CHAPTER 8

CONCLUSIONS AND SUGGESTIONS FOR FURTHER WORK

Solid polymer electrolytes based on MG30–$LiCF_3SO_3$ (single–salted system), MG30–$LiCF_3SO_3$–$LiN(CF_3SO_2)_2$ (double–salted system) and MG30–$LiCF_3SO_3$–PEG200 (plasticized system) were successfully prepared. The effect of double salt has been studied in MG30–based electrolyte for the first time in this thesis. Likewise for the effect of PEG200 in the MG30–based electrolytes. The electrolytes were mixed in appropriate compositions to form films via the solution casting method. XRD studies have shown that all the three systems prepared are amorphous. The interactions between the MG30 polymers with salt were observed by the wavenumber shift of the carbonyl (C=O) IR band from 1731 cm^{-1} to between 1729 cm^{-1} to 1724 cm^{-1}, and the C=C polyisoprene stretching vibration band shift from 1663 cm^{-1} to between 1655 cm^{-1} to 1648 cm^{-1}. Complexation at the C=C group was also discussed in MG30–based electrolytes for the first time although other researchers have studied similar electrolytes. From dielectric studies, the dielectric constant for the MG30 polymer is ~ 1.86.

From the present work, the conductivity has increased due to several factors such as;

- The number density of charge carriers has increased due to the various concentrations of the incorporating salt in the MG30–$LiCF_3SO_3$ system. Pure MG30 polymer film conductivity has increased from 2.60 x 10^{-11} S cm^{-1} to 1.69 x 10^{-6} S cm^{-1} with the incorporation of 30 wt. % of $LiCF_3SO_3$ salt concentration.

- Double salt system has also helped to increase the conductivity of MG30–based electrolytes. Mixed salts have successfully encouraged more ion dissociation by anion–anion dipole interactions. It helps to enhance the conductivity to 1.46×10^{-5} S cm^{-1} from 1.69×10^{-6} S cm^{-1} for MG15L15I sample which is having the same composition of MG30L. This is an increase of about one order of magnitude.
- Plasticization. PEG200 helps to enhance the conductivity of salted system to 3.65×10^{-4} S cm^{-1}, exhibiting more than two orders of magnitude increase from the single salted system.
- Temperature. The temperature dependence of conductivity for the samples shows Arrhenius behavior. The ions need less energy to begin conduction and this is proven. For all the systems studied, the highest conducting sample possesses the lowest activation energy.
- The conductivity of the samples can be affected by amorphosity and crystallinity where the more amorphous and lower crystallinity sample has the higher conductivity and this can be illustrated by the SEM micrograph and XRD studies.

From the present study, the plasticizer has helped to:

- Dissociate the salt hence allowing more conducting ions. This could be seen by increase in the number of mobile ions supported from the deconvoluted FTIR results.
- Increasing the dielectric constant of the samples as depicted from dielectric constant versus frequency plot that shows higher values compared to unplasticized samples.

- Promoting new pathways and shortening distance between transit sites for ions to travel. This is proven by the lower activation energy compared to unplasticized sample.

For future work, the conductivity of the polymer electrolyte should be enhanced as high as 10^{-2} to 10^{-1} S cm^{-1}. There are few ways to follow, in order to make it possible;

- Introducing a second or a third plasticizer

  The first plasticizer may have high dielectric constant and high viscosity. To overcome the disadvantage of high viscosity, a second plasticizer with a lower dielectric constant and very low viscosity may be added. High dielectric constant is good for salt dissociation and low viscosity, good for ion mobility.

- By introducing a suitable filler to the electrolyte

  Fillers can also increase conductivity and also mechanical strength. Plasticizers reduce mechanical strength. A good combination may lead to high conductivity and good mechanical strength.

- Blending the MG30 with other polymers.

  Polymer blending is of great interest due to their advantages in properties and processability compared to single component. The properties of polymer blends depend on the physical and chemical properties of participating polymers and the state of the phase, whether it is in homogeneous or heterogeneous phase.