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Elasticity and Extensibility Determine Printability and Spinnability of Polymer Solutions JELENA DINIC, LEIDY NALLELY JIMENEZ, VICKY MEI, YIRAN ZHANG, VIVEK SHARMA, Chemical Engineering, University of Illinois Chicago — Many advanced manufacturing technologies like inkjet printing, 3D printing, nano-fiber spinning, gravure printing and nanoimprint lithography involve complex free-surface flows, where both shear and extensional rheology affect processability. In applications that involve progressive thinning and break-up of a fluid column or sheet into drops, the dominant flow within the filament is extensional in nature. Polymeric fluids exhibit a much larger resistance to flow in an elongational flow field than Newtonian fluids with same shear viscosity. Characterizing the filament thinning and break-up kinetics in jetting, dripping and stretching liquid bridge provides invaluable insight into the interplay of elastic, viscous, capillary and inertial stresses relevant for these applications. In this talk, we elucidate how polymer composition, flexibility and molecular weight determine the kinetics of capillary-driven thinning and pinch-off in our experiments. Both effective relaxation time and transient extensional viscosity are found to be strongly concentration dependent even for dilute solutions. Further, we show how finite extensibility of polymers dramatically changes the kinematics from elastocapillary to viscocapillary under strong extensional flow fields that can lead to coil-stretch transition.

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