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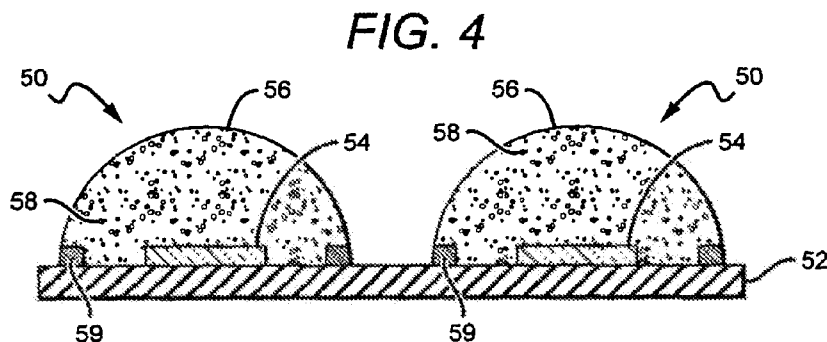
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(54) Title: LIGHT EMITTING DIODE PACKAGE COMPRISING ENCAPSULANT WITH INDEX MATCHED THIXOTROPIC AGENT



(57) Abstract: Emitter packages are disclosed having a thixotropic agent or material, with the encapsulant exhibiting significant reduction of thixotropic agent scattering. The packages exhibit a corresponding reduction or elimination of encapsulant clouding and increased package emission efficiency. This allows for the thixotropic agents to be included in the encapsulant to alter certain properties (e.g. mechanical or thermal) while not significantly altering the optical properties of the encapsulant. One embodiment of a light emitting diode (LED) package according to the present invention comprises an LED chip with an encapsulant over the LED chip. The encapsulant has an encapsulant refractive index and also has a thixotropic material with a refractive index that is substantially the same as the encapsulant refractive index.



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INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER INV. H01L33/56 ADD. C08J5/00 C08K3/00 C08K3/22		
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 practicable, 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	US 2009/272995 A1 (ITO H ET AL) 5 November 2009 (2009-11-05) paragraphs [0043] - [0060] -----	1,2, 4-15,19, 21-27, 35,36
X	US 2005/173708 A1 (SUEHIRO Y ET AL) 11 August 2005 (2005-08-11) paragraphs [0075] - [0084] -----	1,2, 4-15,19, 21-27, 35,36
X	EP 1 529 807 A2 (NITTO DENKO) 11 May 2005 (2005-05-11) paragraphs [0016] - [0066] -----	1,2, 4-15,19, 21-27, 35,36
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<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> 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 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	Date of mailing of the international search report	
15 November 2012	23/11/2012	
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 van der Linden, J	

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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.
X	EP 0 441 622 A1 (SHINETSU CHEMICAL) 14 August 1991 (1991-08-14) page 4, line 59 - page 12, line 21 -----	1,2, 4-13,19, 21-26, 35,36
X	WO 2006/060141 A2 (NANOCRYSTAL LIGHTING) 8 June 2006 (2006-06-08) page 9, line 17 - page 13, line 3; claim 26 -----	1,2, 7-15,19, 23
X	EP 2 042 528 A1 (SONY CHEM & INFORMATION DEVICE) 1 April 2009 (2009-04-01) paragraphs [0041] - [0042] -----	1,2, 7-15,19, 23
X	US 2007/108463 A1 (CHUA J ET AL) 17 May 2007 (2007-05-17) paragraphs [0011] - [0019]; claims 7,13 -----	1,2, 7-10, 12-15, 19,23
X	US 2011/031527 A1 (KOTANI H ET AL) 10 February 2011 (2011-02-10) paragraphs [0068] - [0192] -----	1,2,7,8, 12-15, 19,23
X	EP 2 196 501 A1 (NICHIA) 16 June 2010 (2010-06-16) paragraphs [0020] - [0048] -----	1,2,7,8, 12,13, 15,19,23
X	US 2006/060882 A1 (OHE N ET AL) 23 March 2006 (2006-03-23) paragraphs [0106] - [0157] -----	21-26
X,P	WO 2011/061650 A1 (KONINKL PHILIPS ELECTRONICS; PHILIPS LUMILEDS LIGHTING) 26 May 2011 (2011-05-26) paragraphs [0016] - [0019] -----	1,2, 4-15,19, 21-27, 35,36
X,P	EP 2 336 230 A1 (SHINETSU CHEMICAL) 22 June 2011 (2011-06-22) paragraphs [0014] - [0038] -----	21-25

