shifted, but also the intensity of light is increased.

When light shifted to a larger wavelength band and increased in intensity is left unattended, the user's eyes may be damaged by such light.

In the above description, the wavelength band of 940±2 nm of light emitted from the surface emitting laser device **206** during normal operation is referred to as a unique wavelength band (first wavelength band), and during abnormal operation, the surface emitting laser device **206**, the wavelength band of 946±4 nm may be referred to as a shift wavelength band (the second wavelength band).

According to the sixth embodiment, the wavelength limiting member **150** is provided on the surface emitting laser device **206**, thereby blocking wavelengths outside the wavelength band of light emitted from the surface emitting laser device **206** due to an abnormal operation and it can prevent damage to user's eyes.

According to the sixth embodiment, the wavelength limiting member **150** may be attached to the housing **130** as well as the diffusion unit **140**. Accordingly, separation of the diffusion unit **140** may be prevented, and light from the surface-emitting laser device **206** may not be directly radiated to the outside, thereby preventing the user's eyes from being damaged.

Seventh Embodiment

FIG. **30** is a cross-sectional view illustrating a surface emitting laser package **100**A according to a seventh embodiment.

The seventh embodiment is the same as the sixth embodiment, except that the wavelength limiting member **150** is disposed only on the diffusion part **140**. Accordingly, features not described in the following description can be easily understood from the sixth embodiment already described above.

Referring to FIG. **30**, the surface emitting laser package **100**A according to the seventh embodiment includes a substrate **110**, a surface emitting laser device **206**, a housing **130**, a diffusion part **140**, and a wavelength limiting member **150**. The substrate **110**, the surface emitting laser device **206**, the housing **130**, the diffusion part **140**, and the wavelength limiting member **150** may be configured as a modular module. The surface emitting laser package **100**A according to the seventh embodiment may further include a circuit board **160** on which one or more modules are mounted, but is not limited thereto.

The area (size) of the wavelength limiting member **150** may be the same as the area (size) of the diffusion part **140**. The wavelength limiting member **150** may be disposed on the upper surface of the diffusion part **140**. The wavelength limiting member **150** may contact the upper surface of the diffusion part **140**. That is, the wavelength limiting member **150** may be attached to the upper surface of the diffusion part **140** using an adhesive material. The adhesive material may include a silicone resin.

The upper surface of the wavelength limiting member **150** may be horizontally aligned with the upper surface of the housing **130**. Since the upper surface of the wavelength limiting member **150** does not protrude above the housing **130**, detachment of the wavelength limiting member **150** due to friction with the surrounding may be prevented. Accordingly, the depth of the recess of the housing **130** may be equal to the sum of the thickness of the diffusion part **140** and the thickness of the wavelength limiting member **150**.

Eighth Example

FIG. **31** is a cross-sectional view illustrating a surface emitting laser package **100**B according to an eighth embodiment.

The eighth embodiment is the same as the sixth embodiment except that the wavelength limiting member **150** is disposed only in the diffusion part **140**. In addition, the eighth embodiment is the same as the seventh embodiment except for the arrangement position of the diffusion part **140**. Accordingly, features not described in the following description can be easily understood from the first and seventh embodiments already described above.

Referring to FIG. **31**, a surface emitting laser package **100**B according to an eighth embodiment includes a substrate **110**, a surface emitting laser device **206**, a housing **130**, a diffusion part **140**, and a wavelength limiting member **150**. The substrate **110**, the surface emitting laser device **206**, the housing **130**, the diffusion part **140**, and the wavelength limiting member **150** may be configured as a modular module. The surface emitting laser package **100**B according to the eighth embodiment may further include a circuit board **160** on which one or more modules are mounted, but is not limited thereto.

The wavelength limiting member **150** may be disposed on the lower surface of the diffusion part **140**. The wavelength limiting member **150** may contact the lower surface of the diffusion part **140**. That is, the wavelength limiting member **150** may be attached to the lower surface of the diffusion part **140** using an adhesive material. The adhesive material may include a silicone resin.

