Freezing Point Determination of Water–Ionic Liquid Mixtures

Freezing points of aqueous solutions of HOEtpyBr, HOEtmmimBr, AmimCl, EtOMmimCl, EmimDep, and EmimAc were measured using a modified Beckmann apparatus with automatic data logging. The ionic liquids (ILs) in this study exhibited features similar to those of inorganic salts in depressing the freezing point of water. On the basis of the cryoscopic behavior recorded, the solid phases formed at higher IL contents were presumed to be hydrates of the form IL·nH2O. The HOEtpyBr+H2O and HOEtmmimBr+H2O systems formed simple eutectic systems. The eutectic points were found to be at a water mole fraction of 0.617 and 219.841 K in the first system and at a water mole fraction of 0.657 and 202.565 K in the second system. Water activities in aqueous IL solutions were predicted by COSMO-RS and COSMO-SAC and compared to water activities derived from the experimentally determined freezing points. The COSMO-RS predictions were closer to the experimental water activities than the COSMO-SAC predictions. The experimental results indicate that the freezing points of IL+H2O systems are affected by the nature of both cations and anions. However, according to the COSMO-RS excess enthalpy prediction results, the anions have a relatively higher influence than cations on the IL+H2O interaction.

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