

Electronic Supplementary Information

Vapor-phase transport synthesis of microfibrillar-structured SS- fiber@ZSM-5 catalyst with improved selectivity and stability for methanol- to-propylene

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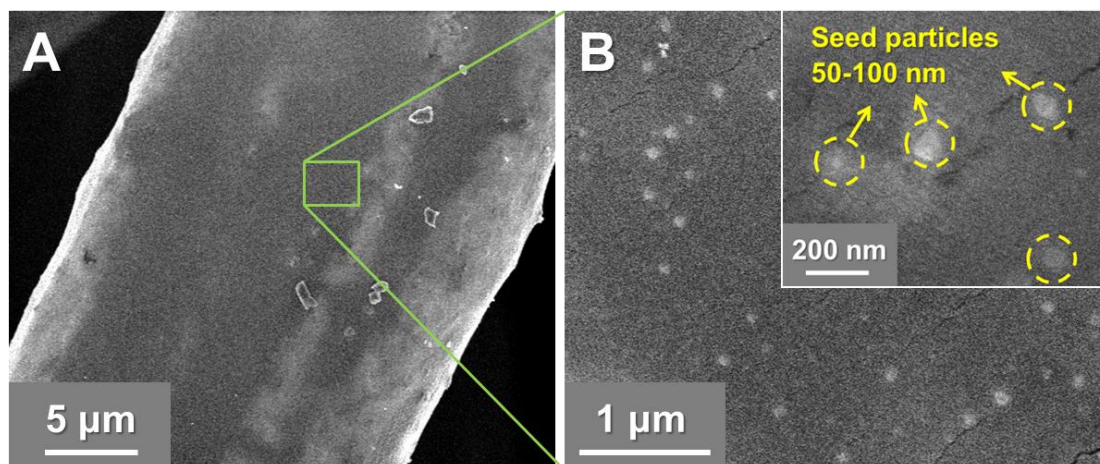


Fig. S1 SEM images of dry gel coated SS-fiber.

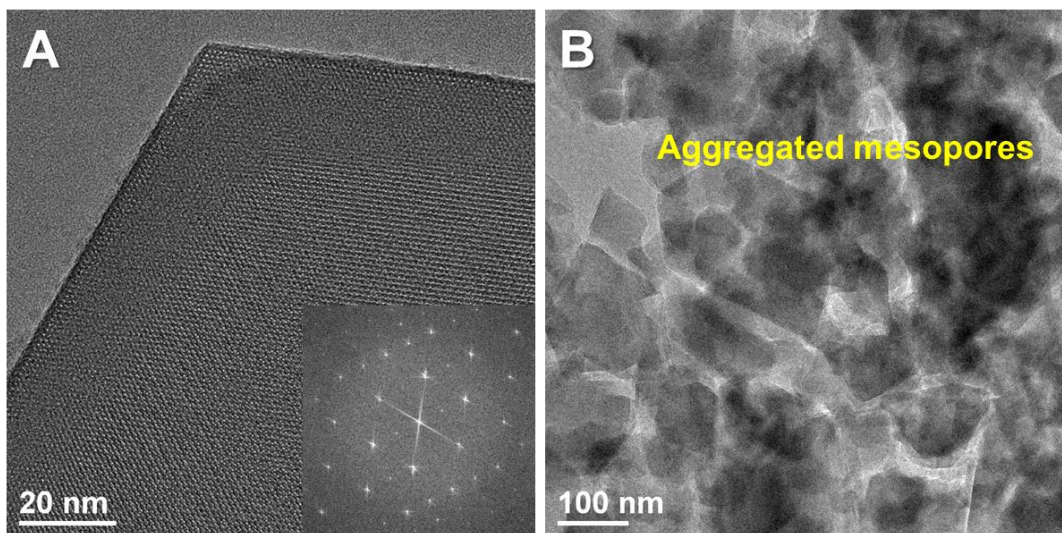


Fig. S2 TEM images of the zeolite shell of representative EDA-200-5/120 core-shell composite.

