Ion Dynamics in a Mixed-Cation Alkoxy-Ammonium Ionic Liquid Electrolyte for Sodium Device Applications

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Abstract

The ion dynamics in a novel sodium-containing room-temperature ionic liquid (IL) consisting of an ether-functionalised quaternary ammonium cation and bis(trifluoromethylsulfonyl)amide [NTf₂] anion with various concentrations of Na[NTf₂] have been characterised using differential scanning calorimetry, impedance spectroscopy, diffusometry and NMR relaxation measurements. The IL studied has been specifically designed to dissolve a relatively large concentration of Na[NTf₂] salt (over 2 mol kg⁻¹) as this has been shown to improve ion transport and conductivity. Consistent with other studies, the measured ionic conductivity and diffusion coefficients show that the overall ionic mobility decreases with decreasing temperature and increasing salt content. NMR relaxation measurements provide evidence for correlated dynamics between the ether-functionalised ammonium and Na cations, possibly with the latter species acting as cross-links between multiple ammonium cations. Finally, preliminary cyclic voltammetry experiments show that this IL can undergo stable electrochemical cycling and could therefore be potentially useful as an electrolyte in a Na-based device.