The Thermal Conductivity of Ionic Liquids. Experiment and Molecular Interpretation

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Ionic liquids (ILs) are salts in the liquid state at room temperature with some relevant properties, namely their low vapor pressure over a large temperature range, and higher thermal conductivity than molecular fluids and molten salts. They are considered sustainable novel solvents in chemical technology for many applications, making them possible candidates for heat transfer and storage applications. Among all known ILs, the ones with imidazolium-based cations are the most studied, given their safety, low cost, low viscosity, and for some of them, low toxicity and biodegradability. Recent efforts to recommend reference values for the thermophysical properties of an IUPAC standard ionic liquid, $[C_6mim][(CF_3SO_2)_2N]$, showed that there are still problems in experimental data. As so, there is a need to fully understand their properties at a molecular/ionic level in order to understand the thermal conduction in these ionic liquids. This work analyzes recent work on the thermal conductivity of pure ionic liquids, reporting new data for three of them, $[C_4mim][(N(CN)_2]$, $[C_6mim][(N(CN)_2]$ and $[C_2mim][SCN]$, while analyzing the effect of the cation and anion on the macroscopic thermal conductivity. The thermal conductivity was measured with a transient hot-wire probe, in the temperature range 303.15 K < T < 348.15 K, with an estimated expanded uncertainty U_r (λ) = 0.02. Regularities of molecular mass and scaled volumes dependence on the effect of anion and cation on the thermal conductivity of the ionic liquids studied are discussed, as the limitations of existing approximate theoretical methods for the calculation of thermal conductivity, namely the Bridgman model.