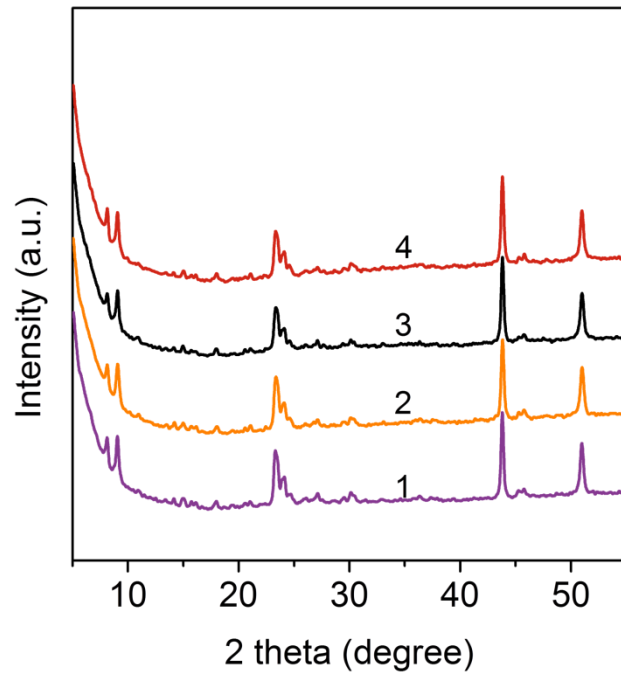


Fig. S3 XRD patterns of SS-fiber@ZSM-5 composite synthesized with recycled EDA solution for different times.

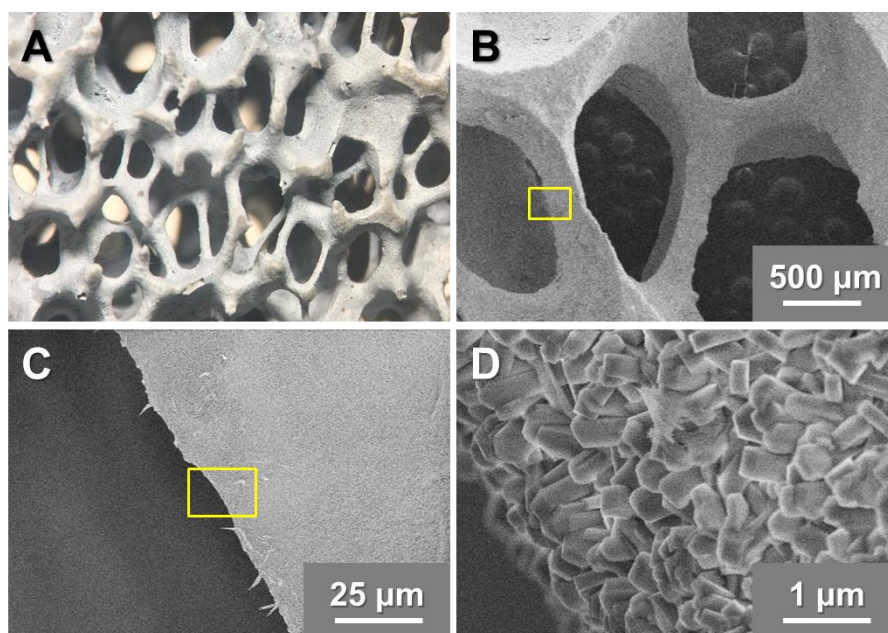


Fig. S4 Photograph (A) of SiC-foam substrate and SEM images (B-D) of SiC-foam@ZSM-5 composite synthesized by VPT method.

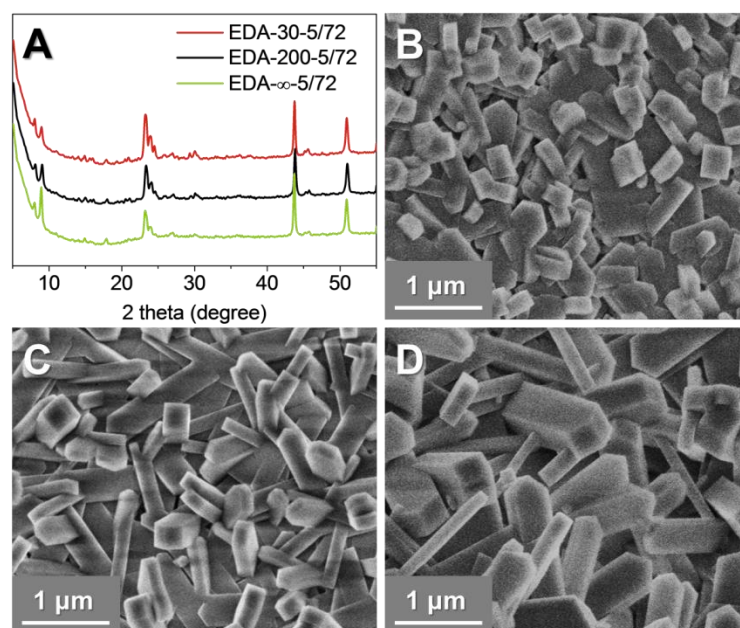


Fig. S5 (A) XRD patterns and (B-D) SEM images of sample EDA- x -5/3 synthesized with $\text{SiO}_2/\text{Al}_2\text{O}_3$ molar ratio of (B) $x = 30$, (C) $x = 200$ and (D) $x = \infty$.

