

UNIVERSITI TEKNOLOGI MARA

**SYNTHESIS AND
CHARACTERIZATION OF WASTE
COOKING OIL-BASED
POLYURETHANE SOLID POLYMER
ELECTROLYTE FOR DSSC
APPLICATION**

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ABSTRACT

A dye sensitized solar cell (DSSC) was fabricated from waste cooking oil (WCO)-based polyurethane (PU) solid polymer electrolyte with lithium iodide (LiI) as conducting material. Epoxidation and hydroxylation reaction was used to convert WCO into polyol. Polyol mixed with 4,4-dimethylphenyl diisocyanate (MDI) at 85:15 ratio of polyol-to-MDI to form PU film. Then, PU solid polymer electrolyte (SPE) was synthesized by adding different amount of LiI using solvent casting method. WCO-based polyol synthesized consist of percent free fatty acid, acid value, hydroxyl value and iodine value of 184 mgKOH/g, 0.34 %, 0.677 mgKOH/g and 0.30 I₂/100g, respectively. FTIR showed the presence of OH peak at frequency around 3300 cm⁻¹ indicates that polyol was successfully synthesized. The presence of urethane linkage on FTIR spectrum proved that PU film was successfully prepared. Thermogravimetric analysis showed WCO-based PU consist of four decomposition stages and prove WCO-based PU stable at room temperature until the first decomposition stage at 270 °C. The GPC analysis showed that PU film Mw and Mn was 60811 and 12128 respectively. The interaction of LiI with PU SPE structure was confirmed by observing the shifting of OH, C=O and C-O-C peak in FTIR. The surface morphology of PU electrolyte investigated using SEM showed no phase separation but increase in surface spherulite when LiI amount increase that indicate increasing of amorphosity. The glass transition temperature was investigated by using differential scanning calorimetry shows decreasing pattern upon addition of LiI due to decreasing the dipole-dipole interaction between PU structure. The ionic conductivity increases with addition of LiI resulted in the highest conductivity of 4.67 x 10⁻⁶ Scm⁻¹ at 30 % LiI. These observations proved that increasing in LiI amount improved PU SPE properties. The transference number analysis show PU electrolyte charge transport was predominantly due to ionic conduction. A dye sensitized solar cell of FTO/TiO₂-dye/PU-LiI-I₂/Pt give response under light intensity of 100 mW cm⁻² and the highest efficiency was obtained at 30 % LiI which is 1.5%. These properties exhibit the WCO-based PU solid polymer electrolyte have potential to be used as alternative for electrochemical devices

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TABLE OF CONTENT

	Page
CONFIRMATION BY PANEL OF EXAMINERS	ii
AUTHOR'S DECLARATION	iii
ABSTRACT	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENT	vi
LIST OF TABLES	ix
LIST OF FIGURES	xi
LIST OF SYMBOLS	xiii
LIST OF ABBREVIATIONS	xv
CHAPTER ONE: INTRODUCTION	1
1.1 Research Background	1
1.2 Problem Statement	3
1.3 Objectives	4
1.4 Significance of Study	5
CHAPTER TWO: LITERATURE REVIEW	7
2.1 Solid Polymer Electrolyte	7
2.1.1 Solid Polymer Electrolyte Host	8
2.1.2 Plasticizer	10
2.1.3 Salt	12
2.2 Polyurethane Solid Polymer Electrolyte	15
2.3 Bio-Based Sources based Polyurethane	19
2.4 Waste Cooking Oil-based Polyurethane Solid Polymer Electrolyte	23
2.5 Dye Sensitized Solar Cell (DSSC)	26
2.5.1 Structure of DSSC	27
2.5.2 Electrode	28
2.5.3 Electrolyte	30
2.5.4 DSSC Operational Principle	31

CHAPTER THREE: RESEARCH METHODOLOGY	33
3.1 Chemical reagent	33
3.2 Research Methodology	36
3.3 Waste Cooking Oil Collection and Pre-Treatment	38
3.4 Synthesis of Waste Cooking Oil-based Polyol by Using One Pot Epoxidation Reaction	38
3.5 Synthesis of WCO-based Polyurethane Solid Polymer Electrolyte	39
3.6 Fabrication of Dye Sensitized Solar Cell (DSSC)	39
3.7 Characterization of Waste Cooking Oil, Waste Cooking Oil-based Polyol and Waste Cooking Oil-based Polyurethane Solid Polymer Electrolyte	40
3.7.1 Fourier Transform Infrared Spectroscopy (FTIR)	40
3.7.2 Iodine Value	40
3.7.3 Hydroxyl Value	42
3.7.4 Percent Free Fatty Acid	43
3.7.5 Acid Value Determination	44
3.7.6 Thermogravimetric Analysis	44
3.7.7 Differential Scanning Calorimetry Analysis	44
3.7.8 Gel Permeation Chromatography Analysis	45
3.7.9 Scanning Electron Microscopy Analysis	45
3.7.10 Electrochemical Impedance Spectroscopy	45
3.7.11 Transference Number Analysis	45
CHAPTER FOUR: RESULTS AND DISCUSSION	47
4.1 Waste Cooking Oil-based Polyol	47
4.1.1 Physical Properties of Waste Cooking Oil-based Polyol	47
4.1.2 Percent Free Fatty Acid and Acid Value Analysis of Waste Cooking Oil-based Polyol	49
4.1.3 Iodine Value Analysis of Waste Cooking Oil-based Polyol	50
4.1.4 Hydroxyl Value Analysis of Waste Cooking Oil based Polyol	50
4.1.5 Fourier Transform Infrared Spectroscopy Analysis	51
4.2 Waste Cooking Oil-based Polyurethane	54
4.2.1 Fourier Transform Infrared Spectroscopy Analysis	57
4.2.2 Thermogravimetric Analysis of Waste Cooking Oil-based Polyurethane Film	58