

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
11 September 2009 (11.09.2009)

(10) International Publication Number  
**WO 2009/109974 A3**

(51) International Patent Classification:  
**G02B 6/00** (2006.01)

(21) International Application Number:  
PCT/IL2009/000248

(22) International Filing Date:  
5 March 2009 (05.03.2009)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
61/033,876 5 March 2008 (05.03.2008) US  
61/059,932 9 June 2008 (09.06.2008) US  
61/085,576 1 August 2008 (01.08.2008) US

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(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, 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, ST, SV, SY, 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, 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, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, 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))
- 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 January 2010

(54) Title: ILLUMINATION APPARATUS AND METHODS OF FORMING THE SAME

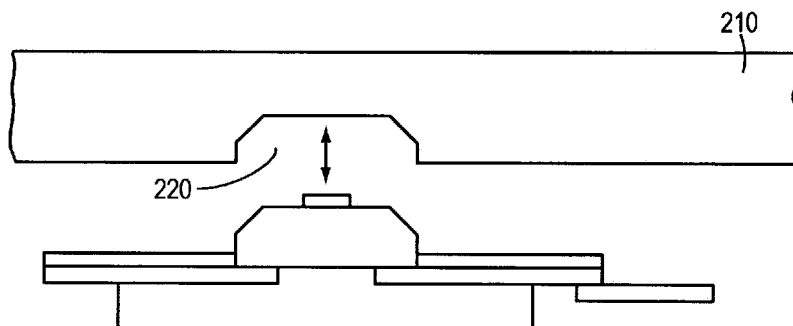


FIG. 2B

(57) Abstract: A sub-assembly (100) matable to a waveguide (210) having a recess (220) therein includes a structure comprising a discrete light source (150) disposed on a carrier (110), and a substrate (120) and a heat spreader (130) disposed beneath the structure. The structure has a contour complementary to the recess, such that, when the sub-assembly is joined to the waveguide, the discrete light source is within the waveguide. A sub-assembly is further disclosed which includes a discrete light source, wherein substantially all of the light emitted therefrom is emitted from a top surface; and a reflective carrier disposed beneath and in direct contact with the discrete light source, a top surface of the reflective carrier comprising an inner diffusive region (500) surrounding the discrete light source and a specular region (510) surrounding the inner diffusive region.



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## INTERNATIONAL SEARCH REPORT

International application No

PCT/IL2009/000248

**A. CLASSIFICATION OF SUBJECT MATTER**  
INV. G02B6/00

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)

G02B F21V G02F 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, 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	WO 2008/013097 A (SHOWA DENKO KK [JP]; GOMI SHUJI [JP]; NAIJO SHUICHI [JP]) 31 January 2008 (2008-01-31) abstract; figures 2(a)-(b) -----	1, 2, 4, 5, 13, 14, 24-26, 28
X	GB 2 339 318 A (LITE ON ELECTRONICS INC [TW]) 19 January 2000 (2000-01-19) page 5, line 27 - page 6, line 6; figures 7, 8 -----	27, 30, 39, 40
A	WO 2005/101070 A (DESIGN LED PRODUCTS LTD [GB]; GOURLAY JAMES [GB]) 27 October 2005 (2005-10-27) page 9, line 29 - page 10, line 2 -----	3, 31, 41
X	US 2006/002146 A1 (BABA MASATAKE [JP]) 5 January 2006 (2006-01-05) figures 5, 6 -----	27, 29, 39
	-/--	

 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

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"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.

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Date of the actual completion of the international search

2 December 2009

Date of mailing of the international search report

14/12/2009

Name and mailing address of the ISA/

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## INTERNATIONAL SEARCH REPORT

International application No  
PCT/IL2009/000248

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 2006/164840 A1 (SONG SI-JOON [KR] ET AL) 27 July 2006 (2006-07-27) paragraph [0028] - paragraph [0052]; figures 1-4 -----	22,36,37
X	US 2007/274094 A1 (SCHULTZ JOHN C [US] ET AL) 29 November 2007 (2007-11-29) paragraph [0038] - paragraph [0050]; figures 1,2 -----	1,10,11, 24
X	US 2006/012286 A1 (CULL BRIAN D [US] ET AL) 19 January 2006 (2006-01-19) paragraph [0022] - paragraph [0024]; figures 3A-B -----	1,4-8, 23,24
X	JP 10 247412 A (OMRON TATEISI ELECTRONICS CO) 14 September 1998 (1998-09-14) abstract; figures 5-8 -----	27,32, 33,39,40
A	GB 512 062 A (ERNST HIRSCH) 29 August 1939 (1939-08-29) page 2, line 92 - line 99; claims 1-3; figure 1 page 1, line 25 - line 56 page 2, line 44 - line 59 -----	22,23

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/IL2009/000248

## 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.:  
  
1-14, 22-41
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 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: 1-5, 13, 14, 24-28, 30, 31, 39-41

Light source comprising a bare-die light emitting diode on a carrier, substrate and heat spreader. Also a waveguide with a recess within which is a light source on a carrier.

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2. claims: 6-9, 22, 23, 29, 32-38

Sub-assembly or illumination device essentially comprising a structure comprising a discrete light source disposed on a carrier, including a reflecting element or characteristic.

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3. claims: 10-12

Sub-assembly essentially comprising a structure comprising a discrete light source disposed on a carrier, wherein the light source is disposed in a recess or on a step of the carrier.

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4. claims: 15-21

Sub-assembly essentially comprising a structure comprising a discrete light source disposed on a carrier, wherein the electrical connections between the light source and/or the carrier and/or the substrate are specified.

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5. claims: 42-46

Plurality of sub-assemblies, each of which comprises a plurality of discrete lighting devices disposed over a carrier; carrier interconnections disposed on the carrier and electrically connected to the discrete lighting devices; and a substrate disposed beneath the carrier and comprising substrate interconnections disposed on the substrate and electrically connected to the carrier interconnections, wherein the plurality of discrete lighting device on a first sub-assembly is connected in series, the plurality of discrete lighting device on a second sub-assembly is connected in parallel, and the carrier interconnections of the first sub-assembly is substantially identical to the carrier interconnections of the second sub-assembly.

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/IL2009/000248
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