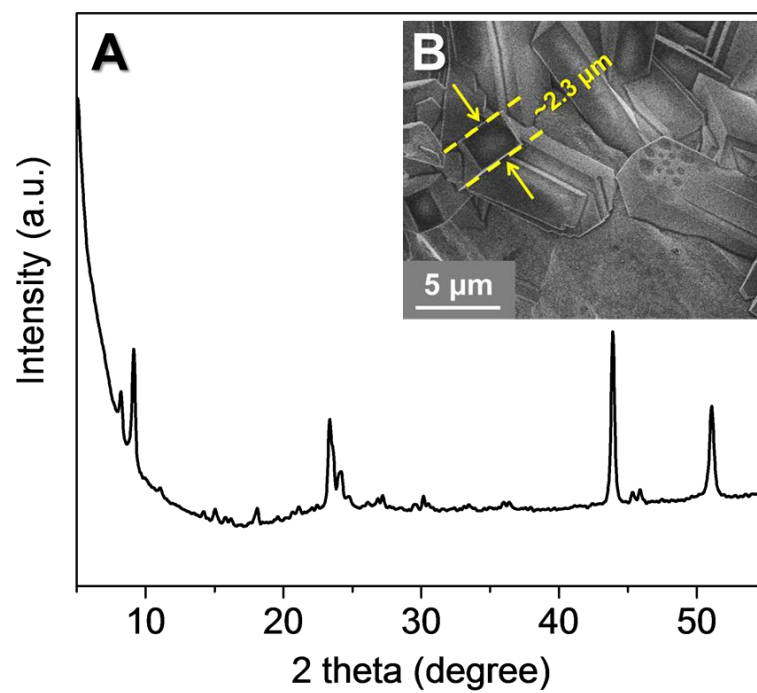


Fig. S6 XRD pattern (A) and SEM image (B) of sample EDA-200-0.018T/72.

