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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
2 August 2012 (02.08.2012)

WIPO | PCT

(10) International Publication Number
WO 2012/102994 A3

(51) International Patent Classification:
H01T 13/39 (2006.01)

(21) International Application Number:
PCT/US2012/022184

(22) International Filing Date:
23 January 2012 (23.01.2012)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/436,746 27 January 2011 (27.01.2011) US

(71) Applicant *(for all designated States except US)*: **FEDERAL-MOGUL IGNITION COMPANY** [US/US]; 26555 Northwestern Highway, Southfield, MI 48033 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **MA, Shuwei** [CN/US]; 3156 Eagle Court, Ann Arbor, MI 48105 (US).

(74) Agent: **ADAMS, Michael, C.**; Reising Ethington P.C., P.O. Box 4390, Troy, MI 48099-4390 (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,

[Continued on next page]

(54) Title: ELECTRODE MATERIAL FOR A SPARK PLUG

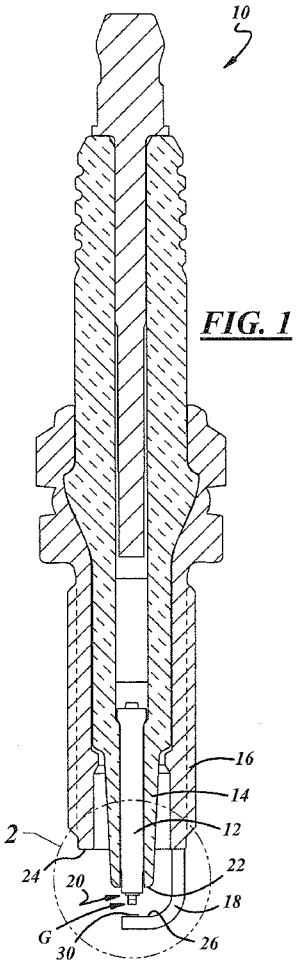

FIG. 1

(57) Abstract: An electrode material that may be used in spark plugs (10) and other ignition devices including industrial plugs, aviation igniters, glow plugs, or any other device that is used to ignite an air/fuel mixture in an engine. The electrode material is a metal composite (100) and includes a particulate component (104) embedded or dispersed within a matrix component (102) such that the metal composite has a multi-phase microstructure. In one embodiment, the metal composite (100) includes a matrix component (102) that includes a precious metal and makes up about 2-80%wt of the overall composite and a particulate component (104) that includes a ruthenium-based material and makes up about 20-98%wt of the overall composite.

WO 2012/102994 A3

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:
8 November 2012

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/022184

A. CLASSIFICATION OF SUBJECT MATTER

H01T 13/39(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)

H01T 13/39; H01T 13/02

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: spark, plug, material, electrode, ruthenium, precious metal, particle, particulate

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2010-0045156 A1 (LARS MENKEN et al.) 25 February 2010 See abstract; paragraphs [0039]-[0040]; claim 18 and figures 1-2.	1-20
A	US 2007-0278924 A1 (THOMAS AISENBREY) 06 December 2007 See abstract; paragraph [0063] and figures 1-2.	1-20
A	US 2006-0043855 A1 (KENJI NUNOME et al.) 02 March 2006 See abstract;paragraphs [0055]-[0067] and figures 1-2.	1-20

☐ 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	Date of mailing of the international search report
12 SEPTEMBER 2012 (12.09.2012)	**14 SEPTEMBER 2012 (14.09.2012)**
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 Park Jung MIn Telephone No. 82-42-481-5562

