Meeting: 1005, Newark, Delaware, SS 7A, Special Session on Frontiers on Complex Fluid Flows: Analytic and Computational Methods

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Iterated stretching and multiple beads-on-a-string phenomena in dilute solutions of flexible macromolecules.

It has been known for at least 40 years that the dynamics of capillary thinning and breakup of polymeric jets and threads are substantially different from the equivalent processes in Newtonian fluids. The capillary necking induced by surface tension results in a strong uniaxial stretching flow in the thread which leads to large molecular elongation and inhibits the finite time singularity associated with breakup in a Newtonian fluid jet. As a result of the absence of external forcing the dynamics of the necking process are often self-similar and observations of this 'self-thinning' can be used to extract the transient extensional viscosity of the material. The large viscoelastic stresses resulting from this stretching can also lead to iterated dynamical processes that result in self-similar spatial structures such as a 'beads on a string' morphology in which spherical fluid droplets are interconnected by long thin fluid ligaments. Understanding the distribution of the droplets resulting from the dynamics of this process is important in numerous commercial applications including jet breakup, fertilizer spraying, roll-coating, electrospinning, and inkjet printing. (Received February 09, 2005)