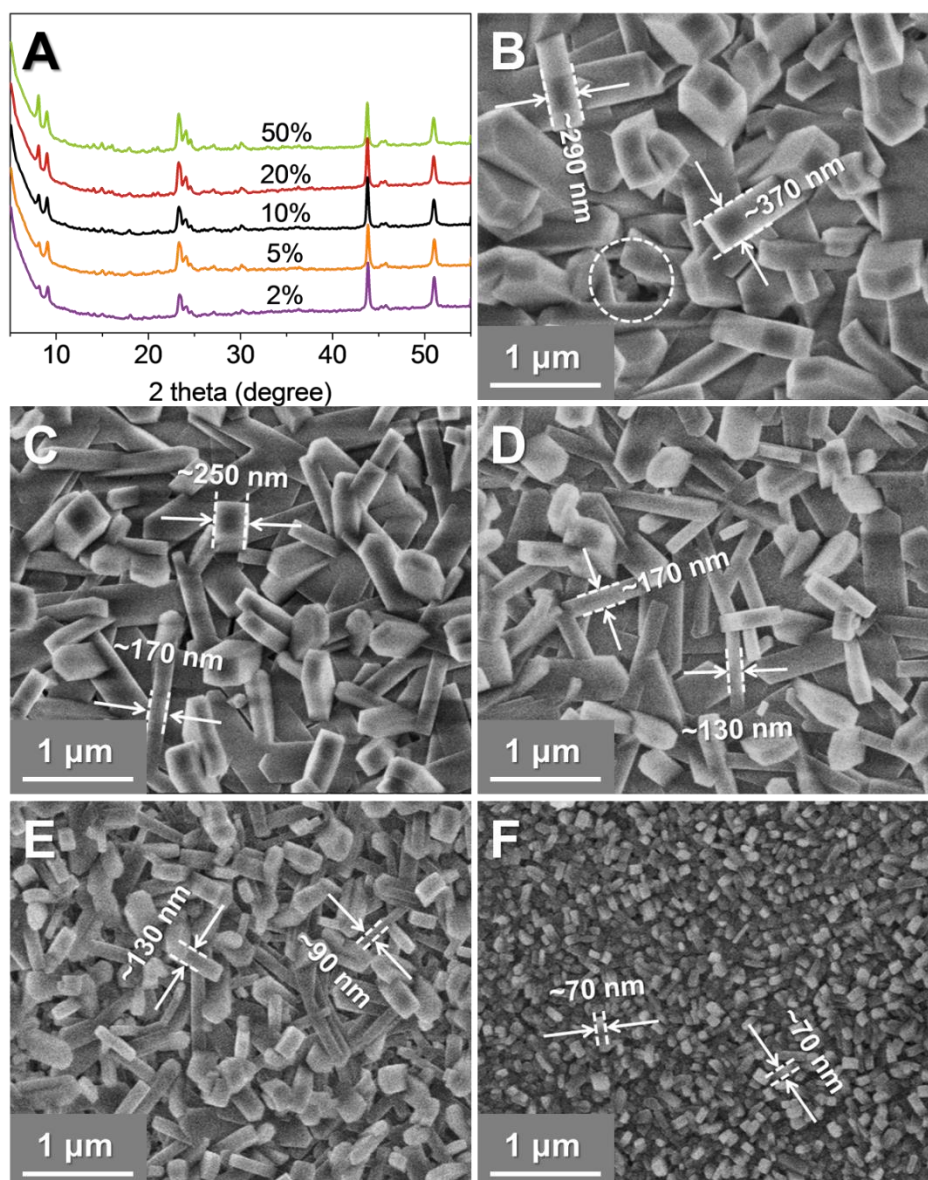


Fig. S7 XRD patterns (A) and SEM images (B-F) of sample EDA-200-y/72 with varied seeding gel amounts from 2% to 50%, (B) $y = 2$, (C) $y = 5$, (D) $y = 10$, (E) $y = 20$, (F) $y = 50$.

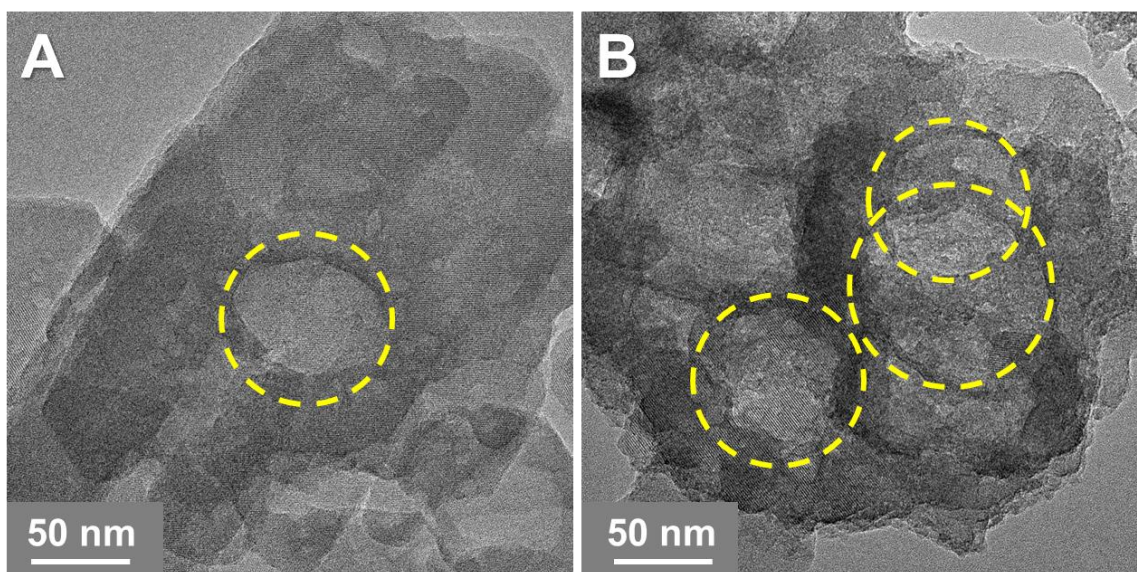


Fig. S8 TEM images of sample (A) EDA-200-5/72 and (B) EDA-200-50/72 after alkaline treatment with 0.8 M Na_2CO_3 solution at 80 °C for 36 h.

