High Pressure Studies of Zeolitic Imidozolate Frameworks (ZIFs)

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Zeolitic imidazolate frameworks (ZIFs) are materials that achieve zeolite-type framework topologies by combination of tetrahedral metal nodes and bridging imidazolate linkers in a stoichiometric ratio of 1:2. In zeolites, it has been shown that high pressure (HP) can give rise to a variety of unusual physical and elastic properties , including phase transitions and pressure-induced amorphization (PIA) [1]. In this talk, we explore how high pressure affects the framework and stabilities of ZIFs with different topologies. Powder X-ray diffraction experiments of three polymorphs of $Zn(EtIm)_2$ with zeolite RHO, analcime (ANA), and β-quartz (QTZ) topologies are reported. These polymorphs were synthesized by mechanochemical milling [1]. They show in increase in framework density (defined as the number of tetrahedral nodes (T) per unit volume) from 1.9 T/nm^3 (RHO), to 2.6 T/nm^3 (ANA) to 3.9 T/nm^3 (QTZ). PIA is observed in both RHO and ANA between 0 and 5 GPa. In ANA the effect is irreversible, but in RHO the effect appears to be reversible. PIA is not observed in the QTZ polymorph up to 6.12 GPa and effects of HP are fully reversible. These results are compared with HP studies of the $Zn(MeIm)_2$ polymorphs with the SOD topology (ZIF-8) and the diamondoid topology (DIA) that were also synthesized by mechanochemical routes [2].

References:
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