UNIVERSITI TEKNOLOGI MARA

PHYSICAL AND ELECTRICAL STUDIES ON METHYLCELLULOSE BASED ION CONDUCTING POLYMER ELECTROLYTES

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ABSTRACT

In present study, thin film electrolytes were prepared using methylcellulose (MC), lithium triflate (LiCF3SO3) and ethylene carbonate (EC) at various weight percentages (wt.%). All samples were prepared by solution cast technique. The impedance spectroscopy (IS) studies shows the highest conductivity of unplasticized system appeared at composition ratio 70:30 wt. % with conductivity value 2.13×10^{-5} S cm^{-1} and enhanced up 1.24×10^{-4} S cm^{-1} for plasticized system (49:21:30) wt.%. The temperature dependence conductivity shows the conductivity of for both systems follow the Arrhenius behaviour. The activation energy (Ea) observed to decrease as the temperature increase hence increase the ionic conductivity. Attenuated total reflectance–Fourier transformed infrared (ATR-FTIR) spectroscopy confirmed the complexation between polymer and salt. The Li^+ observed to form a coordination bond with the oxygen atom of the functional group (C-O) to form $Li^+ \rightarrow$ OC complexes. ATR-FTIR studies also justified that the plasticizer penetrated into the polymer chains and created more free volume without perturbing the polymer-salt complexes. X-ray diffraction (XRD) analysis proved the formation of polymer-salt complexes through the decreasing of peak intensity at 2θ between 15° to 30° of MC upon the addition of salt content. Further studies on XRD spectra shows that the addition of plasticizer has increased the amorphosity of MC-$LiCF_3SO_3$ system thus allowed the ion to migrate easily which contribute to the ionic conductivity enhancement. Differential scanning calorimetry (DSC) analysis shows the Tg in MC-salt system increase due to the addition of salt. The addition of EC into polymer electrolyte system has decreases the glass transition temperature (Tg) value signifying that EC has contributed in reducing the degree of crystallinity of the polymer electrolyte system. The surface morphology analysis of plasticized system was fully smooth due to the effect of EC plasticizer. The value of ionic transference numbers found to be 0.95 and 0.96 respectively. The electrochemical window stability for unplasticized was observed around 3.6V and increases to 4.4V for plasticized system

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