



(51) International Patent Classification:

B01D 67/00 (2006.01) **B01D 71/36** (2006.01)
B01D 69/12 (2006.01) **B01D 59/10** (2006.01)
B01D 71/02 (2006.01) **G21F 9/06** (2006.01)
H01M 8/1018 (2016.01)

(21) International Application Number:

PCT/GB2016/052279

(22) International Filing Date:

26 July 2016 (26.07.2016)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

1513288.9 28 July 2015 (28.07.2015) GB

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(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, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, 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, SA, 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, ST, 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, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— of inventorship (Rule 4.17(iv))

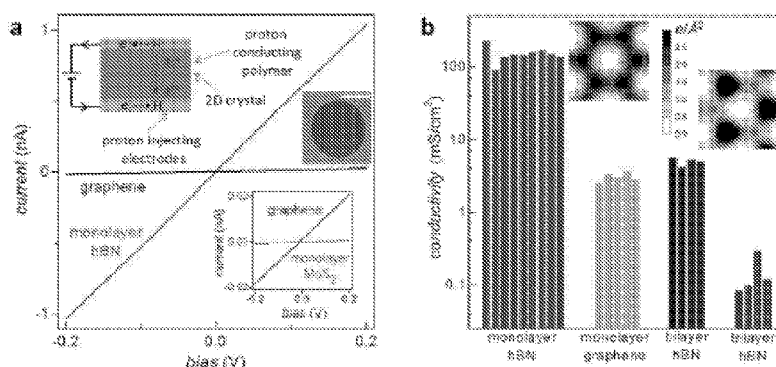
Published:

— 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:

16 March 2017

(54) Title: GRAPHENE MEMBRANE

**FIG 1**

(57) Abstract: The present invention relates to a method of altering the relative proportions of protons, deuterons and tritons in a sample using a membrane. The membrane comprises a 2D material and an ionomer. The invention also relates to a method of making said membranes.

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2016/052279

A. CLASSIFICATION OF SUBJECT MATTER		
INV.	B01D67/00 B01D59/10	B01D69/12 G21F9/06
	B01D71/02	H01M8/1018
		B01D71/36
ADD.		
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) B01D H01M G21F		
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 practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	S. HU ET AL: "Proton transport through one-atom-thick crystals", NATURE, vol. 516, no. 7530, 26 November 2014 (2014-11-26), pages 227-230, XP055226215, United Kingdom ISSN: 0028-0836, DOI: 10.1038/nature14015	22-30
A	abstract; figure 1 page 4 - page 6; figures 3, E. Fig. 1, E. Fig. 10 ----- -/--	1-21
☒ 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 17 January 2017		Date of mailing of the international search report 27/01/2017
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Veríssimo, Sónia

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB2016/052279

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No

PCT/GB2016/052279

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	RASTUNOVA I L ET AL: "New Contact Device for Separation of Hydrogen Isotopes in the Water-Hydrogen System", FUSION SCIENCE AND TECHNOLOGY, AMERICAN NUCLEAR SOCIETY, CHICAGO, IL, US, vol. 48, no. 1, 1 January 2005 (2005-01-01), pages 128-131, XP008181764, ISSN: 1536-1055 abstract -----	1-21
A	CARLOS P. HERRERO ET AL: "Vibrational properties and diffusion of hydrogen on graphene", PHYSICAL REVIEW. B, CONDENSED MATTER AND MATERIALS PHYSICS, vol. 79, no. 11, 1 March 2009 (2009-03-01), page 5, XP055305294, US ISSN: 1098-0121, DOI: 10.1103/PhysRevB.79.115429 abstract -----	1-21
A	SAITO M: "Enrichment reliability of solid polymer electrolysis for tritium water analysis", JOURNAL OF RADIOANALYTICAL AND NUCLEAR CHEMISTRY, KLUWER ACADEMIC PUBLISHERS, DO, vol. 275, no. 2, 24 September 2007 (2007-09-24), pages 407-410, XP019577631, ISSN: 1588-2780 abstract -----	1-21
X,P	WO 2016/042309 A1 (UNIV MANCHESTER [GB]) 24 March 2016 (2016-03-24) page 3, line 7 - line 9; claims page 14, line 27 - line 30 -----	1-30
Y	SEAN C. O'HERN ET AL: "Selective Molecular Transport through Intrinsic Defects in a Single Layer of CVD Graphene", ACS NANO, vol. 6, no. 11, 27 November 2012 (2012-11-27), pages 10130-10138, XP055335576, US ISSN: 1936-0851, DOI: 10.1021/nn303869m page 10131; figure 1 -----	22-30

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2016/052279

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2016042309	A1	24-03-2016	NONE

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-21

A process for altering the relative proportions of two or more of: hydrogen, deuterium and tritium in a substance and use of a membrane for altering the relative amounts of one or more of hydrogen, deuterium and tritium in a mixture.

2. claims: 22-30

A process for preparing a proton, deuteron and/or triton conducting membrane
