

**TRANSIENT AND STEADY STATE DEFORMATIONS OF DISPERSED-
PHASE DROPLETS IN IMMISCIBLE POLYMER BLENDS IN STEADY
STATE SHEAR FLOW**



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ABSTRACT

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Puritat Tanpaiboonkul: Transient and Steady State Deformations
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Transient deformation and breakup of viscoelastic polystyrene (PS) droplets dispersed in an viscoelastic high density polyethylene (HDPE) matrix were observed under a simple steady state shearing flow between two transparent parallel disks. The influence of elasticity of the blend constituent components on the deformation and equilibrium size of dispersed-phase droplet was investigated. The viscosity ratios were fixed at 0.5, 1.0 and 2.6., After the startup of steady state shearing flow, the viscoelastic droplet shape initially showed small oscillations in the flow direction, after which its shape oscillated and deformed in the vorticity direction. The steady-state deformation of droplet in vorticity direction increased with increasing capillary number. When the critical capillary number, Ca_c , was exceeded, the droplet stretched and formed a string which became thinner and finally broke up. At a fixed capillary number, the deformation of droplet in the vorticity direction decreased with increasing droplet elasticity. When the capillary number and the Weissenberg number were kept fixed, the steady-state deformation in vorticity direction and the critical capillary number for breakup were found to increase as the viscosity ratio was varied from 0.5 to 1.0, and to 2.6.

บทคัดย่อ

ภุริทัต ตันไพบุลย์กุล: ศึกษาการแปรรูปของอนุภาคทรงกลมของพอลิเมอร์เหลวที่กระจายตัวในระบบพอลิเมอร์ผสมแบบไม่เข้ากันภายใต้แรงเฉือนที่คงที่ (Transient and Steady State Deformations in Dispersed-Phase Droplets of immiscible Polymer Blends in Steady State Shear Flow) อ.ที่ปรึกษา: รศ.ดร. อนุวัฒน์ ศิริวัฒน์ และ ศ.ดร.โรนัลด์ จี ลาร์ชัน 98 หน้า ISBN 974-9651-63-4

งานวิจัยนี้ได้ศึกษาพฤติกรรมต่าง ๆ ของอนุภาคทรงกลมของพอลิเมอร์เหลวที่กระจายตัวอยู่อย่างเบาบางในพอลิเมอร์ส่วนต่อเนื่องในระบบพอลิเมอร์ผสมแบบไม่เข้ากันของพอลิสไตรีนในพอลิเอทิลีน ซึ่งทดลองภายใต้อุปกรณ์กำเนิดแรงเฉือนชนิดโปร่งใส การทดลองถูกกำหนดค่าความยืดหยุ่นของพอลิเมอร์เฟสกระจายตัวต่อพอลิเมอร์เฟสต่อเนื่องคือ 0.5 1.0 และ 2.6 จากการศึกษาพบว่า ภายใต้แรงเฉือนคงที่ อนุภาคทรงกลมของพอลิเมอร์ส่วนกระจายตัวในตอนแรกจะเริ่มเสียรูปโดยการยืดออกในแนวเดียวกับแรงเฉือนแบบแกว่งไปมาแล้วค่อย ๆ หดตัวในแนวแรงเฉือนพร้อมกับยืดออกในแนวตั้งฉากกับแรงเฉือน จากการทดลองพบว่าเมื่อค่าแคปิลลารีสมคูลย์มากขึ้น การแปรรูปสมคูลย์ของอนุภาคทรงกลมของพอลิเมอร์เหลวในแนวตั้งฉากกับแรงเฉือนจะมากขึ้น และเมื่อค่าแคปิลลารีเกินค่าสมคูลย์หรือเรียกอีกอย่างหนึ่งว่าแคปิลลารีวิกฤติ อนุภาคทรงกลมของพอลิเมอร์เหลวจะยืดออกจนกระทั่งปลายทั้งสองของอนุภาคพอลิเมอร์อยู่ห่างกันมากและอยู่ในระดับที่มีความแตกต่างของความเร็วของของไหลมากขึ้นเรื่อย ๆ จนกระทั่งอนุภาคพอลิเมอร์ส่วนกระจายตัวฉีกขาดในที่สุด และจากการทดลองที่กำหนดค่าแคปิลลารีสมคูลย์คงที่พบว่าเมื่อค่าความยืดหยุ่นของอนุภาคทรงกลมมากขึ้น การบิดเบี้ยวสมคูลย์ในแนวตั้งฉากกับแรงเฉือนจะลดลง ส่วนการทดลองที่ค่าความยืดหยุ่นของพอลิเมอร์เฟสกระจายตัวต่อพอลิเมอร์เฟสต่อเนื่องเพิ่มขึ้น จาก 0.5 1.0 และ 2.6 พบว่า การบิดเบี้ยวสมคูลย์ของอนุภาคทรงกลมในแนวตั้งฉากกับแรงเฉือนและค่าแคปิลลารีวิกฤติจะเพิ่มขึ้นตามลำดับ

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