Supplementary Material

Dual-template assembled hierarchical Cu-SSZ-13: morphology evolution, crystal growth and stable high-temperature selective catalytic reduction performance

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S1. Experimental Section

Reagents

1-bromohexadecane (97%, Aladdin), N-methylpiperidine (98%, Aldrich), ethanol (99.9%, Aladdin). N, N, N-trimethyl-1-adamantammonium hydroxide (TMAdaOH, 25wt%, Aladdin), aluminum sulfate 18-hydrate (99wt%, Adamas), sodium hydroxide (99.5%, Honeywell), colloidal silica (30.5wt%, Shanghai yuanye Bio-Technology).

Synthesis of C_{16}MP

100 ml of ethanol and 2.3 g of N-methylpiperidine were added to a 500 ml triple flask. Heated to 60 °C, 6.1 g of $C_{16}H_{33}Br$ was dropped into the mixture, further heating to 80 °C and magnetic stirring for 24 h. After the reaction, the mixture was dried overnight in a 60 °C oven, then washed 3-4 times with ether and finally dried for 12 h at 25 °C to obtain C_{16}MP.

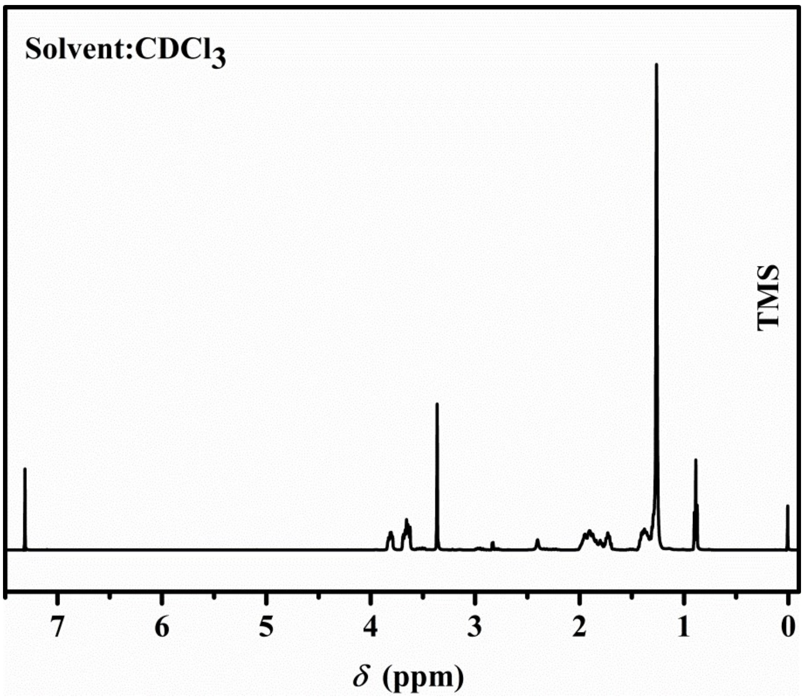


Fig. S1. The liquid ^{1}H NMR profile of C_{16}MP.

^{1}H NMR:

δ 3.75(m, 2H), 3.59(m, 4H), 3.30(S, 3H), 1.76(m, 8H), 1.26(m+br s, 26H)

S2. Catalyst Characterization

Table S1 Textural properties of the SSZ-13(19:1) samples with varied crystallization time.

Sample	S_{BET} $(m^2\cdot g^{-1})^a$	S_{micro} $(m^2\cdot g^{-1})^b$	S_{exter} $(m^2\cdot g^{-1})$	V_{meso} $(cm^3\cdot g^{-1})$	V_{total} $(cm^3\cdot g^{-1})^c$
6 h	195.4	47.0	148.4	0.23	0.24
12 h	253.7	99.6	154.1	0.20	0.21
24 h	314.0	149.0	165.0	0.21	0.25
36 h	527.2	387.8	139.4	0.13	0.31
48 h	583.0	469.1	113.9	0.07	0.32
72 h	585.8	504.6	81.2	0.06	0.32
120 h	575.7	489.0	86.7	0.05	0.28
144 h	576.6	482.0	94.6	0.11	0.34

[a] Deduced by the BET method.

[b] Calculated by the t-plot method.

[c] Volume absorbed at $p/p_0 = 0.99$.

