

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
22 May 2008 (22.05.2008)

PCT

(10) International Publication Number  
**WO 2008/060584 A3**

(51) **International Patent Classification:**  
*HOIL 33/00 (2006.01)*

[JP/US]; 643 Camino Campana, Santa Barbara, CA 93111 (US).

(21) **International Application Number:**  
PCT/US2007/023968

(74) **Agent: ORLER, Anthony, J.;** Gates & Cooper LLP, 6701 Centre Drive West, Suite 1050, Los Angeles, CA 90045 (US).

(22) **International Filing Date:**  
15 November 2007 (15.11.2007)

(81) **Designated States** (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, 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, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW

(25) **Filing Language:** English

(26) **Publication Language:** English

(30) **Priority Data:**  
60/866,025 15 November 2006 (15.11.2006) US

(71) **Applicants** (for all designated States except US): **THE REGENTS OF THE UNIVERSITY OF CALIFORNIA** [US/US]; 1111 Franklin Street, 12th Floor, Oakland, CA 94607 (US). **JAPAN SCIENCE AND TECHNOLOGY AGENCY** [JP/JP]; 4-1-8, Honcho, Kawaguchi City, Saitama Prefecture, 332-0012 (JP).

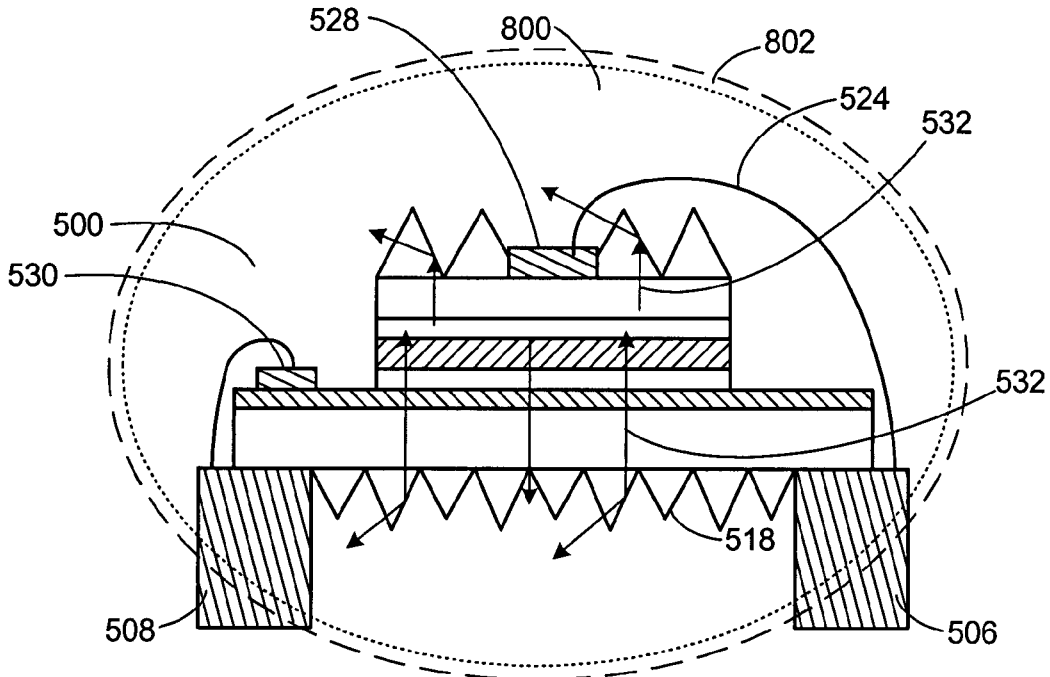
(72) **Inventors; and**

(75) **Inventors/Applicants** (for US only): **DENBAARS, Steven, P.** [US/US]; 283 Elderberry Drive, Goleta, CA 93117 (US). **NAKAMURA, Shuji** [US/US]; Po. Box 61656, Santa Barbara, CA 93160 (US). **MASUI, Hisashi**

(84) **Designated States** (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL,

[Continued on next page]

(54) **Title:** HIGH LIGHT EXTRACTION EFFICIENCY SPHERE LED



(57) **Abstract:** This invention is related to LED Light Extraction for optoelectronic applications. More particularly the invention relates to (Al, Ga, In)N combined with optimized optics for highly efficient (Al, Ga, In)N based light emitting diodes applications, and its fabrication method. A further extension is the general combination of a shaped high refractive index light extraction material combined with a sphere shaped molding.

WO 2008/060584 A3



PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM,  
GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

— *before the expiration of the time limit for amending the  
claims and to be republished in the event of receipt of  
amendments*

**Declaration under Rule 4.17:**

— *of inventorship (Rule 4.17(iv))*

**Published:**

— *with international search report*

**(88) Date of publication of the international search report:**

31 July 2008

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/ISA2007/023968

A CLASSIFICATION OF SUBJECT MATTER IPC(8) - H01L 33/00 (2008 04) <b>USPC - 257/95</b> According to International Patent Classification (IPC) or to both national classification and IPC		
B FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC(8) - H01L 33/00 (2008 04) USPC - 257/95, 99, 100, e33 064, e33 066 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) USPTO EAST System (US, USPG-PUB, USOCR), MicroPatent		
C DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
X	US 6,746,295 B2 (SORG) 08 June 2004 (08 06 2004) entire document	1, 2
Y		3-20
Y	US 2005/0077532 A1 (OTA et al) 14 April 2005 (14 04 2005) entire document	3, 12, 18
Y	US 2004/0094772 A1 (HON et al) 20 May 2004 (20 05 2004) entire document	4-9, 14
Y	US 2005/0184300 A1 (TAZIMA et al) 25 August 2005 (25 08 2005) entire document	7, 8
Y	US 2005/0062830 A1 (TAKI et al) 24 March 2005 (24 03 2005) entire document	10, 15
Y	US 3,999,280 A (HANSEN et al) 28 December 1976 (28 12 1976) entire document	13
Y	US 2005/0212002 A1 (SANGA et al) 29 September 2005 (29 09 2005) entire document	11, 16-20
<input type="checkbox"/> Further documents are listed in the continuation of Box C <input type="checkbox"/>		
* Special categories of cited documents		
"A"	document defining the general state of the art which is not considered to be of particular relevance	"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
"E"	earlier application or patent but published on or after the international filing date	"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
"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)	"V" 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
"O"	document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed	
Date of the actual completion of the international search 14 May 2008	Date of mailing of the international search report <b>05 JUN 2008</b>	
Name and mailing address of the ISA/AJS Mail Stop PCT, Attn ISA/US, Commissioner for Patents P O Box 1450, Alexandria, Virginia 22313-1450 Facsimile No 571-273-3201	Authorized officer Blaine R Copenheaver PCT Hq/tpdesk. 571 272-4300 PCT OSP- 571-272 7774	