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**PREPARATION OF ELECTRICALLY CONDUCTING PLASTIC
FILM BY CVD OF PYRROLE**

Mr. Weeraphan Prathumchai

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for the degree of Master of Science in Polymer Science

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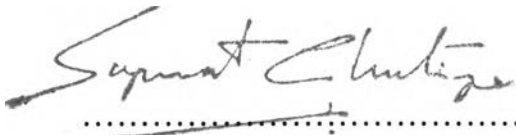
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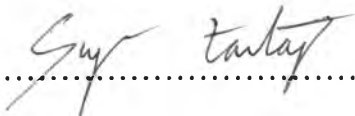
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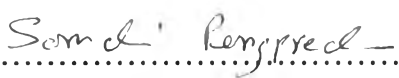
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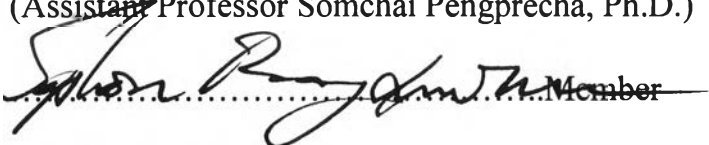
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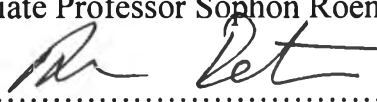

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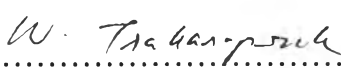
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วีระพันธ์ ประทุมชัย : การเตรียมฟิล์มพลาสติกนำไฟฟ้าโดยวิธีซีวีดีของพิวโรล

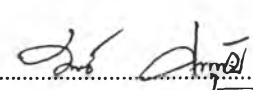
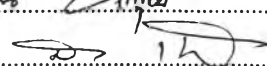
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งานวิจัยนี้ได้ศึกษาภาวะที่เหมาะสมในการเตรียมฟิล์มพลาสติกนำไฟฟ้า โดยวิธีซีวีดีของพิวโรล โดยศึกษาปัจจัยต่างๆที่มีผลต่อการนำไฟฟ้าของฟิล์มที่เตรียมได้ ได้แก่ ความเข้มข้นของเฟอร์ริกคลอไรด์ และ มอนอเมอร์พิวโรล เวลาการเกิดปฏิกิริยา อุณหภูมิการเกิดปฏิกิริยา เวลาในการได้ปไอโอดีน และ อุณหภูมิในการได้ปไอโอดีน ทำการวัดค่าการนำไฟฟ้าของฟิล์มพลาสติกที่เตรียมได้ ด้วยวิธีของ วัน เดอร์ พาว พร้อมทั้งรายงานผลที่ได้ ทำการศึกษาการเกิดพอลิพิวโรล โดยการศึกษาวิเคราะห์ธาตุ C H N O ในโครงสร้างของพอลิเมอร์ที่ได้ ศึกษาผลของความเข้มข้นของเฟอร์ริกคลอไรด์ ที่มีต่อ ค่าการนำไฟฟ้าโดยใช้ UV-visible สเปกโทรสโคปี ศึกษาผลของความเข้มข้นของมอนอเมอร์พิวโรล อุณหภูมิของการเกิดปฏิกิริยา เวลาในการเกิดปฏิกิริยา อุณหภูมิในการได้ปไอโอดีน และ เวลาในการได้ปไอโอดีน ที่มีต่อค่าการนำไฟฟ้าของฟิล์มที่เตรียมได้โดยเครื่องอินฟราเรด สเปกโทรสโคปี และ ออปติคัลไมโครสโคปี พบว่า ภาวะการเตรียมฟิล์มพลาสติกที่เหมาะสม คือ ที่ความเข้มข้นของเฟอร์ริกคลอไรด์ที่ 25% ในน้ำกลั่น และ มอนอเมอร์พิวโรลที่ 25% ในน้ำกลั่น ทำปฏิกิริยาที่อุณหภูมิ -15°C เป็นเวลา 20 ชั่วโมง วัดค่าการนำไฟฟ้าได้ $1.61 \times 10^{-1} \text{ S/cm}$ มีค่าที่ใกล้เคียงกันของฟิล์มแต่ละชนิดที่ศึกษา คือ PVC/PPY PP/PPY และ LDPE/PPY เมื่อได้ปด้วยไอโอดีนในภาวะที่เหมาะสมที่อุณหภูมิ -15°C เป็นเวลา 60 นาที ในสุญญากาศ วัดค่าการนำไฟฟ้าได้สูงมากถึง 26.45 S/cm.

