A Kinetic and Thermodynamic Analysis of Ammonia in Ionic Liquids

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Ionic liquids (ILs) are widely defined as salts composed of discrete cations and anions with melting points below 100 °C that have unique properties such as negligible vapor pressure, nonflammability, relatively high thermal stability, and excellent solvation potential. ILs have unique physical and chemical properties that can be finely tuned by varying both the cation and anion. Ammonia has growing interest in absorption refrigeration systems due to its zero-global warming potential and zero-ozone depletion potential. However, one distinct downfall of the ammonia-water absorption refrigeration (AWAR) cycle is the need of a rectifier unit for complete separation of ammonia and water due to water's affinity with ammonia and its comparable vapor pressure. In this study, our goal is to study potential ionic liquid-ammonia pairs for AWAR system to improve the cycle performance and reduce the operating costs. We will present vapor-liquid equilibria (VLE) measurements for ammonia in various ionic liquids using a XEMIS gravimetric microbalance and model the experimental data with the Peng-Robinson equation of state. To study the kinetics of ammonia absorption, we model the time-dependent absorption of ammonia in a variety of ILs and calculate the diffusion coefficients using the one-dimensional diffusion equation.