The area (size) of the wavelength limiting member **150** may be smaller than the area (size) of the diffusion part **140**. That is, the area (size) of the wavelength limiting member **150** may be equal to or smaller than the area (size) of the opening formed inside the housing **130**. In this case, the wavelength limiting member **150** is not disposed in the recessed area of the housing **130**.

As another example, although not shown, the area (size) of the wavelength limiting member **150** may be the same as the area (size) of the diffusion part **140**. In this case, the peripheral region of the wavelength limiting member **150** disposed under the diffusion part **140** may be disposed in the recess region of the housing **130**.

Meanwhile, the upper surface of the diffusion part **140** may be horizontally aligned with the upper surface of the housing **130**. Since the top surface of the diffusion part **140** does not protrude above the housing **130**, detachment of the diffusion part **140** due to friction with the surrounding area may be prevented.

Ninth Embodiment

FIG. **32** is a cross-sectional view showing a surface emitting laser package **100**C according to the ninth embodiment.

The ninth embodiment is the same as the sixth embodiment, except that the wavelength limiting member **150** is disposed only in the diffusion part **140**. In addition, the ninth embodiment is the same as the seventh embodiment except for the arrangement position of the diffusion part **140**. In addition, the ninth embodiment is the same as the eighth embodiment except that the diffusion part **140** is disposed under the pattern **145** provided on the diffusion part **140**. Therefore, features not described in the following description can be easily understood from the first to eighth embodiments already described above.

Referring to FIG. **32**, the surface emitting laser package **100**C according to the ninth embodiment includes a substrate **110**, a surface emitting laser device **206**, a housing **130**, a diffusion part **140**, and a wavelength limiting member **150**. The substrate **110**, the surface emitting laser device **206**, the housing **130**, the diffusion part **140**, and the wavelength limiting member **150** may be configured as a modular module. The surface emitting laser package **100**C according to the ninth embodiment may further include a circuit board **160** on which one or more modules are mounted, but is not limited thereto.

The diffusion part **140** may include a body **141** and a plurality of patterns **145**. The pattern **145** may be disposed under the body **141**.

The body **141** may be made of a material having excellent durability and strength, such as glass. The pattern **145** may be made of a material that is easy to process, such as a polymer resin.

As another example, the pattern **145** and the body **141** may be made of the same material, glass, or polymer resin. For example, the surface of the polymer resin base substrate **141** may be surface-treated to form the pattern **145** on the surface of the base substrate **141**.

The pattern **145** may be disposed on the lower surface of the body **141** of the diffusion parts **140 140** so as to face the surface emitting laser device **206**.

For example, the pattern **145** may include a micro lens, an uneven pattern, or the like. The size of the pattern **145** may be uniform, but is not limited thereto.

Each pattern **145** may have the same size. Alternatively, each pattern **145** may have a random shape different from each other.

The thickness (or height) of each pattern **145** may be the same. Alternatively, the thickness (or height) of each pattern **145** may be different from each other. The pattern **145** may have a protruding region protruding from the body **141** in a lower direction, for example. The lowest point of the protruding area may be the same or different for each pattern **145**. The lowest point of the protruding area may have a vertex, but is not limited thereto. The surface of each pattern **145** may have a round shape, a straight line shape, or the like. Each pattern **145** may have an uneven shape. Some patterns may be disposed in contact with each other, and other patterns may be disposed apart from each other.

The wavelength limiting member **150** may be disposed on the lower surface of the diffusion part **140**, specifically, on the lower surface of the plurality of patterns **145**. The wavelength limiting member **150** may contact the lower surface of the pattern **145** of the diffusion part **140**. That is, the wavelength limiting member **150** may be attached to the lower surface of the pattern **145** of the diffusion part **140** by using an adhesive. The adhesive material may include a silicone resin.

In the above description, the light emitted from the surface emitting laser device **206** is limited to having a wavelength band of 940±2 nm, but the embodiment is not limited thereto and emits light of any wavelength band including ultraviolet rays and visible rays. The same can be applied to the surface emitting laser device. For example, when the wavelength band of light emitted from the surface emitting laser device is 200±2 nm and is an ultraviolet wavelength band, for example, a wavelength limiting member for passing only this ultraviolet wavelength band and blocking other wavelengths may be adopted.

