

Ion Dissociation in Ionic Liquids and Ionic Liquid Solutions

Joan F. Brennecke
McKetta Department of Chemical Engineering
The University of Texas at Austin
Austin, TX 78712
jfb@che.utexas.edu

The existence of a myriad of salts that are liquid at room temperature, even in the absence of any water or other solvent, encourages a re-examination of our concepts of ion dissociation. It is easy to think of the ions in dilute aqueous salt solutions as being completely dissociated and fully solvated by water. But what happens when there is not just a concentrated salt solution, but a sea of ions with no solvent present whatsoever? How does this picture change as water is added to the ionic liquid? Watanabe (*J. Phys. Chem. B*, 2004, 108, 16593-16600) first started exploring this question for pure ionic liquids by examining the ratio of the molar conductivity obtained from impedance measurements to that calculated from the ionic diffusivity (self-diffusion coefficients determined by pulsed-field-gradient spin-echo NMR) using the Nernst-Einstein equation. This ratio is frequently referred to as the ‘ionicity.’ Here we present a simplified method to estimate the ‘ionicity’ from just ionic conductivity, viscosity and density, along with estimates of the ionic radii from either group contribution methods or limiting ionic conductivity data. We show how the ‘ionicity’ of pure ionic liquids change with cation and anion alkyl chain length and choice of the anion or cation. We also explore ion dissociation as a function of composition for aqueous and non-aqueous solutions of a wide variety of different types of ionic liquids. Finally, we show opportunities to improve predictions of *inorganic salts* sorption into ion exchange membranes by inclusion of ion dissociation estimated from density, viscosity and ionic conductivity data.