Electronic Supplementary Material

Solid-conversion synthesis of three-dimensionally ordered mesoporous ZSM-5 catalysts for the methanol-to-propylene reaction

Weilong Chun[1], Chenbiao Yang[1], Xu Wang[1], Xin Yang[1], Huiyong Chen (✉)[1, 2]

1 School of Chemical Engineering, Northwest University, Shaanxi 710069, China
2 International Science & Technology Cooperation Base for Clean Utilization of Hydrocarbon Resources, Chemical Engineering Research Center of the Ministry of Education for Advanced Use Technology of Shanbei Energy, Collaborative Innovation Center for Development of Energy and Chemical Industry in Northern Shaanxi, Northwest University, Shaanxi 710069, China

E-mail: hychen@nwu.edu.cn

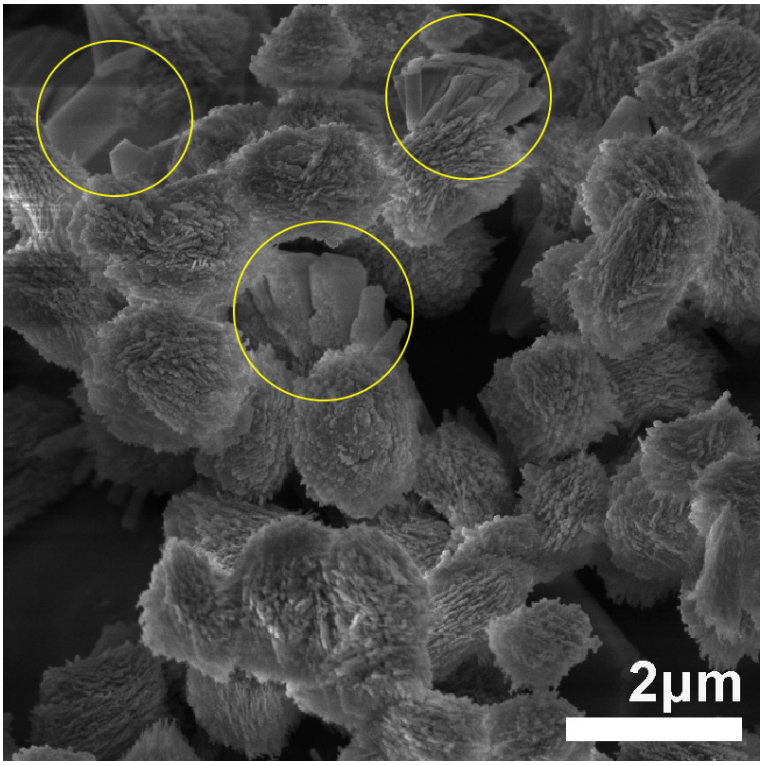

Figure S1. SEM image of 3DZ5_S/C.

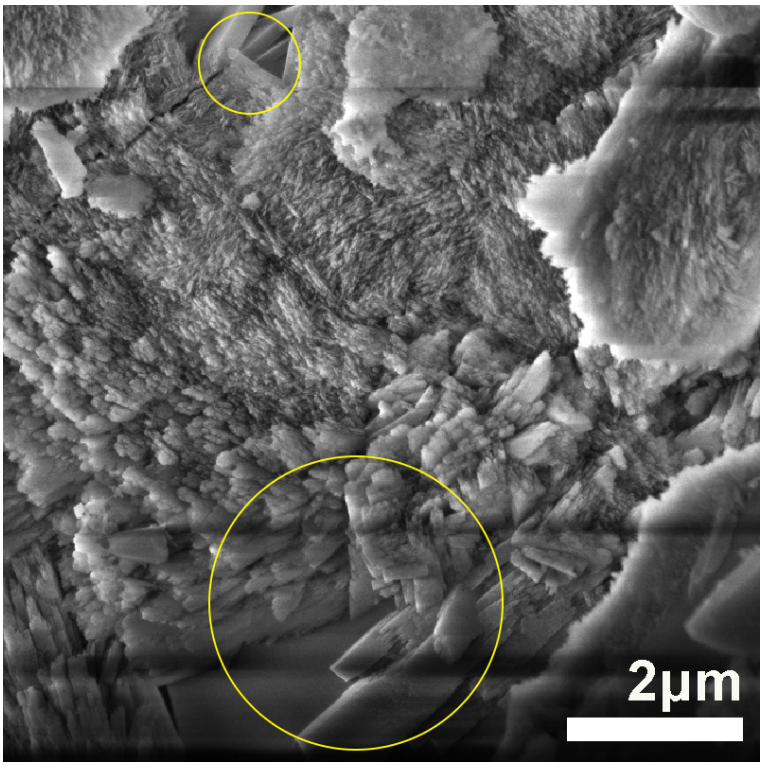

Figure S2. SEM image of 3DZ5_S.

