PREPARATION OF PVDF-HFP BASED POLYMER GEL ELECTROLYTE FOR ZINC BATTERIES

NURUL ATHIRAH BINTI AHMAD EZANI

Final Year Project Report Submitted in
Partial Fulfillment of the Requirements for the
Degree of Bachelor of Science (Hons.) Physics
in the Faculty of Applied Sciences
Universiti Teknologi MARA

MAY 2009

This final Year Project Report entitled **"Preparation of PVdF-HFP Based Polymer Gel Electrolyte For Zinc Batteries"** was submitted by Nurul Athirah binti Ahmad Ezani, in partial fulfillment of the requirements for the Degree of Bachelor of Sciences (Hons.) Physics, in the Faculty of Applied Sciences and was approved by

Dr. Ab Malik Marwan Ali
Supervisor
Faculty of Applied Sciences
Universiti Teknologi Mara

Assoc. Prof. Dr. Muhd Zu Azhan Yahya
Co-Supervisor
Faculty of Applied Sciences
Universiti Teknologi Mara

Assoc. Prof. Md. Yusuf Theeran
Project Coordinator
B. Sc. (Hons.) Physics
Faculty of Applied Sciences
Universiti Teknologi MARA
40450 Shah Alam Selangor

Dr. Ab. Malik Marwan Ali
Head of Programme
B. Sc. (Hons.) Physics
Faculty of Applied Sciences
Universiti Teknologi MARA
40450 Shah Alam Selangor

Date: 18/3/09.

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENT	iii
TABLE OF CONTENTS	iv
LIST OF TABLE	vi
LIST OF FIGURES	vii
LIST OF ABBREVIATIONS	viii
ABSTRACT	ix
ABSTRAK	x
CHAPTER 1 INTRODUCTION	
1.1 Background	1
1.2 Problem Statement	2
1.3 Objectives	3
1.4 Scope of research	3
CHAPTER 2 LITERATURE REVIEW	
2.1 Introduction	5
2.2 Classifications of polymer electrolytes	6
2.3 PVDF-HFP	8
2.4 Plasticizer	8
2.4.1 Dimethylformamide (DMF)	9
2.5 Characteristic of polymer electrolyte	10
CHAPTER 3 METHODOLOGY	
3.1 Materials	12
3.2 Equipments	12
3.3 Sample preparation	14
3.3.1 Stage 1	15
3.3.2 Stage 2	16
3.4 Flow chart of the methodology	19

ABSTRACT

PREPARATION OF PVDF-HFP BASED POLYMER GEL ELECTROLYTES FOR ZINC BATTERIES

In this study, liquid electrolyte samples were prepared where each of the samples contained a constant amount of dimethylformamide (DMF) but different concentration of zinc triflate (ZnTf). The ionic conductivity of each sample then was tested by using the impedance spectroscopy technique. A sample that had the optimum value of ionic conductivity was selected to be used in the preparation of polymer gel electrolyte. The optimum value of ionic conductivity of the liquid electrolyte sample was 4.03×10^{-3} Scm^{-1} and obtained from the sample of 0.5M of ZnTf -DMF. Next, polymer gel electrolyte samples containing the 0.5M of ZnTf + DMF and different weight% of poly (vinylidene fluoride-*co*-hexafluoropropylene) (PVdF-HFP) were prepared. The ionic conductivity of each sample was tested by using the impedance spectroscopy technique. The highest ionic conductivity was 1.50×10^{-2} Scm^{-1} and obtained from the sample of 0.5M of ZnTf-DMF-6wt. % of PVDF-HFP. It was then used in the battery fabrication.

CHAPTER 1

INTRODUCTION

1.1 Background

A polymer is a large molecule (macromolecule) composed of repeating structural units called monomers, connected by covalent chemical bonds. The attractive forces between polymer chains play a large part in determining a polymer's properties. Polymer bulk properties are strongly dependent on their structure and mesoscopic behavior. Polymer electrolytes are made by immobilizing salts and non-aqueous solvents in polymer matrix *(Kim, 2000)*. The added salts make the polymers become ionic conductors by providing mobile species (cations and anions) when dissociated. Good polymer electrolytes should possess high ionic conductivity and low electronic conductivity. There are three main types of polymer electrolytes which are solid polymer electrolyte, gel polymer electrolyte and composite polymer electrolyte. The first group is pure solid polymer electrolytes (SPE). SPE is composed of inorganic salts (e.g. zinc nitrate etc.) dissolved in high molecular weight polymer host (e.g. poly (ethylene oxide) (PEO), poly(vinylidenefluoride) (PVdF) etc.) which act as solid solvents. The second group is gel polymer electrolyte (GPE). GPE is also known as plasticized polymer electrolyte. It is liquid or solid or conversely both liquid and solid. Gels possess both cohesive properties of solids and the diffusive property liquids. Gel polymer electrolytes are formed by addition of a suitable amount of organic solvent of low molecular weight which is also known as plasticizer to an ionically