

Ionothermal Synthesis of Porous Materials: Solubility of the Precursors in Ionic Liquids

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Zeolitic molecular sieves have extensive applications in catalysis and separations, examples of which include water softening, wastewater treatment, odor control, and cracking catalysts in oil industry. These stable, crystalline materials with nanometer-sized pores can have a wide range of chemical compositions, such as silicates, phosphate metal oxides, or all-carbon molecular sieves. Subsequently, there has been extensive research on the synthesis of new frameworks as well as trying understanding their crystallization mechanism. Crystalline molecular sieves traditionally are prepared using a hydrothermal synthesis method. A typical zeolite synthesis would consist of a mixture of water, a source of the framework atoms, a mineralizing agent (e.g. OH^- or F^-), and a structure-directing agent (SDA). In the recent literature, it has been shown that aluminophosphate molecular sieves can be prepared ionothermally. In ionothermal synthesis, an ionic liquid serves as the solvent and often the structure directing agent as well. Our group has focused on the ionothermal synthesis of porous, crystalline aluminophosphates and silicates with the emphasis on determining how the ionic liquid properties influence the final materials. In particular, we are investigating the interactions between the ionic liquid solvent and the molecular sieve precursors prior to the synthetic reaction through solubility measurements. In this work, we will present the saturation solubilities of a range of molecular sieve precursors in ionic liquids with a variety of chemical structures. The precursors considered include those for aluminophosphate-based zeolites (e.g. aluminum isopropoxide, aluminum oxide, phosphorous pentoxide) as well as those for silicate-base zeolites (silicon dioxide). We will present our results from investigating the influence of the ionic liquid structure on the solubility of the precursors and the ionic liquid-precursor complexes seen by NMR spectroscopy.