UNIVERSITI TEKNOLOGI MARA

PEMA/ENR-50 BLEND BASED POLYMER ELECTROLYTES: SOME ELECTRICAL PROPERTIES

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ABSTRACT

In this work, PEMA was used as the principle host to prepare PEMA/ENR-50 blend, PEMA/ENR-50-$LiCF_3SO_3$ and PEMA/ENR-50-$LiCF_3SO_3$-EMIMTFSI systems using solution casting technique. The samples were characterized using Electrical Impedance Spectroscopy (EIS), X-Ray Diffraction (XRD), Fourier Transform Infrared Spectroscopy (FTIR) and Differential Scanning Calorimetry (DSC) in order to investigate their electrical, structural and thermal properties. The polymer blend with PEMA/ENR-50 of ratio 70:30 yielded the most amorphous film. This blend system was selected for the preparation of polymer electrolytes with $LiCF_3SO_3$ as a dopant salt. Impedance study showed that the conductivity of the blend based electrolyte system increases with increasing $LiCF_3SO_3$ concentration. The system containing 40wt.% of $LiCF_3SO_3$ salt exhibited optimum room temperature conductivity of 3.64×10^{-5} Scm^{-1}. The increase of conductivity is attributed to the increase in the number of ions as the concentration of salt increased. The increase in conductivity is also attributed to the increase in amorphousity in the electrolyte as shown from XRD and DSC results. The interaction between the polymers and salt were confirmed by FTIR studies where interactions occurred between Li^+ with PEMA and ENR-50. In order to improve the conductivity of the optimum salted system, EMIMTFSI ionic liquid was added. Impedance study showed increase in ionic conductivity. The system containing 10wt.% of IL exhibited the highest ionic conductivity of 1.72×10^{-4} Scm^{-1}. XRD and DSC studies showed that the amorphous nature of the salted system also increased with addition of IL.

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TABLE OF CONTENTS

CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND OF RESEARCH

Polymer has been recognized as an electrical insulator in that it is a material that is unable to conduct electricity. However some polymer becomes conducting when inorganic salt is added into them (Wright, 1975). This type of polymer-salt system is now known as solid polymer electrolyte. A large number of polymer electrolyte materials involving different transporting ions has been discovered by Armand and co-workers in 1978 (Sekhon et al., 1995). Some of the advantages of polymer electrolyte systems as compared to liquid electrolyte are that they are safe, have high energy density (Sim et al., 2012), good mechanical and adhesive properties and may be easily prepared in different forms (Lim et al., 2013). The main drawback of solid polymer electrolytes, however, are low ionic conductivity at room temperature and poor electrode-electrolyte contact as compared to liquid electrolyte (Mohamed et al., 2008). This material have unique properties that makes them possible to be applied in a wide range of electrochemical devices such as batteries, electrochromic devices and fuel cells (Selvasekarapandian et al., 2005).

Fenton, (1973) initiated the study of polymer electrolytes using poly(ethylene oxide) (PEO) as the polymer host. However, only after Armand (1978) announced their competence as ionic conductors that these materials become technologically important. The complexes of PEO with a wide variety of alkali salts such as $LiCF_3SO_3$ and $LiClO_4$ (Fauteux, 1985), $LiBF_4$, $LiPF_6$ and $Li(C_6H_5)$ (Rietman et al., 1985) and $NaPF_6$ (Hashmi et al., 1992) have been reported in literature. The complex of PEO with alkali metal salts showed high ionic conductivity at ambient temperature due to the presence of lone pair electron of oxygen in the PEO. These oxygen atom acts as defect centers for the transit of free metal ions from the ionic salts as they conduct by hopping in the host polymer. To date, several types of polymer hosts have been explored and amongst others, include poly(methyl methacrylate) (PMMA), poly(acrylonitrile) (PAN), poly(vinyl chloride) (PVC) and poly(vinylidene fluoride) (PVdF).