UNIVERSITI TEKNOLOGI MARA

ELECTRICAL CONDUCTIVITY AND STRUCTURAL STUDIES ON PVA/CHITOSAN-$LiCF_3SO_3$ SOLID POLYMER ELECTROLYTE WITH AMINO ACID AS ADDITIVE

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AUTHOR'S DECLARATION

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

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ABSTRACT

In the present work, PVA and chitosan are used in the based polymer blend. Lithium trifluoromethanesulfonate [$LiCF_3SO_3$] and amino acid, L-leucine have been employed as the doping salt and additive, respectively. The PVA/chtosan solid polymer electrolyte is prepared using solution cast technique. The samples prepared have a plastic-like, free standing consistency, colourless and homogenous. The electrical conductivity of PVA/chitosan blend is in the order of $\sim 10^{-7}$ S cm^{-1} at room temperature. The addition of $LiCF_3SO_3$ improved the conductivity of PVA/chitosan based electrolyte film to $\sim 10^{-4}$ S cm^{-1}. The effect of adding L-leucine on the electrical conductivity of the solid polymer electrolyte was investigated. L-leucine as a standard amino acid can exist as zwitterions and may provide more complexation sites for interaction between based polymer and doping salt. Slight improvement of ionic conductivity is achieved upon addition of L-leucine. Enhancement in ionic conductivity could be due to increased number of mobile ion and mobility of the ion. Complexation and structural properties of the sample have been investigated by FT-IR, XRD, SEM and DSC. From the fourier transform infrared (FT-IR) spectra, the peak at wavenumber 1710 cm^{-1} attributed to C=O has shifted to lower wavenumber at 1708 cm^{-1}. Result from FT-IR showed that complexation has occurred between salt ($LiCF_3SO_3$) and based polymer (PVA/chitosan) or additive (L-leucine). The degree of crystallinity of the polymer electrolytes has been determined through X-ray diffraction (XRD) and indicates the amorphocity structure of the prepared electrolyte samples. The degree of crystallinity of the polymer blend has lowered when complexed with the doping salt. The investigation through the surface morphologies of the samples has been obtained using scanning electron microscope (SEM) which proved the homogeneity for this polymer electrolyte system. For thermal studies using differential scanning calorimetry (DSC) showed lower T_g with highest electrical conductivity for addition of L-leucine in complexes polymer electrolytes due to the more flexible local polymer chain and faster in mobility.

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CHAPTER 1

INTRODUCTION

1.1 Background

Since a few decades ago, many power sources especially in electrochemical devices have been developed and created with extensive studies done by many researchers. The improvement in technology development increases rapidly especially the performance of portable energy sources abetted by the higher global demand for communication products. The challenges to produce batteries which are compact, lightweight, cost–effective and environmental friendly are the criteria that drive the industries to produce lithium polymer batteries.

Recently, many works have been carried out and reported on the performance of lithium batteries including development of new anode, cathode and electrolyte. Electrolyte forms the most important component of the solid-state battery and the search for new solid electrolyte materials has been stimulated by the growing interest in the development of advanced batteries and related electrochemical devices. Lithium batteries using solid polymer electrolytes (SPEs) do not have some of the disadvantages often associated with energy storage devices that use small-molecule organic solvents; such as lack of stability, pressure buildup, volatility and flammability [Krok, 1993].

Polymer electrolytes have attained an important position in solid-state ionic. Studies on polymer electrolytes have attracted great interest in the efforts to clarify the mechanism of conductivity enhancement in such systems and also because of the ease of preparation as polymer films and potential applications as electrolytes in electrochemical devices [Armand, 1994]. Solid polymer electrolyte has an ability to accommodate a wide range of doping compositions which enable the control of