



- (51) International Patent Classification:
H01L 21/02 (2006.01) *H01L 21/306* (2006.01)
H01L 21/20 (2006.01)
- (21) International Application Number:
PCT/GB2012/050560
- (22) International Filing Date:
14 March 2012 (14.03.2012)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
1104261.1 14 March 2011 (14.03.2011) GB
- (71) Applicant (for all designated States except US): **UNIVERSITY OF LEEDS** [GB/GB]; Leeds, Yorkshire LS2 9JT (GB).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **LI, Lianhe** [CN/GB]; School of Electronic and Electrical Engineering, University of Leeds, Leeds, Yorkshire LS2 9JT (GB). **DAVIES, Alexander** [GB/GB]; School of Electronic and Electrical Engineering, University of Leeds, Leeds, Yorkshire LS2 9JT

(GB). **LINFIELD, Edmund** [GB/GB]; School of Electronic and Electrical Engineering, University of Leeds, Leeds, Yorkshire LS2 9JT (GB).

(74) Agent: **HARRISON GODDARD FOOTE**; Saviour House, 9 St Saviourgate, York, Yorkshire YO1 8NQ (GB).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, 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, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,

[Continued on next page]

(54) Title: OXIDE REMOVAL FROM SEMICONDUCTOR SURFACES

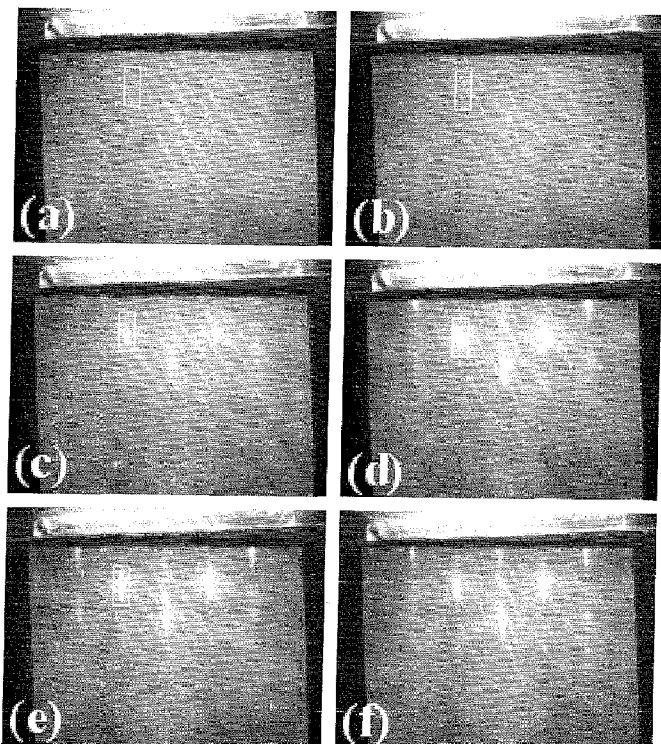


Fig. 1

(57) Abstract: A method of removing at least one oxide from a surface of a body of semiconductor material is disclosed, the method comprising: arranging the body in a vacuum chamber; and maintaining a temperature of the body in the vacuum chamber within a predetermined range, or substantially at a predetermined value, while exposing said surface to a flux of indium atoms. Corresponding methods of processing an oxidised surface of a body of semiconductor material to prepare the surface for epitaxial growth of at least one epitaxial layer or film over said surface, and methods of manufacturing a semiconductor device are also disclosed.





SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
GW, ML, MR, NE, SN, TD, TG).

— 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))

Declarations under Rule 4.17:

— of inventorship (Rule 4.17(iv))

(88) Date of publication of the international search report:

7 March 2013

Published:

— with international search report (Art. 21(3))

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2012/050560

A. CLASSIFICATION OF SUBJECT MATTER
 INV. H01L21/02 H01L21/20 H01L21/306
 ADD.
 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 C30B

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, 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	ATKINSON P ET AL: "Site-controlled growth and luminescence of InAs quantum dots using in situ Ga-assisted deoxidation of patterned substrates", APPLIED PHYSICS LETTERS, AIP, AMERICAN INSTITUTE OF PHYSICS, MELVILLE, NY, US, vol. 93, no. 10, 10 September 2008 (2008-09-10), pages 101908-101908, XP012111344, ISSN: 0003-6951, DOI: 10.1063/1.2980445	36-38, 40-46
A	the whole document ----- -/--	1-35

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 16 October 2012	Date of mailing of the international search report 11/01/2013
--	--

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 Bruckmayer, Manfred
--	---

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2012/050560

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.:

1-38(completely); 40-46(partially)

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: 1-38(completely); 40-46(partially)

A method, use and corresponding device comprising the de-oxidation of a semiconductor surface with a flux to indium atoms.

2. claims: 39(completely); 40-46(partially)

A device comprising an epitaxial layer with a certain indium concentration formed on a patterned semiconductor body.

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2012/050560

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	L. H. LI ET AL: "In-assisted desorption of native GaAs surface oxides", APPLIED PHYSICS LETTERS, vol. 99, no. 6, 11 August 2011 (2011-08-11), pages 061910-061910-3, XP055039866, ISSN: 0003-6951, DOI: 10.1063/1.3623424 the whole document	1-28,31, 32, 34-38, 40,41, 44,45
X	----- BASTIMAN F ET AL: "Ga assisted oxide desorption on GaAs(001) studied by scanning tunnelling microscopy", JOURNAL OF CRYSTAL GROWTH, ELSEVIER, AMSTERDAM, NL, vol. 312, no. 10, 1 May 2010 (2010-05-01), pages 1687-1692, XP026989770, ISSN: 0022-0248 [retrieved on 2010-02-18]	36-38, 40-46
A	the whole document -----	1-35