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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:
14 October 2010

(54) Title: DIGITAL ALLOY ABSORBER FOR PHOTODETECTORS

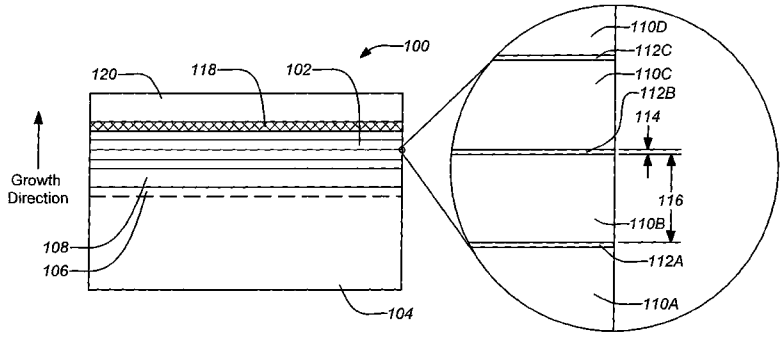

FIG. 1C

(57) Abstract: In order to increase the spectral response range and improve the mobility of the photo- generated carriers (e.g. in an nBn photodetector), a digital alloy absorber may be employed by embedding one (or fraction thereof) to several monolayers of a semiconductor material (insert layers) periodically into a different host semiconductor material of the absorber layer. The semiconductor material of the insert layer and the host semiconductor materials may have lattice constants that are substantially mismatched. For example, this may performed by periodically embedding monolayers of InSb into an InAsSb host as the absorption region to extend the cutoff wavelength of InAsSb photodetectors, such as InAsSb based nBn devices. The described technique allows for simultaneous control of alloy composition and net strain, which are both key parameters for the photodetector operation.

WO 2010/077984 A3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2009/068319

A. CLASSIFICATION OF SUBJECT MATTER

H01L 31/101(2006.01)i

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 31/101; H01L 27/146; H01L 29/15; H01L 31/00; H01L 31/0304; none

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: barrier, absorber, insert, interleave.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2007-113821 A2 (SEMI-CONDUCTOR DEVICES - AN ELBIT SYSTEMS - RAFAEL PARTNERSHIP et al.) 11 October 2007 See abstract, pp. 2-7, 30-32, claims 1-9,11,20 and figures 1-2, 7 and their corresponding descriptions.	1,2,5
A	WO 2008-061141 A1 (LOCKHEED MARTIN CORPORATION et al.) 22 May 2008 See abstract, paragraphs [0031],[0043],[0053], claims 1-3,11-12 and figures 2,8,22 and their corresponding descriptions.	1,2,5
A	US 2007-0215900 A1 (MAIMON; SHIMON) 20 September 2007 See abstract, paragraphs [0043]-[0048], claims 1,18,32 and figure 1 and its corresponding description.	1,2,5
A	US 5965899 A1 (LITTLE, JR.; JOHN W.) 12 October 1999 See abstract, columns 8-9, claims 1-9 and figures 3-5 and their correspondin g descriptions.	1,2,5
A	US 5563423 A1 (WU; CHAN-SHIN et al.) 08 October 1996 See abstract, columns 5-7, claims 1-7 and figures 1-2 and their correspondin g descriptions.	1,2,5

☐ 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 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 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
26 AUGUST 2010 (26.08.2010)	**26 AUGUST 2010 (26.08.2010)**

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
Government Complex-Daejeon, 139 Seonsa-ro, Seo-gu, Daejeon 302-701, Republic of Korea

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2009/068319

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.: 3-4,6-10
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 addtional 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 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.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2009/068319

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2007-113821 A2	11.10.2007	EP 2002487 A2	17.12.2008
		US 2009-0256231 A1	15.10.2009
		US 2009-256231 A1	15.10.2009
		WO 2007-113821 A3	11.10.2007
		WO 2007-113821 A3	17.01.2008
WO 2008-061141 A1	22.05.2008	EP 2087517 A1	12.08.2009
		US 2008-0111152 A1	15.05.2008
		US 2008-111152 A1	15.05.2008
		WO 2008-061141 A1	22.05.2008
		WO 2008-061141 A9	03.07.2008
		WO 2008-061141 A9	03.07.2008
US 2007-0215900 A1	20.09.2007	None	
US 5965899 A1	12.10.1999	EP 0555402 A1	18.08.1993
		EP 0648377 A1	12.04.2000
		EP 0648377 A1	19.04.1995
		EP 0648377 B1	23.08.2000
		WO 92-08250 A1	14.05.1992
		WO 94-00884 A1	06.01.1994
US 5563423 A1	08.10.1996	None	