

**NOVEL PROTON EXCHANGE MEMBRANE  
FOR DIRECT METHANOL FUEL CELL**



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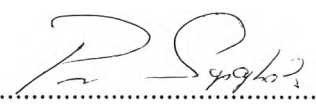
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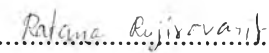
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## บทคัดย่อ

พรศุสดี อ่ำสาริกา : การสังเคราะห์และศึกษาเชื้อเลือกผ่านชนิดซัลโฟเนตโคพอลิอิมมิด สำหรับเซลล์เชื้อเพลิงที่ใช้เมทานอล (Novel Proton Exchange Membrane for Direct Methanol Fuel Cell) อ. ที่ปริกษา : ศ. ดร. อนุวัฒน์ ศิริวัฒน์ 156 หน้า

งานวิจัยนี้เป็นการสังเคราะห์เชื้อเลือกผ่านสำหรับเซลล์เชื้อเพลิงที่ใช้เมทานอลจากซัลโฟเนตโพลี(อะโรมาติกอิมมิด โค อลิฟาติกอิมมิด) พอลิเมอร์ชนิดนี้สังเคราะห์ได้จาก 4,4'-ไดอะมิโนไดฟีนิลมีเทน-2,2'-ไดซัลโฟนิค เอซิดซึ่งสังเคราะห์ 4,4'-ไดอะมิโนไดฟีนิลมีเทน, กรดซัลฟิวริกเข้มข้นและกรดฟุ่มมิงซัลฟิวริก, 4,4'-ไดอะมิโนไดฟีนิลมีเทน, เฮกซะเมทิลลีนไดเอมีน, 3,3',4,4'-เบนโซฟีโนนเตตระคาร์บอกซิลิกไดแอนไฮไดรด์ สารละลายที่ใช้ในการสังเคราะห์คือไดเมทิลซัลฟอกไซด์ (DMSO) จำนวนหมู่ซัลโฟเนตในสายโซ่พอลิอิมมิดสามารถควบคุมโดยการเปลี่ยนแปลงสัดส่วนของ 4,4'-ไดอะมิโนไดฟีนิลมีเทน-2,2'-ไดซัลโฟนิคเอซิด และ 4,4'-ไดอะมิโนไดฟีนิลมีเทนในพอลิเมอร์ ตำแหน่งของหมู่ซัลโฟนิคในพอลิเมอร์สามารถวิเคราะห์ได้จากเครื่องนิวเคลียร์แมกเนติกเรโซแนนซ์ (NMR) โครงสร้างของซัลโฟเนตโคพอลิอิมมิดสามารถยืนยันได้จากเครื่อง FTIR โดยปรากฏกราฟที่ 1777, 1709, 1368, 1248 และ 1157  $\text{cm}^{-1}$  ข้อมูลจากเครื่อง TGA ทำให้ทราบว่าซัลโฟเนตโคพอลิอิมมิดมีความสามารถในการทนต่ออุณหภูมิสูงได้ถึง 200 องศาเซลเซียส ที่อุณหภูมินี้หมู่ซัลโฟนิคจะเริ่มเสื่อมสภาพ พอลิเมอร์ที่มีหมู่ซัลโฟเนตสูงที่สุดให้ค่าการนำโปรตอนได้ถึง 0.023275 ซีเมนต์ต่อเซนติเมตร และความสามารถในการแพร่ของเมทานอลที่สัดส่วนนี้มีค่า  $2.7482 \times 10^{-8}$   $\text{cm}^2$  ต่อวินาที ซึ่งมีค่าต่ำกว่า Nafion<sup>®</sup>117 ที่ใช้ในอุตสาหกรรม นอกจากนี้พอลิเมอร์ยังถูกทดสอบการดูดซับน้ำ, การแลกเปลี่ยนประจุ และสมบัติทางกลสำหรับเป็นเป็นเชื้อเลือกผ่านของเซลล์เชื้อเพลิง

## ABSTRACT

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Keywords: Sulfonated poly(aromatic imide-co-aliphatic imide)/ Direct methanol fuel cell/ Proton conductivity/ Methanol permeability