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2012/022184

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010-0045156 A1	25.02.2010	CN 101164210 A0	16.04.2008
		DE 102005018674 A1	26.10.2006
		EP 1875570 A1	09.01.2008
		JP 2008-538447 A	23.10.2008
		WO 2006-111444 A1	26.10.2006
US 2007-0278924 A1	06.12.2007	CA 2371986 A1	15.08.2002
		CA 2371986 C	30.09.2008
		CA 2462036 A1	24.09.2004
		CA 2464173 A1	16.10.2004
		CA 2464280 A1	14.10.2004
		CA 2464585 A1	15.10.2004
		CN 1536760 A	13.10.2004
		CN 1538554 A	20.10.2004
		CN 1551263 A	01.12.2004
		CN 1551339 A	01.12.2004
		CN 1571076 A	26.01.2005
		EP 1233426 A2	21.08.2002
		EP 1233426 A3	09.07.2003
		EP 1427055 A1	09.06.2004
		EP 1469485 A2	20.10.2004
		EP 1469485 A3	29.03.2006
		EP 1469494 A2	20.10.2004
		EP 1469494 A3	03.05.2006
		EP 1469513 A2	20.10.2004
		EP 1469513 A3	15.12.2004
		EP 1473743 A2	03.11.2004
		EP 1473743 A3	10.11.2004
		JP 2004-236289 A	19.08.2004
		JP 2004-319508 A	11.11.2004
		JP 2004-319985 A	11.11.2004
		JP 2004-342601 A	02.12.2004
		JP 2004-349685 A	09.12.2004
		KR 10-2004-0048848 A	10.06.2004
		KR 10-2004-0084788 A	06.10.2004
		KR 10-2004-0089590 A	21.10.2004
		KR 10-2004-0090487 A	25.10.2004
		KR 10-2004-0090727 A	26.10.2004
		US 2002-0059733 A1	23.05.2002
		US 2002-0109634 A1	15.08.2002
		US 2004-0051666 A1	18.03.2004
		US 2004-0160377 A1	19.08.2004
		US 2004-0164923 A1	26.08.2004
		US 2004-0174318 A1	09.09.2004
		US 2004-0174651 A1	09.09.2004
		US 2004-0188418 A1	30.09.2004
		US 2004-0189170 A1	30.09.2004
		US 2004-0196198 A1	07.10.2004
		US 2004-0196201 A1	07.10.2004

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2012/022184

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		US 2004-0206615 A1	21.10.2004
		US 2004-0211653 A1	28.10.2004
		US 2004-0217405 A1	04.11.2004
		US 2004-0217472 A1	04.11.2004
		US 2004-0217903 A1	04.11.2004
		US 2004-0222863 A1	11.11.2004
		US 2004-0227688 A1	18.11.2004
		US 2004-0233112 A1	25.11.2004
		US 2004-0235351 A1	25.11.2004
		US 2004-0238798 A1	02.12.2004
		US 2004-0239570 A1	02.12.2004
		US 2004-0239578 A1	02.12.2004
		US 2005-0001287 A1	06.01.2005
		US 2005-0001780 A1	06.01.2005
		US 2005-0006126 A1	13.01.2005
		US 2005-0007290 A1	13.01.2005
		US 2005-0024290 A1	03.02.2005
		US 2005-0024291 A1	03.02.2005
		US 2005-0025919 A1	03.02.2005
		US 2005-0029000 A1	10.02.2005
		US 2005-0031823 A1	10.02.2005
		US 2005-0062669 A1	24.03.2005
		US 2005-0078050 A1	14.04.2005
		US 2005-0136326 A1	23.06.2005
		US 2005-0139811 A1	30.06.2005
		US 2005-0139812 A1	30.06.2005
		US 2005-0140042 A1	30.06.2005
		US 2005-0146072 A1	07.07.2005
		US 2005-0160547 A1	28.07.2005
		US 2005-0161142 A1	28.07.2005
		US 2005-0162133 A1	28.07.2005
		US 2005-0166956 A1	04.08.2005
		US 2005-0167133 A1	04.08.2005
		US 2005-0167188 A1	04.08.2005
		US 2005-0167189 A1	04.08.2005
		US 2005-0167873 A1	04.08.2005
		US 2005-0167931 A1	04.08.2005
		US 2005-0170078 A1	04.08.2005
		US 2005-0172950 A1	11.08.2005
		US 2005-178496 A1	18.08.2005
		US 2005-191788 A1	01.09.2005
		US 2005-199413 A1	15.09.2005
		US 2005-199417 A1	15.09.2005
		US 2005-200041 A1	15.09.2005
		US 2005-200136 A1	15.09.2005
		US 2005-200329 A1	15.09.2005
		US 2005-202160 A1	15.09.2005
		US 2005-202161 A1	15.09.2005
		US 2005-202296 A1	15.09.2005
		US 2005-204544 A1	22.09.2005

