

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
9 July 2009 (09.07.2009)

PCT

(10) International Publication Number
WO 2009/083193 A3

(51) International Patent Classification:
C23C 14/02 (2006.01)

(21) International Application Number:
PCT/EP2008/010939

(22) International Filing Date:
19 December 2008 (19.12.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/017,319 28 December 2007 (28.12.2007) US

(71) Applicant (for all designated States except US):
GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN
STIFTUNG ÖFFENTLICHEN RECHTS [DE/DE];
Wilhelmsplatz 1, 37073 Göttingen (DE).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **HOFSAß, Hans**
[DE/DE]; Hanssenstrasse 24, 37073 Göttingen (DE).
ZHANG, Kun [CN/DE]; Liebrechtstrasse 7, 37075 Göttingen (DE).

(74) Agent: **WICHMANN, Hendrik**; Isenbruck Bösl
Hörschler Wichmann LLP, Prinzregentenstrasse 68,
81675 München (DE).

(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, 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, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG,
SK, SL, SM, ST, SV, SY, 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, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM,
ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ,
TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE,
ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, 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:
10 June 2010

(54) Title: METHOD AND APPARATUS FOR SURFACE TREATMENT BY COMBINED PARTICLE IRRADIATION

(57) Abstract: The invention relates to a method for surface treatment of a substrate surface by irradiation of particles onto the substrate constituting the substrate surface. The method comprises the steps of applying first particles onto the substrate surface, thereby causing a positive particle flux component on the substrate surface and emitting eroding particles as at least an eroding particle beam onto the substrate surface, the eroding particle beam causing a negative particle flux component on the substrate surface. The application is performed concurrently or alternately with the step of emitting. An area of the substrate surface onto which the first particles are applied is at least partly overlapping an area of the substrate surface irradiated by the eroding particle beam in an overlapping area of the substrate surface. The resulting cumulative flux of the combined positive and negative flux components in the overlapping area being non-positive, the resulting cumulative flux providing a decreasing or stable net amount of particles in the overlapping area of the substrate surface. The first particles and the eroding particle beam comprising atomic or molecular particles, wherein the first particles are provided by a source outside a plane coextending with at least a part of the substrate surface. Further, the invention relates to a device for surface treatment and a target device for carrying out the inventive surface treatment method.



WO 2009/083193 A3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2008/010939

A. CLASSIFICATION OF SUBJECT MATTER

INV. C23C14/02

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)
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, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	BERG S ET AL: "ATOM ASSISTED SPUTTERING YIELD AMPLIFICATION" JOURNAL OF VACUUM SCIENCE AND TECHNOLOGY: PART A, AVS /AIP, MELVILLE, NY.; US, vol. 10, no. 4, PART 02, 1 July 1992 (1992-07-01), pages 1592-1596, XP000955399 ISSN: 0734-2101 cited in the application the whole document	1-14, 19-26,30
A	US 2006/258142 A1 (HAIDER ASAD M [US] ET AL HAIDER ASAD M [US] ET AL) 16 November 2006 (2006-11-16) the whole document	1-14, 19-30
A	WO 95/23878 A (DIAMONEX INC [US]) 8 September 1995 (1995-09-08)	1-14, 19-30
	----- -/-- -----	

☒ 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 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

14 May 2009

Date of mailing of the international search report

22/04/2010

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Swiatek, Ryszard

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2008/010939

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	HANS HOFSAË SS ET AL: "Surfactant sputtering" APPLIED PHYSICS A; MATERIALS SCIENCE & PROCESSING, SPRINGER, BERLIN, DE, vol. 92, no. 3, 28 May 2008 (2008-05-28), pages 517-524, XP019626888 ISSN: 1432-0630 cited in the application the whole document -----	1-14, 19-30

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2008/010939

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.:
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 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:

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 fees, this Authority did not invite payment of additional fees.
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.:

see annex

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.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-14,19-30

Methods and apparatus for surface treatment

2. claims: 15-18

Target device

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2008/010939

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2006258142 A1	16-11-2006	NONE	
WO 9523878 A	08-09-1995	CA 2184737 A1 EP 0804630 A1	08-09-1995 05-11-1997