

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
3 April 2003 (03.04.2003)

PCT

(10) International Publication Number
WO 03/028069 A3

(51) International Patent Classification⁷: **C23C 16/455**

(21) International Application Number: PCT/US02/30582

(22) International Filing Date:
25 September 2002 (25.09.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/964,075 25 September 2001 (25.09.2001) US

(71) Applicant: **APPLIED MATERIALS, INC.** [US/US];
P.O. Box 450 A, Santa Clara, CA 95052 (US).

(72) Inventors: **LUO, Lee**; 222 Brunswick Place, Fremont,
CA 94539 (US). **AHN, Sang Hoon**; 3467 Warburton
Avenue, Santa Clara, CA 95051 (US). **CHEN, Aihua**;
2278 Quail Bluff Place, San Jose, CA 95121 (US). **IYER,**

Ramaseshan Suryanarayanan; 2288 Lenox Place, Santa
Clara, CA 95054 (US). **WANG, Shulin**; 959 Steinway
Avenue, Campbell, CA 95008 (US). **THAKUR, Randhir,**
P., Singh; 5261 Apennines Circle, San Jose, CA 95138
(US).

(74) Agents: **BERNADICOU, Michael, A.** et al.; Blakely,
Sokoloff, Taylor & Zafman LLP, 12400 Wilshire Boule-
vard, 7th Floor, Los Angeles, CA 90025 (US).

(81) Designated States (*national*): CN, JP, KR.

(84) Designated States (*regional*): European patent (AT, BE,
BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT,
LU, MC, NL, PT, SE, SK, TR).

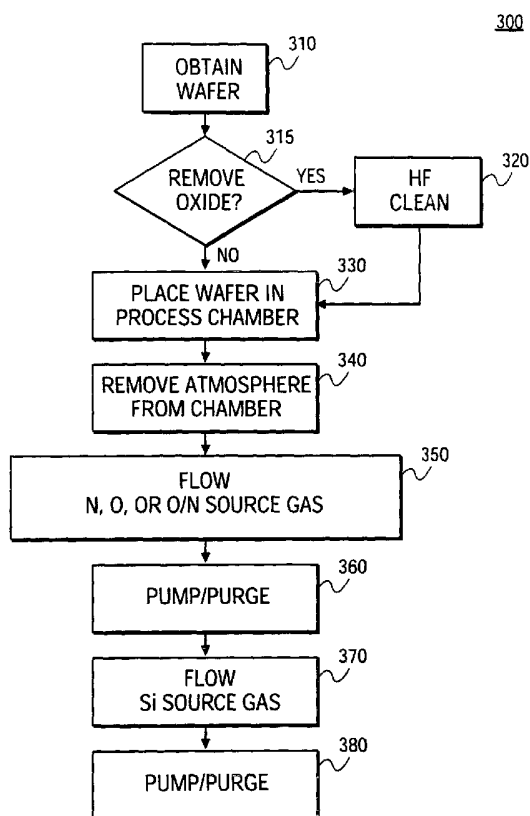
Published:

— with international search report

(88) Date of publication of the international search report:
11 December 2003

[Continued on next page]

(54) Title: METHOD FOR CYCLIC CVD



(57) Abstract: A method for film deposition that includes, flowing a first reactive gas over a top surface of a wafer in a cold wall single wafer process chamber to form a first half-layer of the film on the wafer, stopping the flow of the first reactive gas, removing residual first reactive gas from the cold wall single wafer process chamber, flowing a second reactive gas over the first half-layer to form a second half-layer of the film where deposition of the second half-layer is non self-limiting, controlling a thickness of the second half-layer by regulating process parameters within the cold wall single wafer process chamber, stopping the flow of the second reactive gas; and removing residual second reactive gas from the cold wall single wafer process chamber.



