

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
27 September 2007 (27.09.2007)

PCT

(10) International Publication Number  
**WO 2007/109403 A3**

(51) International Patent Classification:  
*H01L 29/12* (2006.01)

Yorktown, VA 23693 (US). **STOAKLEY, Diane, M.** [US/US]; 14485 Riverside Drive, Ashland, VA 23005 (US).

(21) International Application Number:  
PCT/US2007/063038

(74) Agents: **EDWARDS, Robin, W.** et al.; NASA Langley Research Center, MS 141, Hampton, VA 23681-2199 (US).

(22) International Filing Date: 12 March 2007 (12.03.2007)

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, 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:  
11/387,086 21 March 2006 (21.03.2006) US

(71) Applicant (for all designated States except US): **UNITED STATES OF AMERICA AS REPRESENTED BY THE ADMINISTRATOR OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION** [US/US]; 300 E. Street SW, Washington, DC 20546 (US).

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

(72) Inventors; and

(75) Inventors/Applicants (for US only): **PARK, Yeonjoon** [KR/US]; 308 Timberline Loop, Yorktown, VA 23692 (US). **CHOI, Sang, H.** [US/US]; 11 Trotters Bridge Drive, Poquoson, VA 23662-1257 (US). **KING, Glen, C.** [US/US]; 218 Rich Road, Yorktown, VA 23693 (US). **ELLIOTT, James, R., Jr.** [US/US]; 102 Chowan Turn,

Published:  
— with international search report

[Continued on next page]

(54) Title: GRADED INDEX SILICON GERMANIUM ON LATTICE MATCHED SILICON GERMANIUM

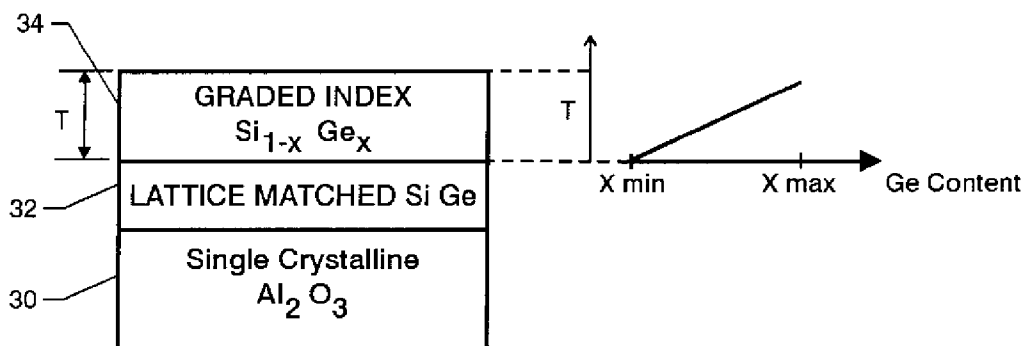


FIG. 3

(57) Abstract: A lattice matched silicon germanium (SiGe) semiconductive alloy is formed when a {111} crystal plane of a cubic diamond structure SiGe is grown on the {0001} C-plane of a single crystalline Al<sub>2</sub>O<sub>3</sub> substrate such that a <110> orientation of the cubic diamond structure SiGe is aligned with a <1,0,-1, 0> orientation of the {0001} C-plane. A lattice match between the substrate and the SiGe is achieved by using a SiGe composition that is 0.7223 atomic percent silicon and 0.2777 atomic percent germanium. A layer of Si<sub>j</sub>-xGe<sub>x</sub> is formed on the cubic diamond structure SiGe. The value of X (i) defines an atomic percent of germanium satisfying 0.2277 < X < 1.0, f ii) is approximately 0.2777 where the layer of Si<sub>1-x</sub>Ge<sub>x</sub> interfaces with the cubic diamond structure SiGe, and (iii) increases linearly with the thickness of the layer of Si<sub>1-x</sub>Ge<sub>x</sub>.

WO 2007/109403 A3



---

**(88) Date of publication of the international search report:**  
6 November 2008

# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US07/63038

**A. CLASSIFICATION OF SUBJECT MATTER**  
 IPC: **H01L 29/12( 2006.01)**

USPC: 428/620  
 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)  
 U.S. : 428/620

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)

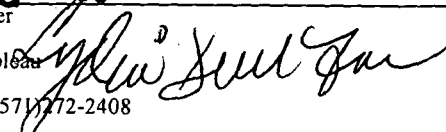
**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
T	US 2007/0069195 A1 Park et al. 29 March 2007 all	1-23

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 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 11 August 2008 (11.08.2008)	Date of mailing of the international search report <b>18 AUG 2008</b>
--	--

Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (571) 273-3201	Authorized officer Davienne Monbléau  Telephone No. (571) 272-2408
---	--