CHAPTER I
INTRODUCTION

Polymer blends play a vital role in polymer industry. Their properties can be altered to satisfy a wide range of properties. Although new polymers can be synthesized, they do not always full fill industrial technological needs. Moreover, conceiving and synthesizing new polymers involves exorbitant costs and time. Blending is an attractive alternative method of creating new materials with more flexible performance and superior properties than existing polymers. Most of the industrial processes involve immiscible polymer blend systems. When two immiscible polymer are blended together one material usually forms the major phase, and the other one forms the minor, discontinuous phase. Generally, the minor phase tends to form spherical drops dispersed in the major matrix phase. The minor phase undergoes fast size reduction during mixing, leading to the formation of drops. The properties of immiscible blends are controlled by the droplet size, shape of drop and distribution and the final morphology of polymer blends mainly results from step in mixing process. Those steps are deformation, relaxation and breakup of the dispersed phase induced by the flow field inside the processing equipment.

Most of the previous works related to drop breakup have focused on Newtonian systems. The pioneering work on the steady state deformation and breakup for Newtonian immiscible blends by Taylor in 1932. He proposed that the breakup of an isolated droplet of the dispersed phase is controlled by two dimensionless parameter, the first is capillary number, Ca, the ratio between the matrix viscous stress and the interfacial stress, which is defined as:

$$Ca = \frac{\eta_m \dot{\gamma} D_0}{2\Gamma} \qquad (1.1)$$

where η_m is the viscosity of the matrix phase, $\dot{\gamma}$ is the shear rate, D_0 is the initial radius of the droplet, and Γ is the interfacial tension. Another parameter is the

viscosity ratio, η_r, the ratio between dispersed (η_d) and matrix (η_m) phase viscosities, which is defined as:

$$\eta_r = \eta_d/\eta_m \tag{1.2}$$

Moreover, Taylor predicted that when the viscous force overcomes the interfacial force that resists the deformation, the droplet will be broken. However, most of the polymers are viscoelastic materials, and the elastic should be an important factor in inducing behaviors of an isolated droplet under shear flow field. Elasticity in the droplet or matrix phase can be quantified by the Weissenberg number, W_i, a ratio of the elastic force to the viscous force, which is defined as:

$$W_i = N_1(\dot{\gamma}) \Big/ [\dot{\gamma}\eta(\dot{\gamma})] \tag{1.3}$$

where N_1 stands for the first normal stress different.

In this work, the behavior of immiscible blend morphology namely the droplet deformation and breakup were investigated. The effect of different viscosity ratios 0.5, 1.0 and 2.6 was studied by using a flow cell mounted on an optical microscope. We observed the transient and steady state deformation of isolated droplets in a simple shearing flow.