Meanwhile, the surface emitting laser packages **106**, **100**A, **100**B, and **100**C according to the embodiment described above may be applied to a proximity sensor, an auto focus device, and the like. For example, the autofocusing device according to the embodiment may include a light emitting part for emitting light and a light receiving part for receiving light.

As an example of the light emitting part, at least one of the surface emitting laser packages **106**, **100**A, **100**B, and **100**C according to the embodiment described with reference to FIG. **24** may be applied. As an example of the light receiving part, a photodiode may be applied. The light receiving part may receive light reflected from an object by light emitted from the light emitting part.

The auto focus device can be variously applied to a mobile terminal, a camera, a vehicle sensor, an optical communication device, and the like. The auto focus device can be applied to various fields for multi-position detection that detects the position of an object.

Features, structures, effects, and the like described in the embodiments above are included in at least one embodiment, and are not necessarily limited to only one embodiment. Further, the features, structures, effects, etc. illustrated in each embodiment may be combined or modified for other embodiments by a person having ordinary knowledge in the field to which the embodiments belong. Therefore, contents related to such combinations and modifications should be interpreted as being included in the scope of the embodiments.

Although the embodiments have been described above, these are only examples and are not intended to limit the embodiments, and it will be seen that branch transformation and application are possible to those of ordinary skill in the field to which the embodiments belong as long as not departing from the essential characteristics of the embodiments. For example, each component specifically shown in the embodiment can be modified and implemented. And differences related to these modifications and applications should be construed as being included in the scope of the embodiments set in the appended claims.

INDUSTRIAL APPLICABILITY

As described above, the surface emitting laser package according to the embodiment may include a vertical cavity surface emitting laser semiconductor device (VCSEL).

The vertical cavity surface emitting laser semiconductor device can convert an electrical signal into an optical signal. In the vertical cavity surface emitting laser semiconductor device, unlike a general side emitting laser (LD), a circular laser beam may be emitted vertically from the substrate surface. Accordingly, the vertical cavity surface emitting laser semiconductor device has an advantage that it is easy to connect to a light receiving device or an optical fiber, and it is easy to arrange a two-dimensional signal, thereby enabling parallel signal processing. In addition, the vertical cavity surface emitting laser semiconductor device has advantages such as high-density integration, low power consumption, simple manufacturing process, and good heat resistance by miniaturization of the device.

As an application field of vertical cavity surface emitting laser semiconductor device, it can be applied to laser printer, laser mouse, DVI, HDMI, high speed PCB, home network, etc. in the digital media sector. In addition, the vertical cavity surface emitting laser semiconductor device can be applied to automotive fields such as multimedia networks and safety sensors in automobiles. In addition, the vertical cavity surface emitting laser semiconductor device can be applied to information and communication fields such as Gigabit Ethernet, SAN, SONET, and VSR. In addition, the vertical cavity surface emitting laser semiconductor device can be applied to sensor fields such as encoders and gas sensors. In addition, the vertical cavity surface emitting laser semiconductor device can be applied to medical and bio fields such as blood glucose meters and skin care lasers.

In addition, the surface emitting laser package according to the embodiment described above may be applied to a proximity sensor, an auto focus device, or the like. The autofocus device may be variously applied to a mobile terminal, a camera, a vehicle sensor, an optical communication device, and the like. The auto focus device can be applied to various fields for multi-position detection that detects the position of an object.

For example, FIG. **33** is a perspective view of a mobile terminal to which a surface emitting laser device according to an embodiment is applied.

The vertical type surface emitting laser device and the flip type surface emitting laser device according to the embodiment may be applied to the mobile terminal shown in FIG. **33**.

As shown in FIG. **33**, the mobile terminal **1500** according to the embodiment may include a camera module **1520**, a flash module **1530**, and an autofocus device **1510** provided on the rear side. Here, the autofocus device **1510** may include one of the packages of the surface emitting laser device according to the above-described embodiment as an emission layer.

The flash module **1530** may include a light emitting device that emits light therein. The flash module **1530** may be operated by a camera operation of a mobile terminal or a user's control.