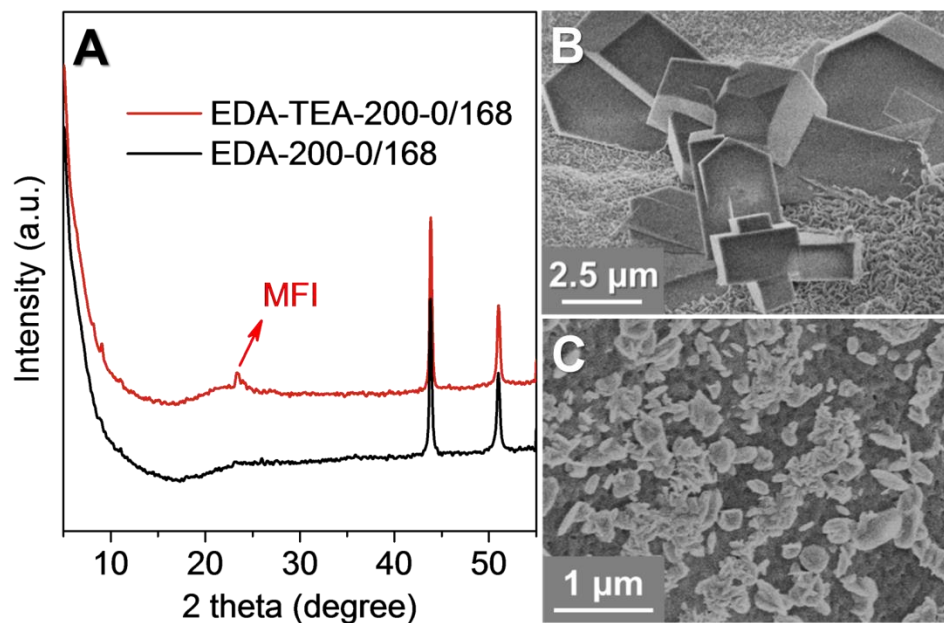


Fig. S9 XRD patterns (A) and SEM images (B-C) of sample (B) EDA-TEA-200-0/168 and (C) EDA-200-0/168.

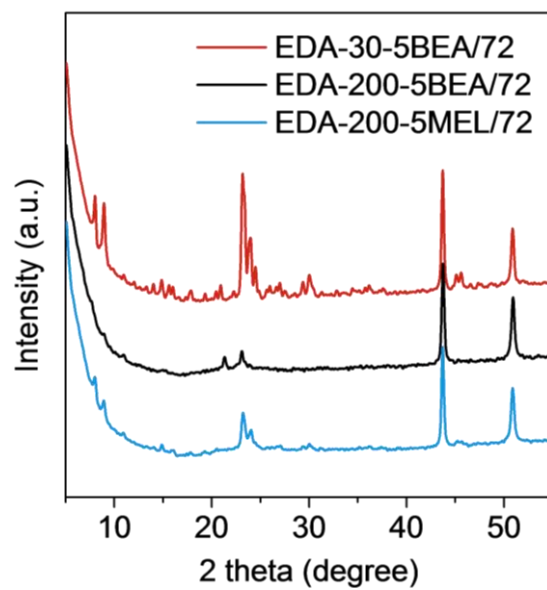


Fig. S10 XRD patterns of SS-fiber@ZSM-5 composite synthesized with different types of seeding gel and SiO₂/Al₂O₃ molar ratios.

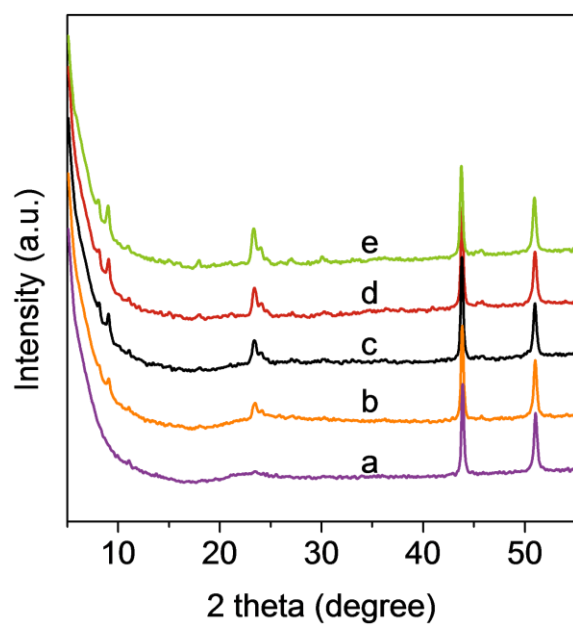


Fig. S11 XRD patterns of sample EDA-200-5/z obtained after the VPT for (a) $z = 1$ h, (b) $z = 2$ h, (c) $z = 3$ h, (d) $z = 12$ h, and (e) $z = 24$ h.