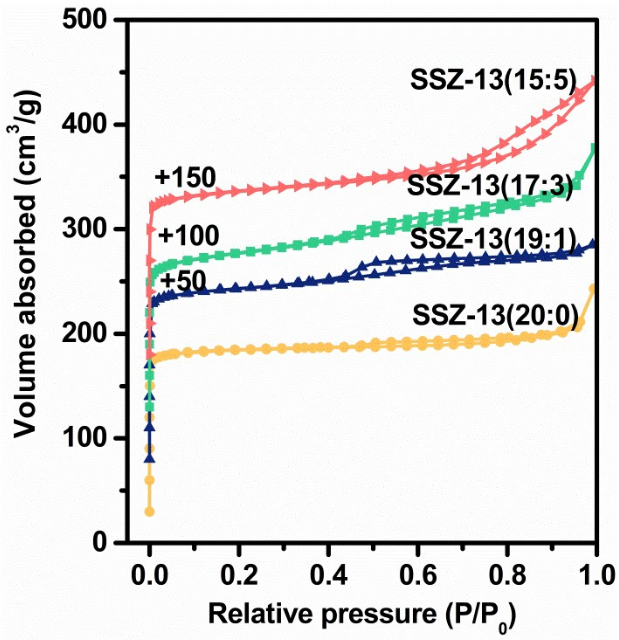


Fig. S2. N_2 adsorption-desorption isotherms of SSZ-13 with different TMAdaOH/C_{16}MP ratio.

