

UNIVERSITI TEKNOLOGI MARA

**PREPARATION AND
CHARACTERIZATION OF MG30
WITH ANTIOXIDANT ADDITIVE AS
POLYMER ELECTROLYTES**

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ABSTRACT

This work is focused on obtaining high conducting solid polymer electrolytes (SPEs) based on treated 30% methyl grafted natural rubber (TMG30). MG30 is easily degraded and deteriorated due to the presence of unsaturated hydrocarbon (C=C) in the natural rubber backbone. 30% methyl grafted natural rubber (MG30) was treated with N-(1,3-dimethylbutyl)-N'-phenyl-p-phenylenediamine (6PPD) as antioxidant to retard MG30 degradation prior to use as polymer host. Lithium trifluoromethanesulfonate (LiTf) was used as dopant salt. All samples were prepared by solution casting technique. 0.5 wt. % of 6PPD was found to be the best composition to retard MG30 thermal degradation. Fourier transform infrared spectroscopy (FTIR) study was carried out to confirm the polymer salt complexation. The percentage of free ion of TMG30 with 40 wt. % of LiTf was found to be the highest among all the prepared samples. The conductivity study showed that the samples with TMG30 with 40 wt. % LiTf have the highest ionic conductivity with value of $1.59\text{E-}04 \text{ Scm}^{-1}$ at room temperature. Differential scanning calorimetry (DSC) studies demonstrated no significant changes in glass transition temperature (T_g) value between MG30 and TMG30 electrolytes. However, X-ray diffraction (XRD) confirms TMG30 electrolytes were more amorphous than MG30 electrolytes. The temperature dependence conductivity showed that the ion transport mechanism of both electrolytes obeys Vogel-Tamman-Fulcher (VTF) behaviour. The study on 6PPD effect in combating thermal degradation of MG30 electrolytes were done by using heat treatment conductivity study to obtain the electrolytes relaxation time (T_o). The difference between MG30 and TMG30 electrolytes T_o revealed that the TMG30 electrolytes is more resistance to physical aging by 5.6 to 6.6 hour for 35 and 40 wt. % respectively. The transference number (t_n) confirmed that the charge carrier of both electrolytes were predominantly ions. The linear sweep voltammetry test showed that both electrolytes obtained window stability of 3.1 V. The introduction of 6PPD in the electrolytes does not provide significant effect in the electrolytes window stability.

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TABLE OF CONTENTS

	Page
CONFIRMATION BY PANEL OF EXAMINERS	ii
AUTHOR'S DECLARATION	iii
ABSTRACT	iv
ACNOWLEDGEMENT	v
TABLE OF CONTENTS	vi
LIST OF TABLE	ix
LIST OF FIGURES	x
CHAPTER ONE: INTRODUCTION	1
1.1 Background	1
1.2 Problem Statement	3
1.3 Objective of Study	4
1.4 Scope and Limitation of Research	4
1.5 Justification	4
1.6 Outline of Dissertation	5
CHAPTER TWO: LITERATURE REVIEW	7
2.1 Introduction	7
2.2 Polymer Host Characteristic	9
2.3 Rubber Based Polymer Electrolytes	14
2.3.1 Poly(Styrene-Co-Butadiene) Rubber And Polyacrylonitrile Butadiene Rubber	15
2.3.2 Epoxidized Natural Rubber	16
2.3.3 Methyl Grafted Natural Rubber	18
2.4 Modified Natural Rubber Degradation	20
2.5 Antioxidant for Rubber Derivatives	22
2.5.1 N-Phenyl-N'-Alkyl-P-Phenylenediamines Antioxidant	24
2.5.2 Accelerated Aging	26
2.6 Salt Selection for Lithium Ion Polymer Electrolytes	28

CHAPTER ONE

INTRODUCTION

1.1 Background

Demand for high efficiency and environmentally friendly energy resources have focused on electrochemical devices such as lithium ion polymer batteries, fuel cell, supercapacitors, and dye sensitized solar cells. Among these devices, one of the most intense researches explored is to improve the performance of lithium ion polymer batteries (LPB) by optimizing capability of electrolytes used. LPB offer higher energy density compared to conventional battery technology utilizing lead–acid, nickel–cadmium and nickel–metal hydride. The comparison of different battery technologies in term of volumetric and gravimetric energy density is shown in Figure 1.1. The electrolytes of LPB composed of dissolved lithium salt in high molecular weight polymer are known as polymer electrolytes (PEs). The strength of PEs compared to conventional electrolytes is that it has no leakage problems, stable at elevated temperature and offer good electrode-electrolyte contact.

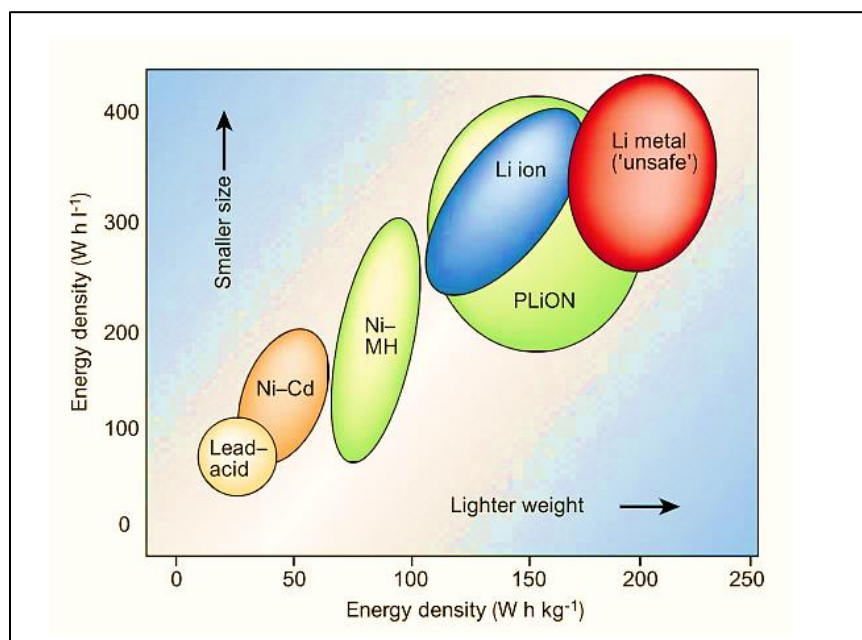


Figure 1.1 Comparison of the different battery technologies in terms of volumetric and gravimetric energy density (Tarascon and Armand, 2001).