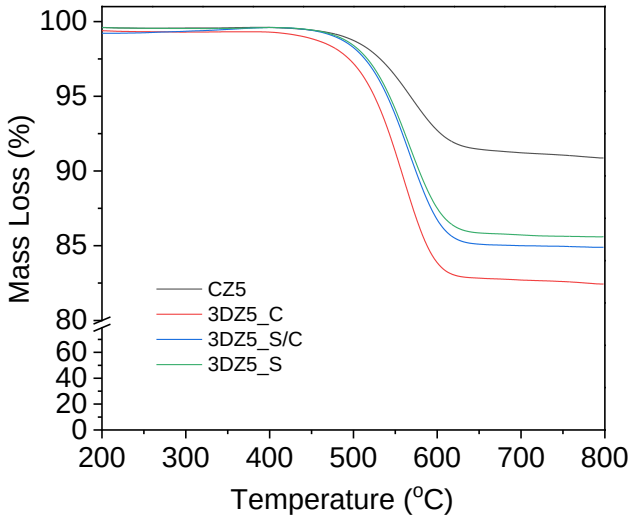

Figure S3. Thermogravimetric analysis curves of used catalysts after MTP reaction.

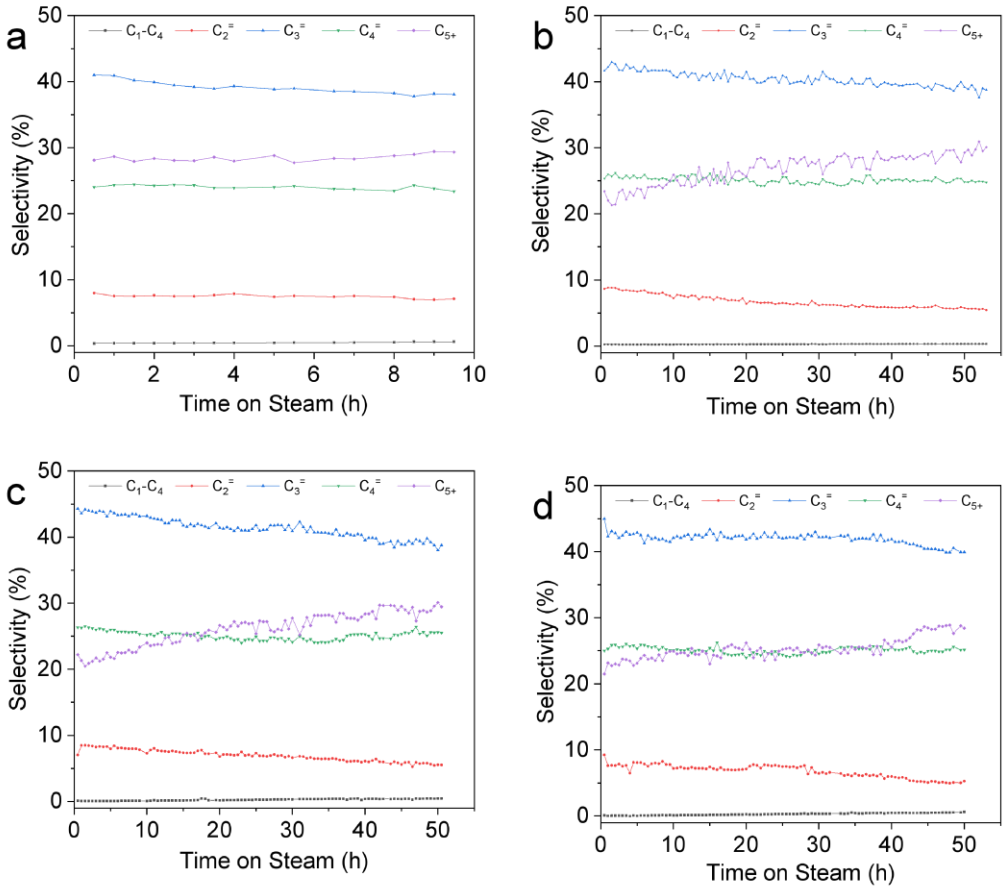

Figure S4. Product distributions versus time on stream over various synthesized 3DZ5 and the commercial CZ5 catalysts. Reaction conditions: T = 723 K, P = 1 atm, WHSV = 1.7 h^{-1}.

