CRYSTALLIZATION BEHAVIOR OF PET, PTT, PBT, AND THEIR BLENDS

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ABSTRACT

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Isothermal crystallization and subsequent melting behavior for three different types of linear aromatic polyester, namely poly(ethylene terephthalate) (PET), poly(trimethylene terephthalate) (PTT), and poly(buthylene terephthalate) (PBT), which are different in their number of methylene groups (i.e., 2, 3, and 4 for PET, PTT, and PBT, respectively), were investigated using differential scanning calorimetry (DSC) and wide-angle X-ray diffraction (WAXD) technique. The kinetics of the crystallization process was assessed by directly fitting the experimental data to the Avrami, Tobin, Malkin and Urbanovici-Segal macrokinetic models. In case of non-isothermal crystallization, the experiment was carried out on PET, PTT, and PBT and the data was analyzed based on the Avrami, Tobin, Ozawa, and Ziabicki models. Moreover, the miscibility and crystallization behavior of PTT/PET and PTT/PBT blends were also studied. A single composition-dependent glass transition temperature (T_g) was observed in both systems, implying that these blends are fully miscible in amorphous phase. The presence of the characteristic X-ray peaks for pure polymers in the blends without the presence of a new peak in the diffraction pattern revealed that each component forms its own crystal phase and there was no co-crystallite in the blends under our experimental condition. The steady rate sweep test showed that these blends behaved as a shear thinning fluid within shear rates studied.

บทคัดย่อ

นุจลีย์ แดงสียุน : การศึกษาพฤติกรรมการตกผลึกของ พอลิเอทิลีนเทเรฟทาเลท พอลิไตรเมทิลีนเทเรฟทาเลท พอลิบิวทิลีนเทเรฟทาเลท และพอลิเมอร์ผสมของพอลิเมอร์เหล่านี้ (Crystallization Behavior of PET, PTT, PBT, and their blends) อ. ที่ปรึกษา: ผศ.ดร.พิชญ์ ศุภผล และ ดร.มานิตย์ นิธิธนากุล 153 หน้า ISBN 974-17-2336-9

การศึกษาการตกผลึกแบบอุณหภูมิคงที่ และพฤติกรรมการหลอมเหลวของอะโรมาติกพอลิเอสเตอร์เชิงเส้นที่แตกต่างกันสามชนิดได้แก่ พอลิเอทิลีนเทเรฟทาเลท พอลิไตรเมทิลีน-เทเรฟทาเลท และ พอลิบิวทิลีนเทเรฟทาเลท ซึ่งแตกต่างกันเพียงแต่จำนวนของหมู่เมทิลีนที่อยู่ระหว่างหมู่เอสเตอร์ถูกติดตามโดยใช้เทคนิค DSC และ WAXD จลศาสตร์ของกระบวนการตกผลึกถูกประเมินโดยการเปรียบเทียบค่าที่ได้จากการทดลองกับค่าที่ได้จากแบบจำลองของ Avrami Tobin Malkin และ Urbanovici-Segal ในกรณีของการศึกษาการตกผลึกแบบอุณหภูมิไม่คงที่ ตัวอย่างที่ใช้ได้แก่ พอลิเอสเตอร์ทั้งสามชนิด และพอลิเมอร์ผสมของพอลิไตรเมทิลีนเทเรฟทาเลท และ พอลิบิวทิลีนเทเรฟทาเลท ข้อมูลที่ได้จากการทดลองจะถูกนำมาเปรียบเทียบกับแบบจำลองของ Avrami Tobin Ozawa และ Ziabicki นอกจากนี้ การศึกษาความเข้าเป็นเนื้อเดียวกันและพฤติกรรมการตกผลึกของพอลิเมอร์ผสมของพอลิไตรเมทิลีนเทเรฟทาเลท/พอลิเอทิลีนเทเรฟทาเลท และพอลิไตรเมทิลีนเทเรฟทาเลท/พอลิบิวทิลีนเทเรฟทาเลท พบว่าพอลิเมอร์ผสมแต่ละระบบแสดงอุณหภูมิเปลี่ยนสถานะคล้ายแก้วค่าเดียว และอุณหภูมินี้จะเปลี่ยนแปลงเมื่ออัตราส่วนของพอลิเมอร์ผสมเปลี่ยนแปลง แสดงให้เห็นว่าพอลิเมอร์ผสมเหล่านี้สามารถผสมเข้ากันได้ในสถานะอสัณฐาณ จากการศึกษาการปรากฏของลักษณะเฉพาะของตำแหน่งของจุดยอดของพอลิเมอร์บริสุทธิ์แต่ละชนิดใน diffraction pattern แสดงให้เห็นว่า ในการทดลองนี้พอลิเมอร์แต่ละชนิดในพอลิเมอร์ผสมมีรูปแบบของการตกผลึกของตนเองและไม่มีการตกผลึกร่วมกัน จากการศึกษาการไหลของพอลิเมอร์โดยเปลี่ยนแปลงอัตราการเฉือน พบว่า ความหนืดของพอลิเมอร์ผสมเหล่านี้ลดลงเมื่อเปลี่ยนแปลงอัตราการเฉือน

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