Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

Assemblies of Hybrid Core-Shell ZSM-5 Zeolite Materials

Daoping He and Dongliang Liu*

Department of Applied Chemistry, Donghua University, North Renmin RD 2999th Shanghai 201620 (P.R.China)

E-mail: dlliu@yahoo.com

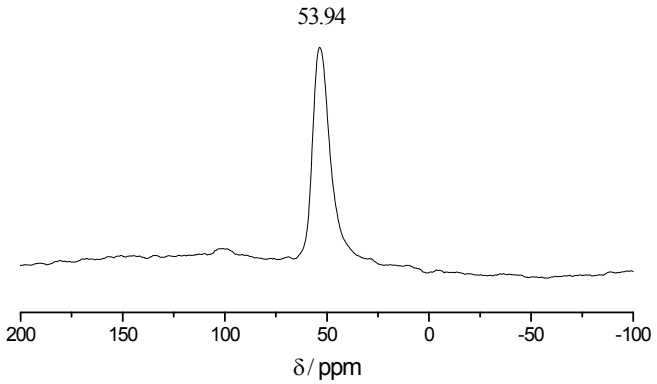
Synthesis of Materials

For the synthesis of HVBZ, TPOAC was added to an alkaline mixture containing TPABr, NaOH, tetraethyl orthosilicate (TEOS), $NaAlO_2$ and distilled water under vigorous stirring to obtain a solution with the following molar composition: 10 SiO_2 : 0.22 Al_2O_3 : 1.9 Na_2O : 2.6 TPABr : 0.5 TPOAC : 600 H_2O. In a typical run, 0.15 g of $NaAlO_2$, 2.8 g of TPABr, 8.58 g of tetraethyl orthosilicate (TEOS) and 0.60 g of NaOH were dissolved in 46 g of distilled water and stirred for 1 h to obtain a clear solution at room temperature. To this solution, 1.7 g of TPOAC (60% in CH_3OH) were added under vigorous stirring. The mixture was stirred for 2h to obtain a homogeneous solution. The final mixture was statically crystallized in a Teflon-lined stainless steel autoclave at 150 °C for 3 days. The product was washed with distilled water, dried in an oven at 100 °C and calcined at 600 °C for 5 h with a heating rate of 1K/min to remove the template. The HLBZ was synthesized by the same procedure except the addition of 0.20 g of adipic acid disodium salt.

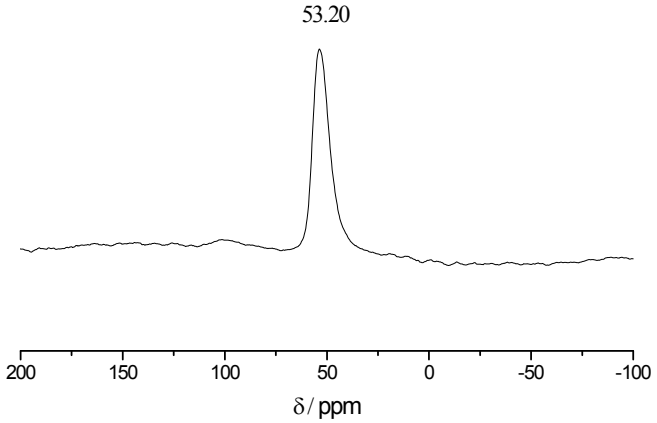
Characterization

XRD patterns were obtained with a Rigaku D/max-2550 PC diffractometer with Cu Kα radiation in steps of 0.02° with an accumulation time of 0.4 s per step. Nitrogen adsorption and desorption isotherms were measured at 77K using a Micromeritics TriStar II 3020 system. The samples were degassed for 12 h at 150 ºC prior to measurements. The pore-size distribution for mesopores was calculated using Barrett-Joyner-Halenda (BJH) model. SEM photographs were taken on a Hitachi TM-1000 electron microscope. TEM was performed on a JEOL JEM-2100 electron microscope at an acceleration voltage of 200 kV. ^{27}Al MAS NMR was recorded on a Bruker Avance 400 spectrometer using a 4 mm zirconia rotor at a spinning frequency of 5 KHz. A 1.0 mol/L solution of aluminum nitrate was used as an external reference. For elemental analysis inductively coupled plasma atomic emission spectroscopy (ICP-AES, instrument Prodigy, Leeman, USA) was used.