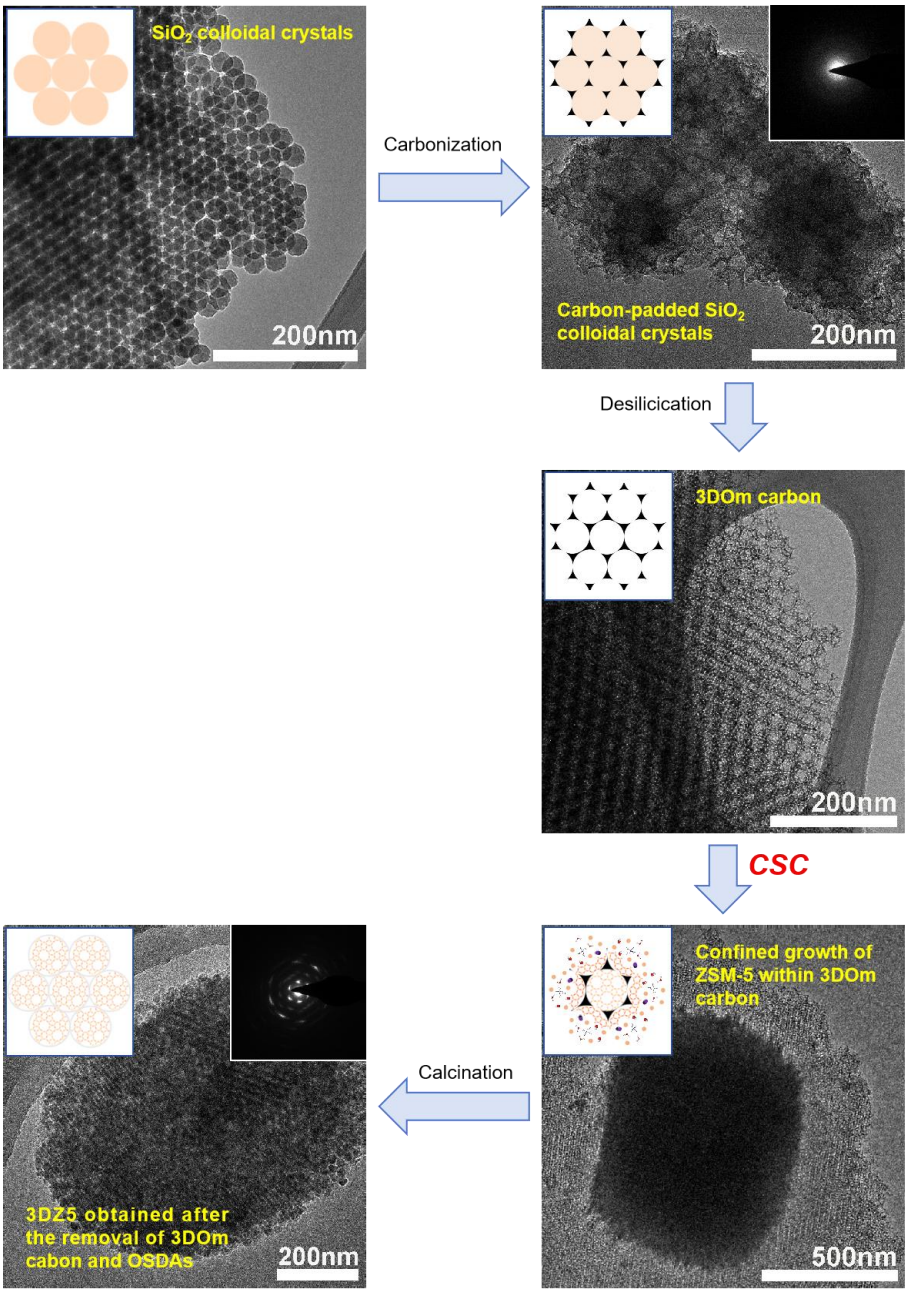

Figure S5. TEM observations of initial SiO_2 colloidal crystals, intermediate products, and final 3DZ5 zeolites by the CSC approach (Route I).

