UNIVERSITI TEKNOLOGI MARA

CHARACTERISTICS OF CELLULOSE ACETATE–LITHIUM SALTS COMPLEXES PLASTICIZED WITH NON CARBONATE PLASTICIZER BASED POLYMER ELECTROLYTES

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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 acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

In this study, cellulose acetate (CA), lithium bis(triflouromethanesulfonyl)imide (LiTFSI or lithium imide) , lithium triflouromethanesulfonate ($LiCF_3SO_3$, LiTf or lithium triflate) and diethylene glycol dibutyl ether (BDG) was used in the preparation of solid polymer electrolytes (SPEs) and gel polymer electrolytes (GPEs). All the SPEs and GPEs samples were prepared by solution cast technique. The conductivity of the samples were characterized by the impedance spectroscopy in the frequency range between 1Hz until 1MHz. Highest ionic conductivity of SPE containing 25 wt.% Lithium Imide in CA+ Lithium Imide and 25 wt.% Lithium Triflate in CA+Lithium Triflate was 5.63×10^{-4} S cm^{-1} and 1.18×10^{-4} S cm^{-1} respectively at room temperature. Further enhancement of ionic conductivity obtained with addition of plasticizer into SPE was 2.88×10^{-3} S cm^{-1} and 1.50×10^{-3} S cm^{-1} at the compósition of 68:22:10 by wt.% for CA+Lithium Imide+BDG and CA+Lithium Triflate+BDG respectively at room temperature. The temperature dependence conductivity shows that the conductivity of SPE and GPE was obeyed Arrhenius rule. The modulus formalism studies show that the unplasticized and plasticized samples behave as an ionic conductor. FTIR spectroscopy justify the interactions between polymer and salt primarily for both systems due to the C=O of CA and Li^+ of salt. The shifting of the carbonyl peak C=O of CA at 1737 cm^{-1} to the lower wavenumber indicates coordination takes place between lithium cation and C=O to form $Li^+ \rightarrow$O=C interaction. FTIR studies also confirm the addition of plasticizer just penetrated in between polymeric chain and create more free volume by reducing the polymer chain cross linking without perturbing the complexation of polymer-salt. XRD analysis confirmed the formation of polymer-salt complexes for both system with the decreasing of peak intensity at 2θ = 13.6°, 17.9° and 23.58° for CA+Lithium Imide and CA+Lithium Triflate upon the addition of salt content. Besides that, XRD spectra analysis demonstrated the incorporation of plasticizer has reduced the crystallinity of both systems promotes to ion migration easily hence lead to the ionic conductivity enhancement. The plasticized sample CA+25wt.% Lithium Imide+10wt.%BDG (t_i = 1.00) and CA+25wt.% Lithium Triflate+10wt.%BDG (t_i = 0.97) for both system are found to be more ionic compared to the unplasticized sample CA+25wt.% Lithium Imide (t_i = 0.75) and CA+25wt.% Lithium Triflate (t_i =0.6) for both system.

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