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- (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, BN, 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, IR, IS, JP, KE, KG, 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, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, 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.

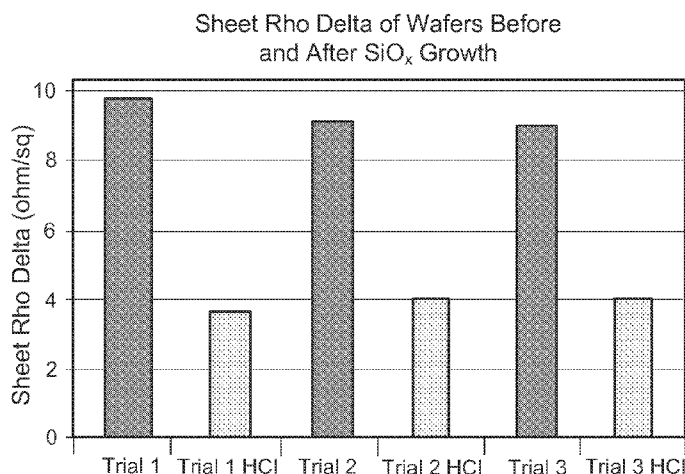
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Published:

- 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:**
5 February 2015

(54) **Title:** CHEMICAL COMPOSITIONS FOR SEMICONDUCTOR MANUFACTURING PROCESSES AND/OR METHODS, APPARATUS MADE WITH SAME

**FIG. 1A**

(57) **Abstract:** The present invention relates generally to the field of semiconductors and/or semiconductor structures (e.g., solar cells, etc.), to chemical compositions for manufacturing such semiconductors and/or semiconductor structures, and/or to methods for manufacturing such semiconductors and/or semiconductor structures. In another embodiment, the present invention relates to chemical compositions and methods for controlling surface passivation, dead layer etchback, anti-reflective, potential induced degradation, and other properties of semiconductor surfaces used for various semiconductor applications including, but not limited to, solar cells.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 14/41682

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - H01L 21/335 (2014.01)

CPC - B82Y 10/00; H01L 29/785

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 (8): H01L 21/335 (2014.01)

CPC: B82Y 10/00; H01L 29/785

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

USPC- 438/142,49;257/E21.276

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
 PatBase (PGPB, USPT, USOC, EPAB, JPAB, DWPI, TBD), FreePatentsOnline (US Pat, PgPub, EPO, JPO, WIPO, NPL),
 GoogleScholar (PL, NPL); search terms: compositions semiconductor manufacturing processes

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Nutsu et al., Solvent Extraction Equilibria of Acids. VII. The Co-extraction of Water with Strong Mineral Acids by Trioctylphosphine Oxide, Bulletin of the Chemical Society of Japan Vol. 52, No. 6, P 1799-1801 (1979) pg 1800, col 2, para 4	1
X	US 2012/0178257 A1 (Sapra et al.) 12 July 2012 (12.07.2012) abstract, para [0011]-[0012]	1
X	US 5,601,656 A (Li) 11 February 1997 (11.02.1997) abstract, col 5, ln 46-50	1
X	US 2012/0273458 A1 (Bret et al.) 1 November 2012 (01.11.2012) abstract, para [0012]-[0052], [0144]).	1-11, 13-17, 22, 24-27, 29-30
X	US 2012/0088318 A1 (Chang et al) 12 April 2012 (12.04.2012) abstract, para [0014]-[0023]	1, 12, 18-21, 28
Y	WO 2012/036760 A1 (Faur et al.) 22 March 2012 (22.03.2012) abstract, para [0028]-[0030], [0226]-[0229], [0234]-[0235]	1-22, 24-30
Y	US 6,613,697 B1 (Faur et al.) 02 September 2003 (02.09.2003) abstract, col 3, ln 15 to col 5, ln 60	1-22, 24-30
Y	US 2009/0192065 A1 (Korzenski et al.) 30 July 2009 (30.07.2009) abstract, para [0081]-[0083]	1-22, 24-30
Y	US 2010/0101453 A1 (Tanaka et al.) 29 April 2010 (29.04.2010) abstract, para [0034]	1-22, 24-30
Y	US 6,783,695 B1 (Torck et al.) 31 August 2004 (31.08.2004) abstract, col 5, ln 66 to col 6, ln 18	1-22, 24-30

☐ Further documents are listed in the continuation of Box C.

* 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 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

"&" document member of the same patent family

Date of the actual completion of the international search

12 November 2014 (12.11.2014)

Date of mailing of the international search report

03 DEC 2014

Name and mailing address of the ISA/US

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 14/41682

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.: 23, 56-72
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 supplemental box

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 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.:
1-22, 24-30

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

International application No.

PCT/US 14/41682

Continuation of Box III:

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1.

Group I, claims 1-22 and 24-30, directed to a composition comprising compounds comprising iodine (HIO₃), fluorine (HF), non-oxidizing acid (HCl) and water

Group II, claims 31-45, directed to a semiconductor device comprising at least one passivation oxide layer, wherein the passivation oxide layer is formed by the method comprising treating the semiconductor device with the composition of claim 1 (i.e., method of use of claim 1)

Group III, claims 46-55, directed to a method of making the composition of claim 1

The groups of inventions listed above do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Special Technical Features (Distinct Technical Features):

The special technical feature of Group II is a semiconductor device having a passivation oxide layer formed by a method comprising the step of treating the semiconductor device with the composition of claim 1, not required in any other group.

The special technical feature of Group III is a method of making comprising admixing the composition of claim 1, not required in any other group.

Common Technical Features (Features Do Not Make a Contribution Over the Prior Art):

Groups I-III are related as a composition (Group I), a method of using the composition to make a device (Group II), and a method of making the composition (Group III) and share the technical feature of claim 1. However, this technical feature is not a unifying technical feature as it does not make a contribution over the anticipating prior art US 20120273458 A1 (Bret et al.), which teaches a composition of claim 1 comprising: (A) a compound comprising iodine (para [0051]); (B) a first acid comprising fluorine (para [0051]: HF); (C) a second, non-oxidizing acid (para [0051]: HCl; para [0052]); and (d) water (para [0050], [0144]).

Therefore, inventions of Groups I-III lack unity under PCT Rule 13.

Continuation of Item 4: Claims 23 and 56-72 are unsearchable improper multidependent claims because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).