THE EFFECT OF TiO_2 NANOPARTICLES ON PROPERTIES OF CARBOXYMETHYL CELULOSE-LITHIUM PERCHLORATE SOLID BIOPOLYMER ELECTROLYTE

NABILAH HANI BINTI NORIHAN

Final Year Project Report Submitted in
Partial Fulfilment of the Requirements for the
Degree of Bachelor of Science (Hons) Chemistry
in the Faculty of Applied Sciences
Univeristi Teknologi Mara

JANUARY 2019

ABSTRACT

Biopolymer is a promising green alternative to replace petroleum-based synthetic polymer in solid biopolymer electrolyte (SBE). However, the low ionic conductivity may limit the future applications. In this study, combination of carboxymethyl cellulose (CMC) as host matrix and lithium perchlorate ($LiClO_4$) SBE have been fabricated with addition of TiO_2 nanoparticles and the effect on chemical, electrical, thermal and mechanical properties were investigated. Various concentration of $LiClO_4$ (5, 10, 15, 20, 25, 30 and 35 wt%) and TiO_2 (1, 2, 3 and 4 wt%) was prepared by solvent casting method. The samples were characterized by Differential scanning calorimetry (DSC), X-ray diffraction (XRD), Fourier Transfer Infrared Spectroscopy (FTIR), Electrical Impedance Spectroscopy (EIS), Universal Testing and Scanning Electron Microscope (SEM). Incorporation of 35 wt% $LiClO_4$ shows the highest conductivity with a value of 5.13×10^{-6} Scm^{-1}. Upon the addition of 3 wt% TiO_2 the ionic conductivity increased to 1.162×10^{-5} S cm^{-1}. DSC and XRD studies show that the addition nanoparticles reduce the crystallinity of SBE which improve the ion mobility and thus cause the increment of ionic conductivity. Nevertheless, the addition of nanoparticles had different effect on the mechanical properties of SBE; they reduce the percent elongation at break but improve the tensile strength. The FTIR spectra shows the complexation of Li^+ with all electron donor atoms in CMC structure but nanoparticles only interact with –OH groups that can be considered as Lewis acid-base interactions. The morphology of the film by SEM showed the homogenous dispersion of nanoparticles in the SBE matrix.

TABLE OF CONTENTS

LIST OF TABLES