The proton exchange membrane for a direct methanol fuel cell was fabricated from sulfonated poly(aromatic imide-co-aliphatic imide) (SPI). 4,4'-diaminodiphenylmethane-2,2'-disulfonic acid disodium salt (SDDM) was synthesized from 4,4'-diaminodiphenylmethane (DDM), using concentrated sulfuric acid and fuming sulfuric acid. Then SPI was synthesized from SDDM, DDM, hexamethylenediamine (HDA), 3,3',4,4'-benzophenonetetracarboxylic dianhydride (BTDA), where dimethylsulfoxide (DMSO) was used as the solvent. SPI was synthesized at various degrees of sulfonation by varying the amount of SDDM in SPI. The membrane was obtained by solution casting. The sulfonated position of SDDM was characterized by <sup>1</sup>H-NMR and FTIR. The chemical structure of SPI was characterized by FTIR. The characteristic peaks of SPI are at 1777, 1709, 1368, 1248 and 1157 cm<sup>-1</sup> respectively. Thermogravimetric analysis was used to investigate the thermal stability of SPI. The sulfonated group of SPI decomposed around 200 °C and the degradation of polymer main chain occurs at around 480 °C. Sulfonated polyimide with the highest degree sulfonation possesses the proton conductivity of 0.003241 S/cm. The highest methanol permeability of sulfonated copolyimide is 2.7482 × 10<sup>-8</sup> cm<sup>2</sup>/s which much lower than those of Nafion<sup>®</sup> (1.7400 × 10<sup>-6</sup> cm<sup>2</sup>/s). The effects of degree of sulfonation on the properties of the membrane were also investigated and reported here: the water uptake (WU), the dynamic mechanical analysis (DMA) and the ion exchange capacity (IEC).

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## TABLE OF CONTENTS

	<b>PAGE</b>
Title Page	i
Abstract (in English)	iii
Abstract (in Thai)	iv
Acknowledgements	v
List of Tables	ix
List of Figures	x
 <b>CHAPTER</b>	
<b>I INTRODUCTION</b>	<b>1</b>
<b>II THEORETICAL BACKGROUND AND LITERATURE REVIEW</b>	<b>4</b>
<b>III METHODOLOGY</b>	<b>23</b>
3.1 Materials	23
3.1.1 Chemicals	23
3.1.2 Instruments	23
3.1.3 Gas	23
3.2 Equipment	24
3.2.1 Analytical Instruments	24
3.2.2 Glassware and Apparatus	24
3.3 Experimental Method	25
3.3.1 Synthesis of 4,4'-Diaminodiphenylmethane -2,2'-Disulfonic Acid Disodium Salt (S-DDM)	25
3.3.2 Preparation of Sulfonated Poly(Aromatic Imide-co-Aliphatic Imide)	25
3.4 Characterizations and Testing	25

<b>CHAPTER</b>	<b>PAGE</b>
3.4.1 <sup>1</sup> H-Nuclear Magnetic Resonance ( <sup>1</sup> H-NMR)	25
3.4.2 Fourier Transform Infrared (FTIR)	26
3.4.3 Thermogravimetric Analysis (TGA)	26
3.4.4 Ion Exchange Capacity (IEC)	26
3.4.5 Degree of Sulfonation (DS)	26
3.4.6 Water Uptake (WU)	27
3.4.7 Proton Conductivity Measurement	27
3.4.8 Methanol Permeability	28
3.4.9 Dynamic mechanical analysis (DMA)	29
<b>IV NOVEL PROTON EXCHANGE MEMBRANE FOR DIRECT METHANOL FUEL CELL</b>	<b>30</b>
Abstract	31
Introduction	32
Experimental	33
Results and Discussion	37
Conclusions	40
Acknowledgments	40
References	41
<b>V CONCLUSIONS</b>	<b>50</b>
<b>REFERENCES</b>	<b>51</b>
<b>APPENDICES</b>	<b>56</b>
<b>Appendix A</b> Fourier Transform Infrared Spectrometer (FTIR)	56
<b>Appendix B</b> Thermogravimetric Analysis (TGA)	70
<b>Appendix C</b> Ion Exchange Capacity (IEC)	77
<b>Appendix D</b> Degree of Sulfonation (DS)	80
<b>Appendix E</b> Water Uptake	83

<b>CHAPTER</b>	<b>PAGE</b>
<b>Appendix F</b> Proton Conductivity	85
<b>Appendix G</b> Methanol Permeability	111
<b>Appendix H</b> Dynamic Mechanical Analysis (DMA)	130
<b>CURRICULUM VITAE</b>	156



**LIST OF TABLES**

<b>TABLE</b>		<b>PAGE</b>
<b>CHAPTER 2</b>		
2.1	Reactions of a polymer electrolyte membrane of hydrogen and methanol feeds	5
<b>CHAPTER 4</b>		
4.1	The ion exchange capacity, water uptake and actual degree of sulfonation of sulfonated copolyimide	44