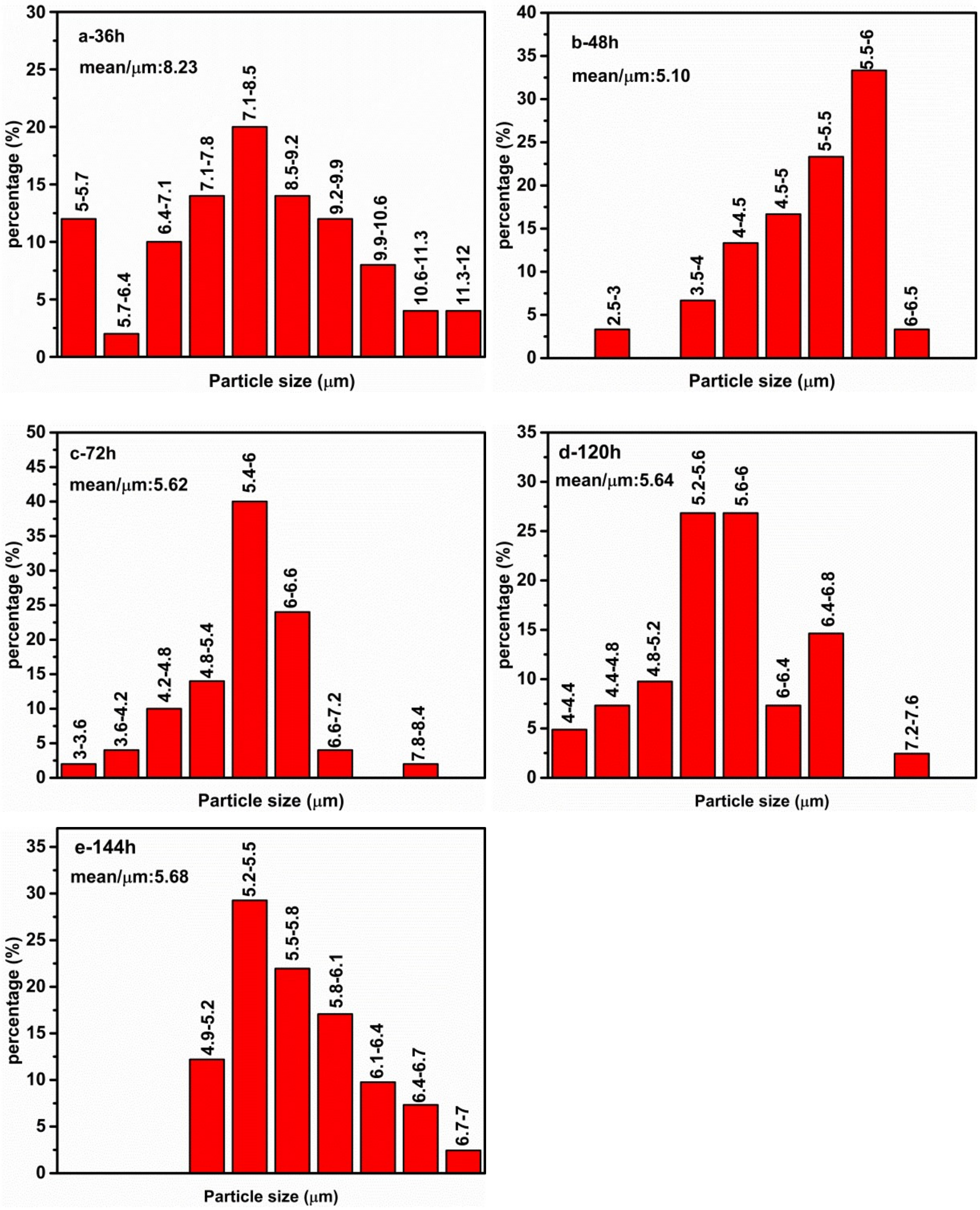


Fig. S3. Particle size distribution of SSZ-13(19:1) with the crystallization from 36 h to 144 h.

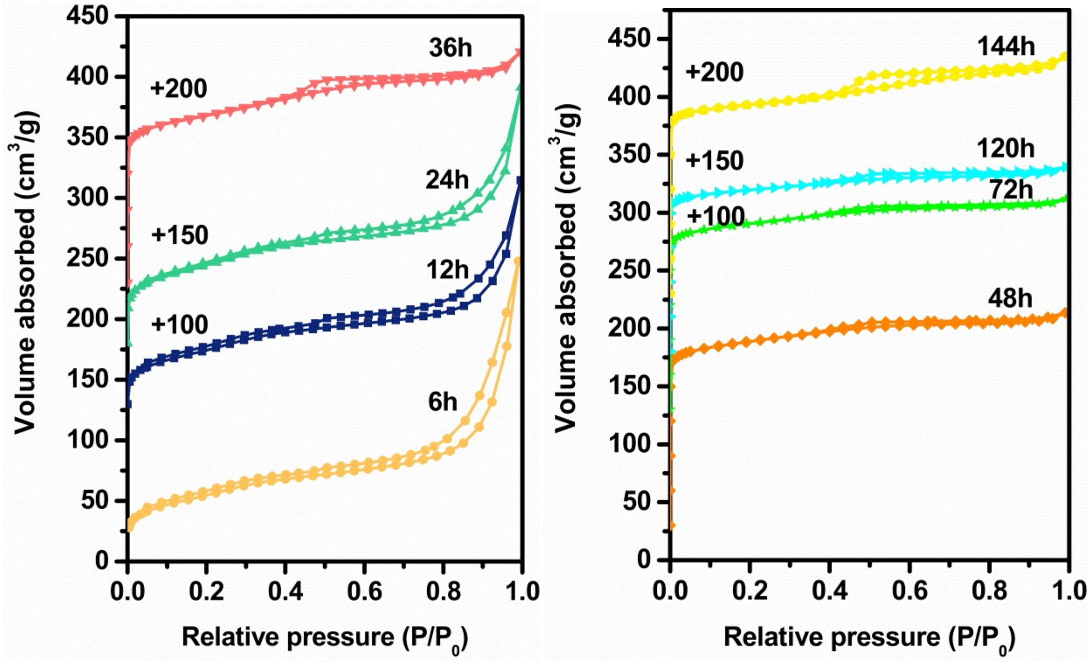


Fig. S4. N_2 adsorption-desorption isotherms of SSZ-13(19:1) with different crystallization time.

