Poster

Structural Stability and Adsorption Behaviour of CO_2-Loaded Pure Silica CHA Zeolite under High Pressure conditions

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Carbon capture and storage (CCS) strategies have emerged as reliable options for addressing the environmental issue of reducing CO_2 concentration in the atmosphere and mitigating climate change worldwide [1]. Zeolites are a versatile class of porous materials that are thermally and chemically stable and can display selective CO_2 adsorption behaviour, which makes them suitable for gas separation. The chabazite-type (CHA) zeolite, in particular, is noted for its small pore size and molecular sieving ability, making it effective in separating CO_2 from CH_4 and N_2 in various applications [2].

The present study investigates the structural stability and adsorption behavior of ultrahigh CO_2-loaded pure-silica zeolite (CHA) under high-pressure conditions. To analyze these properties, we have carried out in situ synchrotron-based X-ray powder diffraction measurements up to 12.2 GPa. Lattice indexation provides information on the filling process and, through Rietveld refinements and Fourier recycling methods, we have been able to tentatively determine the location and amount of guest CO_2 molecules within the cavities of pure-SiO_2 CHA zeolite framework. The complete filling of the zeolite pores with CO_2 molecules was found to have a positive impact on the structural stability of CHA under compression, which does not undergo pressure-induced amorphization in the studied pressure range. Interestingly, low compressibility takes place below 4 GPa during CO_2 loading. These results highlight the influence of CO_2 adsorption on the compressibility behavior of this zeolite and allow comparison with other pure silica zeolites described in the literature [3, 4].

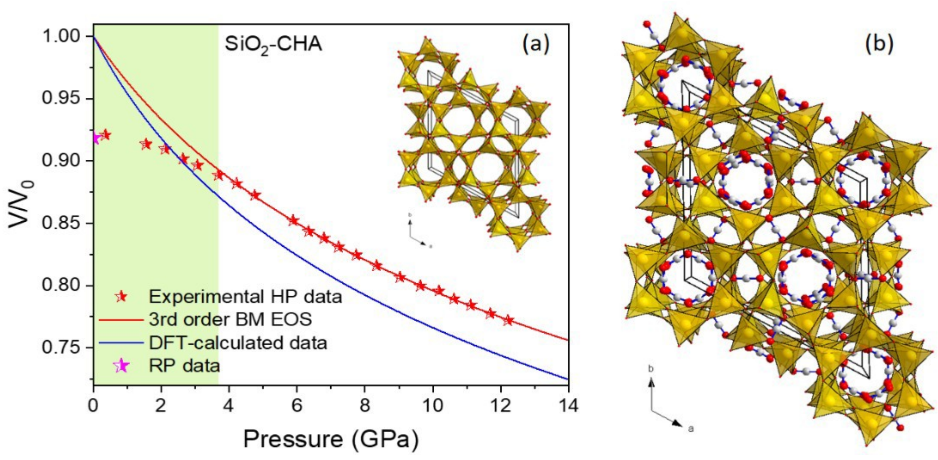

Figure 1. (a) P−V/V_0 data of pure-SiO_2 CHA sample obtained from experiments and theoretical calculations. (b) View of the CO_2-loaded pure-SiO_2 CHA structure along the c axis showing the location of CO_2 molecules.

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