High Pressure X-ray Diffraction Studies Of Purely Siliceous Zeolites

Marek Colligan[1], Joseph Hriljac[1], Thomas Vogt[2], Yongjae Lee[2]
[1]*University of Birmingham, UK.* [2]*BNL, New York.* E-mail: mrc263@bham.ac.uk

High pressure synchrotron X-ray powder diffraction measurements of purely siliceous zeolites were performed using a diamond anvil cell. The behaviour under pressure is partly driven by the ability of the pressure transmitting fluid to enter the neutral SiO_2 framework.

Measurements of purely siliceous zeolite Y (Sil-FAU) using silicone oil as the pressure transmitting medium show compression of the zeolite followed by a loss of long range ordering at 2.2 GPa. When using a methanol:ethanol:water mixture (16:3:1) as the pressure transmitting medium, two distinct compressibility regions are observed with a dramatic change in the compression mechanism at 4 GPa. Rietveld refinement analysis of the powder patterns explains the different regions as sequential pore filling being the main response to pressure up to 4 GPa and distortion of the framework involving the sodalite and double 6 ring (D6R) units at higher pressures.

Purely siliceous chabazite (Sil-CHA) was measured to 5.5 GPa using an alcohols/water mixture, previously described, as the pressure transmitting fluid. As with Sil-FAU, two distinct regions of compressibility were observed. Rietveld refinements indicated initial pore filling occurs upon application of pressure to ~3 GPa in the case of Sil-CHA. This is followed by framework distortion as a response to increased pressure. Further experiments on these and related systems will be performed in April, and results presented.

Keywords: synchrotron x-ray diffraction, zeolite, diamond anvil cell