PREPARATION AND CHARACTERIZATION OF VERY FINE ELECTROSPUN POLYACRYLONITRILE FIBERS AS A PRECURSOR FOR CARBON FIBERS

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จุฑาวรรณ สุธาศิลพรมแพร: การเตรียมและทดสอบคุณสมบัติของเส้นใยพอลิอะคริโลไนไตรขนาดเล็กเพื่อใช้เป็นเส้นใยตั้งต้นสำหรับการผลิตคาร์บอนไฟเบอร์ (Preparation and Characterization of Very Fine Electrospun Polyacrylonitrile Fibers as a Precursor for Carbon Fibers) อ.ที่ปรึกษา: ผศ.ดร. พิญช์ ศุกผล และ ดร. มานิตย์ นิธิทนากุล 83 หน้า ISBN 974-17-2325-3

เส้นใยพอลิอะคริโลไนไตรขนาดเล็กมากถูกผลิตขึ้นโดยขบวนการปั่นเส้นใยแบบใช้ไฟฟ้าสถิตย์เป็นตัวขับเคลื่อน เส้นใยเหล่าได้นี้ต่อมาถูกเปลี่ยนสภาพให้เป็นคาร์บอนไฟเบอร์ โดยมีจุประสงค์ในการผลิตคาร์บอนไฟเบอร์ที่มีพื้นที่ผิวสัมผัสต่อมวลสูง ได้มีการศึกษาผลของสภาวะต่างในการทดลองต่อลักษณะของเส้นใยพอลิอะคริโลไนไตร (ได้แก่ ความเข้มข้นของสารละลายพอลิอะคริโลไนไตร, ปริมาณศักย์ไฟฟ้า, ชนิดของขั้วไฟฟ้า, ระยะทางในการรับเส้นใย, ความเร็วในการดึงเส้นใย และขนาดของปลายท่อ) จากผลการทดลองพบว่า เมื่อเพิ่มความเข้มข้นของสารละลาย ค่าเฉลี่ยของขนาดเส้นใยมีค่าเพิ่มขึ้นในขณะที่ความหนาแน่นของพอลิเมอร์ก้อนกลม (beads) ลดลงจนไม่พบพอลิเมอร์ก้อนกลมเลยเมื่อใช้สารละลายความเข้มข้นสูง สามารถอธิบายผลการทดลองโดยอาศัยคุณสมบัติของสารละลายพอลิเมอร์ ซึ่งประกอบด้วยความหนืด, แรงตึงผิว และความสามารถในการนำไฟฟ้า เมื่อรับเส้นใยในระยะที่ห่างมากขึ้นนอกจากจะสมารถลดขนาดของเส้นใยได้แล้ว ยังมีผลให้เส้นใยเกาะบนฉากรับในบริเวณที่กว้างขึ้น นอกจากนี้ยังพบว่าสามารถลดขนาดของเส้นใยควบคู่ไปกับการลดความหนาแน่นของพอลิเมอร์ก้อนกลมได้ โดยการลดปริมาณศักย์ไฟฟ้าและขนาดของปลายท่อ ขั้วไฟฟ้าของอิเล็กโทรดไม่มีผลต่อขนาดของเส้นใยที่ได้ และจากการศึกษาคุณสมบัติภายใต้ความร้อนพบว่า เส้นใยอะคริลิกที่ได้จากวิธีการปั่นด้ายโดยไฟฟ้าสถิต เริ่มเปลี่ยนแปลงโครงสร้างทางเคมีในขั้นตอนStabilizationเร็วกว่าเส้นใยที่ผลิตโดยวิธีปั่นเส้นใยแบบทั่วไป(Conventional Spinning) โดยคาร์บอนไฟเบอร์ที่ได้มีขนาดประมาณ 250 นาโนเมตร

ABSTRACT

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Keywords : Electrospinning/Polyacrylonitrile-co-methylacrylate/Processing parameter/Carbon fiber precursor/Thermal study.

