

(51) International Patent Classification:
H01L 21/3065 (2006.01)(21) International Application Number:
PCT/US2012/034915(22) International Filing Date:
25 April 2012 (25.04.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/491,679 31 May 2011 (31.05.2011) US(71) Applicant (for all designated States except US): **APPLIED MATERIALS, INC.** [US/US]; 3050 Bowers Avenue, Santa Clara, California 95054 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **SINGH, Saravjeet** [US/US]; 1000 Kiely Blvd., # 74, Santa Clara, California 95051 (US). **SCOTT, Graeme Jamieson** [GB/US]; 405 Stierlin Road, Mountain View, California 94043 (US). **KUMAR, Ajay** [US/US]; 10457 Manzanita Court, Cupertino, California 95014 (US).(74) Agents: **PATTERSON, B. Todd** et al.; Patterson & Sheridan, L.L.P., 3040 Post Oak Blvd., Suite 1500, Houston, Texas 77056-6582 (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.

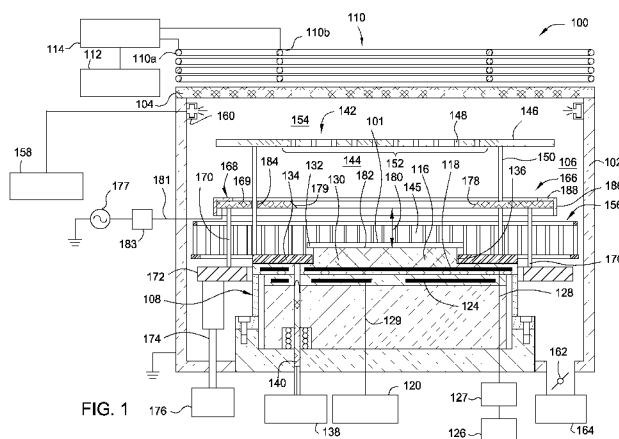
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Art. 21(3))
- 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:
24 January 2013

(54) Title: DYNAMIC ION RADICAL SIEVE AND ION RADICAL APERTURE FOR AN INDUCTIVELY COUPLED PLASMA (ICP) REACTOR



(57) Abstract: Embodiments described herein provide apparatus and methods of etching a substrate using an ion etch chamber having a movable aperture. The ion etch chamber has a chamber body enclosing a processing region, a substrate support disposed in the processing region and having a substrate receiving surface, a plasma source disposed at a wall of the chamber body facing the substrate receiving surface, an ion-radical shield disposed between the plasma source and the substrate receiving surface, and a movable aperture member between the ion-radical shield and the substrate receiving surface. The movable aperture member is actuated by a lift assembly comprising a lift ring and lift supports from the lift ring to the aperture member. The ion-radical shield is supported by shield supports disposed through the aperture member. The aperture size, shape, and/or central axis location may be changed using inserts.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/034915**A. CLASSIFICATION OF SUBJECT MATTER****H01L 21/3065(2006.01)i**

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)

H01L 21/3065; H01L 21/027; H01L 21/205; H01L 21/306; G01L 21/30

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: ion, etch, chamber, plasma, radical, shield, aperture, movable, disk

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 7943005 B2 (AJAY KUMAR et al.) 17 May 2011 See abstract; figures 1-5D; and column 3 line 65 - column 10 line 32.	1-3,9-15
Y	KR 10-2000-0030996 A (SAMSUNG ELECTRONICS CO LTD) 05 June 2000 See abstract; pages 3-4; and figure 1.	1-3,9-15
Y	KR 10-2007-0003172 A (LG.PHILIPS LCD CO LTD) 05 January 2007 See abstract; pages 3-6; and figures 1-5.	15
A	US 2005-0263484 A1 (JONG-CHUL PARK et al.) 01 December 2005 See abstract; figures 2-5; and paragraphs [0031]-[0073].	1-3,9-15
A	WO 2011-062162 A1 (HITACHI HIGH-TECHNOLOGIES CORPORATION et al.) 26 May 2011 See abstract; paragraphs [0038]-[0054],[0080]-[0105]; and figures 1,11,13-17B	1-3,9-15



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 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

30 NOVEMBER 2012 (30.11.2012)

Date of mailing of the international search report

30 NOVEMBER 2012 (30.11.2012)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan
City, 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

CHOI, SANGWON

Telephone No. 82-42-481-5695



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2012/034915**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.: 6-8
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:

Claims [6-8] are not clear, since claims [6-8] refer to multiple dependent claim [5] which do not comply with PCT Rule 6.4(a).
3. ☒ Claims Nos.: 4,5
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:

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 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.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2012/034915

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 7943005 B2	17.05.2011	CN 101174107 A0	07.05.2008
		CN 101174107 B	22.02.2012
		EP 1918970 A1	07.05.2008
		JP 2008-113008 A	15.05.2008
		KR 10-0984422 B1	30.09.2010
		KR 10-2008-0039204 A	07.05.2008
		KR 10-2010-0035142 A	02.04.2010
		TW 200822214 A	16.05.2008
		US 2008-0099431 A1	01.05.2008
		US 2011-0162797 A1	07.07.2011
KR 10-2000-0030996 A	05.06.2000	None	
KR 10-2007-0003172 A	05.01.2007	None	
US 2005-0263484 A1	01.12.2005	KR 10-0532354 B1	30.11.2005
		US 7438765 B2	21.10.2008
WO 2011-062162 A1	26.05.2011	KR 10-2012-0069769 A	28.06.2012
		US 2012-0228261 A1	13.09.2012