Fast synthesis of sub-micron all-silica CHA zeolite particles with seeding method

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Supporting information

1. Synthesis of all-silica CHA without seeding

The gel molar ratio was 1.0SiO$_2$:0.5HF:0.5TMAOH:3H$_2$O. In a typical synthesis, TEOS was mixed with TMAOH aqueous solution (N,N,N-Trimethyl-1-adamant ammonium hydroxide, 25 wt%) and the solution was stirred overnight. The excessive water (and ethanol) was removed by keeping the container in a 358K oven overnight. The obtained solid-like precursor was hand ground into fine powder and mixed with hydrofluoric acid (40 wt%). Then the autoclave was kept at 453 K for 2d. After hydrothermal synthesis, the autoclave was quenched with tap water. The powder product was washed with DI water thoroughly and dried at 340 K. Template removal was conducted at 873K for 6 h in air.

2. Synthesis of all-silica CHA with seeding

The all-silica CHA crystals (obtained in previous section, 8 μm in diameter) were ball-milled for 6h and the resultant sub-micron particles were used as seeds.

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the seeds were added and hand-mixed thoroughly with the precursor (20mg seeds/1.5g SiO$_2$ in the precursor). The autoclave was kept at 453 K for 2d. After hydrothermal synthesis, the autoclave was quenched with tap water. The powder product was washed with DI water thoroughly and dried at 340 K. Template removal was conducted at 873K for 6 h in air.

3. Instrumentation

Scanning electron microscopy (SEM) images were acquired using a Zeiss-LEO model 1530 variable pressure field effect scanning electron microscope at 10 kV. Samples for SEM analysis were coated with a gold-palladium target. SEM images were acquired using a Hitachi S-4800 at 200 keV. X-ray diffraction (XRD) patterns were obtained with a Rigaku Ultima-III X-ray diffractometer using Cu Kα X-radiation. N$_2$ adsorption-desorption isotherms were obtained at 77 K on an ASAP2020 adsorption apparatus.

4. Results and discussions

(a) no seeding(BET=580 m$^2$/g)
Fig S1. N\textsubscript{2} isotherm of CHA prepared with seed (BET=574 m\textsuperscript{2}/g)