



(51) International Patent Classification:

H01S 5/00 (2006.01) *G02B 26/08* (2006.01)
H01S 5/024 (2006.01) *G02B 6/42* (2006.01)
G02F 1/377 (2006.01)

(21) International Application Number:

PCT/US2011/045154

(22) International Filing Date:

25 July 2011 (25.07.2011)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

61/369,660 30 July 2010 (30.07.2010) US
 61/378,571 31 August 2010 (31.08.2010) US

(71) Applicant (for all designated States except US): **CORNING INCORPORATED** [US/US]; 1 Riverfront Plaza, Corning, NY 14831 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **HUGHES, Lawrence, Charles, Jr.** [US/US]; 3453B Gorton Road, Corning, NY 14830 (US). **PIECH, Garrett, A** [US/US]; 623 Hibbard Road, Horseheads, NY 14845 (US).

(74) Agent: **BEAN, Gregory, V.**; Corning Incorporated, Intellectual Property Department, SP-Ti-03-01, Corning, NY 14831 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: FREQUENCY DOUBLED SEMICONDUCTOR LASER HAVING HEAT SPREADER ON SHG CRYSTAL

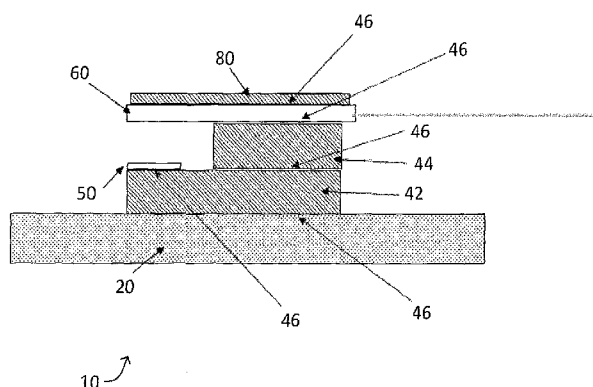


Figure 2

(57) Abstract: A hybrid laser hybrid laser comprises a semiconductor laser (50) supported directly or indirectly on a package substrate (20), a frequency-doubling crystal (60) supported via a first surface thereof on a supporting surface of a thermally conductive support (40) connected to the package substrate, with the crystal positioned so as to be able to receive light from the laser, and a thermally conductive heat spreader element (80) mounted on a second surface of the crystal. The thermally conductive element has a thermal conductivity greater than a thermal conductivity of the crystal, desirably at least 100W/mK or even 300W/mK. The thermally conductive element is not connected to the package substrate or to the thermally conductive support. While the thermally conductive element or "heat spreader" does not act directly to cool the crystal by conducting heat away, it acts to increase the uniformity of the temperature of the crystal, allowing the crystal to achieve higher light conversion efficiencies while remaining within the constraints of the folded-path hybrid laser package. The preferred simple slab structure of the thermally conductive element allows for a very easily manufactured laser package and structure.

FREQUENCY DOUBLED SEMICONDUCTOR LASER HAVING HEAT SPREADER ON SHG CRYSTAL

Priority

[0001] This application claims priority to U.S. Provisional Application No. 61/369,660, filed July 30, 2010, and to U.S. Provisional Application No. 61/378,571, filed August 31, 2010.

Background

[0002] Hybrid or synthetic lasers are light sources that use non-linear optical crystals, or second harmonic generators (SHGs), to convert one wavelength of input light or radiation, typically infrared, into another, typically green, by doubling the frequency (halving the wavelength) of the radiation. The non-linear optical crystal requires the input and output beams to be “phase matched” as the beams propagate inside the crystal in order to efficiently generate the output wavelength. This phase matching places a requirement on the effective indices of refraction for the input and output wavelengths within the SHG. Thermal gradients within the SHG can cause changes in the refractive index within the SHG, and thus can cause some portions of the total SHG length to fail to convert the input light into output light efficiently. In many frequency-doubled laser designs, the SHG is mounted on a large slab of metal that serves as a heat sink for the SHG. This prevents heat from building up in the SHG and thus also minimizes thermal gradients and resulting changes in SHG index of refraction.

