UNIVERSITI TEKNOLOGI MARA

THERMAL, PHOTORESPONSIVE AND CONDUCTIVITY STUDIES OF NITROAZOBENZENE POLYMER

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Thesis submitted in fulfillment
of the requirements for the degree of
Bachelor of Engineering (Hons.) Chemical

Faculty of Chemical Engineering

July 2019

ABSTRACT

The liquid crystalline materials have been greatly used in the application of fuel cell membrane. The fuel cell membrane are now being developed and demonstrated for power conversion system. The problem of nowadays fuel cell is the difficulties of the ion transport in the electrolyte membrane. Hence, by introducing liquid crystal polymer, in this research, the nitroazobenzene polymer will provide a better passage for the ion transport between the electrode of the membrane. This research aim is to study the thermal, photoresponsive and conductivity characteristics of the nitroazobenzene polymer in both homopolymer and terpolymer. The poly[6-(4-nitro-4-oxyazobenzene) hexylmethacrylate] (AzoN6) homopolymer and terpolymer consisting of sulfonic acid (AMPS) and methyl methacrylate (MMA) were synthesized by radical polymerization. Both of the samples were characterized by Differential Scaning Calorimetry (DSC), thermogravimetric analysis (TGA), UV-Visible spectrophotometry and electrochemical impedance spectroscopy (EIS). The azobenzene group that attached with $-NO_2$ in the polymers revealed that the homopolymer and terpolymer have light responsive properties and exhibit glass transition at considerably low temperature. It is hope that the study can contribute to the improvement of fuel cell membrane in the future.

ACKNOWLEDGEMENT

I am grateful to the God for the good health and wellbeing that were necessary to complete this research and giving me the opportunity to embark on my degree and for completing this long and challenging journey successfully. First and foremeost, I want to thank my research supervisor, Pn Sakinah Mohd Alauddin. Without her assistance and dedicated involvement in every step throughout the process, this research would have nener been accomplished. I would like to thank you very much for your endless guidance and support for this work.

My gratitude also goes to Universiti Teknologi MARA and lab assistant for providing lab facilities and assisting. Many thanks to my colleagues and friends for helping me with this project.

Last but not least, I take this opportunity to express my gratitude to both of my parents for the unceasin encouragement, support and for believing me that I can actually complete this degree even when there are times I decided to quit. I am forever grateful and indebted to both of you.

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CHAPTER ONE
INTRODUCTION

1.1 Research Background

Fuel cells are one of the competent devices that generate electric power via chemical reaction of oxygen and fuels. This fuel cells have been attracting attention as a clean energy system. It is crucial for a high quality fuel cell to have an efficient polymer electrolyte membrane (PEM). The PEM must have the following properties profile (1) highly chemical, thermal and mechanical stabilities in harsh environment; (2) possibly low water uptake connected with high proton conductivity (Guan, Xiao, Wang, & Meng, 2010). The design to control the properties as to yield new polymer electrolyte can be modify by chemical and physical. The fuel cells membrane are now being developed and demonstrated for power conversion system and the most frequently used electrolyte membrane is the perfluorinated polymer Nafion (Narayanan, Yen, Liu, & Greenbaum, 2006) (Papadimitriou, Paloukis, Neophytides, & Kallitsis, 2011), however their critical drawbacks of high cost, high methanol permeation and low proton conductivity as well as poor mechanical stability at elevated temperatures (T > 80℃) have led to this research as to investigate promising alternatives.

Previous researchers have studied that, by introducing liquid crystal polymers in the membrane of fuel cell, it surprisingly have the potential components in ionically conducting polymer electrolytes (Vanti et al., 2018). This liquid crystalline materials have been greatly used in the application of fuel cell membrane. With generating the liquid crystallinity to the membrane, their morphology and diffusion properties can be externally controlled. When a liquid crystal meets polymer, it poses some liquid properties for instance fluidity and also crystalline mesophases such that it is strongly anisotropic of optical, magnetic properties and electrical (Andrienko, 2018).

As stated by Taylor & Martínez-felipe (2011), thermotropic liquid crystal offers an alternative mechanism to utilize some control over the morphology of the polymer electrolyte membrane. Their anisotropic behavior response to external stimuli for example mechanical shearing, light or magnetic electrical fields, can be