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- (71) Applicant: **GEORGIA TECH RESEARCH CORPORATION** [US/US]; 505 Tenth Street, NW, Atlanta, GA 30332-0415 (US).
- (72) Inventors: **SINGH, Rachana**; National Physical Laboratory, New Delhi 110012 (IN). **KOROS, William John**; 2939 Ridge Valley Road, NW, Atlanta, GA 30327 (US).
- (74) Agents: **KLECKLEY, Troy S.** et al.; Troutman Sanders LLC, Bank of America Plaza, 600 Peachtree Street, NE, Suite 5200, Atlanta, GA 30308-2216 (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, 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.
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[Continued on next page]

(54) Title: CARBON MOLECULAR SIEVE MEMBRANE (CMSM) PERFORMANCE TUNING BY DUAL TEMPERATURE SECONDARY OXYGEN DOPING (DTSOD)

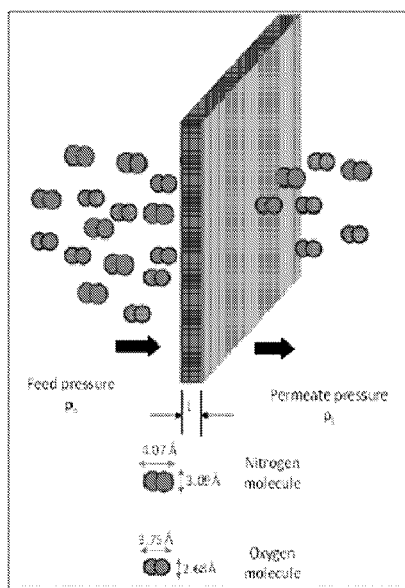


Fig. 2

(57) Abstract: The various embodiments of the disclosure relate generally to carbon molecular sieve membranes (CMSM) and their associated fabrication processes, and more particularly to CMSM that maintain high gas selectivities without losing productivity. Methods for enriching a mixture of gases in one gas via the use of the CMS membranes, and gas enrichment devices using the same, are also disclosed.



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30 January 2014

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2013/043387

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B01D 53/22 (2013.01)

USPC - 95/903

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)

IPC(8) - B01D 53/22, 53/34, 63/02, 63/04, 69/08; C07C 7/13 (2013.01)

USPC - 95/45, 47, 54, 902, 903; 96/4, 8, 10, 11

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

CPC - B91D 53/22, 53/228, 53/34, 63/02, 69/08 (2013.01)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Orbit.com, Google Patents, Public AppFT and PatFT, Google Scholar

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US 2002/0053284 A1 (KOROS et al) 09 May 2002 (09.05.2002) entire document	15-17, 34-36 ----- 24-26
Y	US 2011/0100211 A1 (KIYONO et al) 05 May 2011 (05.05.2011) entire document	1-3, 42-44
Y	US 2007/0017861 A1 (FOLEY et al) 25 January 2007 (25.01.2007) entire document	1-3, 42-44
Y	US 2005/0284293 A1 (RUBAS) 29 December 2005 (29.12.2005) entire document	24-26

 Further documents are listed in the continuation of Box C.

\* 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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

28 October 2013

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Mail Stop PCT, Attn: ISA/US, Commissioner for Patents  
P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-3201

Authorized officer:

Blaine R. Copenheaver

PCT Helpdesk: 571-272-4300  
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2013/043387

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.: 4-14, 18-23, 27-33, 37-41, 45-49  
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:

- 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 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.