(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
11 September 2009 (11.09.2009)

PCT

(10) International Publication Number
WO 2009/111575 A3

(51) International Patent Classification:
C23C 16/24 (2006.01) *C23C 16/448* (2006.01)

(21) International Application Number:
PCT/US2009/036050

(22) International Filing Date:
4 March 2009 (04.03.2009)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/034,103 5 March 2008 (05.03.2008) US

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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, BR, BW, BY, BZ, CA, CH, 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, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, 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, 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, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR),

[Continued on next page]

(54) Title: SUBSTRATES FOR SILICON SOLAR CELLS AND METHODS OF PRODUCING THE SAME

(57) Abstract: Aspects of the invention include methods for depositing silicon on a substrate. In certain embodiments, the methods include exposing a substrate containing silicon to a halogenated silane in a manner sufficient to deposit the silicon on the substrate. In certain embodiments, the method includes providing a substrate, one or more sources of gas, and a reaction vessel that is in fluid communication with the substrate and the one or more sources of gas. In certain embodiments, the substrate is a low or metallurgical grade silicon which may be subjected to a purification process. In certain embodiments, the reaction vessel is a particle bed reaction vessel that includes a moving bed, such as a fluidized bed which contains silicon and the gas includes a halide.

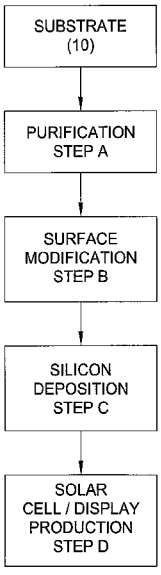

FIG. 1

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

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))*

— *with information concerning one or more priority claims considered void (Rule 26bis.2(d))*

(88) Date of publication of the international search report:
29 October 2009

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2009/036050

A. CLASSIFICATION OF SUBJECT MATTER
INV. C23C16/24 C23C16/448

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)
C23C

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 203 07 886 U1 (GEYER STEFAN [DE]) 28 August 2003 (2003-08-28)	51,52
Y	examples 1,2	1,2,6-8, 16-23, 42-50
Y	US 5 855 678 A (SANJURJO ANGEL [US] ET AL) 5 January 1999 (1999-01-05) column 3, line 14 - column 5, line 54	1,2,6-8, 16-23, 42-50

☐ 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

"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.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 June 2009	28/08/2009

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Fax: (+31–70) 340–3016	Ekhult, Hans

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2009/036050

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 allsearchable 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 reportcovers 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, 2, 6-8, 16-23, 42-52

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: 1,2,6-8,16-23,42-52

A method for depositing silicon on a metallurgical grade silicon substrate.

1.1. claims: 16-23

A method for depositing silicon on a metallurgical grade silicon substrate using specific bed process.

1.2. claims: 42-50

A method for depositing silicon on a metallurgical grade silicon substrate using oparticular parameters.

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2. claims: 1,3-5

A method for depositing silicon on a metallurgical grade silicon substrate using a substrate with a secondary phase.

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3. claims: 9-15, 38-41

A method for depositing silicon on a metallurgical grade silicon substrate purified by a specific process.

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4. claims: 1,24-37

A method for depositing silicon on a metallurgical grade silicon substrate involving doping.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2009/036050

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 20307886 U1	28-08-2003	NONE	
US 5855678 A	05-01-1999	AT 229096 T	15-12-2002
		DE 69809899 D1	16-01-2003
		DE 69809899 T2	28-08-2003
		EP 0979316 A1	16-02-2000
		JP 2001512533 T	21-08-2001
		WO 9849366 A1	05-11-1998