

Solubility in Phosphonium-based Chemically Complexing Ionic Liquids

Joshua Bennett^S, Samuel Seo, Cheng Chung, Joseph Fillion and Joan Brennecke^C

University of Notre Dame, Chemical and Biomolecular Engineering, Notre Dame, Indiana, U.S.A.

jfb@nd.edu

Ionic liquids (ILs) that chemically complex with CO₂ may have application in CO₂ separations, CO₂ conversion and co-fluid vapor compression refrigeration systems, among others. For all these applications, the solubility of the CO₂ as a function of temperature and CO₂ partial pressure, as well as viscosity of both the neat and chemically-complexed IL, are vitally important. Here we focus on phosphonium-based ILs that incorporate aprotic heterocyclic anions. The CO₂ solubility can be tuned by choice of the base heterocycle used in the anion and by introducing electron withdrawing functional groups. The viscosity can also be influenced by the design of the phosphonium cation. We have used a combination of gravimetric and volumetric techniques, that span pressure ranges from 10 mbar to 50 bar, to measure the solubility of CO₂ in various phosphonium based ILs at different temperatures. The resulting isotherms are modeled to obtain chemical equilibrium and Henry's law constants at different temperatures and, subsequently, enthalpies and entropies of reaction and absorption. Viscosities are measured with a Reologica ViscoAnalyser viscometer. We will present results that show how altering the alkyl chain length on the cation, changing the anion, and changing the substituents on the anion can drastically impact the chemical strength of CO₂ absorption. Careful selection of cation-anion pairs allow for the tuning of ILs for a myriad of applications.