

**IMPROVEMENT IN THE THERMAL CONDUCTIVITY OF
PARTICULATE-FILLED EPOXY COMPOSITE**

Karnthidaporn Wattanakul

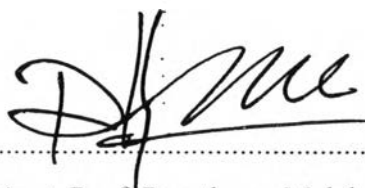
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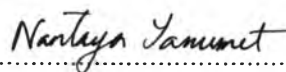


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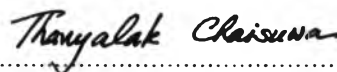
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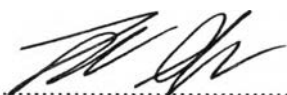
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ABSTRACT

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Keywords: Thermal Conductive Composite/ Epoxy Composite/ Metal Oxide/ Boron Nitride/ Mixing Condition/ Surface Modification/ Admicellar Polymerization/ Silane Treatment/ Interfacial Adhesion/ Surfactant Adsorption

Two approaches to improve thermal conductivity of epoxy composite are considered in this work. One is the approach to form a conductive network and the other approach is the improvement in interfacial adhesion between matrix and filler by surface modification of filler. According to the first approach, the effects of different types and particle sizes of metal oxide on the thermal conductivity of metal oxide-filled epoxy composite is studied. The SEM micrographs of the fractured surface show improvement in particle dispersion of nano-size metal oxide particles resulting in an increase in thermal conductivity of composite. The effect of mixing conditions of the BN-filled epoxy composite is investigated. The thermal conductivity of BN-filled epoxy composite can be enhanced with increases in mixing speed, time and temperature. A maximum thermal conductivity of 1.68 W/mK is obtained at 37 vol% filler content and the mixing conditions of 300 rpm, 30 min, 30 °C. Furthermore, surface modifications of BN with different methods: conventional silane treatment, admicellar polymerization and surfactant treatment are also

investigated. The thermal conductivity of BN-filled epoxy composite is significantly enhanced by admicellar polymerization and surfactant treatment. The mechanical properties of the composite also improve significantly.

บทคัดย่อ

กานต์ธิดาพร วัฒนกุล : การปรับปรุงสมบัติการนำความร้อนของสารคอมพอสิตีอีพอกซี (Improvement in the Thermal Conductivity of Particulate-Filled Epoxy Composite)
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แนวทางในการปรับปรุงสมบัติการนำความร้อนของสารคอมพอสิตีอีพอกซีสองแนวทางได้รับความสนใจในงานวิจัยนี้ แนวทางแรกใช้วิธีการเสริมสร้างโครงข่ายการนำความร้อนภายในสารคอมพอสิตี ส่วนอีกแนวทางหนึ่งเป็นการเพิ่มแรงยึดติดระหว่างสารอีพอกซีกับสารเติมแต่งโดยการตัดแปรพื้นผิวของอนุภาคสารเติมแต่ง การปรับปรุงสมบัติการนำความร้อนในแนวทางแรกนั้น งานวิจัยนี้ได้ศึกษาผลของประเภทและขนาดอนุภาคของสารประกอบโลหะออกไซด์ที่มีต่อความสามารถในการนำความร้อนของสารคอมพอสิตีที่เติมแต่งด้วยสารประกอบโลหะออกไซด์ ซึ่งจากผลการทดลองพบว่าความสามารถในการนำความร้อนของสารคอมพอสิตีดีขึ้น เมื่อมีการใช้สารประกอบโลหะออกไซด์ที่มีขนาดอนุภาคในระดับนาโนเมตร เนื่องจากอนุภาคเหล่านี้สามารถกระจายตัวได้ดีในสารอีพอกซี นอกจากนี้ ยังได้ศึกษาผลของภาวะที่ที่ใช้ในการผสมต่อการเพิ่มความสามารถในการนำความร้อนของสารคอมพอสิตีระหว่างโบรอนไนไตรด์กับอีพอกซี ผลการทดลองพบว่าความสามารถในการนำความร้อนของสารคอมพอสิตีเพิ่มขึ้นเมื่อใช้เวลาในการผสมนานขึ้น รวมทั้งเมื่อใช้ความเร็วและอุณหภูมิในการผสมที่สูงขึ้น โดยค่าการนำความร้อนสูงสุดที่ได้คือ 1.68 วัตต์/เมตร-เคลวิน ซึ่งได้จากการใช้สารเติมแต่งในปริมาณ 37 เปอร์เซ็นต์โดยปริมาตร ทำการผสมที่ความเร็ว 300 รอบต่อนาที เป็นเวลา 30 นาที ที่อุณหภูมิ 30 องศาเซลเซียส นอกจากนี้ยังได้ศึกษาและเปรียบเทียบผลของการตัดแปรพื้นผิวของสารเติมแต่งโบรอนไนไตรด์ โดยใช้สารจำพวกไซเลน, การใช้กระบวนการทำแอคไมเซลลาร์พอลิเมอไรเซชัน, และการใช้สารลดแรงตึงผิว เพื่อเพิ่มความสามารถในการยึดติดของสารเติมแต่งกับสารอีพอกซี ผลการทดลองพบว่ากระบวนการทำแอคไมเซลลาร์พอลิเมอไรเซชันและการใช้สารลดแรงตึงผิวช่วยเพิ่มความสามารถในการนำความร้อนและขั้วสมบัติเชิงกลของสารคอมพอสิตีอย่างเห็นได้ชัด

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