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HOMOGENEITY ANALYSIS OF POLYMER COMPOSITES BY
ATR FT-IR MICROSPECTROSCOPY

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A Thesis Submitted in Partial Fulfillment of the Requirements
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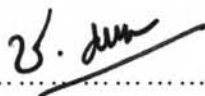


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✓ ดวงตา ทองสกุล: การวิเคราะห์ความเป็นเนื้อเดียวของพอลิเมอร์คอมพอสิตด้วยเอทีอาร์เอฟทีไออาร์ไมโครสเปกโทรสโกปี (HOMOGENEITY ANALYSIS OF POLYMER COMPOSITES BY ATR FT-IR MICROSPECTROSCOPY) อ.ที่ปรึกษา: รศ.ชูชาติ ชรรณเจริญ, อ.ที่ปรึกษาร่วม: รศ. ดร. สนอง เอกสิทธิ์, 83 หน้า.

การกระจายตัวขององค์ประกอบในพอลิเมอร์คอมพอสิต ส่งผลโดยตรงต่อคุณสมบัติเชิงกลของคอมพอสิตที่เตรียมได้ การศึกษาเกี่ยวกับการกระจายตัวขององค์ประกอบต่างๆของพอลิเมอร์คอมพอสิตจึงมีความจำเป็นอย่างยิ่ง งานวิจัยนี้ศึกษาการกระจายตัวหรือความเป็นเนื้อเดียวขององค์ประกอบในคอมพอสิตด้วยเทคนิคเอทีอาร์เอฟทีไออาร์ไมโครสเปกโทรสโกปี โดยใช้อุปกรณ์ตรวจวัดแบบสไลด์ที่มีเจอร์มานีเยมและเพชรเป็นหัวตรวจวัดขนาดเล็ก การทดลองแบ่งออกเป็นสองส่วน ได้แก่ การวิเคราะห์การกระจายตัวขององค์ประกอบเชิงพื้นผิว และการกระจายตัวขององค์ประกอบที่เป็นฟังก์ชันกับความลึกโดยการทำแผนที่พื้นผิว แผนที่พื้นผิวที่ตรวจวิเคราะห์ได้แสดงในรูปสองมิติหรือสามมิติ โดยแสดงในรูปความสัมพันธ์ระหว่างตำแหน่งและค่าการดูดกลืนแสงที่ตำแหน่งต่างๆบนตัวอย่าง ทำให้สามารถวิเคราะห์ระดับของการกระจายตัวหรือความเป็นเนื้อเดียวขององค์ประกอบได้ เนื่องจากตำแหน่งของการดูดกลืนแสงในสเปกตรัมมีความสัมพันธ์โดยตรงกับองค์ประกอบทางเคมีของสาร และความเข้มของการดูดกลืนแสงมีความสัมพันธ์โดยตรงกับปริมาณหรือความเข้มข้นของสารนั้นๆ พอลิเมอร์คอมพอสิตที่มีองค์ประกอบทางเคมีที่ตำแหน่งต่างๆบนชิ้นงานเหมือนกัน และมีความเข้มของการดูดกลืนแสงเท่ากันแสดงว่ามีการกระจายตัวของพอลิเมอร์คอมพอสิตอย่างเป็นเนื้อเดียว ดังนั้นความเข้มของการดูดกลืนแสงของสารตัวอย่างที่ตำแหน่งต่างๆบนชิ้นงาน สามารถนำมาใช้ในการตรวจสอบการกระจายตัวขององค์ประกอบในพอลิเมอร์คอมพอสิตได้ อีกทั้งเทคนิคเอทีอาร์เอฟทีไออาร์ไมโครสเปกโทรสโกปีเป็นเทคนิคที่ไม่ยุ่งยาก มีการเตรียมตัวอย่างเพียงเล็กน้อย และไม่ทำลายตัวอย่าง

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For polymer composites, the homogeneity mixing of filler or reinforcement within the polymer matrix can substantially improve mechanical properties of the composites. The determination of dispersion of components in composite is essential. In this study, homogeneity of polymers and polymer composites were investigated by ATR FT-IR microspectroscopy. Diamond and Ge slide-on were used as IREs. The experiment was divided into two parts: the surface mapping, and depth profiling analysis. The 2D (contour map) or 3D profile (surface map) of the ATR FT-IR absorption was constructed and employed for the investigation of homogeneity. Since the position of an infrared absorption band is unique to the chemical constituent while the absorption intensity is directly related to its concentration, the unique absorption frequency of a component are directly associated with its composition. The same chemical information and the same absorption of spectra indicate that the polymer composite is a homogeneous polymer. ATR FT-IR microspectroscopy requires minimal sample preparation and does not destructive.

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LIST OF ABBREVIATIONS

ATR	: attenuated total reflection
CB	: carbon black
CNT	: carbon nanotube
FT-IR	: Fourier transform infrared
IR	: infrared
IRE	: internal reflection element
μ IRE	: micro internal reflection element
MCT	: mercury cadmium telluride
MSEvF	: mean square evanescent field
TIR	: total internal reflection
μ m	: micrometer
ZnSe	: zinc selenide
Ge	: germanium
ct	: carat
N/A	: not applicable
S/N	: signal to noise ratio

LIST OF SYMBOLS

I	: intensity
I_A	: absorbance intensity
I_R	: reflectance intensity
I_S	: scatter intensity
I_T	: transmittance intensity
a	: absorptivity
b	: thickness
c	: concentration
n	: refractive index
d_p	: penetration depth
ν	: wavenumber
μ	: micro
θ	: angle of incidence
θ_c	: critical angle