

**PREPARATION AND CHARACTERIZATION OF POLYPYRROLE
FILMS FOR GAS SENSOR APPLICATION**

Ms. Walaiporn Prissanaroon

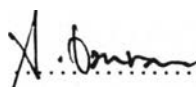
A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science
The Petroleum and Petrochemical College
Chulalongkorn University
in Academic Partnership with
The University of Michigan, The University of Oklahoma
and Case Western Reserve University

1998


ISBN 974-638-517-8

Thesis Title : Preparation and Characterization of Polypyrrole Films
for Gas Sensor Applications
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Program : Polymer Science
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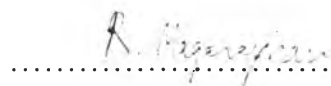
Accepted by the Petroleum and Petrochemical College, Chulalongkorn University, in partial fulfillment of the requirements for the Degree of Master of Science.

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ABSTRACT

962016 : POLYMER SCIENCE PROGRAM

KEY WORDS : Conductive Polymer / Specific conductivity / Polypyrrole / Gas Sensor

Walaiporn Prissanaroon: Preparation and Characterization of Polypyrrole Films for Gas Sensor Application. Thesis Advisors: Prof. Johannes Schwank and Assoc. Prof. Anuvat Sirivat, 85 pp. ISBN 974-638-517-8

Polypyrrole (PPy), a conductive polymer, was synthesized chemically by using dodecylbenzene sulfonic acid (DBSA) as the dopant and ammoniumpersulfate (APS) as the oxidant. PPy films were prepared by casting the solution of PPy dissolved in m-cresol on a glass slide. The doping level of doped PPy was controlled by the DBSA concentration used and determined by elemental analysis. The spectra of FT-IR and UV-VIS light absorption of the soluble PPy indicated that both the sulfate anion and the bipolaron absorptions respectively increased with the doping level. The morphology of DBSA-doped PPy at low doping levels had a granular appearance but changed into a fibrillar type at higher doping levels. The conductivity was found to increase with temperature in N₂ atmosphere in agreement with the variable hopping process theory. However, at low temperatures and doping levels, the opposite behavior occurred due to the free volume expansion which tended to retard the electron hopping process. The specific conductivity of DBSA-doped PPy films increased with SO₂ concentration in the range of 500 - 2500 ppm. In SO₂ atmosphere, we found that the conductivity increased with temperature at low temperatures, indicating semiconductor behavior. But at high temperatures, the conductivity decreased with temperature possibly due to desorption of SO₂ molecules from polypyrrole chains.

บทคัดย่อ

วัลย์พร ปฤษฎารุณ : การเตรียมและทดสอบคุณสมบัติของฟิล์มพอลิไพโรลเพื่อใช้ในการตรวจวัดก๊าซ (Preparation and Characterization of Polypyrrole Films for Gas Sensor Application) อ.ที่ปรึกษา : Prof. Johannes Schwank และ รศ. ดร. อนุวัฒน์ ศิริวัฒน์ 85 หน้า ISBN 974-638-517-8

พอลิไพโรล (Polypyrrole) ซึ่งเป็นพอลิเมอร์นำไฟฟ้าชนิดหนึ่งถูกสังเคราะห์ทางเคมีโดยใช้ โดเดซิลเบนซีนซัลโฟนิค แอซิด (Dodecylbenzene sulfonic acid) เป็นสารได้ป และ แอมโมเนียมเปอร์ซัลเฟต (Ammoniumpersulfate) เป็นสารออกซิเดนต์ ฟิล์มพอลิไพโรลถูกเตรียมโดยการเทสารละลายพอลิไพโรลซึ่งมีเอ็ม-ครีซอล (m-cresol) เป็นตัวทำละลายลงบนแผ่นกระจกสไลด์ ระดับการได้ปของฟิล์มพอลิไพโรลซึ่งวิเคราะห์โดยเครื่องวิเคราะห์ธาตุ (Elemental Analyzer) สามารถถูกควบคุมโดยความเข้มข้นของโดเดซิลเบนซีนซัลโฟนิคแอซิด อินฟราเรดและยูวี-วิสิเบิลสเปกตรัมชี้ให้เห็นว่าการดูดกลืนแสงของซัลเฟตแอนไอออนและไบโพลารอน (Bipolaron) เพิ่มขึ้นตามระดับการได้ป นอกจากนั้นพอลิไพโรลที่มีระดับการได้ปต่ำจะมีสัญญาณวิทยาเป็นแบบเม็ดกลม และจะเปลี่ยนเป็นชนิดเส้นใยเมื่อระดับการได้ปเพิ่มขึ้น ค่าการนำไฟฟ้าของพอลิไพโรลเพิ่มขึ้นตามอุณหภูมิซึ่งเป็นไปตามทฤษฎี Variable Hopping Process Theory อย่างไรก็ตามสำหรับที่ระดับการได้ปต่ำและอุณหภูมิต่ำ จะเกิดพฤติกรรมตรงกันข้ามเนื่องจากการขยายตัวของปริมาตรว่าง (Free volume) เมื่อทดสอบในบรรยากาศของก๊าซซัลเฟอร์ไดออกไซด์ พบว่าค่าการนำไฟฟ้าจะเพิ่มขึ้นตามความเข้มข้นของก๊าซซัลเฟอร์ไดออกไซด์ และในบรรยากาศของก๊าซซัลเฟอร์ไดออกไซด์ พบว่าค่าการนำไฟฟ้าจะเพิ่มขึ้นตามอุณหภูมิช่วงต่ำซึ่งแสดงถึงพฤติกรรมของสารกึ่งตัวนำ ในขณะที่อุณหภูมิช่วงสูง ค่าการนำไฟฟ้าจะลดลงตามอุณหภูมิที่เพิ่มขึ้น ทั้งนี้อาจเนื่องมาจากการที่โมเลกุลของก๊าซซัลเฟอร์ไดออกไซด์บางส่วนหลุดออกจากสายโซ่พอลิไพโรล

