

**PREPARATION OF GRAPHENE/NATURAL RUBBER COMPOSITE
FOR COMPLIANT ELECTRODE APPLICATIONS**

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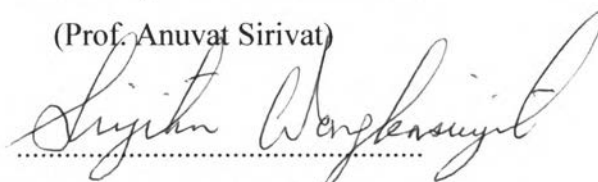
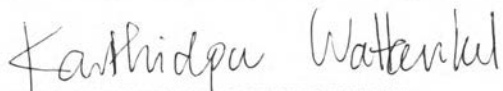
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ABSTRACT

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A compliant electrode is a stretchable electronic device that retains good conductivity under stretching. It has been used in various electro-actuating applications that require large deformations under electrical activated energy. The purpose of this work was to fabricate the compliant electrode possessing high electrical conductivity and good mechanical properties. Due to the excellent mechanical properties of natural rubber (NR), it was used as a matrix for preparing a compliant electrode. Graphene is one of many innovative new conductive fillers that provides excellent electrical conductivity. In order to investigate its mechanical properties and electrical conductivity, an experiment was carried out by using a melt rheometer in tension mode. Both mechanical and electrical properties were improved by introducing graphene into the matrix. Despite the strain of NR films reaching 80%, the films were able to maintain electrical conductivity values with very low drop offs. The highest electrical conductivity was obtained from the 35.0 %v/v graphene/NR composite which was greater than the DANFOSS commercial compliant electrode. In conclusion, a graphene /NR composite was shown as a promising material for using as a compliant electrode.

บทคัดย่อ

ศศิธร ก่อรัตนวิทยา : การเตรียมขั้วไฟฟ้าแปรรูปจากแผ่นฟิล์มคอมโพสิตระหว่างกราฟีนและยางธรรมชาติ (Preparation of Graphene/Natural Rubber Composite for Compliant Electrode Application) อ. ที่ปรึกษา : ศ. อนุวัฒน์ ศิริวัฒน์ 162 หน้า

ขั้วไฟฟ้า แปรรูป (Compliant electrode) เป็นขั้วไฟฟ้าที่คงความสามารถในการนำไฟฟ้าได้ดีในขณะที่ขั้วไฟฟ้าถูกดัด ขั้วไฟฟ้าชนิดนี้เหมาะสำหรับการนำไปใช้ในงานแอคชูเอเตอร์ (Actuators) ซึ่งเป็นวัสดุที่มีการเปลี่ยนแปลงขนาดเมื่อได้รับกระแสไฟฟ้า จุดประสงค์ของงานวิจัยนี้คือ เพื่อเตรียมขั้วไฟฟ้าแปรรูปที่มีความสามารถในการนำไฟฟ้าสูงและมีคุณสมบัติเชิงกลที่ดี ในงานวิจัยนี้จึงเลือกใช้ยางธรรมชาติเป็นวัสดุหลักสำหรับการเตรียมขั้วไฟฟ้าแปรรูป เนื่องจากเป็นวัสดุที่มีคุณสมบัติเชิงกลที่ดี แต่เนื่องจากยางธรรมชาติเป็นวัสดุที่มีคุณสมบัติเป็นฉนวนไฟฟ้า จึงจำเป็นต้องมีการเติมสารเติมแต่งเพื่อปรับปรุงคุณสมบัติการนำไฟฟ้าให้เหมาะสำหรับการนำไปใช้เป็นขั้วไฟฟ้า กราฟีนเป็นวัสดุคาร์บอนที่มีความสามารถในการนำไฟฟ้าสูงจึงถูกเลือกมาใช้ในงานวิจัยเพื่อเสริมความสามารถในการนำไฟฟ้าของขั้วไฟฟ้าแปรรูป

คุณสมบัติเชิงกลและคุณสมบัติการนำไฟฟ้าของแผ่นฟิล์มคอมโพสิต ได้รับการศึกษาด้วยเครื่องเมลท์ โอมิเตอร์ (Melt Rheometer) ผลการศึกษาพบว่า เมื่อใช้กราฟีนเป็นสารเติมแต่ง คุณสมบัติเชิงกลและการนำไฟฟ้าของแผ่นฟิล์มคอมโพสิตมีค่าเพิ่มขึ้น แม้ว่าถูกดัดถึง 80 % แต่แผ่นฟิล์มคอมโพสิตยังคงคุณสมบัติการนำไฟฟ้าที่ดี แผ่นฟิล์มคอมโพสิตที่เตรียมโดยเติมกราฟีน 35.0 % โดยปริมาตร ให้ค่าการนำไฟฟ้าที่สูงสุด ซึ่งมีค่าการนำไฟฟ้าสูงกว่าขั้วไฟฟ้าแปรรูปทางการค้า จากบริษัท DANFOSS จากผลการวิจัยสามารถสรุปได้ว่า แผ่นฟิล์มคอมโพสิตระหว่างกราฟีนและยางธรรมชาติ เหมาะสำหรับการใช้เป็นวัสดุขั้วไฟฟ้าแปรรูป

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