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Effects of geometry and fluid elasticity during polymeric droplet pinch-off in microfluidic environments BEN STEINHAUS, AMY SHEN, RADHAKRISHNA SURESHKUMAR, Washington University in St. Louis — We investigate the effects of fluid elasticity and channel geometry on polymeric droplet pinch-off by performing systematic experiments using viscoelastic polymer solutions which possess practically shear rate-independent viscosity (Boger fluids). Four different geometric sizes (width and depth are scaled up proportionally at the ratio of 0.5, 1, 2, 20) are used to study the effect of the length scale, which in turn influences the ratio of elastic to viscous forces as well as the Rayleigh time scale associated with the interfacial instability of a cylindrical column of liquid. We observe a power law relationship between the dimensionless (scaled with respect to the Rayleigh time scale) capillary pinch-off time, T, and the elasticity number, E, defined as the ratio of the fluid relaxation time to the time scale of viscous diffusion. In general, T increases dramatically with increasing E. The inhibition of "bead-on-a-string" formation is observed for flows with effective Deborah number, De, defined as the ratio of the fluid relaxation time to the Rayleigh time scale becomes greater than 10. For sufficiently large values of De, the Rayleigh instability may be modified substantially by fluid elasticity.

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