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(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZM, ZW.

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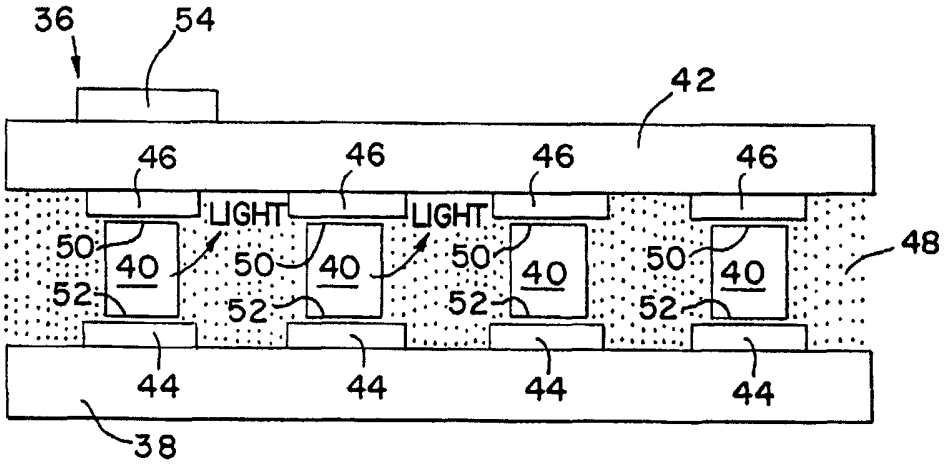
Declarations under Rule 4.17:

— *as to the identity of the inventor (Rule 4.17(i)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZM, ZW, ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES,*

[Continued on next page]

(54) Title: OPTICAL DEVICE MODULE AND METHOD OF FABRICATION



(57) Abstract: An optical device module (36), for example, an LED array module or photosensor module, includes optical devices (40) electrically attached to contact lands (44) on a substrate (38) by electrically conductive hard particles and mechanically attached by a non-electrically conductive adhesive (48). The module (36) may include a cover (42) that is transparent to the light emitted or detected by the optical devices (40) and that has electrically conductive contact pads (46), which are bonded to bond pads (50) on the optical devices (40). A process for fabricating an optical device module (36) includes electrically connecting the optical device (40) to the electrical contact land (44) on the substrate by attaching electrically conductive hard particles to either the base surface (52) of the optical device (40) or to the electrical contact lands (44). An adhesive (48) is applied the substrate (38) or a contact land (44), and the optical device (40) is placed on the contact land (44) and the adhesive (48) is cured.

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FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZM, ZW, ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for all designations*

Published:

— *with international search report*

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8 May 2003

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US02/01822

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : H01L 33/00
US CL : 257/79,99; 156/297; 29/832; 438/118

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)
U.S. : 257/79,99,778; 156/297,298,299,300; 29/832,854,739,740; 438/118

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,616,206 A (SAKATSU et al) 01 April 1997 (01.04.1997), column 7, lines 20-47.	1-39
Y	US 4,744,850 A (IMANO et al) 17 MAy 1988 (17.05.1988), column 3, line 22-52.	1-39
X --- Y	US 6,018,167 A (OOTA) 25 January 2000 (25.01.2000), column 16, lines 45-67.	40- --- 41-69
X --- Y	US 5,990,498 A (CHAPNIK et al) 23 November 1999 (23.11.1999), column 4, lines 25-42.	40, 43 --- 41,42,44-69
A	US 3,899,826 A (RUSS) 19 August 1975 (19.08.1975).	6-8, 13-20, 42, 44-52

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

* Special categories of cited documents:

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

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

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

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

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 July 2002 (16.07.2002)	22 AUG 2002
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703)305-3230	Authorized officer Michael W. Ball Telephone No. (703) 308-0661

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US02/01822

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

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

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

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

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
Please See Continuation 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 fee, this Authority did not invite payment of any additional fee.
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.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US02/01822

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claim(s) 1-8 and 34, drawn to a process for fabricating an optical device module.

Group II, claim(s) 9, drawn to drawn to a process for fabricating an optical device module from a wafer comprising a plurality of undiced optical devices.

Group III, claim(s) 10-12, drawn to a process for fabricating an optical device module wherein the optical device is pressed into a reservoir of electrically conductive hard particles.

Group IV, claim(s) 13-20 and 35, drawn to a process for fabricating an optical device module comprising providing a cover.

Group V, claim(s) 21-23, drawn to a process for fabricating an optical device module with a mounting substrate with first and second contact lands and an optical device with first and second bond pads.

Group VI, claim(s) 40, 43, 44, 46, 52, and 55, drawn to an optical device module.

Group VII, claim(s) 41, drawn to an optical device module with a mounting substrate with first and second contact lands and an optical device with first and second bond pads.

Group VIII, claim(s) 42, 47-49, 62, 65-67, and 69, drawn to an optical device module with a cover.

Claims 24-29 will be examined with either Group I, II, III, IV, or V.

Claims 30 and 31 will be examined with either Group I or IV.

Claim 32 will be examined with either Group I or III or V.

Claim 33 will be examined with either Group II or IV.

Claims 36-39 will be examined with either Group I or V.

Claims 45, 56, 61, 63, 64, and 68 will be examined with either Group VI or VII.

Claims 50-51 will be examined with either Group VI or VIII.

Claims 53-54 and 57-60 will be examined with either Group VI or VII or VIII.

The inventions listed as Groups I - VIII do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Groups I - V share the common technical feature of connecting an optical device to a mounting substrate via electrically conductive hard particles and an adhesive wherein the adhesive and electrically conductive hard particles are applied in different steps. Groups VI - VIII share the common technical feature of an optical device connected to a mounting substrate with electrically conductive hard particles in contact with the contact sites of both the device and substrate and wherein the electrically conductive hard particles are enveloped by an adhesive. The invention of Groups VI-VIII does not require the technical feature of Groups I - V. Therefore there is a lack of unity between Groups I - V and Groups VI - VIII.

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As mentioned above Groups I-V share the common technical feature of connecting an optical device to a mounting substrate via electrically conductive hard particles and an adhesive wherein the adhesive and electrically conductive hard particles are applied in different steps. This feature is not special and is generally well known and conventional as shown for example in Sakatsu et al (U.S. Patent 5,616,206) and Imano et al (U.S. Patent 4,744,850). Since the common technical feature of Groups I-V is not special, they lack unity because each is directed to a different feature. Group II is made from an undiced wafer, Group III attaches the electrically conductive hard particles by pressing the optical device into a reservoir of said particles, Group IV provides a cover to the optical device, and Group V has a mounting substrate with first and second contact lands and an optical device with first and second bond pads.

Also as mentioned above Groups VI-VII share the common technical feature of an optical device connected to a mounting substrate with electrically conductive hard particles in contact with the contact sites of both the device and substrate and wherein the electrically conductive hard particles are enveloped by an adhesive. This feature is not special and is generally well known and conventional as shown for example in Oota (U.S. Patent 6,018,167). Since the common technical feature of Groups VI-VIII is not special, they lack unity because each is directed to a different feature. Group VII has a mounting substrate with first and second contact lands and an optical device with first and second bond pads and Group VIII provides a cover to the optical device.