Very fine polyacrylonitrile (PAN) fibers were successfully prepared by electrostatic spinning process. These fine PAN fibers were converted to carbon fibers, with an aim to produce carbon fibers of high surface-to-mass ratio. The effects of process conditions (i.e., PAN solution concentration, applied voltage, applied electrode polarity, collection distance, and nozzle radius) on the morphology of the as-spun fibers were investigated. It was found that the average fiber diameter monotonically increased with increasing PAN concentration in the solutions, while the number of beads along the fibers decreased and even disappeared altogether at high concentrations. The results could be explained based on properties of the solutions, such as the viscosity, surface tension, and conductivity. An increase in the collection distance did not only result in a decrease in the average fiber diameter, but also result in a widening of the collection area. Decreasing average fiber diameter and bead density along the fibers were obtained by decreasing the electrostatic field strength and the nozzle radius. The applied electrode polarity appeared to have no effect on the average fiber diameter. Conversion of these fine PAN fibers to carbon fibers was carried out and it was found that the stabilization reaction was faster in electrospun PAN fiber than in conventional one. The carbon fibers obtained have diameter of ca. 250 nm.

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TABLE OF CONTENTS

		PAGE
Title Page		i
Abstract (in English)		iii
Abstract (in Thai)		iv
Acknowledgements		v
Table of Contents		vi
List of Tables		viii
List of Figures		x
CHAPTER		
I	**INTRODUCTION**	1
II	**LITERATURE SURVEY**	3
	2.1 Electrospinning	3
	2.1.1 Experimental Setup	3
	2.1.2 Polymer Types	3
	2.1.3 Pathway of Charged Jet	4
	2.1.4 Microstructure and Morphology	5
	2.1.5 Applications	5
	2.2 Carbon Fiber	6
III	**EXPERIMENTAL**	8
	3.1 Electrospinning	8
	3.1.1 Materials	8
	3.1.2 High Voltage Power Supply	8
	3.1.3 Sample Preparation	8
	3.1.4 Electrospinning Process	8
	3.1.4.1 Effect of Concentration	8
	3.1.4.2 Effect of Collection Distance	9
	3.1.4.3 Effect of Applied Voltage	9
	3.1.4.4 Effect of Electrode Polarity	9

CHAPTER **PAGE**

3.1.4.5 Effect of Nozzle Radius 9

3.1.4.6 Effect of Take–up Speed 9

3.2 Continuous Stabilization and Carbonization 10

3.3 Characterization 10

3.3.1 Viscometer 10

3.3.2 Tensiometer 10

3.3.3 Conductivity Meter 10

3.3.4 Fourier–transform Infrared Spectroscopy 10

3.3.5 Scanning Electron Microscopy 11

3.3.6 Wide–angle X–ray Diffraction Spectroscopy 11

3.3.7 Differential Scanning Calorimeter 11

3.3.8 Thermogravimetric Analysis 11

IV PREPARATION AND CHARACTERIZATION OF VERY FINE POLYACRYLONITRILE FIBERS AS A PRECURSOR FOR CARBON FIBERS

Abstract 13

Introduction 14

Experimental 15

Results and Discussion 18

Conclusions 23

Acknowledgements 24

References 24

V CONCLUSIONS 51

REFERENCES 52

APPENDICES 55

Appendix A Influence of concentration on fiber

CHAPTER **PAGE**

	diameter	55
Appendix B	Influence of applied voltage on fiber diameter	59
Appendix C	Influence of collection distance on fiber diameter	63
Appendix D	Influence of electrode polarity on fiber diameter	67
Appendix E	Influence of take-up speed on fiber diameter	73
Appendix F	Influence of nozzle radius on fiber diameter	77
Appendix G	Definitions of electrically terms used in electrospinning	81
CURRICULUM VITAE		83

LIST OF TABLES

TABLE		PAGE
	CHAPTER IV	
1	The condition for studying the effect of processing parameters	28
	APPENDIX A	
A1	Diameter of electrospun PAN fiber (in nm) as a function of PAN concentration in DMF (Conditions for electrospinning process: applied voltage of +20 kV, collection distance of 15 cm, nozzle radius of 0.47 mm and stationary collection screen)	55
A2	Statistics of fiber diameter at various concentrations	58
	APPENDIX B	
B1	Diameter of electrospun PAN fibers (in nm) as a function of applied voltage.(Conditions for electrospinning process: PAN concentration of 9.5 wt%, collection distance of 15 cm, nozzle radius of 0.47 mm and stationary collection screen)	59
B2	Statistics of fiber diameter at various applied voltages	62
	APPENDIX C	
C1	Diameter of electrospun PAN fiber (in nm) as a function of collection distance (Conditions for electrospinning process: PAN solution concentration of 9.5 wt%, applied voltage of +30 kV, nozzle radius of 0.47 mm and stationary collection screen)	63
C2	Statistics of diameter of electrospun PAN fiber at various collection distances	66