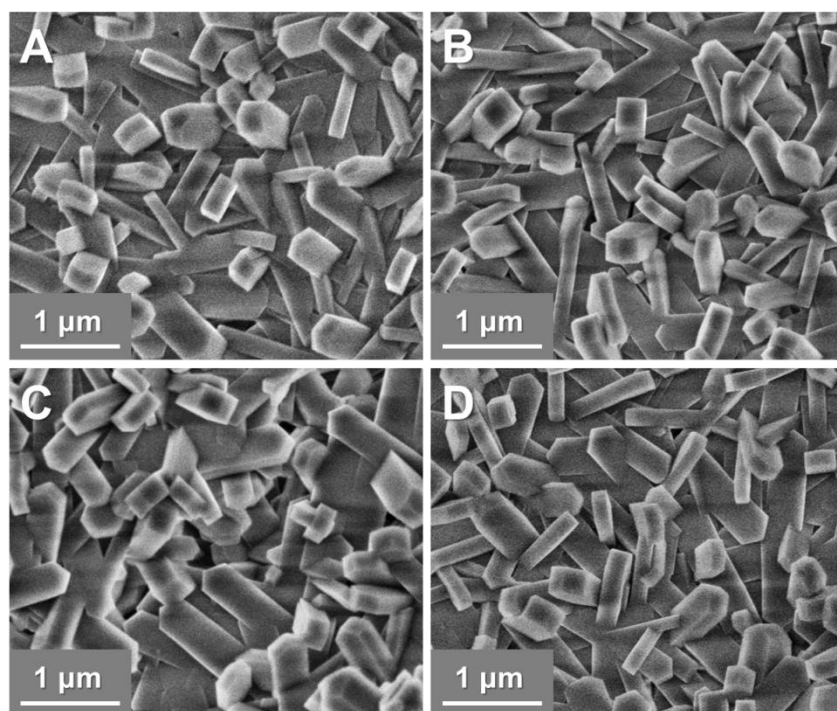


Fig. S12 SEM images of the sample EDA-200-5/z obtained after the VPT for (A) $z = 48$ h, (B) $z = 72$ h, (C) $z = 120$ h, and (D) $z = 168$ h.

