

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
1 November 2001 (01.11.2001)

PCT

(10) International Publication Number
WO 01/82355 A3

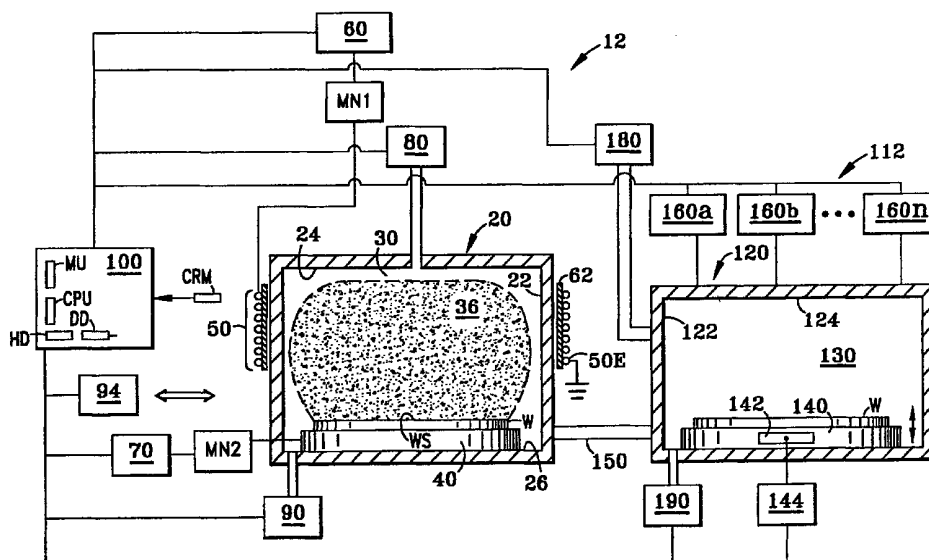
- (51) International Patent Classification⁷: H01L 21/306, 21/285, 21/00, H01J 37/32
- (74) Agents: LAZAR, Dale, S. et al.; Pillsbury Winthrop LLP, 1600 Tysons Boulevard McLean, Virginia 22102 (US).
- (21) International Application Number: PCT/US01/13002
- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (22) International Filing Date: 23 April 2001 (23.04.2001)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data: 60/199,354 25 April 2000 (25.04.2000) US
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
- (71) Applicant (for all designated States except US): TOKYO ELECTRON LIMITED [JP/JP]; TBS Broadcast Center, 3-6 Akasaka 5-chome, Minato-ku, Tokyo 107 (JP).
- (72) Inventor; and
- (75) Inventor/Applicant (for US only): LIU, Lianjun [US/US]; 100 W. Napal Place #232, Chandler, AZ 85224 (US).

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

[Continued on next page]

(54) Title: METHOD AND APPARATUS FOR PLASMA CLEANING OF WORKPIECES



(57) Abstract: A method and apparatus for plasma cleaning a workpiece (W) in a plasma-cleaning chamber (20) having an interior region (30). The method comprises the steps of first, loading the workpiece into the plasma cleaning chamber interior region. The next step is pumping down the plasma cleaning chamber interior region down to a pre-determined pressure, with hydrogen as the ambient gas. The next step is forming from the hydrogen gas a plasma (36) having an ion density in the range between 10^{10} and 10^{13} cm^{-3} and an ion energy lower than 30 eV. The last step is exposing the workpiece to the plasma for a predetermined time. The apparatus of the present invention preferably includes first and second vacuum processing chambers (20 and 120), wherein the first chamber performs the plasma cleaning of the workpiece according to the method of the invention, and the second chamber performs an additional process step, e.g., depositing a metal.



WO 01/82355 A3



(88) Date of publication of the international search report:
21 March 2002

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 01/13002

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01L21/306 H01L21/285 H01L21/00 H01J37/32

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 H01L H01J

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, INSPEC, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 99 34424 A (APPLIED MATERIALS) 8 July 1999 (1999-07-08) page 14, paragraph 3; figures 2,5	15-19
Y	---	1-14
Y	AOKI Y: "IN SITU SUBSTRATE SURFACE CLEANING BY LOW-ENERGY ION BOMBARDMENT FOR HIGH QUALITY THIN FILM FORMATION" JOURNAL OF VACUUM SCIENCE AND TECHNOLOGY: PART A, AMERICAN INSTITUTE OF PHYSICS. NEW YORK, US, vol. 11, no. 2, 1 March 1993 (1993-03-01), pages 307-313, XP000364354 ISSN: 0734-2101 the whole document	1-14
	---	-/--

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.
- *&* document member of the same patent family

Date of the actual completion of the international search

8 January 2002

Date of mailing of the international search report

15/01/2002

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

Gori, P

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 01/13002

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 915 204 A (SUMI) 22 June 1999 (1999-06-22) column 5, line 5 - line 20; claims ---	1-14
A	GROTJOHN T A: "ION SOURCES FOR MICROFABRICATION (INVITED)" REVIEW OF SCIENTIFIC INSTRUMENTS, AMERICAN INSTITUTE OF PHYSICS. NEW YORK, US, vol. 65, no. 4, PART 2, 1 April 1994 (1994-04-01), pages 1298-1303, XP000453928 ISSN: 0034-6748 page 1301, right-hand column, paragraph B ---	1-14
A	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 06, 22 September 2000 (2000-09-22) -& JP 2000 082681 A (SONY CORP), 21 March 2000 (2000-03-21) abstract ---	1-14
P,X	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 08, 6 October 2000 (2000-10-06) -& JP 2000 150479 A (CANON INC), 30 May 2000 (2000-05-30) abstract -----	1-14

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box I.2

The term "ESRF" in claim 17 has not been defined. Consequently it cannot be determined which features this term should comprise.

For the search the term "ESRF" has been replaced by "inductively coupled". The search is thus not complete for said claim 17.

The applicant's attention is drawn to the fact that claims, or parts of claims, relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 01/13002

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9934424	A	08-07-1999	US 6107192 A EP 1042795 A1 TW 411497 B WO 9934424 A1
US 5915204	A	22-06-1999	JP 8264483 A
JP 2000082681	A	21-03-2000	NONE
JP 2000150479	A	30-05-2000	NONE