Vapor Pressures and Activity Coefficients of N-Alcohols in Binary Mixtures with 1-Ethyl-3-Methylimidazolium Ethylsulfate

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Room temperature ionic liquids (ILs) are salts that are liquids at ambient temperatures. They are excellent solvents for a broad range of polar organic compounds and they show partial miscibility with aromatic hydrocarbons. Typical ILs have a stable liquid range of over 300 K and have a very low vapor pressure at room temperature. These unique properties have suggested that ILs might be useful as environmentally benign solvents that could replace volatile organic compounds. By varying the length and branching of the alkane chains of the cationic core and the anionic precursor, the solvent properties of ILs can be tailored to meet the requirements of specific applications to create an almost infinite set of "designer solvents". In this context thermodynamic properties of liquid mixtures containing ILs are of large interest, in particular a systematic study of mixture properties such as VLE data and activity coefficients is required. We have contributed to such a systematic collection of thermophysical data in the past by determining activity coefficients of different classes of solutes in ILs. Vapor pressure measurements of methanol or ethanol in the ionic liquid 1-methyl-3-butyl-imidazolium ethylsulfate [BMIM][$EtSO_4$] at T=(298.15 to 313.15) K have been performed using a static method. From the vapor pressure data activity coefficients at different temperatures have been obtained. The experimental vapor pressure results of investigated solutions were fit to the Antoine equation. The activity of the solvent and osmotic coefficients were calculated from the experimental vapor pressure values. Binary mixtures of ILs with non-electrolyte components belong to the class of electrolyte solutions covering the whole range of composition including the pure liquid electrolyte. Since there exists no reliable theoretical models for the Gibbs energy of mixing of this kind of mixtures we have tried to describe the results of activity coefficients using purely empirical expressions well known in thermodynamics of non-electrolyte mixtures. It turned out that the NRTL equation gives the best empirical description of the activity coefficients and it was used to determine activity coefficients from experimental data of partial pressures including the vapor pressure of the pure solutes.