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# Investigation on the effect of nanoparticles to ammonium salt based gel electrolytes

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Gel electrolytes (GEs) are used in electrochemical devices replacing liquid electrolytes in order to avoid the evaporation of solvent and to increase the stability of devices. Many additives such as polymers, carbon fillers, and inorganic fillers have been used as a matrix in gel electrolytes to increase the viscosity and the ionic conductivity of gel electrolytes. In this work, silica nanoparticles were added to tertraalkyl ammonium based liquid electrolyte with propylene carbonate as a solvent to prepare GE. We selected N(Bu)4PF6 as a supporting solid electrolyte due to its stability at high temperature and under atmosphere as comparison to traditional lithium based electrolyte salt. Silica nanoparticles has been selected as a matrix due to its low cost and solidified properties in electrolytes. The conductivity measurements of GEs with varying nanoparticle contents were performed to determine the effectiveness of ion transport in the GE matrix. The conductivity of gel electrolyte was in a range of 1.0-6.0 mS/cm at room temperature. An operative potential window of the GE in contact with a Pt electrode were determined by cyclic voltammetry was -2.5 - +2.5 V vs. Ag(s). We also evaluated the diffusion coefficient of ferrocenium ions in prepared gel electrolyte to determine the effectiveness of gel electrolyte as a comparison to liquid electrolyte. The cyclic voltammograms of both gel and liquid electrolyte showed that the nanoparticles increased the viscosity of liquid electrolyte while maintained the effectiveness of ferrocenium ions transport in the prepared electrolytes. These novel gel electrolytes are a good candidate for electrochemical based gel electrolytes.

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