



(51) International Patent Classification:

H01M 8/02 (2006.01) *H01M 4/90* (2006.01)
H01M 4/86 (2006.01)

(21) International Application Number:

PCT/US2013/038685

(22) International Filing Date:

29 April 2013 (29.04.2013)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

61/640,446 30 April 2012 (30.04.2012) US

(71) Applicant: **THE REGENTS OF THE UNIVERSITY OF CALIFORNIA** [US/US]; 1111 Franklin Street, Twelfth Floor, Oakland, California 94607 (US).

(72) Inventors: **HUANG, Yu**; c/o The Regents of the University of California, 1111 Franklin Street, Oakland, California 94607 (US). **LI, Yujing**; c/o The Regents of the University of California, 1111 Franklin Street, Oakland, California 94607 (US).

(74) Agents: **LIU, Cliff** et al.; Foley & Lardner LLP, 975 Page Mill Road, Palo Alto, California 94304 (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, BN, 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, PA, 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, 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).

Declarations under Rule 4.17:

— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))

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:

17 April 2014

(54) Title: HIGHLY ACTIVE AND DURABLE FUEL CELL ELECTRO-CATALYST WITH HYBRID SUPPORT

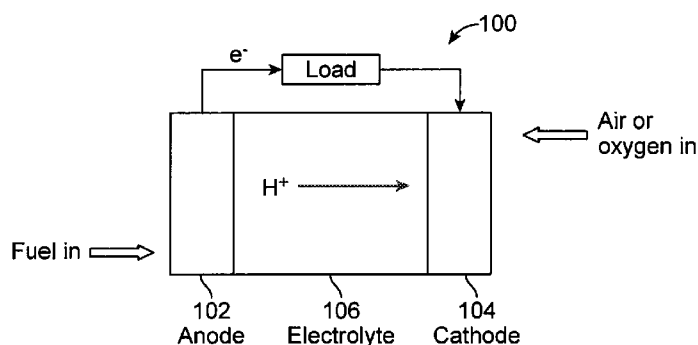


FIG. 1

(57) Abstract: A fuel cell includes: (1) an anode; (2) a cathode; and (3) an electrolyte disposed between the anode and the cathode. At least one of the anode and the cathode includes an electro-catalyst dispersed on a hybrid support, the hybrid support includes a first, carbon-based support and a second support different from the first, carbon-based support, and a weight percentage of the second support is at least 10% relative to a combined weight of the first, carbon-based support and the second support.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/038685**A. CLASSIFICATION OF SUBJECT MATTER****H01M 8/02(2006.01)i, H01M 4/86(2006.01)i, H01M 4/90(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)

H01M 8/02; B01J 21/18; H01M 4/96; H01M 8/10; B01J 23/42; H01M 4/92; H01M 4/86; H01M 4/90

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: fuel cell, carbon, graphene oxide, hybrid support, electrocatalyst, metal nanocrystal, first support, second support**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-2011-0134712 A (INHA INDUSTRY PARTNERSHIP INSTITUTE) 15 December 2011 See abstract, paragraph [0009] and claims 1, 2.	1-19
Y	KR 10-2012-0039992 A (WOOSUK UNIVERSITY) 26 April 2012 See abstract and claims 1, 3, 4, 5, 9, 11.	1-19
A	JP 2007-335248 A (EQUOS RESEARCH CO. LTD.) 27 December 2007 See abstract and claim 1.	1-19
A	LIANG, Y. et al., 'Covalent Hybrid of Spinel Manganese-Cobalt Oxide and Graphene as Advanced Oxygen Reduction Electrocatalysts', Journal of the American chemical society, 23 January 2012, Vol. 134, pp. 3517-3523 See abstract.	1-19
PX	LI, Y. et al., 'Stabilization of High Performance Oxygen Reduction Reaction Pt electrocatalyst Supported on Reduced Graphene Oxide/Carbon Black Composite', Journal of the American chemical society, 2012 (epub. 11 July 2012), Vol. 134, pp. 12326-12329 See the whole document.	1-19

☐ 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 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

24 February 2014 (24.02.2014)

Date of mailing of the international search report

25 February 2014 (25.02.2014)

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

LEE, Dong Wook

Telephone No. +82-42-481-8163



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2013/038685

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 10-2011-0134712 A	15/12/2011	KR 10-1179511 B1	07/09/2012
KR 10-2012-0039992 A	26/04/2012	KR 10-1269418 B1	30/05/2013
JP 2007-335248 A	27/12/2007	None	