

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
25 November 2004 (25.11.2004)

PCT

(10) International Publication Number
WO 2004/102635 A3

(51) International Patent Classification⁷: H01L 21/308, 21/316, 21/265, 21/20

(21) International Application Number: PCT/US2003/034576

(22) International Filing Date: 30 October 2003 (30.10.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data: 60/422,468 30 October 2002 (30.10.2002) US

(71) Applicant: AMBERWAVE SYSTEMS CORPORATION [US/US]; 13 Garabedian Drive, Salem, NH 03079-4235 (US).

(72) Inventors: CURRIE, Matthew, T.; 8 Fletcher Road, Windham, NH 03087 (US). LOCHTEFELD, Anthony, J.; 73 Garison Avenue, Somerville, MA 02144 (US).

(74) Agent: BELOBORODOV, Mark, L.; Patent Administrator, Goodwin Procter LLP, Exchange Place, 53 State Street, Boston, MA 02109 (US).

(81) Designated States (national): 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, 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, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States (regional): ARIPO patent (BW, 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, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

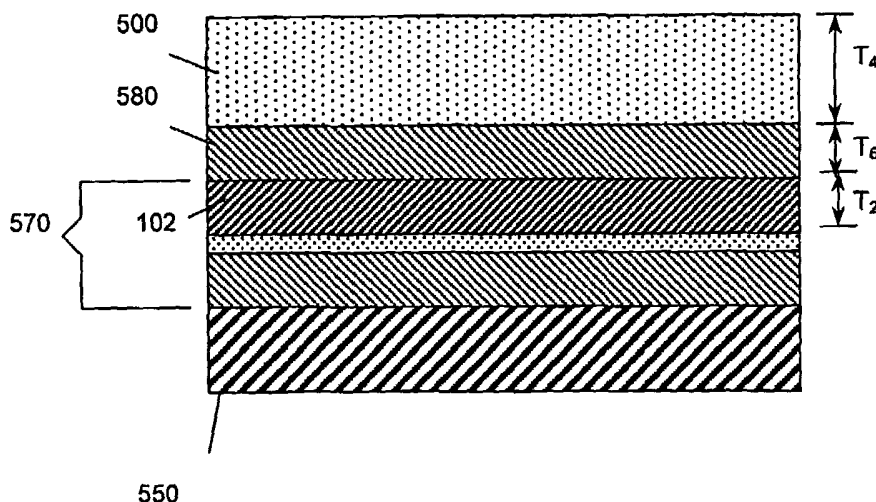
Published:
— with international search report
— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

(88) Date of publication of the international search report: 2 June 2005

(15) Information about Correction:

[Continued on next page]

(54) Title: METHODS FOR PRESERVING STRAINED SEMICONDUCTOR LAYERS DURING OXIDE LAYER FORMATION



(57) Abstract: Oxidation methods, which avoid consuming undesirably large amounts of surface material in Si/SiGe heterostructure-based wafers, replace various intermediate CMOS thermal oxidation steps. First, by using oxide deposition methods, arbitrarily thick oxides may be formed with little or no consumption of surface silicon. These oxides, such as screening oxide and pad oxide, are formed by deposition onto, rather than reaction with and consumption of the surface layer. Alternatively, oxide deposition is preceded by a thermal oxidation step of short duration, e.g., rapid thermal oxidation. Here, the short thermal oxidation consumes little surface Si, and the Si/oxide interface is of high quality. The oxide may then be thickened to a desired final thickness by deposition. Furthermore, the thin thermal oxide may act as a barrier layer to prevent contamination associated with subsequent oxide deposition.

WO 2004/102635 A3



Previous Correction:

see PCT Gazette No. 05/2005 of 3 February 2005, Section II

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.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 03/34576

<p>A. CLASSIFICATION OF SUBJECT MATTER IPC 7 H01L21/308 H01L21/316 H01L21/265 H01L21/20</p>		
<p>According to International Patent Classification (IPC) or to both national classification and IPC</p>		
<p>B. FIELDS SEARCHED</p>		
<p>Minimum documentation searched (classification system followed by classification symbols) IPC 7 C23C</p>		
<p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched</p>		
<p>Electronic data base consulted during the international search (name of data base and, where practical, search terms used) EPO-Internal, PAJ</p>		
<p>C. DOCUMENTS CONSIDERED TO BE RELEVANT</p>		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	-/--	
<p><input checked="" type="checkbox"/> Further documents are listed in the continuation of box C. <input checked="" type="checkbox"/> Patent family members are listed in annex.</p>		
<p>° Special categories of cited documents :</p>		
<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"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</p> <p>"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</p> <p>"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.</p> <p>"&" document member of the same patent family</p>	
<p>Date of the actual completion of the international search 26 November 2004</p>		<p>Date of mailing of the international search report 07 04 2005</p>
<p>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</p>		<p>Authorized officer Klopfenstein, P</p>