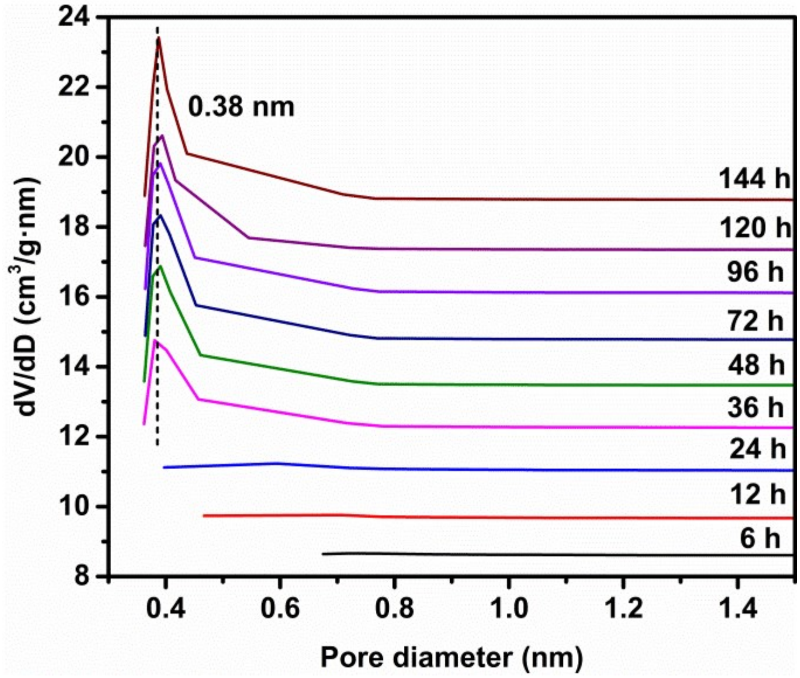
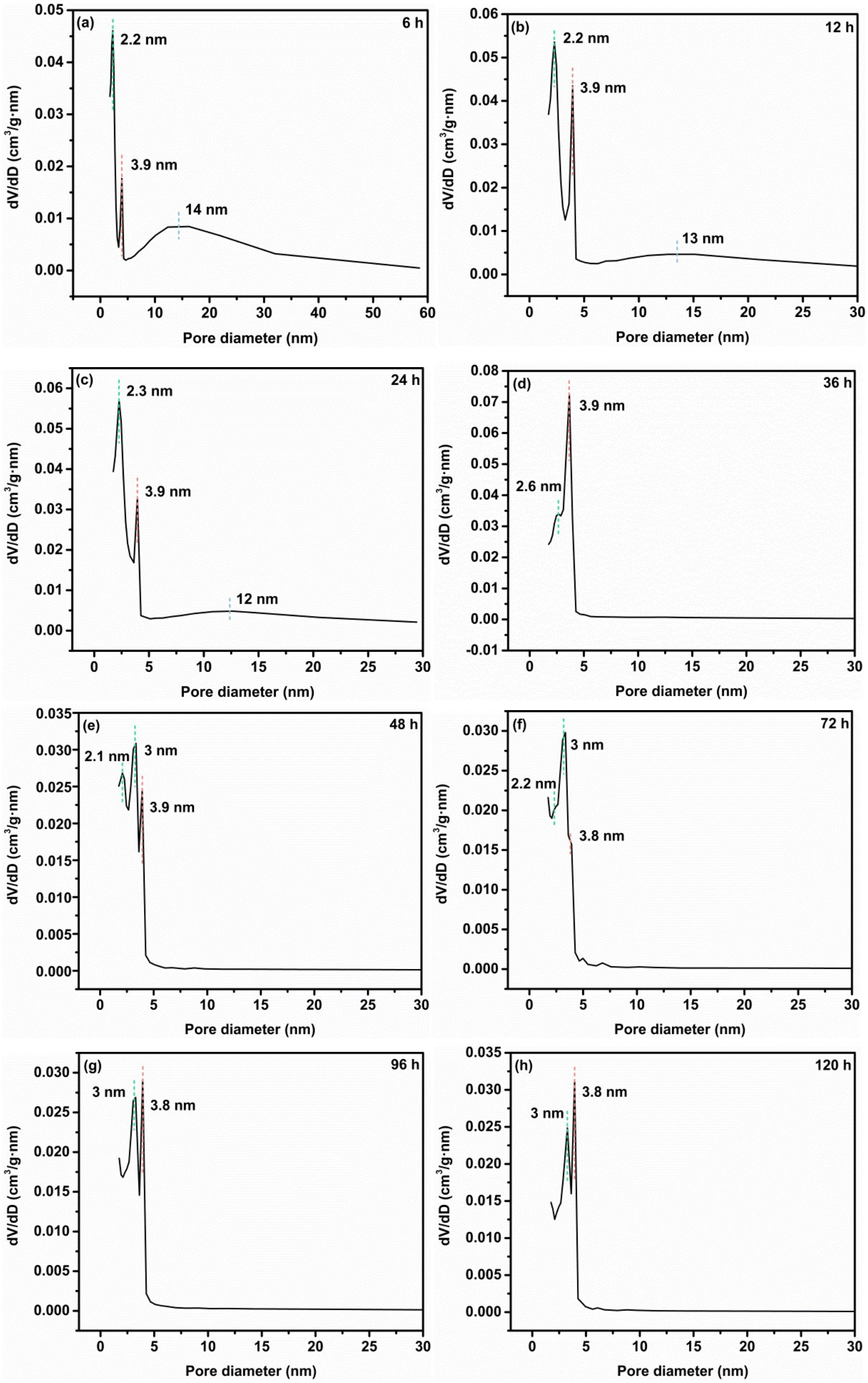