INTERNATIONAL SEARCH REPORT

International application No.
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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.: 3, 16-18, 20, 28-34
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:
see FURTHER INFORMATION sheet PCT/ISA/210

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:

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.:

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

Continuation of Box II.2

Claims Nos.: 3, 16-18, 20, 28-34

Present claims 3,16-18,20,28-34 relate to a light emitting diode package comprising an encapsulant with a thickening / thixotropic material dispersed therein which has a given desired property or effect, namely the encapsulant and thickening / thixotropic material combination being substantially non-scattering, respectively, the thickening / thixotropic material does not substantially alter the optical properties of the encapsulant. However, the description does not provide support and disclosure in the sense of Art. 6 and 5 PCT for such generic compound having the said property or effect and there is no common general knowledge of this kind available to the person skilled in the art. In particular also since the term 'substantially' is vague and unclear and leaves the reader in doubt as to the meaning of the technical features to which it refers, thereby rendering the definition of the subject matter of said claims unclear). This non-compliance with the substantive provisions is to such an extent, that the search was performed taking into consideration the non-compliance in determining the extent of the search of the claim (PCT Guidelines 9.19 and 9.20). The search was consequently restricted to claims 1,2,4-15,19,21-27,35,36 which define the subject matter in more concrete terms, i.e. in terms of how the effect is achieved.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.2), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2012/028327

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 2009272995	A1	05-11-2009	CN 101273089 A	24-09-2008
			JP 2007091960 A	12-04-2007
			KR 20080049064 A	03-06-2008
			US 2009272995 A1	05-11-2009
			WO 2007040107 A1	12-04-2007
US 2005173708	A1	11-08-2005	JP 2005252219 A	15-09-2005
			US 2005173708 A1	11-08-2005
EP 1529807	A2	11-05-2005	CN 1621482 A	01-06-2005
			EP 1529807 A2	11-05-2005
			KR 20050036813 A	20-04-2005
			US 2005082691 A1	21-04-2005
EP 0441622	A1	14-08-1991	DE 69104859 D1	08-12-1994
			DE 69104859 T2	27-04-1995
			EP 0441622 A1	14-08-1991
			US 5175199 A	29-12-1992
WO 2006060141	A2	08-06-2006	CN 101084112 A	05-12-2007
			EP 1817161 A2	15-08-2007
			JP 2008520810 A	19-06-2008
			KR 20070110257 A	16-11-2007
			US 2007221939 A1	27-09-2007
			WO 2006060141 A2	08-06-2006
EP 2042528	A1	01-04-2009	NONE	
US 2007108463	A1	17-05-2007	NONE	
US 2011031527	A1	10-02-2011	NONE	
EP 2196501	A1	16-06-2010	CN 101792572 A	04-08-2010
			EP 2196501 A1	16-06-2010
			JP 2010138347 A	24-06-2010
			KR 20100069584 A	24-06-2010
			RU 2009146439 A	20-06-2011
			TW 201038611 A	01-11-2010
			US 2010148380 A1	17-06-2010
US 2006060882	A1	23-03-2006	DE 102005044396 A1	06-04-2006
			TW I280673 B	01-05-2007
			US 2006060882 A1	23-03-2006
WO 2011061650	A1	26-05-2011	CN 102714261 A	03-10-2012
			EP 2504870 A1	03-10-2012
			KR 20120086731 A	03-08-2012
			TW 201123552 A	01-07-2011
			US 2011121331 A1	26-05-2011
			WO 2011061650 A1	26-05-2011
EP 2336230	A1	22-06-2011	CN 102153863 A	17-08-2011
			EP 2336230 A1	22-06-2011
			JP 2011144360 A	28-07-2011
			KR 20110068867 A	22-06-2011
			TW 201137042 A	01-11-2011
			US 2011140289 A1	16-06-2011