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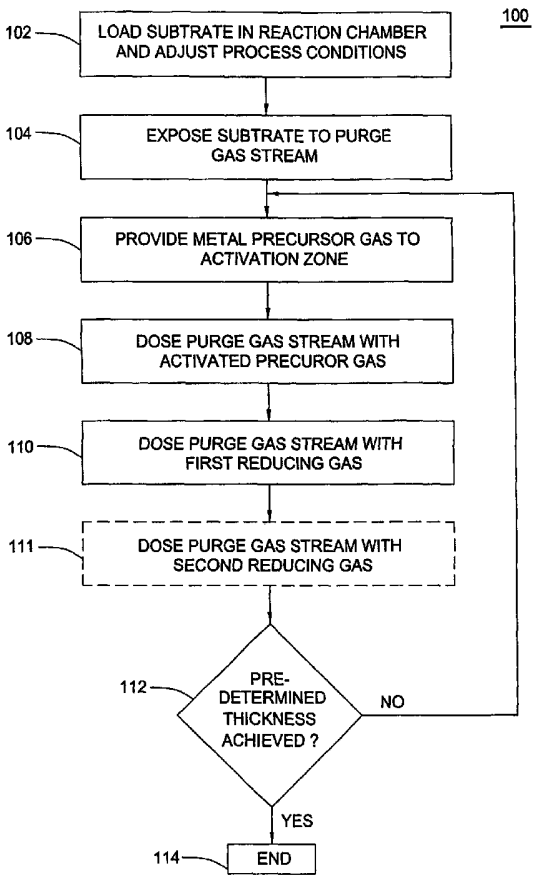
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD OF FILM DEPOSITION USING ACTIVATED PRECURSOR GASES



(57) Abstract: A method for depositing a film on a substrate is provided. In one aspect, the method includes providing a metal-containing precursor to an activation zone, and activating the metal-containing precursor to form an activated precursor. The activated precursor gas is transported to a reaction chamber, and a film is deposited on the substrate using a cyclical deposition process, wherein the activated precursor gas and a reducing gas are alternately adsorbed on the substrate. Also provided is a method of depositing a film on a substrate using an activated reducing gas.

WO 2004/007792 A3

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 03/19706

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 C23C16/455 C23C16/34

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 7 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, PAJ, WPI Data, IBM-TDB, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 02 43114 A (SIMPLUS SYSTEMS CORP) 30 May 2002 (2002-05-30)	1,7-9, 11-13, 15,19, 21-23
Y	page 3, line 23 -page 9, line 24	5,14
X	DE KEIJSER M ET AL: "Atomic layer epitaxy of gallium arsenide with the use of atomic hydrogen" APPLIED PHYSICS LETTERS, 18 MARCH 1991, USA, vol. 58, no. 11, pages 1187-1189, XP002268294 ISSN: 0003-6951 page 1187, right-hand column, line 14 - line 33	1,6, 10-12, 15,19,20

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in 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

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"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
2 February 2004	26/02/2004

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, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Ekhult, H

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 03/19706

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2002/060363 A1 (MARCADAL CHRISTOPHE ET AL) 23 May 2002 (2002-05-23)	24,25,27
A	paragraphs '0030!-'0032!	26
Y	JIN-SEONG PARK ET AL: "Plasma-enhanced atomic layer deposition of Ta-N thin films" JOURNAL OF THE ELECTROCHEMICAL SOCIETY, JAN. 2002, ELECTROCHEM. SOC, USA, vol. 149, no. 1, pages C28-C32, XP002268295 ISSN: 0013-4651	24,25,27
A	*EXPERIMENTAL*	26
Y	US 2001/024871 A1 (YAGI SHIGERU) 27 September 2001 (2001-09-27) paragraphs '0072!-'0074!,'0120!-'0127!; figure 1	5
Y	KIM H ET AL: "The growth of tantalum thin films by plasma-enhanced atomic layer deposition and diffusion barrier properties" SILICON MATERIALS - PROCESSING, CHARACTERIZATION AND RELIABILITY SYMPOSIUM (MATER. RES. SOC. PROCEEDINGS VOL. 716), SILICON MATERIALS - PROCESSING, CHARACTERIZATION AND RELIABILITY. SYMPOSIUM, SAN FRANCISCO, CA, USA, 1-5 APRIL 2002, pages 407-412, XP008026978 2002, Warrendale, PA, USA, Mater. Res. Soc, USA ISBN: 1-55899-652-4 *EXPERIMENTS*	14
A	WO 01 27346 A (ASM MICROCHEMISTRY OY ;ELERS KAI ERIK (FI)) 19 April 2001 (2001-04-19) page 9, line 1 - line 18	2-4, 16-18
A	JUPPO M ET AL: "TRIMETHYLALUMINUM AS A REDUCING AGENT IN THE ATOMIC LAYER DEPOSITION F TI(AI)N THIN FILMS" CHEMICAL VAPOR DEPOSITION, VCH PUBLISHERS, WEINHEIM, DE, vol. 7, no. 5, September 2001 (2001-09), pages 211-217, XP001099852 ISSN: 0948-1907 paragraphs '0001!,'02.1!	2-4, 16-18

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 03/19706

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	M.RITALA ET AL: "CONTROLLED GROWTH OF TAN, TA3N5, AND TAOXNY THIN FILMS BY ATOMIC LAYER DEPOSITION" CHEMISTRY OF MATERIALS, vol. 11, 1999, pages 1712-1718, XP002268297 US *EXPERIMENTAL SECTION* ---	2-4, 16-18
A	SHENG T ET AL: "Decomposition of trimethylgallium in the downstream region of a near afterglow plasma" APPLIED PHYSICS LETTERS, 4 DEC. 1989, USA, vol. 55, no. 23, pages 2411-2413, XP002268298 ISSN: 0003-6951 figure 2 -----	1-27

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 03/19706

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.:

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: 1-10,15-23

   Deposition process using activated metal-containing precursor .

2. Claims: 11-14,24-27

   Deposition process using activated reducing gas.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 03/19706

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