Fig. S5. HK pore size distributions of SSZ-13(19:1) at different crystallization time.



(a) 6 h
2.2 nm
3.9 nm
14 nm
(b) 12 h
2.2 nm
3.9 nm
13 nm
(c) 24 h
2.3 nm
3.9 nm
12 nm
(d) 36 h
3.9 nm
2.6 nm
(e) 48 h
2.1 nm
3 nm
3.9 nm
(f) 72 h
3 nm
2.2 nm
3.8 nm
(g) 96 h
3 nm
3.8 nm
(h) 120 h
3.8 nm
3 nm
dV/dD (cm3/g·nm)
Pore diameter (nm)

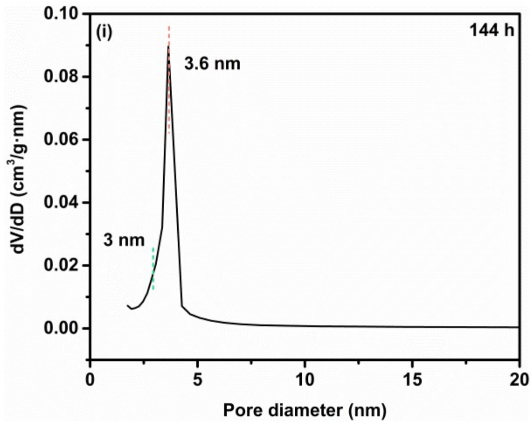


Fig. S6. BJH pore size distributions of SSZ-13(19:1) at different crystallization time.

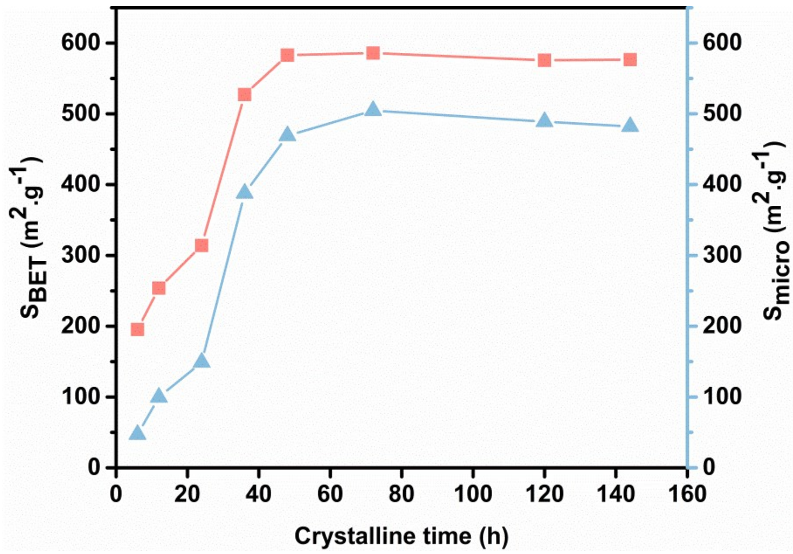


Fig. S7. S_{BET}/S_{micro} cures of SSZ-13(19:1) sample relative crystallization time.

