Intermolecular Interactions between Acetone and the Room-Temperature Ionic Liquid [EMIM][EtSO4]

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The accurate and precise determination of thermophysical properties of working fluids is vitally important in the field of chemical and process engineering. The knowledge of these data allows optimizing processes and apparatuses in terms of ecological as well as economic respects. In recent years ionic liquids have experienced increasing interest as media in numerous applications. For instance, they are used as lubricants and solvents in separation or catalytic processes. For this reason, there is an increasing demand for the determination of the thermophysical properties of these liquids and their mixtures with other substances. However, one desirable aim in the future will be the tailor-made design of ionic liquids for particular applications. This means that not only the macroscopic thermophysical properties need to be measured but a detailed understanding of the microscopic molecular structure and intermolecular interactions, and eventually their influences on the thermophysical properties is required. In this work a systematic variation of mixtures of the room-temperature ionic liquid 1-ethyl-3-methylimidazolium ethylsulfate [EMIM][$EtSO_4$] and the co-solvent acetone has been investigated by means of Fourier-transform infrared (FTIR) spectroscopy. The IR spectra reveal both the vibrational structure of the individual molecules as well as the changes in the vibrational structure in the presence of the other species. The latter one is evidenced by a change in frequency of characteristic spectral lines due to changes in the dipole moments, which in turn can be attributed to the formation of intermolecular hydrogen bonds. Such interactions certainly exert influence on the thermophysical properties. Data from additional dynamic light scattering (DLS) experiments seem to corroborate this hypothesis.