

Study of Bis(Trifluoromethylsulfonyl)Imide Based Ionic Liquids by Gas Chromatography

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Abstract : Development of safer and environmentally friendly processes and products is needed to achieve sustainable production and consumption patterns. Ionic liquids, which are of great interest to the chemical and related industries because of their attractive properties as solvents, should be considered. Ionic liquids are comprised of an asymmetric, bulky organic cation and a weakly coordinating organic or inorganic anion. A large number of possible combinations allows for the ability to 'fine tune' the solvent properties for a specific purpose. Physical and chemical properties of ionic liquids are not only influenced by the nature of the cation and the nature of cation substituents but also by the polarity and the size of the anion. These features infer to ionic liquids numerous applications, in organic synthesis, separation processes, and electrochemistry. Separation processes required a good knowledge of the behavior of organic compounds with ionic liquids. Gas chromatography is a useful tool to estimate the interactions between organic compounds and ionic liquids. Indeed, retention data may be used to determine infinite dilution thermodynamic properties of volatile organic compounds in ionic liquids. Among others, the activity coefficient at infinite dilution is a direct measure of solute-ionic liquid interaction. In this work, infinite dilution thermodynamic properties of volatile organic compounds in specific bis(trifluoromethylsulfonyl)imide based ionic liquids measured by gas chromatography is presented. It was found that apolar compounds are not miscible in this family of ionic liquids. As expected, the solubility of organic compounds is related to their polarity and hydrogen-bond. Through activity coefficients data, the performance of these ionic liquids was evaluated for different separation processes (benzene/heptane, thiophene/heptane and pyridine/heptane). Results indicate that ionic liquids may be used for the extraction of polar compounds (aromatics, alcohols, pyridine, thiophene, tetrahydrofuran) from aliphatic media. For example, 1-benzylpyridinium bis(trifluoromethylsulfonyl) imide and 1-cyclohexylmethyl-1-methylpyrrolidinium bis(trifluoromethylsulfonyl)imide are more efficient for the extraction of aromatics or pyridine from aliphatics than classical solvents. Ionic liquids with long alkyl chain length present important capacity values but their selectivity values are low. In conclusion, we have demonstrated that specific bis(trifluoromethylsulfonyl)imide based ILs containing polar chain grafted on the cation (for example benzyl or cyclohexyl) increases considerably their performance in separation processes.

Keywords : interaction organic solvent-ionic liquid, gas chromatography, solvation model, COSMO-RS

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