Summary

[0003] With reference to Figure 1, some synthetic or hybrid lasers 10 use a folded cavity design, which design enables wider placement tolerances on optical components 30, and allows different adaptive optics actuators to be employed than in linear cavity designs. (For example, a MEMs mirror 32 may be employed to provide adaptive optics in the folded cavity design.) A folded cavity hybrid laser 10 is shown, for example, in the schematic cross section of Figure 1. One or more thermally conductive supports 40, desirably copper shims or slabs, are attached to a package substrate 20 and support an diode laser 50, desirably an infrared diode laser 50 and a PPLN crystal 60 which are attached thereto, desirably by a suitable adhesive such as an epoxy based adhesive, not shown. Infrared light L from the diode laser propagates through the optical components, including in this embodiment a lens 34 and a MEMs mirror 32 as shown. The lens 34 and mirror 32 cooperate to image the beam from the diode laser 50 onto one end of a waveguide 62 of the PPLN crystal 60. Light of doubled frequency DL is generated in the crystal, resulting in output light OL, desirably

green output light OL of about 530 nm wavelength coming out of the crystal at the other end of the waveguide 62 as shown.

[0004] In a folded cavity green laser 10 such as that shown in Figure 1, optical performance restrictions mean that the SHG 60 and diode laser 50 are desirably placed very close together. In order to thermally isolate the SHG 60 from the diode laser 50, a small air gap 70 is provided between the two components as, shown in the Figure. The air gap thermally insulates a portion of the SHG 60 from the package base, and eliminates the detrimental impact of having heat from the diode laser 50 cause thermal gradients in the SHG 60, and also leaves clearance for top-surface wire bonds 52 providing electrical connection to the diode laser 50. But the air gap 70 and cantilevered design prevent the SHG 60 from being mounted on a heat sink along its entire length.

[0005] While complex-shaped heat sinks or heat conductors may be used, the present disclosure describes a heat spreader in the form of a thermally conductive material which is mounted along the top and/or side of the SHG to prevent thermal gradients from developing in such a folded cavity design. It serves to equalize temperature along the SHG, and not generally to remove heat from the SHG into the package substrate. The disclosed heat spreader is simple to make, and the simple surface-butting attachment to the SHG is compatible with a conventional high volume “top down” assembly processes. The spreader itself is desirably formed of aluminum or copper or other materials of similar or greater thermal conductivity, and may be formed as simply as by shearing or stamping a shim or small slab from a metal sheet.

[0006] The resulting hybrid laser comprises a semiconductor laser supported directly or indirectly on a package substrate, a frequency-doubling crystal supported via a first surface thereof on a supporting surface of a thermally conductive support connected to the package substrate, with the crystal positioned so as to be able to receive light from the laser, and a thermally conductive element mounted on a second surface of the crystal. The thermally conductive element has a thermal conductivity greater than a thermal conductivity of the crystal, desirably at least 100W/m·K or even 300W/m·K. The thermally conductive element is not connected to the package substrate or to the thermally conductive support. While the thermally conductive element or “heat spreader” does not act directly to cool the crystal by conducting heat away, it acts to increase the uniformity of the temperature of the crystal, allowing the crystal to achieve higher light conversion efficiencies while remaining within the constraints of the folded-path hybrid laser package, and allows the use of very easily manufactured structures.

Brief Description of the Drawings

[0007] Figure 1 is a diagrammatic cross-sectional view of a folded optical path hybrid laser, using an air gap to separate the diode laser from the crystal waveguide, with the crystal cantilevered over the diode laser;

[0008] Figure 2 shows a partial cross section of the device of Figure 1, but with a heat spreader or thermally conductive element attached to the top surface of the SHG crystal.

[0009] Figure 3 is a perspective view of a laser package design incorporating the SHG heat spreader on top of the SHG.

