UNIVERSITI TEKNOLOGI MARA

THE EFFECT OF IONIC LIQUID ON THE ELECTRICAL AND STRUCTURE PROPERTIES OF PEO-$NaCF_3SO_3$ THIN FILM

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulation of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged work. This topic has not been submitted to any academic institution or non-academic institution for any other degree qualification.

I, hereby acknowledge that I have been supplied with the Academic, Rules and Regulation for Post Graduate, University MARA, regulating the conduct of my study and research.

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ABSTRACT

In the present study, polymer electrolyte films composed of poly-(ethylene oxide) (PEO) as polymer host, sodium trifluoromethanesulfonate ($NaCF_3SO_3$) as the dopant salt and 1-ethyl-3 methylimidazolium trifluoromethanesulfonate (EMiTF) as the ionic liquid were prepared by solution cast technique. The ionic conductivity for each compound is determined by using Electro Impedance Spectroscopy (EIS). The conductivity value of pure PEO is 3.57 x 10^{-11} S cm^{-1} at room temperature. This value has increased as both salt and liquid were added. The optimum value of the ionic conductivity of PEO-18. wt.% $NaCF_3SO_3$ and PEO-18. wt.%-NaTF-30 wt. % EMiTF systems are 1.006 x 10^{-5} S cm^{-1} and 1.062 x 10^{-3} S cm^{-1}, respectively. The temperature dependence conductivity studies have identified both systems as Arrehenius in nature with the activation energy, E_a obtained at 0.29 eV and 0.26 eV, respectively. The Fourier Transform Infrared (FTIR) spectra of PEO-$NaCF_3SO_3$-EMiTF shows the existence of C-O-C functional groups. The oxygen atom carries lone pairs of an electron, which are donated to Na^+ conduction in the formation of complexes with the polymer-salt-ionic liquid system. In the perspective of thermal properties, the DSC studies show that the pure PEO has a glass transition temperature, T_g of -55.26 °C. The T_g value of the SPEs increases upon addition of salt. However, when ionic liquid is added to the system, the T_g value of the SPEs is decreased. TGA has shown that the thermal stability of PEO is improved after the addition of salt. Upon introducing EMiTF into the optimized polymer-salt composition, the onset decomposition temperature of PEO is decreased from 376 °C to 366 °C. The high thermal of a polymer-salt-ionic liquid system is stable around 300 °C. Following this, the X-ray diffractogram of solid polymer electrolytes with EMiTF showed that the system has less crystalline structure, which has modified the atomic arrangements. The transference number obtained for PEO-18 wt. $NaCF_3SO_3$ and PEO-18 wt. % $NaCF_3SO_3$-30 wt. % EMiTF are 0.68 and 0.95, respectively. Collectively, the ionic liquids and salts introduced to the PEO systems have shown some compatibility properties to be used as solid polymer electrolytes. The findings imply that the samples are ionic in nature and have a potential in battery application.

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TABLE OF CONTENTS