UNIVERSITI TEKNOLOGI MARA

PREPARATION AND CHARACTERIZATION OF MG30-PEMA BLEND POLYMER ELECTROLYTE

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ABSTRACT

Solid polymer electrolyte have low ionic conductivity at room temperature which become the major drawback when applied in electrochemical devices. Therefore in the present study, 30% Poly (methyl methacrylate)-grafted-naturalrubber (MG30), poly (ethyl methacrylate), lithium triflouromethanesulfonate ($LiCF_3SO_3$), and ethylene carbonate (EC) were used in preparation of blend polymer, solid polymer electrolytes (SPEs) and gel polymer electrolytes (GPEs). Solvent cast technique were used to prepared all samples. Blend polymer was characterized by means of physical spectroscopy in order to improved polymer host composition for developing plasticized polmer electrolyte. SPE and GPE were characterized by physical and electrical properties in order to find the suitable polymer electrolytes composition. The conductivity of all samples was calculated using the bulk resistance value obtained from complex impedance plot in frequency range 100 to 1MHz. The SPE film containing B6 exhibit 9.24×10^{-6} $S.cm^{-1}$ at room temperature. This was due to the increase number of charge carrier in polymer electrolyte. Further addition of plasticizer with C5, boosted the ionic conductivity to 4.1×10^{-4} $S.cm^{-1}$. This enhancement is attributed to the increase in the number of mobile ions that associated with conformational free volume and the flexibility of the polymer host upon introduction of plasticizer. Attenuated total reflectance-Fourier transform infrared (ATR-FTIR) spectroscopy indicate the plasticizer penetrated into the polymer chains and created more free volume by reducing the polymer chain transient cross-linking without perturbing the complexation that occurred between the polymer host and $LiCF_3SO_3$. The morphology of the polymer electrolyte was analyzed by polarized optical microscope (POM) and Field effect scanning electron microscope (FESEM). The image confirm interaction $LiCF_3SO_3$ salt with the polymer host. Differential scanning calorimetry (DSC) studies confirmed the reduction in transient chain crosslink by the reduction in the value of the glass transition temperature (T_g) of the SPE. From temperature dependence conductivity shows that the conductivity of SPE obeys Arrhenius rule while GPEs system was observed to obey Vogel- Tamman- Fulcher (VTF) rule. The formalism studies show that MG30-PEMA-$LiCF_3SO_3$ and MG30-PEMA-$LiCF_3SO_3$-EC behave as an ionic conductor with the value of transference number 0.801.

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CHAPTER ONE
INTRODUCTION

1.1 INTRODUCTION

Electrolyte is a compound that produce ionic solution when dissolve in an aqueous solution. Generally electrolyte are found integrated in electrochemical devices such as batteries, supercapacitor, electrochromic devices etc. The main function of the electrolyte is to provide a medium for ion transport. It also act as an electrical insulator for electron to travel through outer circuit of the device. Conventional electrolytes consist of aqueous or liquid such as potassium hydroxide solution in alkaline battery, sulfuric acid in a lead acid battery etc. The conductivity of those electrolyte are very high ($\sim > 10^{-3}$ $S.cm^{-1}$). However those electrolyte may cause corrosion or sometimes flammable. In addition designation container of those devices are robust in order to prevent leakage.

Therefore, in the last few years Lithium ion battery has brought new prospect in the portable electronics industry. The characteristic of this batteries such as lighter, cheaper and smaller than other types of batteries has gain favorable in battery development. In addition, it does not suffer from the 'memory' effect and contain relatively few toxic metals. However organic solvents was used to suspend the lithium ion in Li-ion batteries. This organic solvent can vent and ignite from pressurized battery cause a toxicity combustion (Thi et al., 2010) and dangerous to the user. By considering risk of Li-ion battery, new battery base on polymer electrolyte was develop called Lithium polymer battery. This invention was intensively develop after Arman and his co-worker, proposed the use of poly(ethylene oxide), PEO, based electrolyte in solid-state battery (Cheang et al., 2010). They reported that the poly (ethylene oxide) (PEO) complexed with alkali metal salts demonstrated good ionic conductivity at ambient temperature ($\sim 10^{-8}$ to 10^{-7} $S.cm^{-1}$) however the value is inadequate for practical applications.

Thus many research have been done widely to enhance the ionic conductivity of Polymer Electrolytes (PEs) based on PEOs. However, PEOs exhibits semi-crystalline state at ambient temperature has become hindrance towards excellent contact with the