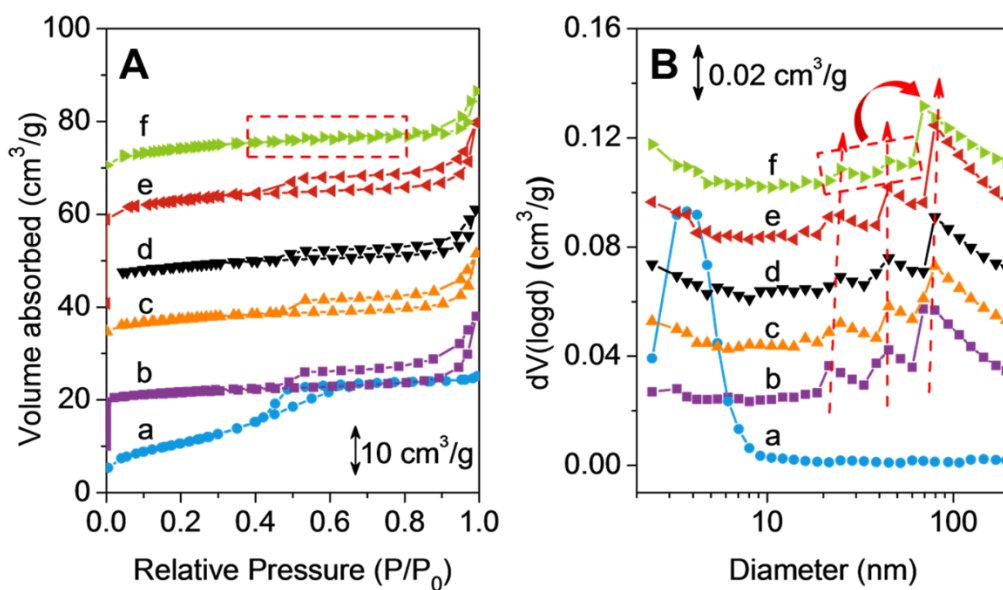


Fig. S13 N₂ adsorption-desorption isothermals (A) and Barrett-Joyner-Halenda (BJH) mesopore size distribution curves (B) of the sample EDA-200-5/z with zeolite content of ~23.0 wt% obtained after the VPT for (a) z = 24 h, (b) z = 48 h, (c) z = 72 h, (d) z = 120 h, and (e) z = 168 h.

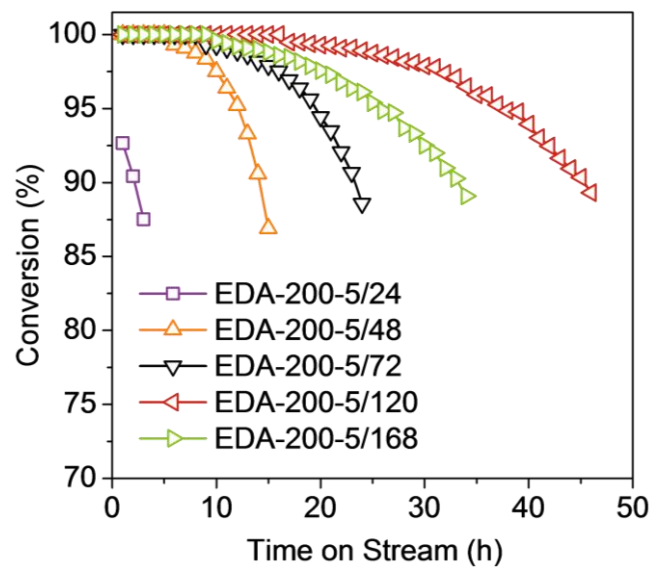


Fig. S14 Conversion of methanol as a function of time on stream over EDA-200-5/z catalysts. Reaction conditions: 450 °C, WHSV of 10 h⁻¹, 0.1 MPa, 30 vol% methanol in N₂, zeolite 0.4 g. Reaction was quitted at ~90 % methanol conversion.

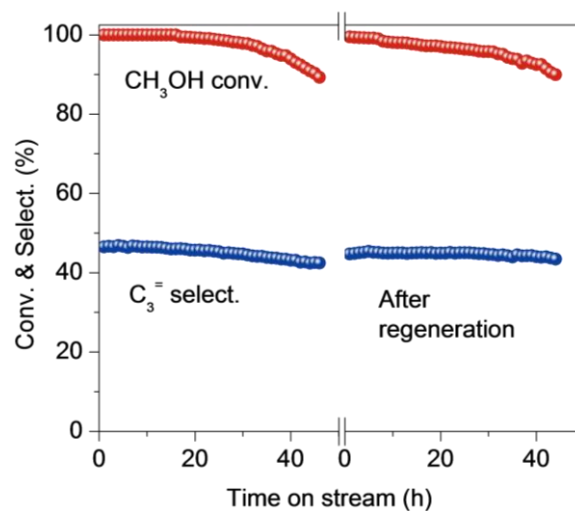


Fig. S15 Methanol Conversion of and propylene selectivity over EDA-200-5/120 catalyst. Reaction conditions: WHSV = 10 h⁻¹, T = 450 °C, P = 1 atm. Regeneration conditions: 550 °C in air for 5 hours.