ACKNOWLEDGMENTS

The author would like to gratefully acknowledges all professors who have taught her at the Petroleum and Petrochemical College, Chulalongkorn University, especially those in the Polymer Science Program.

She greatly appreciates the efforts of her research advisors, Professor Johannes Schwank, Department of Chemical Engineering, University of Michigan and Associate Professor Anuvat Sirivat of the Petroleum and Petrochemical College, Chulalongkorn University for their constructive criticisms, suggestions and proof-reading of this manuscript. She would like to give thanks to Dr. Ratthanawan Magaraphan for being a thesis committee member.

She would like to give a special thank for C.P.O. Poon Arjpru, the electrical technician, at the Petroleum and Petrochemical College who helped in the design and fabrication of the four-point probe detector with gas chamber.

The author also thanks all of her friends and the staff at the PPC who encouraged her in carrying out the experiment and this thesis writing. Finally, she is deeply indebted to her presents for their love, understanding, encouragements, and for being a constant source of her inspiration.

TABLE OF CONTENTS

	PAGE
Title Page	i
Abstract	iii
Acknowledgments	v
List of Tables	ix
List of Figures	xi
 CHAPTER	
I INTRODUCTION	
1.1 Electrically Conductive Polymers	1
1.1.1 Basic Concept	1
1.1.2 Charge Carriers and Conductivity in Electrically Conductive Polymers	3
1.2 Conductive Polymer Films in Gas Sensor Applications	7
1.3 Polypyrrole	8
1.4 General Objectives	9
1.5 Literature Survey	9
 II EXPERIMENTAL SECTION	
2.1 Materials	13
2.2 Methodology	13
2.2.1 Synthesis of DBSA-doped polypyrrole	13
2.2.2 Preparation of DBSA-doped polypyrrole films	15

CHAPTER	PAGE
2.3 Characterization / Sample Preparation	16
2.3.1 FTIR Spectrometer	16
2.3.2 Elemental Analyzer	16
2.3.3 SEM	17
2.3.4 UV-VIS Spectrometer	18
2.4 Electrical Properties	19
2.4.1 The Four-Points Probe for Characterizing Sheet Resistivity	19
2.4.2 Conductivity Detector with Gas Chamber	21
III RESULTS AND DISCUSSION	
3.1 Characterization	27
3.1.1 FTIR Spectrometry	27
3.1.2 Elemental Analysis	30
3.1.3 UV-VIS Spectrometer	33
3.1.4 SEM	35
3.2 Preliminary Test	39
3.2.1 Effect of Aging Time on Conductivity Response	39
3.2.2 Statistical Test	42
3.2.3 Effect of Applied Current on Conductivity Response	44
3.3 Electrical Conductivity	45
3.3.1 Effect of Dopant Concentration	45
3.3.2 Effect of Testing Temperature	46

CHAPTER	PAGE
3.3.3 Effect of Exposure Time to SO ₂	53
3.3.4 Effect of SO ₂ Concentration	55
3.3.5 Effect of Testing Temperature in SO ₂ atmosphere	58
IV COCLUSIONS	60
REFERENCES	62
APPENDICES	64
A Properties and Toxicity Data of SO ₂	64
B Determination of Geometric Correction Factor	67
C Calculation of atom mole ratios from elemental analyzer of DBSA-doped polypyrrole	69
D Electrical Property Data	72
CURRICULUM VITAE	85

