



(51) International Patent Classification:

B01J 23/04 (2006.01) *C07C 67/343* (2006.01)
C07C 51/09 (2006.01)

(21) International Application Number:

PCT/GB2020/051793

(22) International Filing Date:

24 July 2020 (24.07.2020)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

1910754.9 26 July 2019 (26.07.2019) GB

(71) Applicant: **mitsubishi chemical uk limited**
[GB/GB]; Cassel Works, New Road, Billingham Hampshire TS23 1LE (GB).

(72) Inventors: **runnacles, Jonathan**; Wilton Centre, Wilton, Redcar TS10 4RF (GB). **JOHNSON, David William**; Wilton Centre, Wilton, Redcar TS10 4RF (GB). **HASEGAWA, Toshio**; c/o Hiroshima R&D Center, Mitsubishi Chemical Corporation, 20-1, Miyukicho, Otake-Shi, Hiroshima, 739-0693 (JP). **NISHIDA, Kazufumi**; c/o Hiroshima R&D Center, Mitsubishi Chemical Corporation, 20-1, Miyukicho, Otake-Shi, Hiroshima, 739-0693 (JP). **NINOMIYA, Wataru**; c/o Hiroshima R&D Center, Mitsubishi Chemical Corporation, 20-1, Miyukicho, Otake-Shi, Hiroshima, 739-0693 (JP).

(74) Agent: **APPLEYARD LEES IP LLP**; 15 Clare Road, Halifax Yorkshire HX1 2HY (GB).

(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, DJ, DK, DM, DO,

(54) Title: A CATALYST AND A PROCESS FOR THE PRODUCTION OF ETHYLENICALLY UNSATURATED CARBOXYLIC ACIDS OR ESTERS

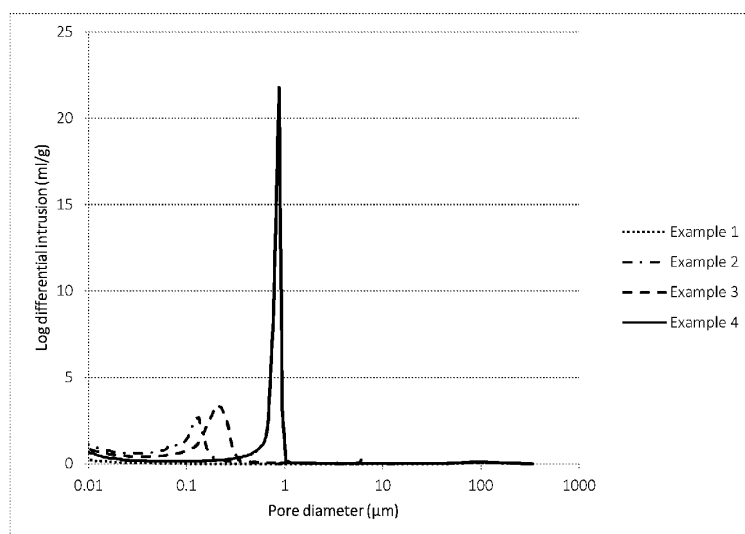


Figure 1: Macropore Distribution of Silica Supports: Results of Mercury Porosimetry for Examples 1 to 4.

(57) Abstract: The invention discloses a catalyst comprising a silica support, a modifier metal and a catalytic alkali metal. The silica support has a multimodal pore size distribution comprising a mesoporous pore size distribution having an average pore size in the range 2 to 50 nm and a pore volume of said mesopores of at least 0.1 cm³/g, and a macroporous pore size distribution having an average pore size of more than 50 nm and a pore volume of said macropores of at least 0.1 cm³/g. The level of catalytic alkali metal on the silica support is at least 2 mol%. The modifier metal is selected from Mg, B, Al, Ti, Zr and Hf. The invention also discloses a method of producing the catalyst, a method of producing an ethylenically unsaturated carboxylic acid or ester in the presence of the catalyst, and a process for preparing an ethylenically unsaturated acid or ester in the presence of the catalyst.

[Continued on next page]

DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN, KP, KR, KW, 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, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, 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))