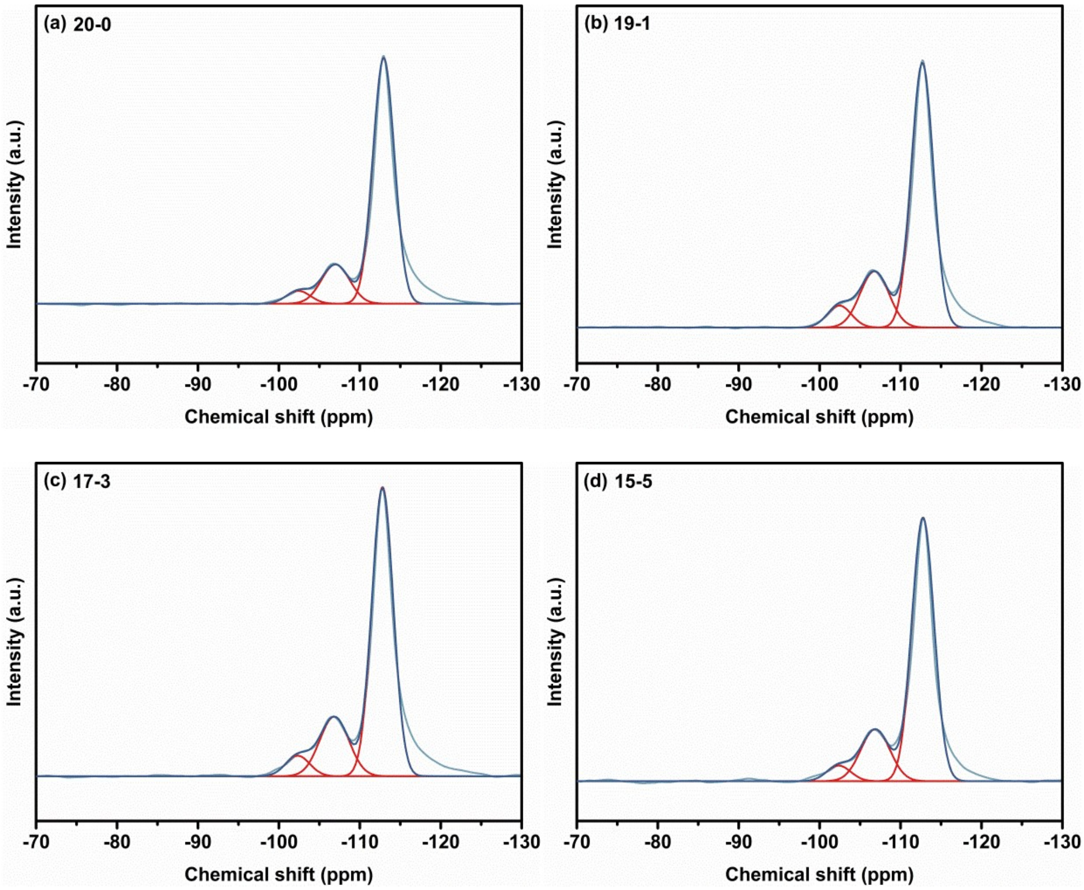


Fig. S8. ^{29}Si NMR spectra of SSZ-13 samples with different TMAdaOH/C_{16}MP molar ratio.

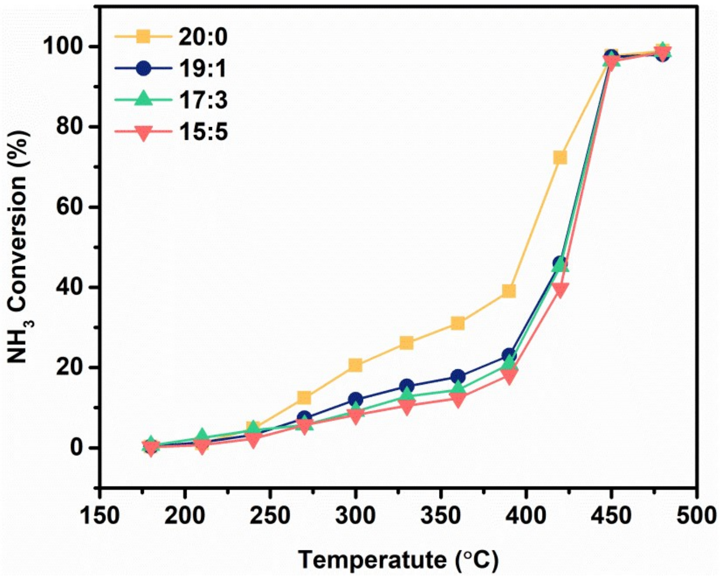


Fig. S9. Dependences of the NH_3 conversion on temperature over SSZ-13 samples with different TMAdaOH/C_{16}MP molar ratio.