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 03/34576

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>CURRIE M T ET AL: "Carrier mobilities and process stability of strained Si <emph type=1>n</emph>- and <emph type=1>p</emph>-MOSFETs on SiGe virtual substrates" JOURNAL OF VACUUM SCIENCE AND TECHNOLOGY. B, MICROELECTRONICS AND NANOMETER STRUCTURES PROCESSING, MEASUREMENT AND PHENOMENA, AMERICAN INSTITUTE OF PHYSICS, NEW YORK, NY, US, vol. 19, no. 6, November 2001 (2001-11), pages 2268-2279, XP012009031 ISSN: 1071-1023 page 2269; figure 1 page 2276, left-hand column, paragraph 2; figure 16</p>	1-4, 7-10, 12-20,22
Y		5,6,9, 11,18, 21,23-26
X	<p>----- LEITZ C W ET AL: "Hole mobility enhancements and alloy scattering-limited mobility in tensile strained Si/SiGe surface channel metal-oxide-semiconductor field-effect transistors" JOURNAL OF APPLIED PHYSICS, AMERICAN INSTITUTE OF PHYSICS. NEW YORK, US, vol. 92, no. 7, 1 October 2002 (2002-10-01), pages 3745-3751, XP012057340 ISSN: 0021-8979 page 3746, paragraph II page 3748, paragraph C</p>	1-10, 12-20
Y		5,6,11, 21,23-26
X	<p>----- SUGII NOBUYUKI ET AL: "Role of Si_{1-x}Ge_x buffer layer on mobility enhancement in a strained-Si n-channel metal-oxide-semiconductor field-effect transistor" APPLIED PHYSICS LETTERS, AMERICAN INSTITUTE OF PHYSICS. NEW YORK, US, vol. 75, no. 19, 8 November 1999 (1999-11-08), pages 2948-2950, XP012023936 ISSN: 0003-6951 page 2948 - page 2949, left-hand column; figure 1a</p>	1-4,7,8, 10,12-20
Y		5,6,9, 11,21, 24,26
	----- -/--	

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 03/34576

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>US 2002/068393 A1 (FITZGERALD EUGENE A ET AL) 6 June 2002 (2002-06-06)</p> <p>paragraph [0003] paragraph [0006]; figure 1A paragraph [0009] paragraph [0028] - paragraph [0029]; figures 3A-3D paragraph [0058]</p>	1-10, 12-17, 19,20
Y	-----	11,18,21
Y	<p>LUCOVSKY G ET AL: "Low-temperature plasma-assisted oxidation of Si: A new approach for creation of device-quality Si-SiO₂ interfaces with deposited dielectrics for applications in Si MOSFET technologies" JOURNAL OF NON-CRYSTALLINE SOLIDS, NORTH-HOLLAND PHYSICS PUBLISHING. AMSTERDAM, NL, vol. 179, 1994, pages 354-366, XP004067829 ISSN: 0022-3093 page 354 - page 355; figure 1</p>	24-26
A	-----	
A	<p>US 5 726 087 A (TSENG HSING-HUANG ET AL) 10 March 1998 (1998-03-10) page 1, line 13 - line 20 page 2, line 10 - line 53; figure 1 page 3, line 39 - line 47; figures 4,5 page 4, line 1 - line 14; figure 8 page 4, line 56 - page 5, line 20; figure 11</p>	1,2, 18-26
P,X	<p>WO 03/001607 A (MASSACHUSETTS INST TECHNOLOGY) 3 January 2003 (2003-01-03) page 7, line 1 - line 25; figure 1 page 8, line 14 - line 22; figure 2 page 9, line 17 - line 20; figure 3 page 14, line 15 - line 18 page 14, line 24 - line 30</p>	1-21,24

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 03/34576

Box I Observations where certain claims were found unsearchable (Continuation of item 1 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 II Observations where unity of invention is lacking (Continuation of item 2 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 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.:

1-26

Remark on Protest

The additional search fees were accompanied by the applicant's protest.

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: 1-26

A method for forming a semiconductor structure comprising the formation over a substrate, of a strained semiconductor layer and a deposited screening layer.

2. claims: 27-50

A method for forming a semiconductor structure comprising the formation over a substrate, of a strained semiconductor layer, a deposited pad oxide layer and a masking layer.

INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/US 03/34576

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 2002068393	A1	06-06-2002	US 2003207571 A1	06-11-2003
			AU 8313801 A	18-02-2002
			EP 1307917 A2	07-05-2003
			JP 2004519090 T	24-06-2004
			WO 0213262 A2	14-02-2002
			US 2002104993 A1	08-08-2002

US 5726087	A	10-03-1998	US 5712208 A	27-01-1998

WO 03001607	A	03-01-2003	EP 1399974 A1	24-03-2004
			JP 2004531901 T	14-10-2004
			WO 03001607 A1	03-01-2003
			WO 03001671 A2	03-01-2003
			US 2002197803 A1	26-12-2002
			EP 1415331 A2	06-05-2004
			JP 2004538634 T	24-12-2004
			WO 03015142 A2	20-02-2003
			US 2003025131 A1	06-02-2003
			US 2004164318 A1	26-08-2004