The camera module **1520** may include an image capturing function and an auto focus function. For example, the camera module **1520** may include an auto focus function using an image.

The auto focus device **1510** may include an auto focus function using a laser. The auto focus device **1510** may be mainly used in a condition in which an auto focus function using an image of the camera module **1520** is deteriorated, for example, in a proximity or dark environment of 10 m or less. The autofocusing device **1510** may include a light emitting layer including the surface emitting laser device of the above-described embodiment and a light receiving unit that converts light energy such as a photodiode into electrical energy.

The invention claimed is:

1. A surface emitting laser package comprising:

a housing including a cavity having a first cavity and a second cavity on the first cavity, wherein the first cavity and the second cavity are connected to each other to form one hollow space;

a surface emitting laser device disposed in the first cavity; and

a diffusion part disposed in the second cavity,

wherein a width of the second cavity is wider than that of the first cavity,

wherein the diffusion part comprises:

a polymer layer having a flat top surface disposed on the second cavity; and

a glass layer having a flat bottom surface disposed on the flat top surface of the polymer layer; and

an adhesive member between the housing and a bottom surface of the polymer layer,

wherein the polymer layer includes a first layer vertically overlapping the surface emitting laser device, and a second layer not vertically overlapping the surface emitting laser device,

wherein the second layer comprises protruding portions at both end of the first layer,

wherein each top surface of the first layer and the second layer is disposed at a same level,

wherein a ratio of a thickness of the second layer in a vertical direction to a thickness of the glass layer in the vertical direction is in a range of greater than 1 and less than or equal to 3, and

wherein a ratio of a thermal expansion coefficient of the adhesive member to a thermal expansion coefficient of the polymer layer is in a range of greater than 1 and less than or equal to 2.

2. A light emitting device comprises the surface emitting laser package according to claim **1**.

3. The surface emitting laser package according to the claim **1**, wherein a thickness of the first layer is thinner than that of the second layer.

4. A surface emitting laser package comprising:

a housing including a cavity having a first cavity and a second cavity on the first cavity, wherein the first cavity and the second cavity are connected to each other to form one hollow space;

a surface emitting laser device disposed in the first cavity; and

a diffusion part disposed in the second cavity,

wherein the diffusion part comprises:

a polymer layer; and

a glass layer disposed on the polymer layer,

wherein the polymer layer comprises:

a first layer vertically overlapping the surface emitting laser device;

a second layer not vertically overlapping the surface emitting laser device; and

an adhesive member between the housing and a bottom surface of the polymer layer,

wherein a thickness of the second layer in a vertical direction is greater than a thickness of the first layer in the vertical direction,

wherein a ratio of the thickness of the second layer in the vertical direction to a thickness of the glass layer in the vertical direction is in a range of greater than 1 and less than or equal to 3, and

wherein a ratio of a thermal expansion coefficient of the adhesive member to a thermal expansion coefficient of the polymer layer is in a range of greater than 1 and less than or equal to 2.

5. The surface emitting laser package according to claim **4**, wherein a bottom surface of the first layer is patterned.

6. A surface emitting laser package comprising:

a housing including a cavity having a first cavity and a second cavity on the first cavity, wherein the first cavity and the second cavity are connected to each other to form one hollow space;

a surface emitting laser device disposed in the first cavity; and

a diffusion part disposed in the second cavity,

wherein the diffusion part comprises:

a polymer layer; and

a glass layer disposed on the polymer layer,

wherein the polymer layer comprises:

a first layer vertically overlapping the surface emitting laser device;

a second layer not vertically overlapping the surface emitting laser device; and

an adhesive member between the housing and a bottom surface of the second layer,

wherein a bottom surface of the first layer is patterned,

wherein a ratio of a thickness of the second polymer layer in a vertical direction to a thickness of the glass layer in the vertical direction is in a range of greater than 1 and less than or equal to 3, and

wherein a ratio of a thermal expansion coefficient of the adhesive member to a thermal expansion coefficient of the polymer layer is in a range of greater than 1 and less than or equal to 2.

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