## LIST OF FIGURES

FIGURE	PAGE
<b>CHAPTER 1</b>	
1.1 The operation of fuel cell.	2
<b>CHAPTER 2</b>	
2.1 Operation principle of hydrogen fuel cell.	4
2.2 Operation of alkaline fuel cell.	6
2.3 Operation principle of phosphoric acid fuel cell.	7
2.4 Operation of solid oxide fuel cell.	8
2.5 Operation of molten carbonate fuel cell.	9
2.6 Operation of direct methanol fuel cell.	10
2.7 The chemical structure of sulfonated poly(arylene ether sulfone).	11
2.8 Selectivity of 4,4'-biphenol based disulfonated poly(arylene ether sulfone) copolymers and Nafion <sup>®</sup> at 25 °C.	11
2.9 Sulfonated poly(ether ether ketone) properties: (a) Arrhenius plots of proton conductivity; and (b) Arrhenius plots of the methanol permeability for samples.	12
2.10 The chemical structure of sulfonated polybenzimidazoles.	12
2.11 Proton conductivity of sulfonated polybenzimidazoles with various temperature.	13
2.12 TEM image of sulfonated polybenzimidazoles at mole ratio of 3,3'-disulfonate-4,4'-dicarboxylbiphenyl: (a) 30%; (b) 50%; and (c) 70%.	13
2.13 The TGA curve of sulfonated poly(phenylene oxide).	14
2.14 The chemical structure of sulfonated polyimide.	14
2.15 The chemical structure of sulfonated polyimide: (a) 4,4'-diaminodiphenyl ether 2,2'-disulfonic acid-based (ODADS-based); and (b) sulfonated diamine 2,2'-benzidine disulfonic acid-based (BDSA-based) polyimide	15
2.16 The methanol permeability of ODADS-based, BDSA-based and Nafion <sup>®</sup> .	15

<b>FIGURE</b>	<b>PAGE</b>
2.17 The chemical structure of sulfonated copolyimide.	16
2.18 FTIR spectra of sulfonated copolyimide.	16
2.19 Water uptake as a function of ion exchange capacity of sulfonated polyimide (a); and Proton conductivity and methanol permeability as a function of sulfonation level (b).	17
2.20 The chemical structure of sulfonated naphthalenic polyimides.	17
2.21 Temperature dependence of conductivity of the membrane with different type of solvent.	18
2.22 The chemical structure of sulfonated polyimides.	18
2.23 The TGA curve of sulfonated polyimides.	19
2.24 Relative humidity dependence of conductivity of the membrane with different type of monomer.	19
2.25 Effect of the microwave irradiation time on the yield of polyimide.	20
2.26 The properties of sulfonated polyimide: (a) proton conductivity at 30 °C and 80% RH; (b) amount of adsorbed water at 30 °C and 50% RH as a function of DVB composition in semi-IPN coating films measured; and (c) methanol concentration during permeation test	20
2.27 The properties of sulfonated polyimide: (a) proton conductivity; and (b) methanol permeability	21
2.28 The dynamic mechanical behavior of sulfonated poly(arylene-co-imide)s.	22
2.29 The conductivity of sulfonated poly(arylene-co-imide)s.	22

### **CHAPTER 3**

3.1 Schematic diagram of methanol permeability measurement.	28
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### **CHAPTER 4**

4.1 Synthesis of the SDDM monomer.	44
4.2 The $^1\text{H}$ -NMR spectra of monomer and sulfonated monomer: (a) DDM; (b) SDDM.	45
4.3 Synthesis of the sulfonated copolyimide.	45

<b>FIGURE</b>		<b>PAGE</b>
4.4	The FTIR spectra of unsulfonated copolyimide and sulfonated copolyimide.	46
4.5	The TGA curves of sulfonated copolyimides.	46
4.6	Ion exchange capacity and degree of sulfonation of sulfonated copolyimides.	47
4.7	The conductivity of sulfonated copolyimides as a function of degree of sulfonation by an LCR meter.	47
4.8	The comparison of methanol permeability of SDH 3, SDH 4, and SDH 5 at 60 °C.	48
4.9	Methanol permeability of sulfonated copolyimides at 60 °C.	48
4.10	The storage modulus ( $E'$ ) of sulfonated copolyimides vs. frequency at 30 °C by DMA.	49