Properties and Phase Behavior of Ionic Liquid and Polymer Blends

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Atmospheric carbon dioxide (CO_2) traps heat and increases global temperatures. Both ionic liquids (ILs) and polymers have been researched for use in CO_2 capture technologies. However, composite polymer/IL materials could enhance capture and maintain favorable physical properties for industrial usage. Previously, we identified 1-hexyl-3-methylimidazolium bis(trifuloromethylsulfonyl)imide ([hmim][Tf_2N]) and triethyl(octyl)phosphonium 2-cyanopyrrolide ([P_{2228}][2CNpyr]) as ILs with excellent physical and chemical CO_2 solubility, respectively. In an effort to increase mass transfer area during carbon capture and possibly exclude water, we propose to synthesize composite IL/polymer materials. We first investigated their phase behavior and composite properties. We present results of the phase behavior of [hmim][Tf_2N] and [P_{2228}][2CNpyr] with hydrophobic polyethers with appreciable CO_2 solubility. The polymers studied include, poly(n-butyl glycidyl ether), poly(allyl glycidyl ether), and poly(isopropyl glycidyl ether). The compatibility of the ILs and polymers was verified using ^1H NMR spectroscopy. The glass transition temperatures of blends ranging from ten to ninety weight percent IL were determined using differential scanning calorimetry. The presence of a singular glass transition and optical clarity suggested miscibility. Further, the phase separation temperatures of the blends were measured using a cloud point apparatus to determine the miscibility limit. The effect of the pendant functional groups in the glycidyl ether polymers (isopropyl vs. butyl, and the presence of the double bond in the allyl version) was investigated. In the future, we plan to apply this knowledge to design self-assembled polymer structures with ionic liquid to improve the use of ionic liquids in carbon capture.