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(54) Title: HIGH BRIGHTNESS DIRECTIONAL DIRECT EMITTER WITH PHOTONIC FILTER OF ANGULAR MOMENTUM

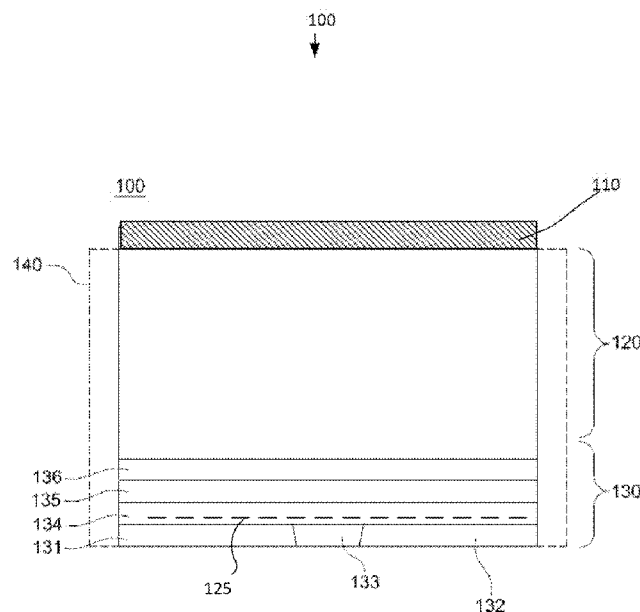


FIG. 1A

(57) Abstract: A nano-structure layer is disclosed. The nano-structure layer includes a plurality of nano-photonic structures that are configured in a first configuration such that light incident upon the nanostructured layer below a cut-off angle passes through the nanostructured layer and light incident upon the nanostructured layer above the cut-off angle is reflected back in direction of the incidence.



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- *with international search report (Art. 21(3))*
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INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
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ADD.
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B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
G02B F21V 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, COMPENDEX, INSPEC, 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 2017/175148 A1 (NOVAGAN [CH]) 12 October 2017 (2017-10-12)	1,3-5, 7-11,14, 15,19,20
Y	paragraphs [0025], [0031] - [0039], [0045]; claims 1,6,7; figures 2,5,7,10	2,6
Y	----- EP 2 496 052 A1 (NEC CORP [JP]) 5 September 2012 (2012-09-05) paragraphs [0056], [0070], [0122]; figures 26,1	2,6
A	----- US 2016/181485 A1 (LEE JOON SUB [KR]) 23 June 2016 (2016-06-23) paragraph [0051]; figure 2A ----- -/--	12,13, 16-18

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	"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)	"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
"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 7 September 2020	Date of mailing of the international search report 25/09/2020
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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 Girardin, François
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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.
A	YUN-WEI CHENG ET AL: "GaN-based LEDs with photonic crystal nanorod sidewall reflectors for versatile radiation directionality control", LASERS AND ELECTRO-OPTICS (CLEO), LASER SCIENCE TO PHOTONIC APPLICATIONS)-CLEO: 2011 - LASER SCIENCE TO PHOTONIC APPLICATIONS- 1-6 MAY 2011, BALTIMORE, MD, USA, IEEE, US, 1 May 2011 (2011-05-01), pages 1-2, XP031892426, ISBN: 978-1-4577-1223-4 figure 1	12,13, 16-18
A	----- US 2011/198619 A1 (CHIANG CHUNG-I [TW] ET AL) 18 August 2011 (2011-08-18) figure 9C	12,13, 16-18
A	----- EP 0 442 002 A1 (SIEMENS AG [DE]) 21 August 1991 (1991-08-21) the whole document	1-11
A	----- US 2018/274750 A1 (BYRNES STEVE [US] ET AL) 27 September 2018 (2018-09-27) paragraph [0162]; figures 14-16	1-11
A	----- YANG H P D ET AL: "InGaAs submonolayer quantum-dot photonic-crystal LEDs for fiber-optic communications", MICROELECTRONICS AND RELIABILITY, ELSEVIER SCIENCE LTD, GB, vol. 50, no. 5, 1 May 2010 (2010-05-01), pages 688-691, XP027036200, ISSN: 0026-2714 [retrieved on 2010-02-20] the whole document	1-11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2019/001351

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.:

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: 1-11

A light emitting device comprising: a semiconductor diode structure; a substrate transparent to light emitted by the semiconductor diode structure and comprising a top surface, an oppositely positioned bottom surface, and side surfaces connecting the top and bottom surfaces, the bottom surface disposed on or adjacent the semiconductor diode structure; and a nanostructured layer disposed on or adjacent the top surface of the substrate and comprising a plurality of nano-antennas disposed in a dielectric medium in a periodic or aperiodic arrangement such that light emitted by the semiconductor diode structure into the substrate and incident on the nanostructured layer at an angle of incidence less than a cut-off angle is transmitted through the nanostructured layer and light emitted by the semiconductor diode structure into the substrate and incident on the nanostructured layer at an angle of incidence greater than or equal to the cut-off angle is reflected back into the transparent substrate, in which the nano-antenna structure is chosen to obtain a particular output distribution.

2. claims: 12-20

A light emitting device comprising: a semiconductor diode structure; a substrate transparent to light emitted by the semiconductor diode structure and comprising a top surface, an oppositely positioned bottom surface, and side surfaces connecting the top and bottom surfaces, the bottom surface disposed on or adjacent the semiconductor diode structure; and a nanostructured layer disposed on or adjacent the top surface of the substrate and configured such that light emitted by the semiconductor diode structure into the substrate and incident on the nanostructured layer at an angle of incidence less than a cut-off angle is transmitted through the nanostructured layer and light emitted by the semiconductor diode structure into the substrate and incident on the nanostructured layer at an angle of incidence greater than or equal to the cut-off angle is reflected back into the transparent substrate, with an additional nanostructured reflective layer disposed on a side or bottom surface of the substrate having particular reflection properties.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2019/001351

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2017175148	A1	12-10-2017	NONE

EP 2496052	A1	05-09-2012	CN 102598852 A 18-07-2012
			EP 2496052 A1 05-09-2012
			JP 5527327 B2 18-06-2014
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