

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
12 August 2010 (12.08.2010)

PCT

(10) International Publication Number
WO 2010/090788 A3

- (51) International Patent Classification:
C21D 1/09 (2006.01) C21D 1/38 (2006.01)
- (21) International Application Number:
PCT/US2010/020479
- (22) International Filing Date:
8 January 2010 (08.01.2010)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
61/150,564 6 February 2009 (06.02.2009) US
- (71) Applicant (for all designated States except US):
UCHICAGO ARGONNE, LLC [US/US]; c/o Mark Hilliard, Esq. Building No. 201, 9700 South Cass Avenue, Argonne, Illinois 60439 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): ERYILMAZ, Osman [TR/US]; 16616 Winding Creek Road, Plainfield, Illinois 60586 (US). ERDEMIR, Ali [US/US]; 2227 Stowe Circle, Naperville, Illinois 60439 (US).
- (74) Agents: LOMPNEY, Jeffrey R. et al.; FOLEY & LARDNER LLP, 150 East Gilman Street, P.O. Box 1497, Madison, Wisconsin 53701-1497 (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, RO, RS, RU, 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, 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, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

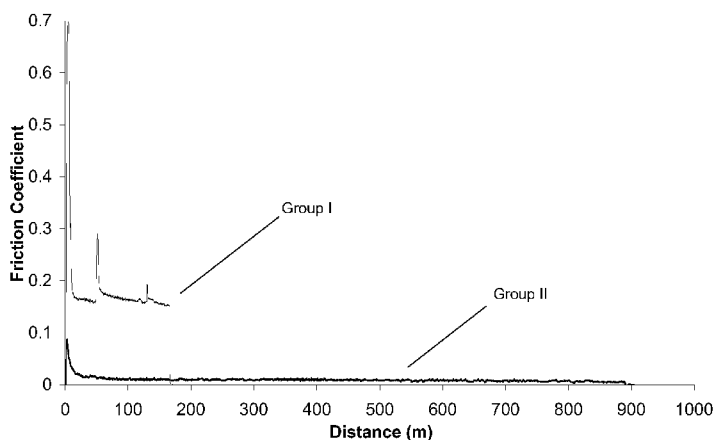
Published:

- 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))

[Continued on next page]

(54) Title: PLASMA TREATMENT OF CARBON-BASED MATERIALS AND COATINGS FOR IMPROVED FRICTION AND WEAR PROPERTIES

FIG. 1



(57) Abstract: A method of plasma modification of a film includes applying about -400 V to about -600 V to a gas in a chamber to generate a gas-discharge plasma; and subjecting the film to the gas-discharge plasma to form a plasma-modified film, where the gas comprises H₂, H₂S, NH₃, deuterium, methane, or a mixture of any two or more. Films may be prepared. Devices coated with the films may be prepared.

WO 2010/090788 A3

(88) Date of publication of the international search report:
21 October 2010

A. CLASSIFICATION OF SUBJECT MATTER*C21D 1/09(2006.01)i, C21D 1/38(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)

C21D 1/09; A61L 27/00; B05D 1/08; B05D 3/04; B32B 27/30; C23C 16/30; C23C 16/50; G02C 7/04; H05H 1/02

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: plasma, treatment, modify, carbon, film similar terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6213604 B1 (VALINT, JR.; PAUL L. et al.) 10 April 2001 See the abstract; examples and claims 1-6.	1-2, 5-17
A	US 2006-0275619 A1 (DENES; FERENCZ et al.) 07 December 2006 See the abstract; paragraph 23-paragraph 48 and claims 1-19.	1-23
A	US 6200626 B1 (GROBE, III; GEORGE L. et al.) 13 March 2001 See the abstract; examples and claims 1-21.	1-23
A	US 5464476 A (GIBB; IAN et al.) 07 November 1995 See the abstract.	1-23

 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

23 AUGUST 2010 (23.08.2010)

Date of mailing of the international search report

23 AUGUST 2010 (23.08.2010)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
Government Complex-Daejeon, 139 Seonsa-ro, Seo-gu,
Daejeon 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

KIM, Seong Kon

Telephone No. 82-42-481-5526



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2010/020479

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6213604 B1	10.04.2001	AU 2000-48413 A1	12.12.2000
		AU 2000-48413 B2	29.05.2003
		BR 0011612 A	19.03.2002
		CA 2373552 C	21.12.2004
		CA 2373552-A1	30.11.2000
		CN 1117799 C	13.08.2003
		CN 1351631 A	29.05.2002
		CN 1351631 C0	29.05.2002
		DE 60006667 D1	24.12.2003
		DE 60006667 T2	30.09.2004
		EP 1187871 A1	20.03.2002
		EP 1187871 B1	19.11.2003
		ES 2212772 T3	01.08.2004
		HK 1046420 A1	26.11.2004
		JP 2003-517503 A	27.05.2003
		KR 10-0594414 B1	03.07.2006
		MX PA01011851A	06.05.2002
		TW 546332 A	11.08.2003
		TW 546332 B	11.08.2003
		WO 00-71611 A1	30.11.2000
ZA200109526A	19.02.2003		
US 2006-0275619 A1	07.12.2006	US 2005-0084680 A1	21.04.2005
		US 7138180 B2	21.11.2006
		WO 2005-038071 A2	28.04.2005
		WO 2005-038071 A3	14.07.2005
US 6200626 B1	13.03.2001	AU 2000-48445 A1	12.12.2000
		AU 2000-48445 B2	18.09.2003
		BR 0011611 A	06.08.2002
		CA 2373556 C	06.12.2005
		CA 2373556-A1	30.11.2000
		CN 1196733 C0	13.04.2005
		CN 1351629 A0	29.05.2002
		DE 60007862 D1	26.02.2004
		DE 60007862 T2	18.11.2004
		EP 1187872 A1	20.03.2002
		EP 1187872 B1	21.01.2004
		ES 2214275 T3	16.09.2004
		HK 1044553 A1	03.12.2004
		JP 2003-500507 A	07.01.2003
		JP 2003-500507 T	07.01.2003
		KR 10-2002-0005755 A	17.01.2002
		MX PA01011855A	06.05.2002
		TW 581783 A	01.04.2004
		TW 581783 B	01.04.2004
		WO 00-71612 A1	30.11.2000
ZA200109523A	19.02.2003		

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2010/020479

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5464476 A	07.11.1995	EP 0651427 A1	03.05.1995