Development and Characterization of Poly-ε-Caprolactone-Based Polymer Electrolyte for Lithium Rechargeable Battery

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A biodegradable polymer electrolyte based on Poly-ε-caprolactone (PCL) with various level of concentrations of Lithium salt and plasticizer have been synthesized under both the ambient and vacuum environments. The ionic conductivity, morphology, topology and structural properties are examined using EIS, SEM and XRD respectively. Conductivity as high as $3.48 \times 10^{-04}$ S cm$^{-1}$ and $4.99 \times 10^{-04}$ S cm$^{-1}$ are obtained for the ambient and vacuum environment respectively. Ionic mobility is improved by increasing the amorphousity content of the polymer and degree of salt dissociation with plasticizer. Ionic conductivity is further enhanced with the addition Li salt to increase the free ions concentration. Ionic conductivity measurements are further supported by the XRD data which reveal that sample with higher amorphous content tends to show higher conductivity. The dielectric relaxation study in terms of characteristic of the structural molecular interaction and ionic transportation properties are also carried out. Both of the conductivity and XRD results are further verified by SEM images.

Keywords: Polymer Electrolyte; Impedance Spectroscopy; Biodegradation; Poly-ε-caprolactone; Lithium Triflate.

1. INTRODUCTION

The ongoing efforts to replace liquid electrolyte have led to the development of polymer electrolyte battery. Polymer electrolyte battery is not only well-known for its safety features but for its high power density, flexibility, plasticity of size and shape [1, 2]. In addition, it also play a key role as binder for the electrode as it simplifies the fabrication process of battery cell. It is anticipated that the reduction in power consumption of electronics devices, and a thin film like solid polymer electrolyte