

**OPTICAL PROPERTIES OF CONDUCTIVE POLYMERS
IN THEIR SOLUTIONS AND ELECTROSPUN FIBERS**



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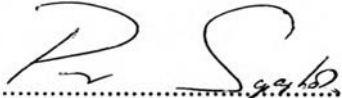
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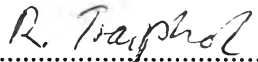
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บทคัดย่อ

สุธีรัตน์ ช้างสาร : สมบัติทางแสงของพอลิเมอร์นำไฟฟ้าในสารละลายและเส้นใยอิเล็กโตรสปิน (Optical Properties of Conductive Polymers in their Solutions and Electrospun Fibers)
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งานวิจัยนี้ ได้ทำการศึกษาคุณสมบัติทางแสงของสารละลายและเส้นใยอิเล็กโตรสปินจากพอลิเมอร์นำไฟฟ้าหลายชนิด เช่น พอลิ(2-เมทอกซี-5-(2'-เอทิลเฮกซิลออกซี)-1,4-ฟีนิลีน ไวนิลีน) (MEH-PPV) พอลิ(เอทิลเฮกซิลออกซี-ออกทิลออกซี-พารา-ฟีนิลีน เอทิลนิตีน) (EHO-OPPE) และ พอลิ(2,7-(9,9-บิส(2-เอทิลเฮกซิล)ฟลูออรีน) (BEH-PF)

พบว่า การปรับเปลี่ยนคุณสมบัติทางแสงของพอลิ(2-เมทอกซี-5-(2'-เอทิลเฮกซิลออกซี)-1,4-ฟีนิลีน ไวนิลีน) ในตัวทำละลาย 1,2 ไคคลอโรอีเทน สามารถทำได้โดยการเติมเกลืออินทรีย์ไพริดีเนียมฟอร์เมต การปรับความเข้มข้นของเกลืออินทรีย์ไพริดีเนียมฟอร์เมตในสารละลายควบคุมตำแหน่งของสเปกตรัมการดูดกลืนและการเปล่งแสงโฟโตลูมิเนสเซนส์ของพอลิ(2-เมทอกซี-5-(2'-เอทิลเฮกซิลออกซี)-1,4-ฟีนิลีน ไวนิลีน) ได้อย่างเป็นระบบ โดยการเปลี่ยนสีของการเปล่งแสงจากสีส้มเป็นสีเหลืองและเขียว สามารถสังเกตได้ด้วยตาเปล่าในสารละลายพอลิ(2-เมทอกซี-5-(2'-เอทิลเฮกซิลออกซี)-1,4-ฟีนิลีน ไวนิลีน) ที่มีเกลืออินทรีย์ไพริดีเนียมฟอร์เมตร้อยละ 0.1 และ 10 โดยปริมาตร ตามลำดับ เกิดจากการปรับเปลี่ยนโครงสร้างทางเคมีของสายโซ่และกิ่งของพอลิ(2-เมทอกซี-5-(2'-เอทิลเฮกซิลออกซี)-1,4-ฟีนิลีน ไวนิลีน)

สำหรับการศึกษากระบวนการปั่นเส้นใยด้วยไฟฟ้าสถิตของพอลิ(เอทิลเฮกซิลออกซี-ออกทิลออกซี-พารา-ฟีนิลีน เอทิลนิตีน) และพอลิ(2,7-(9,9-บิส(2-เอทิลเฮกซิล)ฟลูออรีน) พบว่าสามารถเตรียมเส้นใยที่มีความละเอียดสูง จากสารละลายพอลิเมอร์ผสมของพอลิเมอร์นำไฟฟ้าดังกล่าวกับพอลิเมอร์แม่แบบที่สามารถขึ้นรูปเส้นใยด้วยกระบวนการปั่นเส้นใยด้วยไฟฟ้าสถิตได้นั้นคือ พอลิสไตรีน โดยได้ทำการตรวจสอบคุณสมบัติทางสัณฐานวิทยาและคุณสมบัติทางเคมีของเส้นใยอิเล็กโตรสปินดังกล่าวด้วยกล้องจุลทรรศน์อิเล็กตรอนแบบส่องกราดและเทคนิคฟูเรียร์ทรานสฟอร์มอินฟราเรดสเปกโตรสโคปี และได้ทำการศึกษาคุณสมบัติทางแสง เช่น การดูดกลืนและการเปล่งแสงโฟโตลูมิเนสเซนส์ ด้วยเครื่องยูวีวิซิเบิลสเปกโตรสโคปีและโฟโตลูมิเนสเซนส์สเปกโตรสโคปี ตามลำดับ โดยได้ทำการศึกษาเปรียบเทียบกับฟิล์มบางของพอลิเมอร์เปล่งแสงดังกล่าว ที่เตรียมได้จากเทคนิคสปิน โคล์ดดิ้งและเทคนิคการขึ้นรูปด้วยสารละลายอีกด้วย

ABSTRACT

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The studies on optical properties of various conductive polymers (i.e., poly(2-methoxy-5-(2'-ethylhexyloxy)-1,4-phenylene vinylene) (MEH-PPV), poly(ethylhexyloxy-octyloxy-p-phenylene ethynylene) (EHO-OPPE), poly(2,7-(9,9-bis(2-ethylhexyl)fluorene)) (BEH-PF)) either in their solution or electrospun fibrous form were successfully reported here.

First, a versatile method for tuning optical properties of MEH-PPV in its solution with 1,2-dichloroethane was accomplished by reacting with pyridinium formate (PF), a volatile organic salt. Adjusting the concentration of PF in the solution led to a systematic control for the position of the absorption and the photoluminescent (PL) spectra of MEH-PPV. The changes in the emission color from orange to yellow and, finally, to green were observed by naked eyes in the MEH-PPV solution that contained 0.1 and 10 vol.-% of PF, respectively. The changes in the optical properties were due to chemical modifications along the main chain and the side groups of MEH-PPV.

For the studies on the electrospinning of EHO-OPPE and BEH-PF, ultra-fine fibers from their blend solutions with an electrospinnable and inert template polymer, i.e., polystyrene (PS) were successfully prepared. Scanning electron microscopy (SEM) and Fourier-transformed infrared (FT-IR) spectroscopy were respectively used to observe the morphology and chemical integrity of the electrospun fibers. The optical properties (i.e., absorption and PL emission) were investigated by UV-Visible and PL spectroscopy, respectively. Moreover, the corresponding spin-coated and solution-cast films were also studied for comparison.

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