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**SMART MATERIAL FROM CHITOSAN HYDROGEL
CONTAINING BARAKOL**

Mr. Kongsak Pannguen

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for the Degree of Master of Science Program in Petrochemistry and Polymer Science
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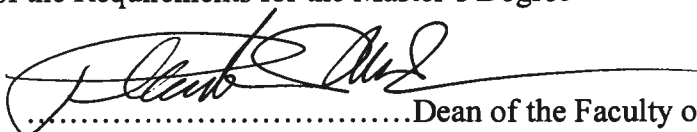
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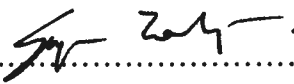
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ไฮโดรเจลพอลิเมอร์บางชนิดประกอบด้วย โครงสร้างที่มีการเชื่อมขวางกันเป็นร่างแหที่ยืดหยุ่น ช่องว่างภายในโครงสร้างแบบร่างแหยอมให้ของเหลวแทรกเข้าไปอยู่และสามารถเปลี่ยนแปลงปริมาตรและรูปร่างกลับไปกลับมาได้ตามการตอบสนองต่อปัจจัยต่างๆภายนอก เรียกว่าวัสดุอัจฉริยะ วัสดุอัจฉริยะมักเตรียมจากวัสดุราคาแพงหรือใช้วิธีการเตรียมที่ยาก อีกทั้งการตอบสนอง ความสามารถในการเปลี่ยนแปลงย้อนกลับและความแข็งแรงเชิงกลยังไม่ดีนัก

วิทยานิพนธ์นี้เสนอวัสดุอัจฉริยะไฮโดรเจลพอลิเมอร์ชนิดใหม่ที่ตอบสนองต่อกระแสไฟฟ้าซึ่งเตรียมจากไคโตซาน พอลิอะคริลิกแอซิด บาราคอลและสารเชื่อมขวาง ศึกษาพฤติกรรมการบวมตัวโดยการแช่ในสารละลายโซเดียมคลอไรด์ที่ความเข้มข้นต่างๆ นอกจากนี้ยังศึกษาการตอบสนองทางไฟฟ้าของวัสดุอัจฉริยะ ความเร็วในการ โคง้ มุม โคง้และการ โคง้กลับ รวมทั้งศึกษาปัจจัยอื่นๆ เช่น อัตราส่วนของพอลิเมอร์ผสม ความเข้มข้นของสารละลายโซเดียมคลอไรด์และกระแสไฟฟ้าที่ใช้ จากนั้นนำวัสดุอัจฉริยะไปพิสูจน์เอกลักษณ์ด้วยเทคนิค FT-IR สมบัติทางความร้อนด้วยเครื่อง DSC และสมบัติเชิงกลด้วยการวัดกำลังต้านทานการดึงและค่าความยืดหยุ่นตัว เมื่อเปรียบเทียบประสิทธิภาพของวัสดุอัจฉริยะขนาด 25 x 2 มิลลิเมตร ที่เสนอกับงานวิจัยอื่นๆพบว่า วัสดุอัจฉริยะที่เสนอมีความเร็วในการ โคง้และการ โคง้กลับที่ดีกว่า อีกทั้งไคโตซานและบาราคอลสามารถสกัดจากสัตว์และต้นไม้ตามธรรมชาติซึ่งหาได้ง่ายในประเทศไทย วัสดุอัจฉริยะนี้จึงมีราคาไม่แพงและเตรียมได้ง่ายกว่าของงานวิจัยอื่นๆ

การนำบาราคอลมาใช้กับวัสดุอัจฉริยะที่ตอบสนองต่อกระแสไฟฟ้าเป็นประโยชน์ที่ค้นพบใหม่ ของบาราคอล บาราคอลสามารถช่วยให้การ โคง้ของวัสดุอัจฉริยะรวดเร็วขึ้น โดยช่วยให้โซเดียมไอออนและคลอไรด์ไอออนเคลื่อนที่เข้าไปในวัสดุอัจฉริยะได้ง่ายขึ้นทำให้มีความไวต่อกระแสไฟฟ้าเพิ่มมากขึ้น

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Some polymer hydrogels consisting of an elastic cross-linked network and a fluid filling the interstitial spaces of the network can change their volume and shape reversibly in response to several external physiochemical factors and are so-called “intelligent or smart materials”. However, they are often made of expensive materials or by a difficult process and desired properties such as responsiveness, reversibility and mechanical strength are still unsatisfactory.

This thesis proposes a novel electric-sensitive polymer hydrogel prepared from chitosan, poly(acrylic acid), barakol and crosslinking agents. Its swelling behaviors were investigated by immersion of the hydrogel films in NaCl aqueous solution and applying an electric field. Bending speed, bending angle and reversibility were among observed characteristics. The effects of several parameters including the ratio of the component materials, concentration of the surrounding solution and electric potential being applied were studied. In addition, the hydrogel films were characterized by Fourier transform infrared spectroscopy. Their thermal properties were characterized by differential scanning calorimetry (DSC). Their mechanical properties were characterized by testing tensile strength and elongation at break.

The results showed that the performance of the proposed smart material was comparable to those in the literature for most key characteristics and better in terms of bending speed and reversibility. Since both chitosan and barakol can be extracted from natural organisms widely available in Thailand, the proposed smart material is cheaper and easier to prepare than those in the literature.

The use in electric-sensitive polymer hydrogel is a novel application of barakol. Interestingly, the present of barakol significantly improved the bending speed of the hydrogel films. The most probable explanation is that barakol helped move sodium ions and chloride ions into the hydrogel films more easily and therefore increased the electric sensitivity.

Field of Study :Petrochemistry and Polymer Science.

Academic Year :.....2006.....

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LIST OF ABBREVIATIONS AND SYMBOLS

| | |
|------|-----------------------------------|
| B | Barakol |
| Cit | Citric acid |
| CS | chitosan |
| DC | direct-current |
| EAPs | electroactive polymers |
| GA | Glutaraldehyde |
| Glu | Glutaric acid |
| IPNs | interpenetrating polymer networks |
| min. | minute (s) |
| ml | milliliter (s) |
| NaCl | Sodium Chloride |
| PAA | Poly(acrylic acid) |
| w/w | weight by weight |
| w/v | weight by volume |
| v/v | volume by volume |
| V | volts |