UNIVERSITI TEKNOLOGI MARA

STUDY ON ELECTRICAL AND PHYSICAL PROPERTIES OF PEMA/PVC BLEND BASED POLYMER ELECTROLYTES FOR ITS APPLICATION IN PROTON ELECTROCHEMICAL CELL

SHAHRUL AMIR

Thesis submitted in fulfillment of the requirements for
the degree of
Master of Science

Faculty of Applied Science

October 2011

ABSTRACT

In this work, PEMA was used as the principle host to prepare PEMA/PVC blend, PEMA/PVC-NH4I electrolyte and PEMA/PVC-NH_4I-EC plasticized electrolyte systems using solution casting technique. The prepared samples were characterized using XRD, DSC, FTIR, and IS in order to investigate their structural, thermal and electrical properties. XRD and DSC show that the degree of amorphousity of PEMA increases with increasing concentration of PVC. The interactions between the polymers are indicated by FTIR studies and are believed to occur between carbonyl group and chlorine. The polymer blend with PEMA:PVC of ratio 70:30 yielded the most amorphous film. This blend system was selected for the preparation of polymer electrolytes with NH_4I as the dopant. Impedance study showed that the conductivity of the blend based electrolyte system increases with increasing NH_4I concentration. The system containing 40 wt % of salt exhibited optimum room temperature conductivity of 4.44×10^{-5} Scm^{-1}. The increase of conductivity is attributable to the increase in the number of ions as the salt concentration is increased. The increase in conductivity is also attributable to the increase in amorphousity in the electrolytes as shown by XRD and DSC studies. The interactions between the polymers and salt were confirmed by FTIR studies where interactions occurred between $NH4^+$ with PEMA and PVC. In order to further improve the conductivity of the optimum salted system, EC plasticizer was added. XRD and DSC studies showed that the amorphousity of the salted system increased with addition of EC while impedance study showed an enhancement of conductivity. The system containing 40 wt % EC exhibited the highest room temperature conductivity of 1.42×10^{-4} Scm^{-1}. The interactions between polymer, salt and plasticizer were confirmed by FTIR studies. Temperature dependent conductivity studies showed that conductivity increased with the reciprocal of temperature. The plasticized PEMA/PVC-NH_4I-EC system with the highest conductivity was used to fabricate all-solid-state proton electrochemical cells. The electrochemical cell discharged at high load or low current drain had the longest time of stable performance. This indicated that the polymer electrolyte was more suitable for low current density battery applications.

ACKNOWLEDGEMENT

Assalamu'alaikum warahmatullahi wabarakatuh..

As his slave, in a very humble way, I wish to Praise Allah, the Almighty God for His Mercy has given me the strength and blessing to complete my thesis entitled '*Study on Electrical and Physical Properties of PEMA/PVC Blend Based Polymer Electrolytes and Its Application in Proton Electrochemical Cell*'.

I am deeply indebted and wish to express my special gratitude to my supervisor Prof. Dr. Ri Hanum Yahaya Subban and my co-supervisor, Assoc. Prof. Dr. Nor Sabirin Mohamed, for their patience, supervision, encouragement and thoughtful guidance towards the completion of this thesis. May Allah give you more and more bless for you and your family. I am most fortunate to be surrounded by intelligent, and helpful friends that made significant assistance and contributions whenever the need arises. My special thanks to my only one brother Shahizat Amir in providing much support.

Finally and with heart felt thanks to my beloved mother, Pn. Siti Daraesah Ismail for her patience and love which has enabled me to complete this thesis.

TABLE OF CONTENTS