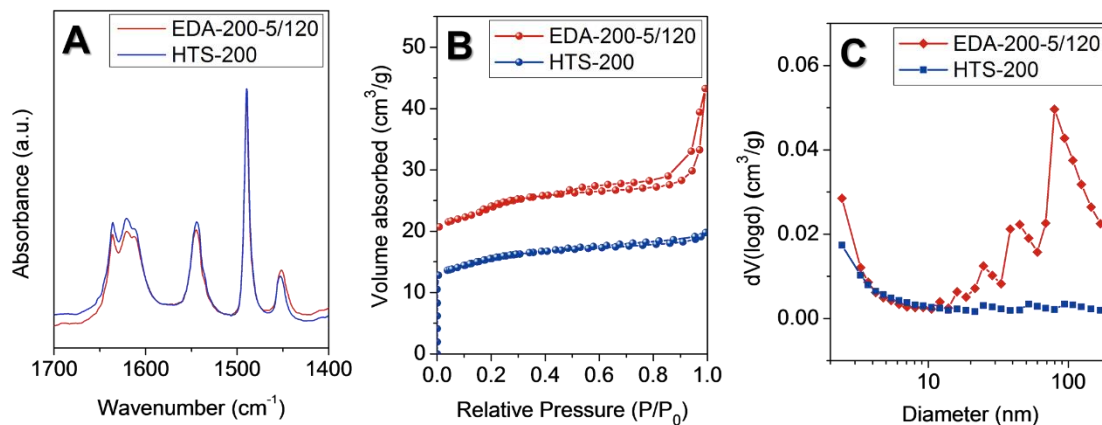


Fig. S16 (A) pyridine adsorption IR spectra, (B) N_2 adsorption-desorption isothermals and (C) Barrett-Joyner-Halenda (BJH) mesopore size distribution curves of samples EDA-200-5/120 (~24.4 wt% HZSM-5) and HTS-200 (~16.9 wt% HZSM-5).

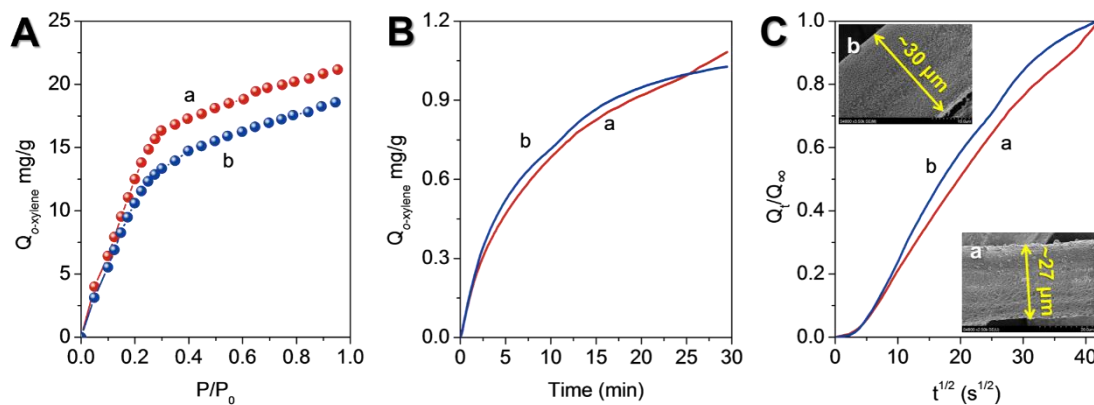


Fig. S17 (A) The o-xylene adsorption isotherms by IGA at 298 K, (B) the o-xylene adsorption kinetics curves at 298 K and $P/P_0 = 0.1$ and (C) dependence of normalized o-xylene adsorption on the square root of the adsorption time as well as SEM images for (a) EDA-200-5/120 (~24.4 wt% HZSM-5) and (b) HTS-200 (~16.9 wt% HZSM-5).

Supplementary Text | Calculation of diffusion coefficients (D)

Fig. S17 shows the results of o-xylene diffusion measurement. The diffusion coefficient was estimated from the time-dependent adsorption uptake by the following equation^{S1}:

$$\frac{Q_t}{Q_\infty} = \frac{2}{\sqrt{\pi}} \sqrt{\frac{D}{L^2}} \sqrt{t}$$

where Q_t and Q_∞ represent the adsorption uptake of o-xylene at time t and after reaching equilibration respectively. The L denotes the average zeolite shell thickness of SS-fiber@HZSM-5, being $\sim 5.0 \mu\text{m}$ and $\sim 3.5 \mu\text{m}$ for EDA-200-5/120 and HTS-200, respectively, as estimated as estimated from their SEM images (Fig. S17C). The curve in Fig. S17C was made by plotting the Q_t/Q_∞ versus the square root of the adsorption time, and the slope of the linear part of the curve ($Q_t/Q_\infty = 0.3-0.6$) was used for estimation of the diffusion coefficient (D)^{S2}.

References

S1. J. Crank, *The Mathematics of Diffusion*, Oxford Press, London, 1975, p. 203.

S2. Y. Li, H. Wang, M. Dong, J. Li, Z. Qin, J. Wang and W. Fan, *Rsc Adv.* 2015, **5**, 66301-66310.