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Declarations under Rule 4.17:

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(88) Date of publication of the international search report:
28 October 2010

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(54) Title: METHOD OF BONDING A SEMICONDUCTOR DEVICE USING A COMPLIANT BONDING STRUCTURE

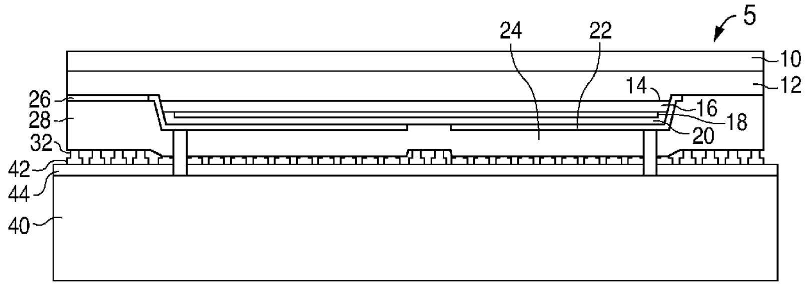

FIG. 5

(57) **Abstract**: A compliant bonding structure is disposed between a semiconductor device and a mount (40). In some embodiments, the device is a light emitting device. When the semiconductor light emitting device is attached to the mount, for example by providing ultrasonic energy to the semiconductor light emitting device, the compliant bonding structure collapses to partially fill a space between the semiconductor light emitting device and the mount. In some embodiments, the compliant bonding structure is plurality of metal bumps (32) that undergo plastic deformation during bonding. In some embodiments, the compliant bonding structure is a porous metal layer (46).

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INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. H01L33/48 H01L33/62 H01L33/38 H01L21/60
ADD. H01L33/00

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)
H01L

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

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

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 2008/054290 A1 (SHIEH YUH-REN [TW] ET AL) 6 March 2008 (2008-03-06) paragraph [0017]; figures 2,3,6,7	1-6,8,9, 11,14,15 7,12,13
Y	US 5 904 499 A (PACE BENEDICT G [US]) 18 May 1999 (1999-05-18) figure 7b	7
Y	WO 2006/013800 A1 (MATSUSHITA ELECTRIC IND CO LTD [JP]; UEMOTO TAKAARI; NAITO HIROYUKI) 9 February 2006 (2006-02-09) abstract; figures	7
Y	US 6 455 878 B1 (BHAT JEROME CHANDRA [US] ET AL) 24 September 2002 (2002-09-24) column 3, line 50 - column 4, line 8; claim 2; figures 2,4	12,13

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☒ 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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search 20 May 2010	Date of mailing of the international search report 27/08/2010
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 Ott, André

INTERNATIONAL SEARCH REPORT

International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2007/176288 A1 (DAUBENSPECK TIMOTHY H [US] ET AL DAUBENSPECK TIMOTHY HARRISON [US] ET) 2 August 2007 (2007-08-02) abstract; figures 1gi,2	12,13
A	JP 09 064238 A (OKI ELECTRIC IND CO LTD) 7 March 1997 (1997-03-07) abstract; figure 1	7,12
A	US 2007/057271 A1 (SCHIAFFINO STEFANO [US] ET AL SCHIAFFINO STEFANO [US] ET AL) 15 March 2007 (2007-03-15) paragraph [0021] - paragraph [0022]; figures 4,7,8	7,12,15
A	US 2002/179921 A1 (COHN MICHAEL B [US]) 5 December 2002 (2002-12-05) figures	12-15

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2010/050748

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

3-9, 15(completely); 1, 2, 11-14(partially)

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 3-9, 15(completely); 1, 2, 11-14(partially)

    Method of bonding a semiconductor device and a mount using micro-bumps having different desitys on different contacts.

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2. claims: 10(completely); 1, 2, 11-14(partially)

    Method of bonding a semiconductor device and a mount using posous metal layer as a compliant bonding structure.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2010/050748

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