THE EFFECT OF NANOALUMINA (Al_2O_3) FILLER ON THE STRUCTURAL, MORPHOLOGICAL AND ELECTRICAL PROPERTIES OF POLY(METHYL METHACRYLATE) (PMMA) / 50% EPOXIDIZED NATURAL RUBBER (ENR 50) ELECTROLYTES

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This Final Year Project Report entitled **"The Effect of Nanoalumina (Al_2O_3) Filler on The Structural, Morphological and Electrical Properties of Poly(methyl methacrylate) (PMMA) / 50% Epoxidized Natural Rubber (ENR 50) Electrolytes"** was submitted by Nur `Ain binti Habep in partial fulfilment of the requirements for the Degree of Bachelor of Science (Hons.) Chemistry with Management, in the Faculty of Applied Sciences, and was approved by

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ABSTRACT

THE EFFECT OF NANOALUMINA (Al_2O_3) FILLER ON THE STRUCTURAL, MORPHOLOGICAL AND ELECTRICAL PROPERTIES OF POLY(METHYL METHACRYLATE) (PMMA) / 50% EPOXIDIZED NATURAL RUBBER (ENR 50) ELECTROLYTES

Previously, polymer blend of polymethyl methacrylate (PMMA) and 50% epoxidized natural rubber (ENR 50) was found to improve the brittleness of PMMA electrolyte film leading to improved ionic conductivity. Unfortunately, PMMA/ ENR 50 blend produced inhomogeneous film due to the highly viscous condition of ENR 50. To eliminate the issues associated with inhomogeneous electrolyte film, in this study, nanoalumina (Al_2O_3) filler was incorporated into the PMMA/ ENR 50 blend system. It was chosen since it has less tendency to react with surrounding moisture if compared to SiO_2 as aluminium (Al) is more electropositive than the silicon (Si). The PMMA/ ENR 50 blend system was also doped with LiTf salt to provide additional charge carrier. The effect of various weight % (i.e.: 1, 3, 5, 7 and 10 weight %) of nanoalumina (Al_2O_3) filler on the structural, morphological, and electrical properties of PMMA/ ENR 50 electrolyte using Fourier Transform Infrared (FTIR), Optical Microscopy (OM) and Electrochemical Impedance Spectroscopy (EIS), respectively was conducted. The electrolyte films were prepared using the simple solution casting technique. Flexible, free-standing PMMA/ ENR 50/ LiTf electrolyte films with improved homogeneity were successfully obtained by the addition of up to 1 and 3 weight % of nanoalumina (Al_2O_3) filler (i.e.: $PMMAF_1$ and $PMMAF_3$). This can be further confirmed by smooth and homogenous morphology of the films as observed using OM. The FTIR studies confirmed that there was interaction between the oxygen atoms of the PMMA-based electrolyte with the coordination sites of ENR 50, LiTf and nanoalumina (Al_2O_3) filler. This interaction has successfully increased the amorphous phase of the system which further supports the flexible films obtained. The reduced number of grains in the morphology of $PMMAF_3$ film in OM studies confirms the improvement in the amorphous phase. Apart from that, the improved amorphous phase of the system will ease the mobility of the Li^+ ions which can be further confirmed by the highest ionic conductivity of 4.36×10^{-4} S/cm exhibited by $PMMAF_3$ sample. Meanwhile, the incorporation of ≥ 5 weight % Al_2O_3 (i.e.: $PMMAF_5$, $PMMAF_7$ and $PMMAF_{10}$) however produced brittle PMMA/ ENR 50 electrolyte films which was confirmed by their rough and agglomerate structure via OM. As confirmed from FTIR analysis, the occurrence of agglomeration due to excessive addition of filler has hindered the polymer and filler interaction. Overall, it was determined that the optimum incorporation of Al_2O_3 for this PMMA/ ENR50/ LiTf system was 3 weight % ($PMMAF_3$). This sample has potential to be applied in lithium-ion batteries as its ionic conductivity achieves the requirements for the devices.

TABLE OF CONTENTS