

**PERMETHYLPOLYAZINE-ETHYLENE PROPYLENE DIENE
ELASTOMER (EPDM) AS AN ELECTROACTIVE ACTUATOR**



Patcharee Intanoo

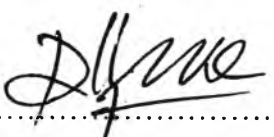
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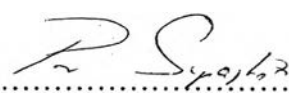
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ABSTRACT

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Elastomers that can respond to external stimuli, such as temperature and electric field, are known as dielectric elastomers, consisting of either a polar molecule or an unsaturated structure on the side chain with induced dipole moments. In our work, we prepared the electroactive polymers from blends of dielectric elastomers and a conductive polymer. For the dielectric elastomers, ethylene propylene diene elastomer (EPDM NORDEL IP 5565) was used as the matrix phase. The conductive polymers, permethylpolyazine (PAZ), were synthesized and doped with iodine at various doping levels for improving the electrical conductivity. The blends were prepared by the mechanical blending of highly doped PAZ particles with EPDM at various particle concentrations from 5 vol% to 20 vol%. The chemical structures of undoped and doped PAZ were characterized by FT-IR. The electromechanical properties were studied under an oscillatory shear mode in the frequency range 0.1-100 rad/s with electric field strength varying from 0 to 1 kV/mm at 27°C. The effects of particle concentration on storage modulus response, $\Delta G'$, storage modulus sensitivity, $\Delta G'/G'_0$, and electrical conductivity, σ , and dielectric constant, ϵ' at 27°C and 100 rad/s were also studied. $\Delta G'$ and $\Delta G'/G'_0$ increase with increasing electric field strength, and particle concentration. The electrical conductivity and dielectric constant increase with particle concentration.

บทคัดย่อ

นางสาวพัชรี อินธนู : การเตรียมวัสดุที่ตอบสนองต่อสนามไฟฟ้าจากเพอร์เมทิลพอลิเอซีนและยางเอทีลีนพรอพิลีนไดอินหรือยางอีพีดีเอ็ม (Permethylypolyazine-Ethylene Propylene Diene Elastomer as an Electroactive Actuator) อ. ที่ปรึกษา : รศ. ดร. อนุวัฒน์ ศิริวัฒน์ 135 หน้า

ไดอิเล็กทริกอีลาสโตเมอร์ เป็นวัสดุที่มีความสามารถในการตอบสนองต่อสิ่งเร้าภายนอก เช่น อุณหภูมิ และสนามไฟฟ้า ประกอบไปด้วยโมเลกุลที่มีขั้วหรือมีโครงสร้างพันธะไม่อิ่มตัวบนกิ่งของสายโซ่ซึ่งเป็นตัวเหนี่ยวนำให้เกิดไดโพลโมเมนต์ งานวิจัยนี้ได้ทำการเตรียมอิเล็กโตรแอคทีฟพอลิเมอร์จากไดอิเล็กทริกอีลาสโตเมอร์และพอลิเมอร์นำไฟฟ้า โดยไดอิเล็กทริกอีลาสโตเมอร์ที่ถูกนำมาใช้ในงานวิจัยนี้คือยางเอทีลีนพรอพิลีนไดอิน หรือยางอีพีดีเอ็มซึ่งทำหน้าที่เป็นเมทริกซ์ ส่วนของพอลิเมอร์นำไฟฟ้าที่ถูกนำมาใช้ในงานวิจัยนี้คือเพอร์เมทิลพอลิเอซีนซึ่งทำหน้าที่เป็นฟิลเลอร์ และถูกสังเคราะห์ขึ้นรวมไปถึงการปรับปรุงคุณสมบัติทางด้านไฟฟ้าโดยการ โดป (doping process) ด้วยสารไอโอดีนในปริมาณที่แตกต่างกัน สำหรับการเตรียมอิเล็กโตรแอคทีฟพอลิเมอร์ทำได้โดยการผสมเพอร์เมทิลพอลิเอซีนที่มีปริมาณการโดปสูงสุดลงบนยางอีพีดีเอ็มในอัตราส่วน 5-20% โดยปริมาตร ซึ่งลักษณะโครงสร้างทางเคมีของเพอร์เมทิลพอลิเอซีนและเพอร์เมทิลพอลิเอซีนที่ผ่านการโดปศึกษาได้จากอินฟราเรดสเปกโทรสโกปี นอกจากนี้ยังศึกษาสมบัติทางด้านอิเล็กโตรแมคคานิคอล (electromechanical property) ภายใต้ออสซิลเลอรี (oscillatory shear mode) อยู่ในช่วงความถี่ 0.1-100 รอบต่อวินาทีและสนามไฟฟ้า 0-1 กิโลโวลต์ต่อมิลลิเมตร อีกทั้งยังศึกษาถึงผลกระทบของปริมาณเพอร์เมทิลพอลิเอซีนที่มีปริมาณการโดปสูงสุดบนการตอบสนองของโมดูลัสการสะสม (storage modulus response, $\Delta G'$ and sensitivity, $\Delta G'/G'_0$), ค่าการนำไฟฟ้า (electrical conductivity, σ), และค่าคงที่ไดอิเล็กทริก (dielectric constant, ϵ') ณ อุณหภูมิ 27°C และความถี่ 100 รอบต่อวินาที การตอบสนองของโมดูลัสการสะสมเพิ่มขึ้นเมื่อขนาดของสนามไฟฟ้าและปริมาณเพอร์เมทิลพอลิเอซีนที่มีปริมาณการโดปสูงสุดเพิ่มขึ้น ค่าการนำไฟฟ้าเพิ่มขึ้นเมื่อปริมาณเพอร์เมทิลพอลิเอซีนที่มีปริมาณการโดปสูงสุดเพิ่มขึ้นด้วย

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