[0010] Figure 4 is a plot of the output power of green light from an structure like that of the hybrid laser of Figure 1 (no heat spreader) and from an inventive structure like that of the hybrid laser a portion of which is shown in Figure 2 (with heat spreader) showing the beneficial effects of the heat spreader.

Detailed Description

[0011] As noted above, Figure 1 shows a folded cavity design for a hybrid (desirably green) laser 10. Optical aberrations make it desirable to keep the SHG 60 and diode laser 50 close together. This folded cavity hybrid laser uses an air gap 70 to thermally isolate the SHG 60 from the diode laser 50. As a result of the tight spacing and use of the air gap 70, the SHG crystal 60 is cantilevered on its support 40, and thus the full length of the SHG crystal 60 is not be held in contact with the thermally conductive support 40 upon which it is mounted.

[0012] Figure 2 shows a cross section like that of Figure 1, but omitting the optics and showing one embodiment of thermally conductive element or heat spreader 80 according to the present disclosure. The components are the same as in Figure 1, except that adhesive 46 is shown between the various layers and that the thermally conductive element or heat spreader 80 is present. The heat spreader 80 ensures that second-order light can be efficiently generated in the SHG 60. Many synthetic (hybrid) green lasers mount the SHG 60 to a metal heat sink or other thermally conductive support in order to pull heat out of the SHG 60. Such heat sink, in some designs, can also act to eliminate thermal gradients in the SHG. However, the use a separate heat spreader 80 as in the present disclosure is distinct from that of a heat sink for the SHG, in that the heat spreader 80 is not designed to pull heat out of the SHG 60 or to cool the SHG 60, but is instead designed to act as a “thermal short” that prevents any one region of the SHG 60 from having a significantly different temperature from any other region so as to disrupt the efficiency of the SHG 60. This distinction is particularly important in the folded laser 10 shown in Figures 1 and 2, where the thermally conductive support or

heat sink 44 that touches and supports the SHG 60 cannot contact the entire length of the bottom of the SHG 60.

[0013] Figure 3 is a perspective view of another embodiment showing a synthetic or hybrid laser 10 within a laser package 12 incorporating a heat spreader 80 on top of the SHG crystal 60. Also shown is an exit window 90 for the output light. Note that a significant portion of the overall length of the SHG crystal 60 is not in contact with the support structure(s) 40.

[0014] Figure 4 shows a graph 100 of the results of a series of three experiments that indicate that a copper heat spreader placed solely on the top surface of the SHG improves the conversion efficiency of the hybrid laser device. The duty cycle (or the on-time) of the diode laser was varied and the output green power was measured. Plotted is the duty cycle-normalized green power on the y-axis, as a function of duty cycle percentage on the x-axis. If there is no thermal gradient issue in the SHG, then the data should show a green power that scales linearly with the duty cycle percentage, and hence the normalized green power should be flat. The trace 102 that rolls off is taken with no copper heat spreader on top of the SHG, and indicates a drop in conversion efficiency as the (optical) heat load into the SHG is increased. Some of the IR light propagating through the SHG is absorbed, which creates a thermal gradient in the SHG. The two traces 104, 106 that do not roll off were taken (before and after the trace 102 was taken) with a copper block placed on the top of the SHG. This thermally conductive element or heat spreader on top of the SHG acts as a thermal short along the length of the SHG, eliminating any thermal gradients and improving the conversion efficiency. The improvement mainly stems from the fact the copper (thermal conductivity of about $300\text{W/m}\cdot\text{K}$) is a much better thermal conductor than the lithium niobate of the SHG (thermal conductivity $\sim 4\text{W/m}\cdot\text{K}$).

[0015] The heat spreader is desirably made of copper and is desirably designed to extend along at least about 85% of the full length of the SHG. Preferably the heat spreader should be along the entire length of the SHG. The heat spreader may be attached with epoxy for the adhesive 46, desirably with a thermally conductive epoxy. The epoxy should be applied in such a way that no large air bubbles or gaps are created that would act as thermal barriers to heat flow from the lithium niobate into the heat spreader.

