UNIVERSITI TEKNOLOGI MARA

STUDIES ON ALKALINE SOLID POLYMER BLENDS ELECTROLYTE FOR BATTERIES

FAIZATUL FARAH HATTA

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ABSTRACT

Alkaline solid polymer blends electrolyte (ASPBE) films comprising a blend of poly(vinylalcohol) (PVA) and poly(vinylpyrrolidone) (PVP), potassium hydroxide (KOH) as ionic dopant, ethylene carbonate (EC) and propylene carbonate (PC) as plasticizer have been prepared by solution casting technique. The concentration ratio of the polymer blend, ionic dopant and plasticizer was varied systematically. The PVA-PVP blend has good mechanical strength as tested using tensile measurement. X-ray diffraction (XRD) studies have been conducted to investigate the complexation in the alkaline solid polymer blends electrolyte. The XRD results revealed that the amorphous domain of PVA was increased when the PVP was blended. The variation in film morphology was examined by scanning electron microscopic (SEM). The thermal properties of these films were performed using differential scanning calorimeter (DSC) and the result has confirmed the miscibility between the polymeric components. The conductivity was studied using complex impedance spectroscopy to investigate ionic conduction in blending PVA/PVP, PVA/PVP-KOH, PVA/PVP-KOH-EC and PVA/PVP-KOH-PC electrolyte systems. The complex impedance spectroscopy results revealed that the high-frequency semicircle was due to the bulk effect of the material. The conductivity was found to increase in the order of 10^{-7}–10^{-4} Scm^{-1} with the increase in ionic dopant and plasticizer concentrations at temperature range from 30-110 °C. The PVA/PVP system with a composition of 80 wt.% PVA and 20 wt.% PVP exhibited the highest conductivity of $(2.2 \pm 1.4) \times 10^{-7}$ Scm^{-1} and the value was enhanced to $(1.5 \pm 1.1) \times 10^{-4}$ Scm^{-1} when 40 wt.% KOH was added. For samples containing plasticizer, maximum ionic conductivity was achieved when 20 wt.% EC and 30 wt.% PC was added into the PVA-PVP/KOH sample electrolytes. The model of Rice and Roth has been built up to calculate the number of ion (η), mobility (μ) and diffusion coefficient (D). Using PVA/PVP-KOH-EC and PVA/PVP-KOH-PC film electrolytes, electrochemical cells were fabricated and their discharge characteristics were studied

under a constant current load of 1 mA. A discharge curve of the Zn|PVA/PVP-KOH-EC|MnO_2 and Zn|PVA/PVP-KOH-PC|MnO_2 cells at room temperature have been carried out with open circuit potential of 1.6 V for both cells. The open circuit voltage (OCV) obtained for Zn|PVA/PVP-KOH-EC|MnO_2 and Zn|PVA/PVP-KOH-PC|MnO_2 cells showed a decrease from 1.6 V to 1.4 V during the first two hours and remained constant for 24 h storage.

Candidte'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 topic has not been submitted to any other academic institution for any other degree or qualification.

In the event that my thesis be found to violate the conditions mentioned above, I voluntarily waive the right of conferment of my degree and agree to be subjected to the disciplinary rules and regulations of Universiti Teknologi MARA.

Name of Candidate	Faizatul Farah bt. Hj. Hatta
Candidate's ID No.	2004188416
Programme	Master of Science (Advanced Materials)
Faculty	Applied Sciences
Thesis Title	Studies On Alkaline Solid Polymer Blends Electrolyte For Batteries
Signature of Candidate	
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