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- (71) Applicant (for all designated States except US): **BOARD OF REGENTS OF THE UNIVERSITY OF TEXAS SYSTEM** [US/US]; 201 West 7th Street, Austin, TX 78701 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **CHEN, Chonglin** [US/US]; 223 Roan Hunt, San Antonio, TX 78258 (US). **LIU, Jian** [CN/US]; 6267 Cypress Circle, San Antonio, TX 78240 (US). **COLLINS, Gregory, Roy** [US/US]; 5711 Lakefront Street, San Antonio, TX 78222 (US).
- (74) Agent: **GOEL, Gaurav**; Jackson Walker L.L.P., 100 Congress Avenue, Suite 1100, Austin, TX 78701 (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, 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.
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21 February 2013

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[Continued on next page]

- (54) Title: ION CONDUCTIVE MULTILAYER STRUCTURE

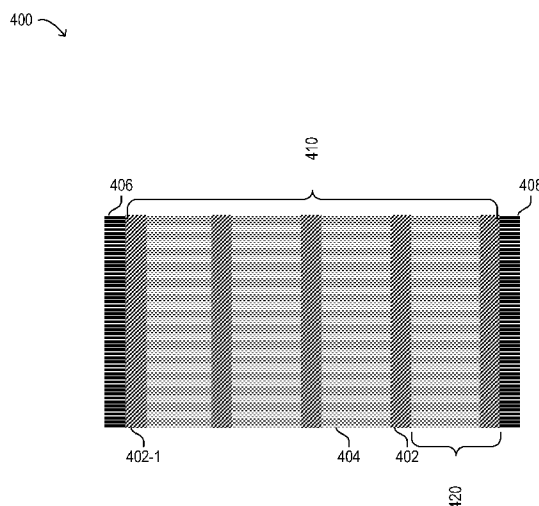


FIG. 4

(57) Abstract: A novel ion conductive material may be formed as a thin-film multilayered structure. The thin-film multilayered structure may be formed using multiple ion conductive sublayers of an electronic insulator and an ionic conductor. A nanometer-range thickness of the electronic insulator may be selected to provide desirable ion conductive properties that may be different from bulk material properties due to quantum size effects. The thin-film multilayered structure may behave in aggregate as an electronic insulator while behaving as an ion conductor at relatively low temperatures. The thin-film multilayered structure may be used as an electrolyte in a solid-oxide fuel cell (SOFC) for conduction of oxygen ions at relatively low temperatures, for example, less than about 600°C.

Previous Correction:

see Notice of 20 December 2012

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/034285**A. CLASSIFICATION OF SUBJECT MATTER****H01M 6/18(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 6/18; B05D 5/12; H01M 8/12; H01M 8/10; H01M 812

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: ion conductivity, electronic conductivity, insulator, temperature, solid oxide fuel cell electrolyte

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6849354 B2 (HARA NAOKI et al.) 01 February 2005 See column 5, lines 5-65, column 7, line 41-64, claim 1, and figure 4A.	1-20
A	US 2011-0076594 A1 (FAN ZENG et al.) 31 March 2011 See abstract, paragraphs [0015]-[0024], claims 1-7, and figure 2.	1-20
A	US 2009-0011314 A1 (CHAO CHENG-CHIEH et al.) 08 January 2009 See abstract, paragraphs [0025]-[0029],[0037]-[0038], claim 1, and figures 1, 7-8.	1-20
A	WO 2010/029242 A1 (COMMISSARIAT A L'ENERGIE ATOMIQUE) 18 March 2010 See abstract, page 5, lines 1-29, claims 1-5, and figure 2.	1-20
A	US 7452622 B2 (SARKAR PARTHO et al.) 18 November 2008 See abstract, column 1, lines 23-31.	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

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189 Cheongsu-ro, Seo-gu, Daejeon Metropolitan
City, 302-701, Republic of Korea

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Authorized officer

NA, Sun Hee

Telephone No. 82-42-481-5746



INTERNATIONAL SEARCH REPORT

Information on patent family members

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