



Novel high-pressure chemistry and application of small-pore zeolites

Yongjae Lee

Yonsei University, Earth System Sciences, Seoul, Korea, Republic Of (yongjaelee@yonsei.ac.kr)

Pressure-induced hydration and accompanying volume expansion, first discovered in zeolite natrolite ($\text{Na}_{16}\text{Al}_{16}\text{Si}_{24}\text{O}_{80}\text{x}16\text{H}_2\text{O}$) in 2002, has now been established to be a systematic property of this class of small-pore zeolite. Depending on the type of nonframework cations (Li, Ag, K, Rb, Cs, Ca, Sr, Pb, Cd), the degree of volume expansion and its onset pressure are controlled by up to 21% and in the pressure range of 0.4 – 3.0 GPa, respectively. One of the novel structural phenomena discovered in the systematic high-pressure investigations is the overturn of the zeolitic nanopores concomitant with the reversion of the cation-water distribution within. These unique high-pressure structural and chemical changes are especially encouraging in terms of finding appropriate applications as they occur in the industrially-achievable low-pressure regime, i.e. as low as a few kilibars. We have developed a procedure to exchange and sequester both Cs cation and I anion under intermediate pressure and temperature conditions. This result points towards the possibility of designing novel storage means for important radionuclides. Another avenue to utilize the unique pressure-induced chemistry of small-pore zeolite natrolite is to trap nominally non-adsorbable gas molecules via auxetic expansion under pressure. We have recently succeeded in pressure-induced insertion of Xe into silver-natrolite. Intriguingly, Xe adsorption occurs concomitant with charge disproportionation of silver cations to form silver nanoparticles on the surface of natrolite crystals.