

Contribution of Li⁺ Ions to a Gel Polymer Electrolyte Based on Polymethyl Methacrylate and Polylactic Acid Doped with Lithium Bis(oxalato) Borate

N. M. Khan¹ · N. F. Mazuki¹ · A. S. Samsudin^{1,}*

¹Faculty of Industrial Sciences and Technology, Universiti Malaysia Pahang

ABSTRACT

In this work, gel polymer electrolyte systems based on a polymethyl methacrylate (PMMA) and polylactic acid (PLA) blend that was doped with various compositions of lithium bis(oxalato) borate (LiBOB) were successfully prepared. Several characterizations, which included Fourier transform infrared (FTIR) spectroscopy, X-ray diffraction (XRD), and electrical impedance spectroscopy, were carried out to determine their structural and ionic conduction properties. FTIR analysis revealed that molecular interactions had occurred via Li⁺ ions in several regions, representing the functional groups of C-O, C=O and C-H stretching of the PMMA-PLA. Moreover, an increase in the amorphous phase upon the incorporation of LiBOB was revealed through XRD analysis. A sample containing 20 wt.% of LiBOB (PPLi20) was found to be the most amorphous sample in this study. This result is in alignment with the ionic conduction properties, showing an increase of ionic conductivity up to the PPLi20 sample, which exhibited the highest ionic conductivity with a value of $1.37 \times 10^{-3} \text{ S cm}^{-1}$. The contribution of Li⁺ ions towards the enhancement of ionic conductivity was determined through the transport parameter analysis. It was proven that upon the addition of LiBOB, the value of η , μ , and D increased, which signified the high dissociation of ions. Beyond 20 wt.%, the transport parameters decreased due to the overcrowding of ions.

KEYWORDS:

Ionic conductivity; transport properties; polymer blending; gel polymer electrolyte

ACKNOWLEDGEMENT

The authors would like to thank the Ministry of Higher Education (MOHE) for providing financial support under the Fundamental Research Grant Scheme (FRGS) (RDU1901114) and Universiti Malaysia Pahang for laboratory facilities as well as additional financial support under the internal research Grant PGRS2003112.