[0016] The design of the present disclosure, as shown in the example embodiments of figures 2 and 3, is also very advantageous for low cost manufacturing, as a more complicated 3D dual-purpose heat spreader/heat sink would be difficult to employ using automated assembly techniques. A simple block or slab shape heat spreader 80 as is shown in these figures is easy to use with well-established machine-vision guided “top down” assembly methods. The

simple block shape is also inexpensive to make with low cost processes, such as metal stamping.

[0017] Desirably the heat spreader 80 should be:

- Mounted to at least 80% of the length of the SHG, ideally along 100% of the length.
- Mounted to the top or side of the SHG, but does not provide a thermal path directly to the package base.
- Made of a material with a thermal conductivity $>100\text{W/m.K}$. Stainless steel may be OK for some applications, but is generally too low ($\sim 16\text{W/m.K}$). Copper ($\sim 300\text{W/m.K}$) or aluminum (or even higher thermal conductivity materials) are preferred.
- Bonded with a uniform layer of epoxy that has no large air bubbles or gaps. Thermally conductive epoxy is desirable, but ordinary epoxy may be used in some embodiments.
- Flat on the SHG mounting side, so that good thermal contact (a uniform bond) can be made with the SHG.

[0018] In accordance with the foregoing, the present disclosure provides a hybrid laser comprising a semiconductor laser, a frequency-doubling crystal supported via a first surface thereof on a supporting surface, the crystal positioned so as to be able to receive light from the laser; and a thermally conductive element mounted on a second surface of the crystal, the thermally conductive element having a thermal conductivity greater than a thermal conductivity of the crystal. The thermally conductive element mounted on the second surface of the crystal is desirably not mounted on or in close contact with any other surface of the crystal. The shortest solid state thermal path from the thermally conductive element mounted on the second surface of the crystal to the supporting surface lies across the crystal, thus the thermally conductive element serves as a heat spreader and not as a heat sink or heat conduction path toward an outer surface of the hybrid laser package. The thermally conductive element or heat spreader is desirably in contact with no other solid state structure other than the crystal.

[0019] The length of the crystal the length of the thermally conductive element are desirably chosen such that the thermally conductive element has a length at least 80% of the length of the crystal, more desirably at least 85% and most desirably 95 or 100% or more. The crystal is typically supported on the supporting surface along less than 95% of the length thereof, desirably less than 80% of the length thereof, and more desirably along less than 60% of the length thereof. The supporting surface desirably has a thermal conductivity of at least 300W/mK , which may be achieved by the use of copper as the material for the supporting surface.

[0020] The thermally conductive element or heat spreader desirably has a thermal conductivity of at least 100W/mK, more desirably at least 300W/mK. The thermally conductive element is desirably in the form of a rectangular slab of thermally conductive material, desirably comprising one (or more) of copper and aluminum. Desirably, the second surface of the crystal upon which the thermally conductive element or heat spreader is positioned is opposite the first surface via which the crystal is supported.

[0021] For the purposes of describing and defining the present invention, it is noted that reference herein to a variable being a “function” of a parameter or another variable is not intended to denote that the variable is exclusively a function of the listed parameter or variable. Rather, reference herein to a variable that is a “function” of a listed parameter is intended to be open ended such that the variable may be a function of a single parameter or a plurality of parameters.

[0022] It is also noted that recitations herein of “at least one” component, element, etc., should not be used to create an inference that the alternative use of the articles “a” or “an” should be limited to a single component, element, etc.

[0023] It is noted that recitations herein of a component of the present disclosure being “programmed” in a particular way, “configured” or “programmed” to embody a particular property, or function in a particular manner, are structural recitations, as opposed to recitations of intended use. More specifically, the references herein to the manner in which a component is “programmed” or “configured” denotes an existing physical condition of the component and, as such, is to be taken as a definite recitation of the structural characteristics of the component.