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2012/022184

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		US 2005-204548 A1	22.09.2005
		US 2005-205551 A1	22.09.2005
		US 2005-205712 A1	22.09.2005
		US 2005-206028 A1	22.09.2005
		US 2005-206270 A1	22.09.2005
		US 2005-206289 A1	22.09.2005
		US 2005-206491 A1	22.09.2005
		US 2005-208246 A1	22.09.2005
		US 2005-208251 A1	22.09.2005
		US 2005-208746 A1	22.09.2005
		US 2005-208862 A1	22.09.2005
		US 2005-212161 A1	29.09.2005
		US 2005-212162 A1	29.09.2005
		US 2005-224280 A1	13.10.2005
		US 2005-225485 A1	13.10.2005
		US 2005-230867 A1	20.10.2005
		US 2005-236406 A1	27.10.2005
		US 2005-236407 A1	27.10.2005
		US 2005-263124 A1	01.12.2005
		US 2005-263935 A1	01.12.2005
		US 2005-269727 A1	08.12.2005
		US 2005-271838 A1	08.12.2005
		US 2006-000590 A1	05.01.2006
		US 2006-003667 A1	05.01.2006
		US 2006-060690 A1	23.03.2006
		US 2006-071862 A1	06.04.2006
		US 2006-091887 A1	04.05.2006
		US 2006-114169 A1	01.06.2006
		US 2006-118554 A1	08.06.2006
		US 2006-119522 A1	08.06.2006
		US 2006-119523 A1	08.06.2006
		US 2006-128895 A1	15.06.2006
		US 2006-131547 A1	22.06.2006
		US 2006-137688 A1	29.06.2006
		US 2006-138646 A1	29.06.2006
		US 2006-174753 A1	10.08.2006
		US 2006-287126 A1	21.12.2006
		US 2007-023272 A1	01.02.2007
		US 2007-204459 A1	06.09.2007
		US 2007-204460 A1	06.09.2007
		US 2007-207316 A1	06.09.2007
		US 2008-036241 A1	14.02.2008
		US 2008-063864 A1	13.03.2008
		US 2010-192361 A1	05.08.2010
		US 2010-326236 A1	30.12.2010
		US 2011-024275 A1	03.02.2011
		US 6370783 B1	16.04.2002
		US 6588113 B2	08.07.2003
		US 6741221 B2	25.05.2004
		US 6870516 B2	22.03.2005

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2012/022184

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		US 6940468 B2	06.09.2005
		US 6947005 B2	20.09.2005
		US 6947012 B2	20.09.2005
		US 7002234 B2	21.02.2006
		US 7006046 B2	28.02.2006
		US 7006050 B2	28.02.2006
		US 7017822 B2	28.03.2006
		US 7027304 B2	11.04.2006
		US 7079086 B2	18.07.2006
		US 7084826 B2	01.08.2006
		US 7102077 B2	05.09.2006
		US 7115825 B2	03.10.2006
		US 7136008 B2	14.11.2006
		US 7164388 B2	16.01.2007
		US 7182889 B2	27.02.2007
		US 7198735 B2	03.04.2007
		US 7222727 B2	29.05.2007
		US 7223144 B2	29.05.2007
		US 7223469 B2	29.05.2007
		US 7224108 B2	29.05.2007
		US 7230572 B2	12.06.2007
		US 7244890 B2	17.07.2007
		US 7268461 B2	11.09.2007
		US 7268479 B2	11.09.2007
		US 7268562 B2	11.09.2007
		US 7268637 B2	11.09.2007
		US 7273135 B2	25.09.2007
		US 7316838 B2	08.01.2008
		US 7317420 B2	08.01.2008
		US 7326463 B2	05.02.2008
		US 7339146 B2	04.03.2008
		US 7372006 B2	13.05.2008
		US 7372127 B2	13.05.2008
		US 7372422 B2	13.05.2008
		US 7425885 B2	16.09.2008
		US 7432448 B2	07.10.2008
		US 7549521 B2	23.06.2009
		US 7644488 B2	12.01.2010
		US 7644495 B2	12.01.2010
		US 7658663 B2	09.02.2010
		US 7708920 B2	04.05.2010
		US 7726440 B2	01.06.2010
		US 7759002 B2	20.07.2010
		US 7829006 B2	09.11.2010
		US 7829807 B2	09.11.2010
		US 7872405 B2	18.01.2011
US 2006-0043855 A1	02.03.2006	CN 100470975 C0	18.03.2009
		CN 100583580 C	20.01.2010
		CN 1698244 A	16.11.2005

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2012/022184

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		CN 1698245 A	16.11.2005
		DE 602004027028 D1	17.06.2010
		EP 1517419 A1	23.03.2005
		EP 1517419 B1	11.05.2011
		EP 1628375 A1	22.02.2006
		EP 1628375 A4	01.08.2007
		EP 1628375 B1	05.05.2010
		EP 2197077 A2	16.06.2010
		JP 04-402046 B2	06.11.2009
		JP 04-672551 B2	28.01.2011
		JP 2011-003545 A	06.01.2011
		JP 4402046 B2	20.01.2010
		US 2006-0061250 A1	23.03.2006
		US 7279827 B2	09.10.2007
		US 7382084 B2	03.06.2008
		WO 2004-105204 A1	02.12.2004
		WO 2004-107517 A1	09.12.2004