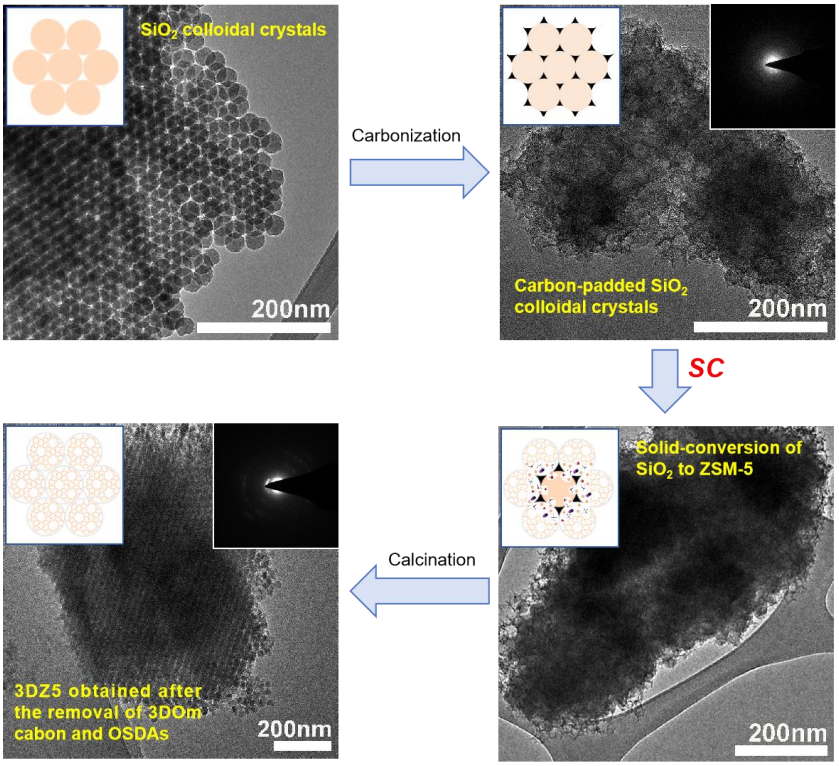

Figure S6. TEM observations of initial SiO_2 colloidal crystals, intermediate products, and final 3DZ5 zeolites by the modified solid-conversion synthesis of 3DZ5 from the carbon-padded SiO_2 colloidal crystals (Route II).

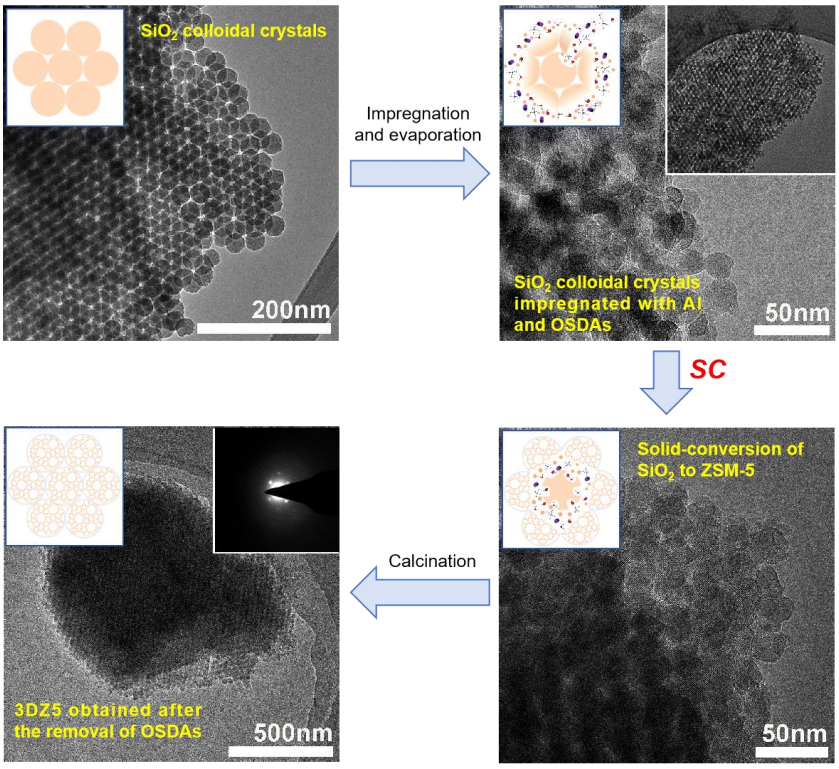

Figure S7. TEM observations of initial SiO_2 colloidal crystals and the the in-situ zeolitization process (Route III).

Table S1. Coke contents and coke formation rates (R_{coke}) of various synthesized 3DZ5 and the commercial CZ5 catalyst in MTP reaction

Sample	Coke Content [mg . gcat^{-1}]	R_{coke} [mg . gcat^{-1}. h^{-1}]
CZ5	81	2.02
3DZ5_C	164	1.49
3DZ5_S/C	145	1.61
3DZ5_S	138	1.73

Table S2. Product properties and synthesis efficiency of various synthesis approaches

Sample	Crystallinity[a)] [%]	Mesoporosity[b)] [%]	Acidity[c)] [%]	Time-efficiency[d)] [%]	Productivity[e)] [%]
3DZ5_C	72.3	34.1	56.3	35.0	82.2
3DZ5_S/C	83.2	32.6	56.2	56.0	90.5
3DZ5_S	87.3	29.7	58.0	82.4	88.8

a) Calculated according to the diffraction peaks based on the standard test method ASTM D5758-01 (2015) and the sample of CZ5 was used as a benchmark of RC = 100%; b) Defined as the fraction of external surface area (S_{ext}/S_{BET}); c) Defined as the fraction of strong acid sites (N_{strong}/N_{total}); d) Defined as the deviation from the time of SiO_2 colloidal crystals preparation (T_{SiO2}/T_{total}); e) Defined as the synthesis yield from raw material.