[0024] It is noted that terms like “preferably,” “commonly,” and “typically,” when utilized herein, are not utilized to limit the scope of the claimed invention or to imply that certain features are critical, essential, or even important to the structure or function of the claimed invention. Rather, these terms are merely intended to identify particular aspects of an embodiment of the present disclosure or to emphasize alternative or additional features that may or may not be utilized in a particular embodiment of the present disclosure.

[0025] For the purposes of describing and defining the present invention it is noted that the term “approximately” is utilized herein to represent the inherent degree of uncertainty that may be attributed to any quantitative comparison, value, measurement, or other representation. The term “approximately” is also utilized herein to represent the degree by which a quantitative representation may vary from a stated reference without resulting in a change in the basic function of the subject matter at issue.

[0026] Having described the subject matter of the present disclosure in detail and by reference to specific embodiments thereof, it is noted that the various details disclosed herein should not be taken to imply that these details relate to elements that are essential components of the various embodiments described herein, even in cases where a particular element is illustrated in each of the drawings that accompany the present description. Rather, the claims appended hereto should be taken as the sole representation of the breadth of the present disclosure and the corresponding scope of the various inventions described herein. Further, it will be apparent that modifications and variations are possible without departing from the scope of the invention defined in the appended claims. More specifically, although some aspects of the present disclosure are identified herein as preferred or particularly advantageous, it is contemplated that the present disclosure is not necessarily limited to these aspects.

[0027] It is noted that one or more of the following claims utilize the term “wherein” as a transitional phrase. For the purposes of defining the present invention, it is noted that this term is introduced in the claims as an open-ended transitional phrase that is used to introduce a recitation of a series of characteristics of the structure and should be interpreted in like manner as the more commonly used open-ended preamble term “comprising.”

What is claimed is:

1. A hybrid laser comprising:
 - a semiconductor laser supported directly or indirectly on a package substrate;
 - a frequency-doubling crystal supported via a first surface thereof on a supporting surface of a thermally conductive support connected to the package substrate, the crystal positioned so as to be able to receive light from the laser; and
 - a thermally conductive element mounted on a second surface of the crystal, the thermally conductive element having a thermal conductivity greater than a thermal conductivity of the crystal, the thermally conductive element not connected to the package substrate or to the thermally conductive support.
2. The hybrid laser according to claim 1 wherein the thermally conductive element mounted on the second surface of the crystal is not mounted on or in close contact with any other surface of the crystal.
3. The hybrid laser according to claim 2 wherein the thermally conductive element is in contact with no other solid state structure other than the crystal.
4. The hybrid laser according to any of claims 1-3 wherein the crystal has a first length and the thermally conductive element has a second length and wherein the second length is at least 80% of the first length.
5. The hybrid laser according to any of claims 1-3 wherein the crystal has a first length and the thermally conductive element has a second length and wherein the second length is at least 95% of the first length.
6. The hybrid laser according to any of claims 1-3 wherein the crystal has a first length and the thermally conductive element has a second length and wherein the second length is at least as great as the first length.
7. The hybrid laser according to any of claims 1-6 wherein the first surface of the crystal is supported on said supporting surface along less than 95% of the length thereof.
8. The hybrid laser according to any of claims 1-6 wherein the first surface of the crystal is supported on said supporting surface along less than 80% of the length thereof.

9. The hybrid laser according to any of claims 1-6 wherein the first surface of the crystal is supported on said supporting surface along less than 60% of the length thereof.
10. The hybrid laser according to any of claims 1-9 wherein the supporting surface has a thermal conductivity of at least 300W/mK.
11. The hybrid laser according to any of claims 1-10 wherein the thermally conductive element has a thermal conductivity of at least 100W/mK.
12. The hybrid laser according to any of claims 1-10 wherein the thermally conductive element has a thermal conductivity of at least 300W/mK.
13. The hybrid laser according to any of claims 1-10 wherein the thermally conductive element is in the form of a rectangular slab of thermally conductive material.
14. The hybrid laser according to any of claims 1-13 wherein the thermally conductive element comprises one or more of copper and aluminum.
15. The hybrid laser according to any of claims 1-14 wherein second surface of the crystal is opposite the first surface.

