

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
24 August 2006 (24.08.2006)

PCT

(10) International Publication Number
WO 2006/089180 A3

(51) International Patent Classification:

H01M 4/86 (2006.01) H01M 8/10 (2006.01)
H01M 4/88 (2006.01) H01M 4/90 (2006.01)

(21) International Application Number:

PCT/US2006/005766

(22) International Filing Date:

16 February 2006 (16.02.2006)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

60/653,359 16 February 2005 (16.02.2005) US

(71) Applicant (for all designated States except US): **3M INNOVATIVE PROPERTIES COMPANY** [US/US];
3M Center, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US).

(72) Inventor: **ATANASOSKI, Radoslav**; 3M Center, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US).

(74) Agents: **DAHL, Phillip, Y**, et al.; 3M Center, Office Of Intellectual Property Consel, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, 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, HU, IE, IS, IT, LT, LU, LV, MC, NL, 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:

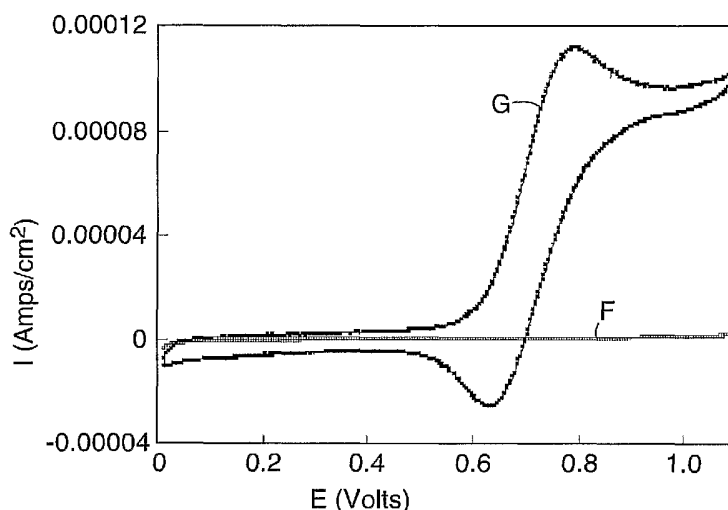
— with international search report

(88) Date of publication of the international search report:

21 December 2006

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: FUEL CELL CATALYST



(57) Abstract: A method is provided for making a supported catalyst comprising nanostructured elements which comprise microstructured support whiskers bearing nanoscopic catalyst particles, where the method comprises step a) of vacuum deposition of material from at least a first carbon target in the presence of nitrogen and step b) of vacuum deposition of material from a second target comprising at least one transition metal, the second target comprising no precious metals. In one embodiment, step a) is carried out prior to step b). In another embodiment, steps a) and b) are carried out simultaneously. Typically the deposition steps are carried out in the absence of oxygen. Typically, the transition metal is iron or cobalt, and most typically iron. The present disclosure also provides a supported catalyst comprising nanostructured elements which comprise microstructured support whiskers bearing nanoscopic catalyst particles made according to the present method. The present disclosure also provides a fuel cell membrane electrode assembly comprising the present supported catalyst.

WO 2006/089180 A3

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/005766

A. CLASSIFICATION OF SUBJECT MATTER INV. H01M4/86 H01M4/88 H01M8/10 H01M4/90		
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) H01M B01J		
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		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 100 38 800 A1 (REPENNING, CORNELIA; REPENNING, DETLEV) 20 June 2002 (2002-06-20) abstract column 2, paragraph 9 - column 4, paragraph 16 claims 1-16	1-21
A	PATENT ABSTRACTS OF JAPAN vol. 2003, no. 12, 5 December 2003 (2003-12-05) & JP 2004 217977 A (NATIONAL INSTITUTE OF ADVANCED INDUSTRIAL & TECHNOLOGY), 5 August 2004 (2004-08-05) abstract	1-21
	----- -/--	
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> 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 4 September 2006		Date of mailing of the international search report 13/09/2006
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 Kelly, M

INTERNATIONAL SEARCH REPORT

 international application No
 PCT/US2006/005766

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 5 879 827 A (DEBE ET AL) 9 March 1999 (1999-03-09) abstract column 2, line 66 - column 3, line 21 -----	1-21
A	US 6 403 245 B1 (HUNT ANDREW T) 11 June 2002 (2002-06-11) abstract -----	1-21
A	US 2004/197638 A1 (MCEL RATH KENNETH O [US] ET AL) 7 October 2004 (2004-10-07) page 1, column 18 - page 2, column 27 -----	1-21
A	US 6 610 436 B1 (DEARNALEY GEOFFREY ET AL) 26 August 2003 (2003-08-26) abstract column 3, line 6 - column 4, line 61 -----	1-21
A	US 6 150 569 A (HAMANN ET AL) 21 November 2000 (2000-11-21) abstract column 1, line 60 - column 2, line 42 -----	1-21
A	US 4 333 916 A (IWAI ET AL) 8 June 1982 (1982-06-08) the whole document -----	1-21

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2006/005766

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 10038800	A1	20-06-2002	NONE
JP 2004217977	A	05-08-2004	NONE
US 5879827	A	09-03-1999	AU 7469698 A 03-05-1999 CA 2304157 A1 22-04-1999 CN 1278747 A 03-01-2001 DE 69824875 D1 05-08-2004 DE 69824875 T2 07-07-2005 EP 1021246 A1 26-07-2000 JP 2001519594 T 23-10-2001 WO 9919066 A1 22-04-1999 US 6040077 A 21-03-2000
US 6403245	B1	11-06-2002	AU 774842 B2 08-07-2004 AU 5151300 A 12-12-2000 CA 2371428 A1 30-11-2000 EP 1181727 A2 27-02-2002 JP 2003500822 T 07-01-2003 MX PA01011968 A 15-10-2003 WO 0072391 A2 30-11-2000
US 2004197638	A1	07-10-2004	NONE
US 6610436	B1	26-08-2003	US 2003104266 A1 05-06-2003
US 6150569	A	21-11-2000	CN 1227212 A 01-09-1999 CZ 9900183 A3 11-08-1999 DE 19802013 A1 22-07-1999 EP 0931785 A1 28-07-1999 JP 3540954 B2 07-07-2004 JP 11269108 A 05-10-1999 JP 2004091496 A 25-03-2004 PL 330947 A1 02-08-1999
US 4333916	A	08-06-1982	CA 1151837 A1 16-08-1983 DE 3162219 D1 22-03-1984 EP 0038632 A2 28-10-1981 JP 1179120 C 30-11-1983 JP 56149308 A 19-11-1981 JP 58009764 B 22-02-1983