TABLE **PAGE**

APPENDIX D

D1 Diameter of electrospun PAN fiber (in nm) as a function of concentration when the positive electrode was attached to the nozzle tip.(Conditions for electrospinning process: applied voltage of 20 kV, collection distance of 15 cm, nozzle radius of 0.47 mm and stationary collection screen) 67

D2 Statistics of fibers diameter at various concentrations when positive eletrode was used 69

D3 Diameter of electrospun PAN fiber (in nm) as a function of concentration when the positive electrode was attached to the nozzle tip.(Conditions for electrospinning process: applied voltage of 20 kV, collection distance of 15 cm, nozzle radius of 0.47 mm and stationary collection screen) 70

D4 Statistics of fiber diameter at various concentrations when negative electrode was used 72

APPENDIX E

E1 Diameter of electrospun PAN fiber (in nm) as a function of take-up speed when the positive electrode was attached to the nozzle tip.(Conditions for electrospinning process: of 14.4 wt% PAN solution, appied voltage of +20 kV, collection distance of 10 cm, nozzle radius of 0.47 mm and adjustable speed rotationally collection screen) 73

E2 Statistics of fiber diameter at various take-up speeds when positive electrode was used 76

APPENDIX F

F1 Diameter of electrospun PAN fiber (in nm) as a function of nozzle radius when the positive electrode was attached to the nozzle tip.(Conditions for electrospinning process:

TABLE **PAGE**

	14.4 wt% PAN solution, applied voltage of +15 kV, collection distance of 15 cm and stationary collection screen)	77
F2	Statistics of fiber diameter at various nozzle radiuses when positive eletrode was used	80

LIST OF FIGURES

FIGURE		PAGE
	CHAPTER IV	
1	Schematic diagram of experimental set up of electrospinning process	29
2	FT-IR spectra of cast film of PAN fibers	30
3	SEM micrographs of obtained electrospun PAN fibers at various concentrations (2.1-17.4%wt)	31
4	Viscosity (●) and surface tension (▼) of PAN solution in DMF as a function of concentration	33
5	Conductivity of PAN solution in DMF at concentration of 2.1 to 17.4 %wt	34
6	Concentration dependence on fiber diameter obtained by electrospinning process at collection distance of 15 cm and applied voltage of -20 kV	35
7	The effect of collection distance on fiber diameter	36
8	Photographs of obtained PAN electrospun fibers at various collection distance (10-30cm)	37
9	The average of fiber diameter as function of electric field strength	38
10	SEM micrographs of obtained PAN electrospun fibers at various applied voltages (10-30kV)	39
11	Influence of polarity of electrode on fiber diameter	40
12	Effect of take-up speed on fiber diameter when the adjustable speed rotational drum was used as a collector	41
13	SEM micrographs of fiber alignment at various take-up speeds of the adjustable speed rotational drum	42
14	The average diameter of electrospun fiber obtained by using various nozzle radius	43
15	SEM micrographs of PAN electrospun fibers when	

FIGURE **PAGE**

	various sizes of needle radius were used	44
16	FT-IR spectra of (a)cast film of PAN fibers, (b)stabilized electrospun PAN fibers, and (c)carbonized electrospun PAN fibers	45
17	WAXD patterns of (a) PAN precursors, (b) electrospun PAN fibers, (c) stabilized electrospun PAN fibers, and (d) carbonized electrospun PAN fibers	46
18	DSC thermograms of (a) conventional PAN fibers and (b) electrospun PAN fibers	47
19	TGA thermogram of electrospun PAN fiber	48
20	TGA thermogram of conventional PAN fiber	49
21	SEM micrograph of carbonized PAN electrospun fibers	50