Electrochemical properties of Imidazolium-based ionic liquids

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There has been an upsurge in interest in energy storage systems such as lithium batteries, which are applicable in small electronic and personal communication devices and even in electric vehicles. The transport of lithium ions is an essential criterion in the lithium batteries. The main requirements for a good electrolyte, which acts as the transport medium of these ions, are high Li-ion conductivity, negligible electronic conductivity and high thermal and (electro)chemical stability.

State-of-the-art non-aqueous electrolytes in modern Li-ion batteries are based on organic solvents and / or polymers. Specialized electrolytes exist also in the form of glasses, ceramic conductors and high temperature molten salt systems. Unfortunately, the organic solvent systems present some problems in terms of high volatility, toxicity, flammability and thermal stability. Interestingly, the recent developments of non-aqueous room temperature ionic liquids (RTILs) have begun to challenge some of these problems due to the versatile nature of these materials. For example, imidazolium based RTILs have shown to be excellent ionic conductors. Other important features of these materials are that they are non-flammable, chemically, thermally and electrochemically stable, with negligible vapor pressure. These RTILs can be used as novel electrolyte systems in combination with a suitable lithium salt with potential use in lithium-ion batteries¹.

In this study, the electrochemical transport properties of 1-hexyl-3-methyl imidazolium bis(trifluoromethylsulfonyl) amide (HMIMTfSA) have been measured. These include ionic conductivity, lithium ion diffusion coefficient and lithium transference number i.e. the fraction of charge carried by the ions of such a binary salt electrolyte. The main objective of this research is to determine the transport properties and viscosity of HMIMTfSA based electrolyte system as a function of lithium salt concentration and temperature.

Figure 1: Hexyl-methyl-imidazolium bis(trifluoromethanesulfonyl)amide (HMIMTfSA)

References:

¹ M. Holzapel, C. Joost and P. Novak, Chem. Commun., 2098 – 2099 (2004).