^{27}Al MAS NMR spectra of HVBZ and HLBZ



^{27}Al MAS NMR spectrum of HVBZ.



^{27}Al MAS NMR spectrum of HLBZ.

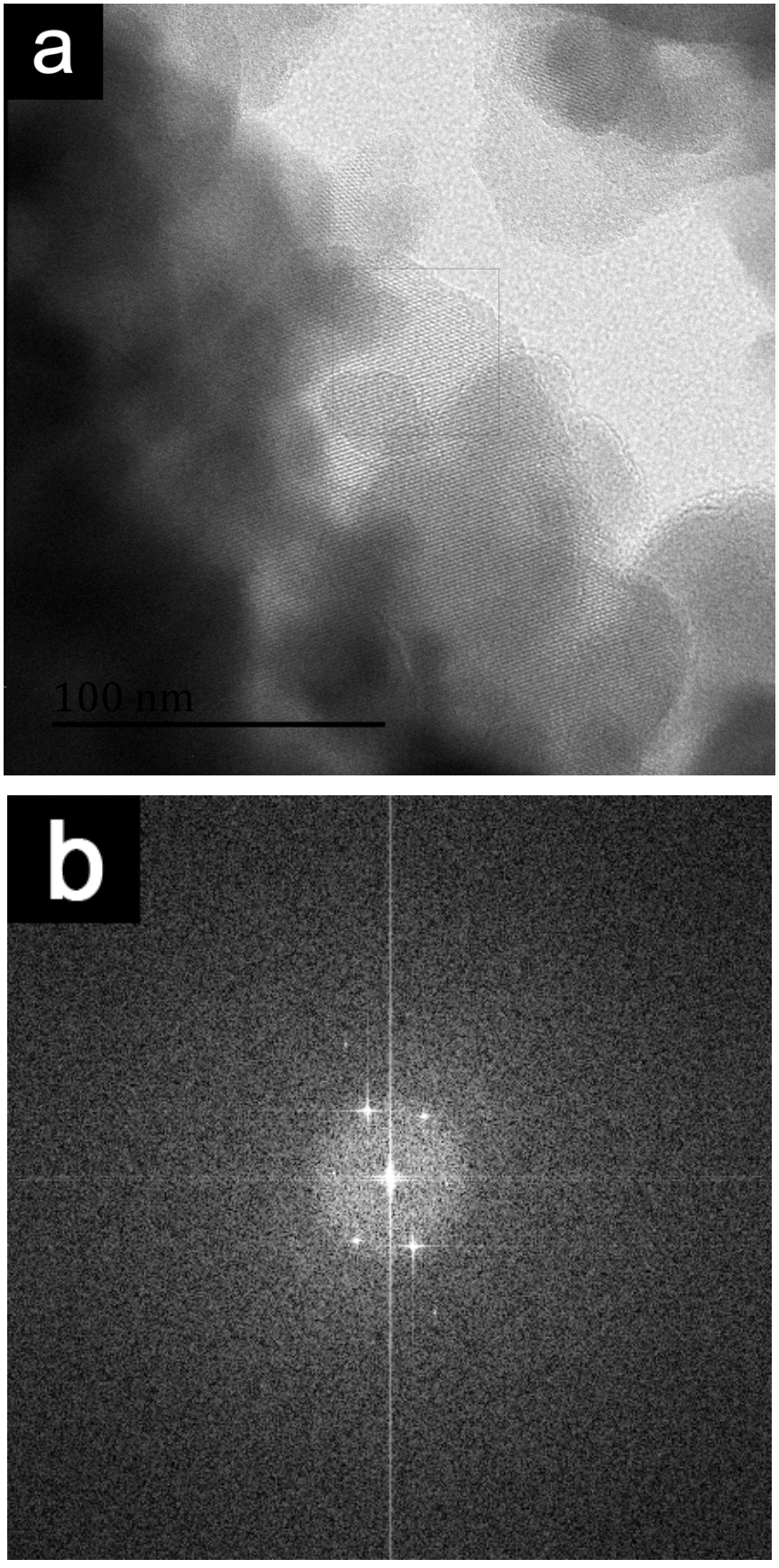


Figure S1: (a) TEM image of the shell of HLBZ and (b) the corresponding Fast Fourier Transform.