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(71) Applicant *(for all designated States except US)*: **AIR PRODUCTS AND CHEMICALS, INC.** [US/US]; 7201 Hamilton Boulevard, Allentown, Pennsylvania 18195 (US).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **XIAO, Manchao** [US/US]; 5534 Caballos Place, San Diego, California 92130 (US). **LEI, Xinjian** [US/US]; 1928 Cherrywood, Vista, California 92081 (US). **PEARLSTEIN, Ronald Martin** [US/US]; 1156 Glen Ellen Place, San Marcos, California 92078 (US). **CHANDRA, Haripin** [ID/US]; 888 Buttercup Road, Carlsbad, California 92011 (US). **KARWACKI, Eugene Joseph** [US/US]; 5620 Snowdrift Lane, Orefield, Pennsylvania 18069 (US). **HAN, Bing** [CN/US]; 1258 Jarvis Lane, Lansdale, Pennsylvania 19446 (US). **O'NEILL, Mark Leonard** [CA/US]; 1296 Holmgrove Drive, San Marcos, California 92078 (US).

(74) Agents: **OLTMANS, Andrew L.** et al.; McNees Wallace & Nurick LLC, 100 Pine Street, P.O. Box 1166, Harrisburg, Pennsylvania 17108-1166 (US).

(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.

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Published:
— *with international search report (Art. 21(3))*

[Continued on next page]

(54) Title: COMPOSITIONS AND PROCESSES FOR DEPOSITING CARBON-DOPED SILICON-CONTAINING FILMS

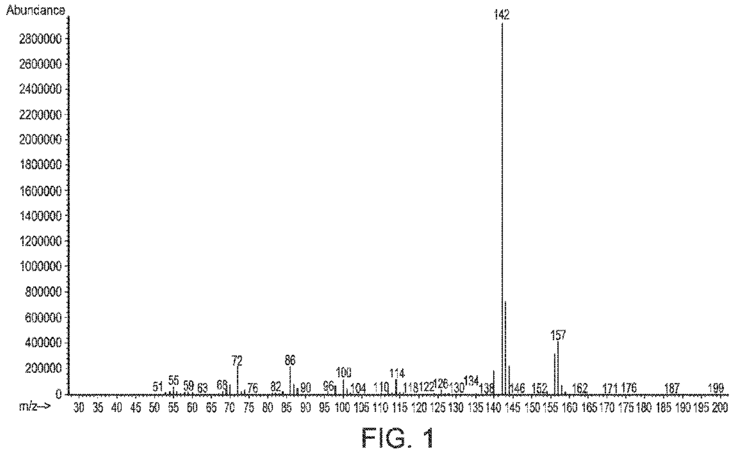

FIG. 1

(57) Abstract: Described herein are compositions for depositing a carbon-doped silicon containing film wherein the composition comprises a first precursor comprising at least one compound selected from the group consisting of: an organoaminoalkylsilane having a formula of $R^5Si(NR^3R^4)_xH_{3-x}$ wherein x=1, 2, 3; an organoalkoxyalkylsilane having a formula of $R^6Si(OR^7)_xH_{3-x}$ wherein x=1, 2, 3; an organoaminosilane having a formula of $R^8N(SiR^9(NR^{10}R^{11})H)_2$; an organoaminosilane having a formula of $R^8N(SiR^9LH)_2$ and combinations thereof; and optionally a second precursor comprising a compound having the formula: $Si(NR^1R^2)H_3$. Also described herein are methods for depositing a carbon- doped silicon-containing film using the composition wherein the method is one selected from the following: cyclic chemical vapor deposition (CCVD), atomic layer deposition (ALD), plasma enhanced ALD (PEALD) and plasma enhanced CCVD (PECCVD).

— *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:
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INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. C23C16/30 C07F7/00 C07F7/08 C23C16/34 C23C16/40
C23C16/455 C07F7/10 C07F7/18
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)
C23C C07F

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, IBM-TDB, WPI Data, CHEM ABS Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	BLASZCZYK-LEZAK ET AL: "Silicon carbonitride by remote microwave plasma CVD from organosilicon precursor: Physical and mechanical properties of deposited Si:C:N films", APPLIED SURFACE SCIENCE, ELSEVIER, AMSTERDAM, NL, vol. 253, no. 18, 7 June 2007 (2007-06-07), pages 7404-7411, XP022107405, ISSN: 0169-4332, DOI: 10.1016/J.APSUSC.2007.03.027 the whole document ----- -/--	1,15,16

☒ 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 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

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"&" document member of the same patent family

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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 Brisson, Olivier

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/040433

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	A. M. WROBEL ET AL: "Reactivity of organosilicon precursors in remote hydrogen microwave plasma chemical vapor deposition of silicon carbide and silicon carbonitride thin-film coatings", APPLIED ORGANOMETALLIC CHEMISTRY, vol. 24, no. 3, 1 March 2010 (2010-03-01), pages 201-207, XP55036872, ISSN: 0268-2605, DOI: 10.1002/aoc.1589 the whole document -----	1,15,16
X	JP 2010 275602 A (ADEKA CORP) 9 December 2010 (2010-12-09) cited in the application abstract -----	1,15,16
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	HOLGER FLEISCHER ET AL: "Gas-phase molecular structures of bis(chloromethylsilyl)amine and bis(chloromethylsilyl)methylamine by electron diffraction and ab initio calculations; experimental support for n(N)-[sigma]*(Si-Cl) hyperconjugation?+", JOURNAL OF THE CHEMICAL SOCIETY, DALTON TRANSACTIONS, no. 4, 1 January 1998 (1998-01-01), pages 593-600, XP55043355, ISSN: 0300-9246, DOI: 10.1039/a708219c the whole document -----	1,21,22
X	BE 672 101 A (YISSUM RESEARCH DEVELOPMENT COMPANY) 1 March 1966 (1966-03-01) page 4, line 10 - page 5, line 8	1,21,22
X	-& Chemical Abstract 1966:473661 XP55043368 abstract -----	1,21,22
X	ERIC BACQUÉ ET AL: "Synthesis and chemical properties of 1,3-dichloro-1,3-dihydridodisilazanes", JOURNAL OF ORGANOMETALLIC CHEMISTRY, vol. 481, 1 January 1994 (1994-01-01), pages 167-172, XP55043403, the whole document -----	1,21,22

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/040433

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.:

   15-22(completely); 1-14(partially)

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.:

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: 21, 22(completely); 1-14(partially)

   A composition for depositing a carbon-doped silicon containing film comprising a precursor of formula (iv) and a method of forming a carbon-doped silicon oxide film involving the use of such a precursor

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2. claims: 15, 16(completely); 1-6(partially)

   A composition comprising optionally a second precursor as defined in claim 2, in addition to a first precursor comprising an organoaminoalkylsilane of formula (i)

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3. claims: 7-14(partially)

   Methods comprising the step of introducing into a reactor a first precursor comprising an organoaminoalkylsilane of formula (i)

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4. claims: 17, 18(completely); 1-14(partially)

   A composition for depositing a carbon-doped silicon containing film comprising a precursor of formula (ii) and a method of forming a carbon-doped silicon oxide film involving the use of such a precursor

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5. claims: 19, 20(completely); 1-14(partially)

   A composition for depositing a carbon-doped silicon containing film comprising a precursor of formula (iii) and a method of forming a carbon-doped silicon oxide film involving the use of such a precursor

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2012/040433

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