

**ELECTRICALLY RESPONSIVE MATERIALS BASED ON
POLYCARBAZOLE/SODIUM ALGINATE BIO-HYDROGEL BLENDS FOR
ACTUATOR**

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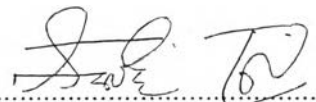
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ABSTRACT

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Keywords: Sodium alginate hydrogel/ Biocompatible actuator/
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Actuator is a mechanical device for displacing a system component under some kind of energy. For the actuating applications, it should provide a large deformation under activated energy. Generally, electric field is often used to induce material deformation and certain electroactive polymers can offer large mechanical responses under electric field. The aims of this work are to study the effects of concentration and type of surfactant on the synthesized Polycarbazole (PCB), and to use it as conductive filler in sodium alginate hydrogels (SA). The electromechanical properties of materials under the influence of the electric field strength were investigated. The electromechanical properties of pristine SA were studied under effects of crosslinking type and SA molecular weight. The electromechanical properties of PCB/SA composites were studied under the effect of PCB concentration. The particle shape of PCB synthesized by cetyltrimethylammonium bromide was of the connected hollow microsphere which showed the highest electrical conductivity (2.62×10^{-3} S/cm). The electromechanical properties of pristine SA crosslinked by an ionic crosslinking agent were higher than those of the covalent crosslinking. Moreover, the electromechanical responses of SA increased with increasing molecular weight. Finally, the electromechanical response of the PCB/SA composite was the highest at 0.10 %v/v PCB.

บทคัดย่อ

วัชระ สังวาลย์: การศึกษาสมบัติเชิงกลทางไฟฟ้าของพอลิเมอร์ผสมระหว่างพอลิคาร์บาโซลและโซเดียมแอลจิเนตเพื่อใช้ในงานแอกชูเอเตอร์ (Electrical Responsive Material based Polycarbazole/Sodium Alginate Bio-Hydrogel Composites as an Actuator)
 อ. ที่ปรึกษา : ศ.ดร. อนุวัฒน์ ศิริวัฒน์ 174 หน้า

แอกชูเอเตอร์เป็นอุปกรณ์ที่มีความสามารถในการเคลื่อนไหวหรือเปลี่ยนแปลงรูปร่างภายใต้การให้พลังงาน โดยทั่วไปสนามไฟฟ้าจะถูกใช้ในการเหนี่ยวนำให้เกิดการเคลื่อนไหวหรือการเปลี่ยนแปลงรูปร่างของแอกชูเอเตอร์ พอลิเมอร์ที่มีคุณสมบัติในการตอบสนองทางไฟฟ้าเป็นหนึ่งในตัวเลือกสำหรับการนำมาประยุกต์ใช้งานเป็นแอกชูเอเตอร์ ซึ่งวัตถุประสงค์ของงานวิจัยนี้คือ การเตรียมแอกชูเอเตอร์จากพอลิเมอร์ผสมระหว่างพอลิคาร์บาโซลและโซเดียมแอลจิเนตไฮโดรเจล ในขั้นตอนแรก เป็นการศึกษาผลของชนิดและความเข้มข้นของสารลดแรงตึงผิวที่มีต่อรูปร่าง ขนาด และค่าการนำไฟฟ้าของพอลิคาร์บาโซล ซึ่งจะถูกนำไปใช้เป็นตัวเติมในการเตรียมพอลิเมอร์ผสมต่อไป ในขั้นที่สอง เป็นการศึกษาผลของน้ำหนักโมเลกุลของโซเดียมแอลจิเนต และชนิดของการเชื่อมขวาง (การเชื่อมขวางเชิงกายภาพและการเชื่อมขวางเชิงเคมี) ต่อสมบัติการตอบสนองเชิงกลทางไฟฟ้าของโซเดียมแอลจิเนตไฮโดรเจล ส่วนที่สาม เป็นการศึกษาผลของความเข้มข้นของพอลิคาร์บาโซลที่เติมลงไปในพื้นที่โซเดียมแอลจิเนตไฮโดรเจล ต่อสมบัติเชิงกลทางไฟฟ้าของพอลิเมอร์ผสม ซึ่งจากผลการศึกษาพบว่า พอลิคาร์บาโซลที่สังเคราะห์โดยการเติมซิทิลไตรเมทิลแอมโมเนียมโบรไมด์เป็นสารลดแรงตึงผิว ทำให้พอลิคาร์บาโซลที่สังเคราะห์ได้มีค่าการนำไฟฟ้ามากที่สุด ซึ่งเท่ากับ 2.62×10^{-3} ซีเมนต์ต่อเซนติเมตร และรูปร่างของพอลิคาร์บาโซลที่ได้คือ รูปทรงกลมกลวงที่มีการเชื่อมติดกัน และผลของการศึกษาสมบัติเชิงกลทางไฟฟ้าของโซเดียมแอลจิเนตพบว่า โซเดียมแอลจิเนตที่เชื่อมขวางเชิงกายภาพให้ค่าการตอบสนองเชิงกลทางไฟฟ้าที่มากกว่าการเชื่อมขวางเชิงเคมี นอกจากนี้ การตอบสนองเชิงกลทางไฟฟ้ามีค่าเพิ่มขึ้นเมื่อน้ำหนักโมเลกุลของพอลิคาร์บาโซลเพิ่มขึ้น และในกรณีของพอลิเมอร์ผสมระหว่างพอลิคาร์บาโซลและโซเดียมแอลจิเนตพบว่า การตอบสนองเชิงกลทางไฟฟ้ามีค่าเพิ่มขึ้นเมื่อความเข้มข้นของพอลิคาร์บาโซลเพิ่มขึ้น และเพิ่มขึ้นสูงสุดที่ความเข้มข้นของพอลิคาร์บาโซลเท่ากับ 0.10 เปอร์เซ็นต์โดยปริมาตรของพอลิคาร์บาโซล

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