

High frequency dielectric measurements on PPG-Li salt systems

Dielectric studies on polymer electrolytes where alkali salts are dissolved in polyethers such as poly (ethylene glycol) (PEG) and poly (propylene glycol) (PPG) can be used to study the effect of polymer chain mobility on the ionic conductivity mechanism. Among the different lithium salts suitable for complexing with the polymer are lithium triflate (LiCF_3SO_3) and lithium imide ($\text{LiN}(\text{CF}_3\text{SO}_3)_2$) which have delocalized anionic charge distributions, and consequently a weak electrostatic anion-cation interaction.

In this work we have carried out high frequency dielectric measurements of the two polymers/ salt systems, $\text{PPG}_n\text{LiCF}_3\text{SO}_3$ and $\text{PPG}_n\text{LiN}(\text{CF}_3\text{SO}_3)_2$ where $n = 8, 16, 32, 64, \dots, 256$ in the frequency range 1MHz - 1.8 GHz from - 25° C to +80 °C. Poly (propylene glycol) of average molecular weight 4000 was used as the polymer solvent after high vacuum drying (10^{-5} Pa) at 80 °C for 48 h. Lithium triflate and lithium imide were dried under the same vacuum conditions but at a temperature of 120 °C. All solutions were prepared by mixing appropriate amounts of the salt and the polymer in a Pyrex flask.

The dielectric measurements were performed using a HP4291A High Frequency Impedance Analyser. $\text{PPG}_n\text{LiN}(\text{SO}_2\text{CF}_3)_2$ and $\text{PPG}_n\text{LiCF}_3\text{SO}_3$ polymer electrolytes show a maximum conductivity of $2.07 \times 10^{-4} \text{ S cm}^{-1}$ and $1.57 \times 10^{-4} \text{ S cm}^{-1}$ respectively for $n = 8$ at room temperature. Dielectric spectra suggest that PPG polymer chains are well ordered in the PPG+LiTf (triflate) complex. The PPG+LiTFSI (imide) complex show a maximum in a peak frequency at intermediate salt concentrations indicating that LiTFSI salt is acting not only as a Li^+ cation source to the PPG polymer but also as a plasticizer.