LIST OF TABLES

TABLE		PAGE
3.1	Atom mole ratios from elemental analyzer of DBSA-doped polypyrrole with various DBSA concentration	31
3.2	The conductivity change of DBSA-doped polypyrrole films as a function of DBSA concentration	40
3.3	The statistical data of 0.30 M DBSA-doped polypyrrole films	42
3.4	The activation energy for various DBSA concentration in the temperature range : 18 °C to 70 °C	48
B-1	Data of K factor determination	67
C-1	Raw data from element analyzer and the resulting doping level	69
D-1	Effect of aging time on the specific conductivity for the DBSA-doped polypyrrole with various DBSA concentrations	72
D-2	X-bar charts of the specific conductivity for 0.30 M DBSA-doped polypyrrole at 18 °C	74
D-3	Effect of the applied current on the specific conductivity of the DBSA-doped polypyrrole films at 18 °C	75
D-4	Effect of DBSA concentration on the specific conductivity of the DBSA-doped polypyrrole films at 18 °C	76
D-5	Plot of σ_{dc} versus T for the DBSA-doped polypyrrole with various DBSA concentrations	77

TABLE		PAGE
D-6	Effect of exposure time to 2500 ppm SO ₂ at 18 °C for DBSA-doped polypyrrole films with various DBSA concentrations	80
D-7	Effect of SO ₂ concentration at 18 °C for DBSA-doped polypyrrole films with various DBSA concentrations	82
D-8	Effect of temperature in SO ₂ atmosphere at 18 - 70 °C for DBSA-doped polypyrrole films with various DBSA concentrations	84

LIST OF FIGURES

FIGURE		PAGE
1.1	Repeat unit of several electrically conductive polymers	1
1.2	Schematic representation of band structure of metal, semiconductor/conductive polymer and insulator	4
1.3	Generation of polaron and bipolaron defects in conjugated organic polymer	5
1.4	Band structure of conjugated polymer as function of doping level	6
2.1	Flow chart of synthesis of soluble polypyrrole	14
2.2	A scheme of the apparatus for synthesis DBSA-doped polypyrrole	15
2.3	Scheme of the four-point probe	19
2.4	A schematic representation of conductivity detector with gas chamber	23
3.1	The FTIR spectra of DBSA-doped polypyrrole and neutral polypyrrole	28
3.2	The FTIR spectra of DBSA-doped polypyrrole prepared by using various DBSA concentrations	29
3.3	Plot of the doping level as a function of DBSA concentration	30
3.4	The proposed chemical structures of polypyrrole	32
3.5	UV-VIS spectra of m-cresol solution of polypyrrole doped by various DBSA concentrations	33

FIGURE	PAGE
3.6 SEM image in the edge view of 0.30 M DBSA-doped polypyrrole film	35
3.7 SEM micrographs of the synthesized DBSA-doped polypyrrole with various DBSA concentrations	38
3.8 Effect of aging time on the specific conductivity for the DBSA-doped polypyrrole with various DBSA concentrations	41
3.9 X-bar charts of the specific conductivity for 0.30 M DBSA-doped polypyrrole at 18 °C	43
3.10 Effect of the applied current on the specific conductivity of the DBSA-doped polypyrrole films at 18 °C	44
3.11 Effect of DBSA concentration on the specific conductivity of the DBSA-doped polypyrrole films at 18 °C	45
3.12 Plot of σ_{dc} versus T for the DBSA-doped polypyrrole with various DBSA concentrations	47
3.13 Plot of $\ln \sigma_{dc}$ versus $1/T$ for the DBSA-doped polypyrrole with various DBSA concentrations	48
3.14 A possible model for low-doped polypyrrole chains when temperature increases	50
3.15 Plots of $\ln \sigma_{dc}$ versus $1/T^2$ and $1/T^3$ for the DBSA-doped polypyrrole with various DBSA concentrations	51
3.16 Aromatic (ground state) and quinoid-like geometric structures for polypyrrole, polythiophene and poly(p-phenylene)	52

FIGURE		PAGE
3.17	Effect of exposure time to 2500 ppm SO ₂ at 18 °C for DBSA-doped polypyrrole films with various DBSA concentrations	54
3.18	Effect of SO ₂ concentration at 18 °C for DBSA-doped polypyrrole films with various DBSA concentrations	56
3.19	Plot of the specific conductivity change <i>versus</i> SO ₂ concentration at 18 °C for DBSA-doped polypyrrole films with various DBSA concentrations	57
3.20	Plot of the specific conductivity <i>versus</i> temperatures in 1000 ppm SO ₂ atmosphere of the DBSA-doped polypyrrole films with various DBSA concentrations	59