



(51) International Patent Classification:

B01J 20/20 (2006.01) **C01B 31/08** (2006.01)
B01J 20/30 (2006.01) **C01B 31/02** (2006.01)
B01J 20/28 (2006.01)

(21) International Application Number:

PCT/US2015/055529

(22) International Filing Date:

14 October 2015 (14.10.2015)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

14/513,707 14 October 2014 (14.10.2014) US

(71) Applicant: **SAUDI ARABIAN OIL COMPANY**
 [SA/SA]; 1 Eastern Avenue, Dhahran, 31311 (SA).

(71) Applicant (for AG only): **ARAMCO SERVICES COMPANY** [US/US]; 9009 West Loop South, Houston, TX 77096 (US).

(71) Applicant: **KOREA ADVANCED INSTITUTE OF SCIENCE AND TECHNOLOGY** [KR/KR]; 291 Daehak-ro (373-1 Guseong-dong), Yuseong-gu, Daejeon 305-701 (KR).

(72) Inventors: **WANG, Yuguo**; P. O. Box 2189, Saudi Aramco, Dhahran, 31311 (SA). **ERCAN, Cemal**; P.O. Box 2893, Saudi Aramco, Dhahran, 31311 (SA). **OTHMAN, M., Rashid**; P. O. Box 6558, Saudi Aramco, Dhahran, 31311 (SA). **CHOI, Seokin**; Korea Advanced Institute Of Science And Technology, 291 Kaehak-ro (373-1 Guseong-dong), Yuseong-gu, Daejeon 305-701 (KR). **CHOI, Min-kee**; Korea Advanced Institute Of Science And Techno-

logy, 291 Kaehak-ro (373-1 Guseong-dong), Yuseong-gu, Daejeon 305-701 (KR).

(74) Agent: **RHEBERGEN, Constance, Gall**; Bracewell & Giuliani LLP, P.O. Box 61389, Houston, TX 77208-1389 (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, 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).

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))

(54) Title: SYNTHESIS OF ORDERED MICROPOROUS CARBONS BY CHEMICAL VAPOR DEPOSITION

(57) Abstract: A methane microporous carbon adsorbent comprising a thermally-treated CVD carbon having a shape in the form of a negative replica of a crystalline zeolite has a BET specific surface area, a micropore volume, a micropore to mesopore volume ratio, a stored methane value and a methane delivered value and a sequential carbon synthesis method for forming the methane microporous carbon adsorbent. Introducing an organic precursor gas for a chemical vapor deposition (CVD) period to a crystalline zeolite that is maintained at a CVD temperature forms the carbon-zeolite composite. Introducing a non-reactive gas for a thermal treatment period to the carbon-zeolite composite maintained at a thermal treatment temperature forms the thermally-treated carbon-zeolite composite. Introducing an aqueous strong mineral acid mixture to the thermally-treated carbon-zeolite composite forms the methane microporous carbon adsorbent.



WO 2016/061225 A1