1/4

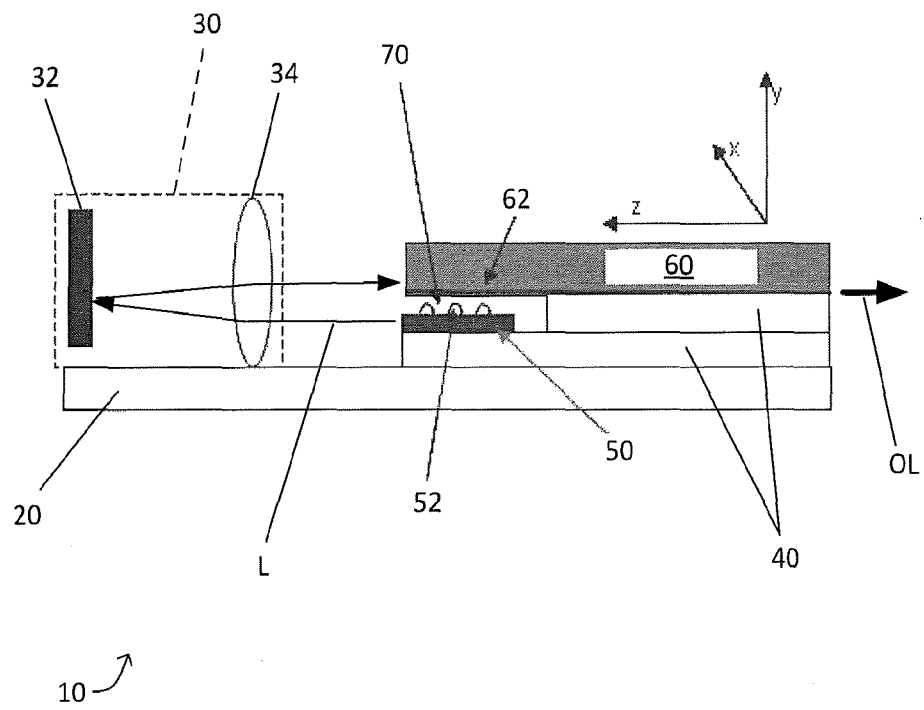


Figure 1

2/4

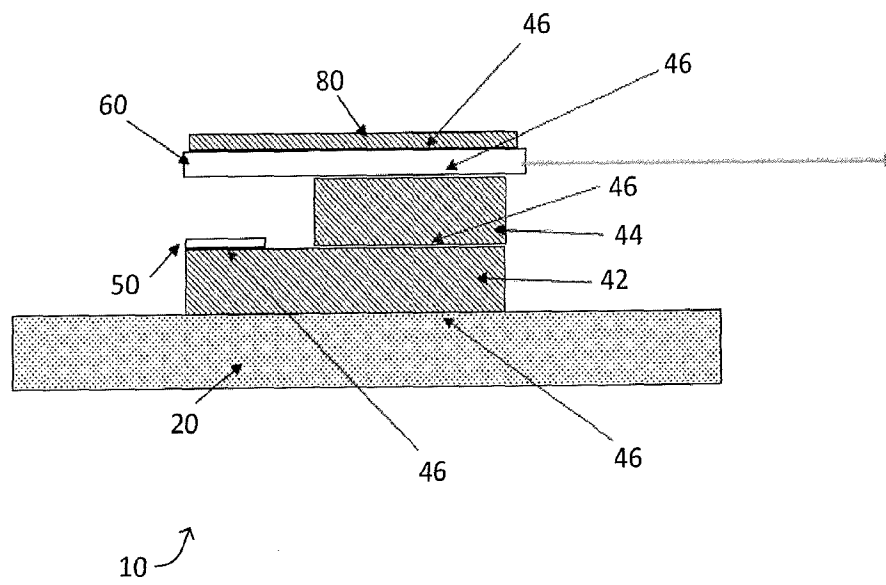


Figure 2

3/4

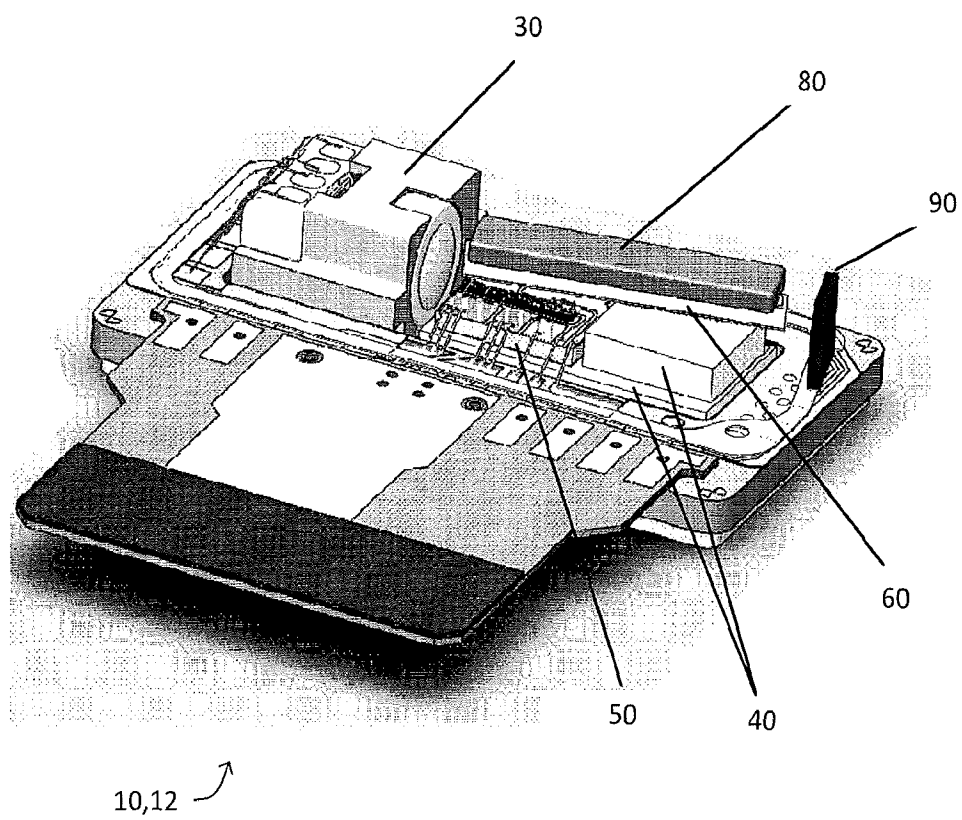


Figure 3

4/4

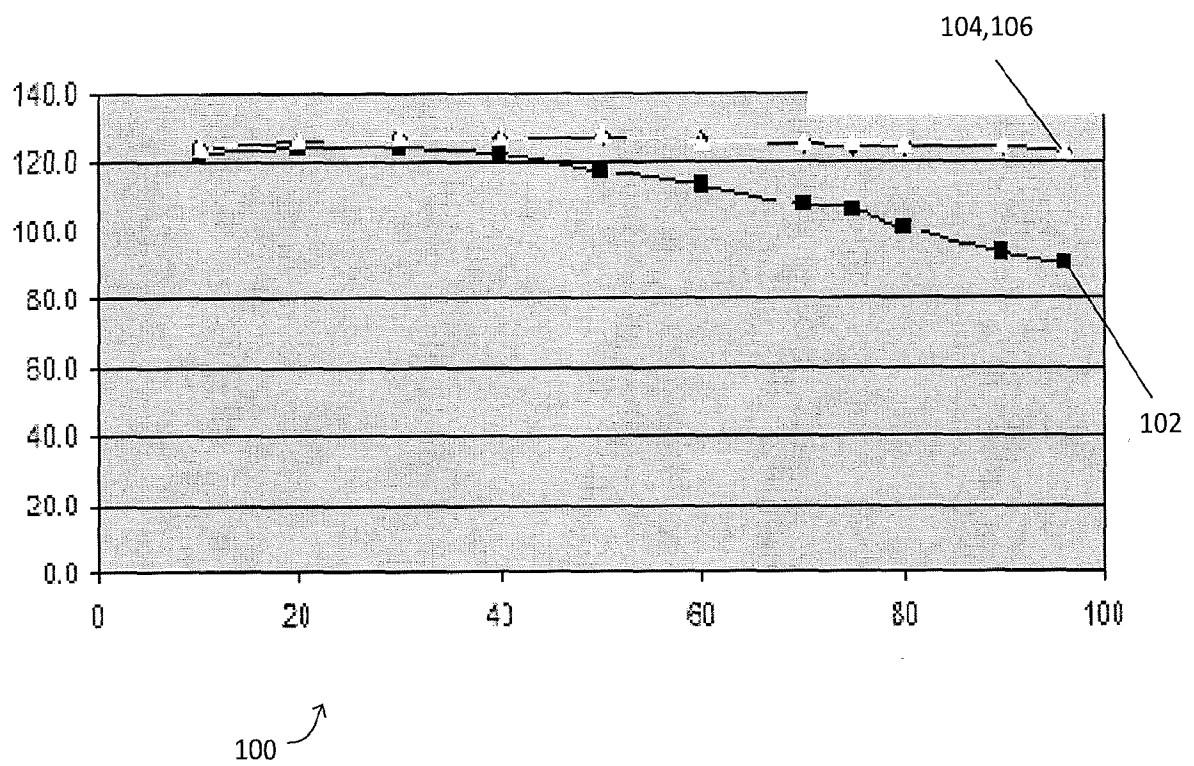


Figure 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2011/045154

A. CLASSIFICATION OF SUBJECT MATTER

INV. H01S5/00 H01S5/024
ADD. G02F1/377 G02B26/08 G02B6/42

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01S G02B G02F

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

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

EPO-Internal, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	XINGSHENG LIU ET AL: "Wavelength Matching and Tuning in Green Laser Packaging using Second Harmonic Generation", ELECTRONIC COMPONENTS AND TECHNOLOGY