

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
31 July 2003 (31.07.2003)

PCT

(10) International Publication Number
WO 2003/063213 A3

(51) International Patent Classification⁷: **H01L 21/18**,
21/265, 21/762, 21/20, 21/76

(21) International Application Number:
PCT/EP2003/000692

(22) International Filing Date: 21 January 2003 (21.01.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0200813 23 January 2002 (23.01.2002) FR

(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(71) Applicant (*for all designated States except US*):
S.O.I.TEC SILICON INSULATOR TECHNOLOGIES [FR/FR]; Parc Technologique des Fontaines,
Chemin des Franques, F-38190 Bernin (FR).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): **GHYSELEN, Bruno** [FR/FR]; 58, rue Georges Maeder, F-38170 Seyssinet-Pariset (FR). **LETERTRE, Fabrice** [FR/FR]; 33, Quai Jongkind, F-38000 Grenoble (FR).

(74) Agent: **CABINET REGIMBEAU**; Espace Performance, Bâtiment K, F-35769 Saint-Gregoire (FR).

Declaration under Rule 4.17:

— *of inventorship (Rule 4.17(iv)) for US only*

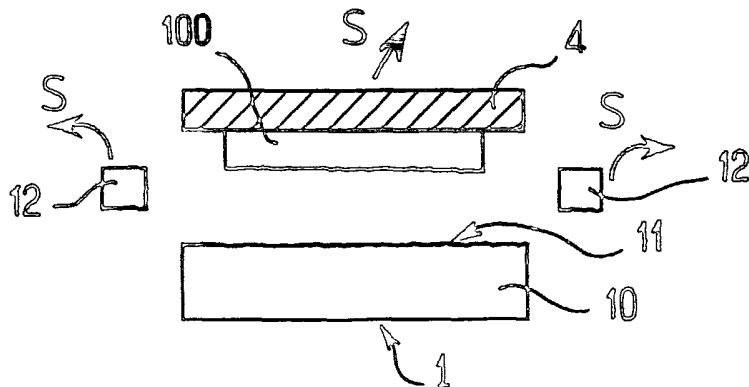
Published:

— *with international search report*

(88) Date of publication of the international search report:
15 January 2004

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: OPTIMIZED METHOD OF TRANSFER OF A THIN LAYER OF SILICON CARBIDE TO A RECEIVING SUBSTRATE



(57) Abstract: The invention relates to an optimized method of transfer of a thin layer (100) of monocrystalline silicon carbide, derived from a source substrate (1), to a receiving substrate (4), comprising the steps consisting of: - bombarding the front face of the said source substrate (1) with a majority of H⁺ ions to form an embrittlement zone (5), - detaching the said thin layer (100) from the remainder (10) of the said source substrate (1) along the said embrittlement zone (5), characterized in that the implantation of H⁺ ions is performed according to the following inequality, in which the implantation dose D is expressed in number of H⁺

ions/cm² and the implantation energy E, expressed in keV, is greater than or equal to 95 keV: $[(E \cdot 1.10^{14} + 5.10^{16}) / 1.1] \leq D \leq [(E \cdot 1.10^{14} + 5.10^{16}) / 0.9]$ and in that after the step of bonding, a thermal budget is applied sufficient to exfoliate completely or almost completely the zone (12) of the said thin layer (100) of the source substrate (1) which has not been transferred to the said receiving substrate (4).

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 03/00692

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H01L21/18 H01L21/265 H01L21/762 H01L21/20 H01L21/76

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)

IPC 7 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, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>DI CIOCCIO L ET AL: "Silicon carbide on insulator formation by the Smart-Cut(R) process"</p> <p>MATERIALS SCIENCE AND ENGINEERING B, ELSEVIER SEQUOIA, LAUSANNE, CH, vol. 46, no. 1-3, 1 April 1997 (1997-04-01), pages 349-356, XP004085343</p> <p>ISSN: 0921-5107</p> <p>page 349 -page 351, paragraph 3.2.1.1; figures 1,2</p> <p>page 352, paragraph 3.2.2.2 -page 355, paragraph 5; figures 8-11</p> <p>---</p> <p>-/--</p>	<p>1-3,6,7, 9-13,15</p>

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in 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
- *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.
- *G* document member of the same patent family

Date of the actual completion of the international search

22 July 2003

Date of mailing of the international search report

30/07/2003

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Klopfenstein, P

INTERNATIONAL SEARCH REPORT

Int. Patent Application No.

PCT/EP 03/00692

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DI CIOCCIO L ET AL: "Silicon carbide on insulator formation using the Smart Cut process" ELECTRONICS LETTERS, IEE STEVENAGE, GB, vol. 32, no. 12, 6 June 1996 (1996-06-06), pages 1144-1145, XP006005228 ISSN: 0013-5194 the whole document ---	1-3,6,7, 9-13,15
A	US 6 355 541 B1 (GREGORY RICHARD BAYNE ET AL) 12 March 2002 (2002-03-12) column 1, line 5 - line 33 column 3, line 42 - line 47 column 4, line 4 - line 46; figures 1A-1C column 5, line 29 - line 35 column 5, line 61 -column 6, line 19; figure 3 column 6, line 45 - line 59 column 6, line 66 -column 7, line 6; figure 4B ---	1-3, 6-13,15
A	BENNETT J A ET AL: "COMPLETE SURFACE EXFOLIATION OF 4H-SIC BY H+- AND SI+-COIMPLANTATION" APPLIED PHYSICS LETTERS, AMERICAN INSTITUTE OF PHYSICS. NEW YORK, US, vol. 76, no. 22, 29 May 2000 (2000-05-29), pages 3265-3267, XP000954315 ISSN: 0003-6951 cited in the application page 3265 -page 3266, left-hand column ---	1-4,6,7, 10-13
A	US 6 150 239 A (TONG QIN-YI ET AL) 21 November 2000 (2000-11-21) column 1, line 18 - line 39 column 3, line 13 - line 42 column 3, line 60 -column 4, line 2 column 6, line 13 - line 38; figure 1 column 11, line 46 -column 12, line 33; claims 10,14,15 ---	1-3,6,7, 10,13-15
A	GREGORY R B ET AL: "THE EFFECTS OF DAMAGE ON HYDROGEN-IMPLANT-INDUCED THIN-FILM SEPARATION FROM BULK SILICON CARBIDE" MATERIALS RESEARCH SOCIETY SYMPOSIUM PROCEEDINGS, MATERIALS RESEARCH SOCIETY, PITTSBURG, PA, US, vol. 572, 5 April 1999 (1999-04-05), pages 33-38, XP001040858 ISSN: 0272-9172 cited in the application page 33 -page 34; figure 1 page 35 -page 36; figures 3,4 ---	1-3,6-13

-/--

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 03/00692

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>TONG Q-Y ET AL: "Si and SiC layer transfer by high temperature hydrogen implantation and lower temperature layer splitting"</p> <p>ELECTRONICS LETTERS, IEE STEVENAGE, GB, vol. 34, no. 4, 19 February 1998 (1998-02-19), pages 407-408, XP006009324</p> <p>ISSN: 0013-5194</p> <p>the whole document</p> <p>-----</p>	1,3,6,7,13

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 03/00692

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 6355541	B1	12-03-2002	NONE	
US 6150239	A	21-11-2000	US 5877070 A WO 0019499 A1 EP 1118108 A1	02-03-1999 06-04-2000 25-07-2001