

Dynamic Light Scattering (DLS) for the Determination of Thermophysical Properties of Ionic Liquids

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This work presents for the first time – to the best of our knowledge – the application of dynamic light scattering (DLS) for the determination of thermophysical properties of ionic liquids, an unusual class of solvents with many novel and promising properties. The successful and large-scale application of ionic liquids requires the knowledge of their thermophysical properties. Here, fundamental thermodynamic and transport properties are of interest for pure ionic liquids, ionic liquid mixtures, ionic liquids mixed with organic solvents and water, and their liquid-liquid systems.

A survey is given on various applications of DLS for the determination of thermophysical properties of ionic liquids. For the pure ionic liquid [EMIM] [EtOSO₃] (1-Ethyl-3-methyl-imidazolium ethylsulfate) and its mixture with [EMIM] [N(CN)₂] (1-Ethyl-3-methyl-imidazolium dicyanamide), measurements by light scattering from bulk fluids are shown for the determination of the speed of sound, sound attenuation, thermal diffusivity, and binary diffusion coefficient. Additionally, the measurement of the dynamic viscosity based on the determination of the diffusion coefficient of suspended seed particles is demonstrated for [EMIM] [N(CN)₂]. The application of DLS to phase boundaries, also called surface light scattering (SLS), is exemplified for the ionic liquid [EMIM] [NTf₂] (1-Ethyl-3-methyl-imidazolium bis(trifluoromethylsulfonyl)imide) and its liquid-liquid systems with toluene and water for the determination of liquid viscosity, surface tension, and interfacial tension, respectively. The investigations demonstrate that for ionic liquids a broad variety of thermophysical properties is accessible by DLS with an excellent performance regarding both the achievable accuracy and the application over a wide range of state.