CONFERENCE 2006, 56TH SAN DIEGO, CA MAY 30 - JUNE 2, 2006, PISCATAWAY, NJ, USA, IEEE, 30 May 2006 (2006-05-30), pages 1064-1069, XP010923514, DOI: 10.1109/ECTC.2006.1645785 ISBN: 978-1-4244-0152-9 figures 1,5,9b page 1064, right-hand column, last paragraph - page 1065, left-hand column, paragraph 1 page 1067, left-hand column, paragraph 2 - right-hand column ----- -/--	1-9, 11-15

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search

19 October 2011

Date of mailing of the international search report

26/10/2011

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Riechel, Stefan

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2011/045154

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 7 729 046 B2 (KUHNELT MICHAEL [DE] ET AL KUEHNELT MICHAEL [DE] ET AL) 1 June 2010 (2010-06-01) column 12, line 31 - column 13, line 4; figures 5a,5b,6,7,8a -----	1-15
A	WO 2009/151558 A1 (CORNING INC [US]; CHAPARALA SATISH C [US]; HUGHES LAWRENCE C JR [US]) 17 December 2009 (2009-12-17) paragraphs [0023] - [0025], [0028]; figures 1c,1e -----	1-15
A	US 2008/304526 A1 (PARK SUNG-SOO [KR] ET AL) 11 December 2008 (2008-12-11) paragraphs [0020] - [0037]; figures 1-7 -----	1,7-9

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2011/045154

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 7729046	B2	01-06-2010	DE 102005015148 A1	05-10-2006
			EP 1708319 A2	04-10-2006
			JP 2006287231 A	19-10-2006
			US 2009003393 A1	01-01-2009
			US 2006221439 A1	05-10-2006

WO 2009151558	A1	17-12-2009	NONE	

US 2008304526	A1	11-12-2008	KR 20080107581 A	11-12-2008
