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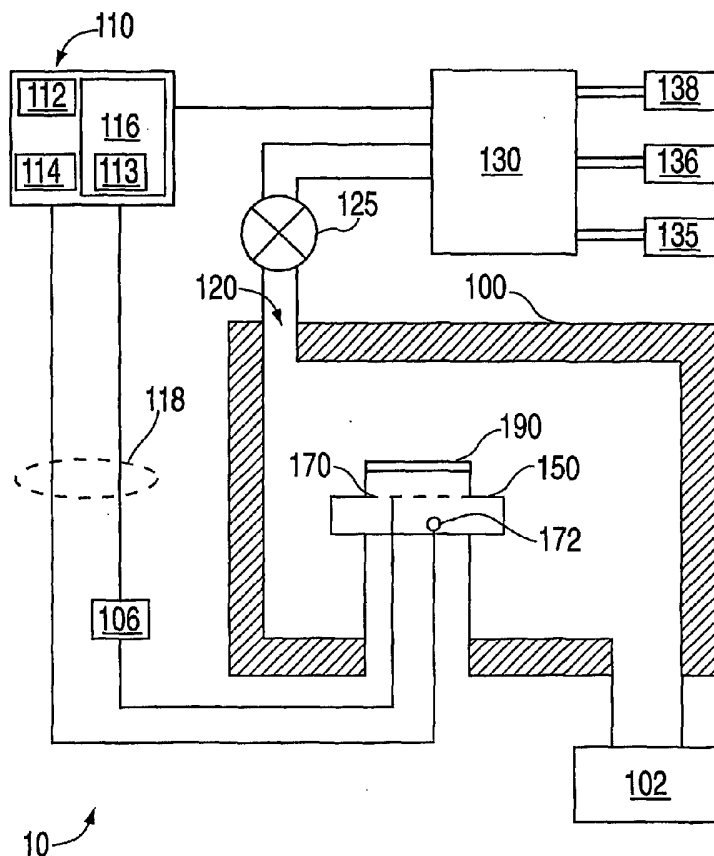
(43) International Publication Date  
15 August 2002 (15.08.2002)

PCT

(10) International Publication Number  
WO 02/063677 A3

- (51) International Patent Classification<sup>7</sup>: H01L 21/768, 21/285
  - (74) Agent: PATTERSON, William, B.; Moser, Patterson & Sheridan, LLP, 3040 Post Oak Blvd., Suite 1500, Houston, TX 77056 (US).
  - (21) International Application Number: PCT/US02/02651
  - (81) Designated States (national): JP, KR.
  - (22) International Filing Date: 30 January 2002 (30.01.2002)
  - (84) Designated States (regional): European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR).
  - (25) Filing Language: English
  - (26) Publication Language: English
  - Published: — with international search report
  - (30) Priority Data: 09/776,329 2 February 2001 (02.02.2001) US
  - (88) Date of publication of the international search report: 9 October 2003
  - (71) Applicant: APPLIED MATERIALS, INC. [US/US]; 3050 Bowers Avenue, Santa Clara, CA 95054 (US).
  - (15) Information about Correction: Previous Correction: see PCT Gazette No. 33/2003 of 14 August 2003, Section II
  - (72) Inventors: SEUTTER, Sean, M.; 4261 Stevenson Boulevard, # 277, Fremont, CA 94538 (US). YANG, Michael, X.; 793 Cereza Dr., Palo Alto, CA 94306 (US). XI, Ming; 138 Beaumere Way, Milpitas, CA 95035 (US).
- 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: FORMATION OF A TANTALUM-NITRIDE LAYER



(57) Abstract: A method of forming a tantalum-nitride layer (204) for integrated circuit fabrication is disclosed. Alternating or co-reacting pulses of a tantalum containing precursor and a nitrogen containing precursor are provided to a chamber (100) to form layers (305, 307) of tantalum and nitrogen. The nitrogen precursor may be a plasma gas source. The resultant tantalum-nitride layer (204) may be used, for example, as a barrier layer. As barrier layers may be used with metal interconnect structures (206), at least one plasma anneal on the tantalum-nitride layer may be performed to reduce its resistivity and to improve film property.

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## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 02/02651

<b>A. CLASSIFICATION OF SUBJECT MATTER</b> IPC 7 H01L21/768 H01L21/285		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b>		
Minimum documentation searched (classification system followed by classification symbols) IPC 7 H01L		
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, WPI Data, PAJ, INSPEC		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No. .
X	WO 00 54320 A (GENUS INC) 14 September 2000 (2000-09-14) page 2-4 page 11, line 7-24; figure 2	1,2,9, 10,14,15
Y	---	11-13
A		29,30
Y	WO 00 16377 A (KANG SANG WON ;YI KYOUNG SOO (KR); GENITECH CO LTD (KR); KOH WON Y) 23 March 2000 (2000-03-23) page 5, line 17-29	11-13
A	---	1-10,12, 14,15
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<input checked="" type="checkbox"/> Further documents are listed in the continuation of box C. <input checked="" type="checkbox"/> 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. "&" document member of the same patent family		
Date of the actual completion of the international search  2 October 2002		Date of mailing of the international search report  14-02-2003
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  Ploner, G

## INTERNATIONAL SEARCH REPORT

International Application No  
PCT/US 02/02651

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	ROSSNAGEL S M ET AL: "Plasma-enhanced atomic layer deposition of Ta and Ti for interconnect diffusion barriers" JOURNAL OF VACUUM SCIENCE & TECHNOLOGY B (MICROELECTRONICS AND NANOMETER STRUCTURES), JULY 2000, AIP FOR AMERICAN VACUUM SOC, USA, vol. 18, no. 4, pages 2016-2020, XP002215505 ISSN: 0734-211X the whole document -----	1,2, 9-15,29, 30

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US 02/02651

## 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.:  
  
1, 2, 9-15, 29, 30

### 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: 1,2,9-15,29,30

Atomic layer deposition of a tantalum nitride film by sequentially depositing a tantalum layer and a nitrogen layer

2. Claims: 4-8,16-23, 31

Plasma treatment of a tantalum nitride film to enhance the tantalum to nitrogen ratio in the film

3. Claims: 24-28

Forming a tantalum nitride barrier layer in a recess formed in a layer of dielectric material and etching through the barrier layer prior to deposition of a metal in the recess

4. Claims: 3, 32-34, 37-50

Deposition of a tantalum nitride film by providing a tantalum and a nitrogen precursor simultaneously and co-reacting said precursors

5. Claims: 35,36

Plasma assisted deposition of a tantalum nitride film from tantalum and nitrogen precursors

## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 02/02651

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			EP 1125324 A1 22-08-2001
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			WO 0016377 A2 23-03-2000
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