

Measuring Physical Solubilities of Gases in Ionic Liquids using Gas Chromatography

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Ionic liquids are widely studied for gas separations because of their low vapor pressures and high gas solubilities. Volumetric and gravimetric apparatuses are used to accurately determine solubilities of gases in ionic liquids; however, these methods can be incredibly time consuming. A faster method is needed due to the fact that there are many possible ionic liquids (estimated as $> 10^{18}$) from which to choose the best ionic liquid for particular gas separation applications. We use gas chromatography (GC) to quickly and easily screen multiple ionic liquids and gases. We present solubilities of various gases, including propane, propylene, methane, carbon dioxide, and argon in imidazolium ionic liquids including 1-ethyl-3-methylimidazolium ethyl sulfate ([emim][EtSO₄]), 1-ethyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide ([emim][Tf₂N]), and 1-butyl-3-methylimidazolium bis(trifluoromethylsulfonyl)imide ([emim][Tf₂N]). Using the retention times from the GC, Henry's Law constants and estimated solubilities of the above gases are calculated and presented for a wide range of temperatures (from 25 °C to 100 °C), showing the flexibility of this method.