งานวิจัยนี้มีการศึกษาการนำฟิล์มพลาสติกนำไฟฟ้าของฟิล์มที่เตรียมได้ ไปประยุกต์ใช้ที่อุณหภูมิสูง โดยศึกษาสมบัติเชิงกลและสมบัติทาง ความร้อน ด้วย เครื่องทดสอบแรงดึง เทคนิค TGA และ DSC ตามลำดับ อนึ่งยังได้ศึกษาผลของปัจจัยต่างๆ ที่มีต่อสมบัติเชิงกลและสมบัติทางความร้อนของฟิล์มพลาสติกนำไฟฟ้าที่ได้ด้วย จากการศึกษาพบว่าที่ภาวะอุณหภูมิต่ำ ฟิล์มพลาสติกนำไฟฟ้าของ PVC/PPY จะมีสมบัติเชิงกลและสมบัติทางความร้อนที่ดี แต่ขณะเดียวกันที่ภาวะอุณหภูมิสูงขึ้น (ที่ 70°C และสูงกว่า) ฟิล์มพลาสติกนำไฟฟ้าของ PP/PPY หรือ LDPE/PPY จะมีสมบัติเชิงกลและสมบัติทางความร้อนที่ดีกว่า จึงมีความเหมาะสมที่จะนำไปใช้งานในภาวะที่อุณหภูมิสูงได้ดี จากการศึกษาโดยใช้เทคนิค DSC พบว่า DSC เทอร์โมแกรม ของฟิล์มพลาสติกนำไฟฟ้าที่ได้ ปรากฏว่าค่า T_g และ T_m คล้ายกับฟิล์มพลาสติกต้นแบบอย่างเด่นชัด สำหรับค่าการทนแรงดึงของฟิล์มพลาสติกนำไฟฟ้า PP/PPY ที่นำไปได้ปด้วยไอโอดีนจะมีค่าลดลงมากกว่า ฟิล์มพลาสติกนำไฟฟ้าของ PVC/PPY และ LDPE/PPY เมื่อเพิ่มเวลาได้ป.

ภาควิชา
สาขาวิชา ปิโตรเคมีและวิทยาศาสตร์พอลิเมอร์
ปีการศึกษา 2541.....

ลายมือชื่อนิสิต 
ลายมือชื่ออาจารย์ที่ปรึกษา 
ลายมือชื่ออาจารย์ที่ปรึกษาร่วม

3971774423 : MAJOR

PETROCHEMISTRY AND POLYMER SCIENCE

KEY WORD: CONDUCTING PLASTIC FILM / PYRROLE / POLYPYRROLE / ELECTRICAL CONDUCTIVITY

WEERAPHAN PRATHUMCHAI : PREPARATION OF ELECTRICALLY CONDUCTING PLASTIC FILM BY CVD OF PYRROLE. THESIS ADVISOR : ASSIST. PROF. SOMCHAI PENGPRECHA, Ph.D. 229 pp. ISBN 974-331-393-1.

The optimum condition of preparation of conducting plastic film by CVD of pyrrole was studied. The conducting plastic film was carried out by varying concentration of ferric chloride solution and pyrrole monomer, reaction temperature, reaction time, iodine doping time, and iodine doping temperature. The electrical conductivity of prepared conducting plastic film was measured by van der Pauw method. The occurrence of polypyrrole was confirmed by Elemental Analyzer. The effect of ferric chloride concentration on electrical conductivity of prepared conducting plastic film was determined by UV-visible spectroscopy. The effect of pyrrole monomer concentration, reaction temperature, reaction time, iodine doping temperature and iodine doping time on electrical conductivity of prepared conducting plastic film was studied by infrared spectroscopy (FT-IR), and optical microscopy. The optimum conditions of preparation of conducting plastic films were 25%FeCl₃, 25%pyrrole in distilled water, at -15⁰C and 20 hours for polymerization, and electrical conductivity was measured as 1.16x10⁻¹ S/cm at nearby for each PVC/PPY, PP/PPY, and LDPE/PPY film. When performed to iodine doping at -15⁰C about 60 minutes in reduced pressure the electrical conductivity was as high as 26.45 S/cm.

The applications of conducting plastic films in high temperature condition were studied. The mechanical and thermal properties were investigated by Universal testing material machine, Thermogravimetric Analyzer (TGA), and Differential Scanning Calorimetry (DSC), respectively. The effect of parameters on mechanical and thermal properties of prepared conducting plastic films were also studied. It was found that PCV/PPY at low temperature has well electrical conductivity, and mechanical properties, but at high temperature (~70⁰C and above) PP/PPY or LDPE/PPY has good mechanical and thermal properties that suitable for applications. From DSC thermogram of prepared conducting plastic film, it clearly exhibited T_g and T_m similar to original plastic film. The tensile strength of exposed iodine vapor of PP/PPY film decreased more with increasing iodine doping time than those of PP/PPY and LDPE/PPY films.

ภาควิชา.....
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 สาขาวิชา.....
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 ลายมือชื่ออาจารย์ที่ปรึกษา.....
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ABBREVIATIONS

b.p.	:	Boiling point.
CHNO	:	Carbon hydrogen nitrogen oxygen.
d^{20}	:	Density at 20°C.
DSC	:	Differential Scanning Calorimetry.
EA	:	Elemental Analysis.
FT-IR	:	Fourier Transform Infrared Spectroscopy.
g	:	Gram.
HDPE	:	High Density Polyethylene.
Hrs.	:	Hours.
LDPE	:	Low Density Polyethylene.
mins.	:	Minutes.
mL	:	Millilitre.
Mw	:	Weight-average molecular weight.
PP	:	Polypropylene.
PPY	:	Polypyrrole.
PVA	:	Poly(vinyl alcohol).
PVC	:	Poly(vinyl chloride).
PYR	:	Pyrrole.
S/cm	:	Seimen/centimetre.
T_d	:	Decomposition temperature.
T_g	:	Glass transitions temperature.
T_m	:	Melt transitions temperature.
UV-vis.	:	Ultraviolet-visible.
σ	:	Electrical conductivity, S/cm.
Ω	:	Ohm.
μm	:	Micrometre.