WO 03/028069 A3



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.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 02/30582

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 C23C16/455

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)

PAJ, WPI Data, IBM-TDB, 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	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 25, 12 April 2001 (2001-04-12) & JP 2001 237243 A (ASM AMERICA INC), 31 August 2001 (2001-08-31) abstract	1-6, 10-17
P, X	& US 6 348 420 B1 (I. RAAIJMAKERS) 19 February 2002 (2002-02-19) column 5, line 22 - line 65; examples 1,6 ---	1-6, 10-17
X	US 6 284 583 B1 (SAIDA SHIGEHICO ET AL) 4 September 2001 (2001-09-04) examples 3,5 --- -/--	28-38, 63-66

☒ Further documents are listed in the continuation of box C.☒ 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
- *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.
- *Z* document member of the same patent family

Date of the actual completion of the international search

14 March 2003

Date of mailing of the international search report

20/03/2003

Name and mailing address of the ISA

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

Authorized officer

EkhuIt, H

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 02/30582

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>Ooba K ET AL: "SELF-LIMITING ATOMIC-LAYER SELECTIVE DEPOSITION OF SILICON NITRIDE BY TEMPERATURE-CONTROLLED METHOD"</p> <p>EXTENDED ABSTRACTS OF THE INTERNATIONAL CONFERENCE ON SOLID STATE DEVICES AND MATERIALS, JAPAN SOCIETY OF APPLIED PHYSICS. TOKYO, JA, September 1998 (1998-09), pages 22-23, XP000823058 paragraph '0002!</p> <p>---</p>	39-48
X	<p>EP 1 047 117 A (OKI ELECTRIC IND CO LTD) 25 October 2000 (2000-10-25) paragraphs '0020!-'0022!,'0056!; figures 6,7</p> <p>---</p>	1,9,10, 19,20
X	<p>PATENT ABSTRACTS OF JAPAN vol. 1995, no. 08, 29 September 1995 (1995-09-29) & JP 07 130731 A (NEC CORP), 19 May 1995 (1995-05-19) abstract</p> <p>---</p>	49,53-56
A	<p>EP 0 340 113 A (FUJITSU LTD) 2 November 1989 (1989-11-02) column 5, line 24 -column 6, line 18</p> <p>---</p>	28-38
A	<p>US 5 939 333 A (LI LI ET AL) 17 August 1999 (1999-08-17) column 6, line 45 -column 8, line 10; figure 5</p> <p>---</p>	1-66
A	<p>NAGATA T ET AL: "SINGLE-CHIP INTEGRATION OF LIGHT-EMITTING DIODE, WAVEGUIDE AND MICROMIRRORS"</p> <p>JAPANESE JOURNAL OF APPLIED PHYSICS, PUBLICATION OFFICE JAPANESE JOURNAL OF APPLIED PHYSICS. TOKYO, JP, vol. 34, no. 2B, PART 1, 1 February 1995 (1995-02-01), pages 1282-1285, XP000599443 ISSN: 0021-4922 figure 2</p> <p>---</p>	28-38, 63-66
A	<p>HIROSHI GOTO ET AL: "ATOMIC LAYER CONTROLLED DEPOSITION OF SILICON NITRIDE WITH SELF-LIMITING MECHANISM"</p> <p>APPLIED PHYSICS LETTERS, AMERICAN INSTITUTE OF PHYSICS. NEW YORK, US, vol. 68, no. 23, 3 June 1996 (1996-06-03), pages 3257-3259, XP000599530 ISSN: 0003-6951 the whole document</p> <p>-----</p>	28-38, 63-66

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 02/30582

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
JP 2001237243	A	31-08-2001	US 6348420 B1	19-02-2002
			US 2002052124 A1	02-05-2002
US 6284583	B1	04-09-2001	JP 11074485 A	16-03-1999
			US 2001024867 A1	27-09-2001
EP 1047117	A	25-10-2000	JP 3350478 B2	25-11-2002
			JP 2000307082 A	02-11-2000
			EP 1047117 A2	25-10-2000
			TW 469498 B	21-12-2001
			US 6319763 B1	20-11-2001
JP 07130731 3	A		NONE	
EP 0340113	A	02-11-1989	DE 68918150 D1	20-10-1994
			EP 0340113 A1	02-11-1989
			JP 2080639 C	09-08-1996
			JP 2191318 A	27-07-1990
			JP 7118450 B	18-12-1995
			US 5484664 A	16-01-1996
			US 5130269 A	14-07-1992
			US 5300186 A	05-04-1994
US 5939333	A	17-08-1999	US 6350708 B1	26-02-2002
			US 6204206 B1	20-03-2001
			US 6127287 A	03-10-2000