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Exploring the effect of liquid crystalline phase on droplet breakup

ITAI COHEN, JOHN SAVAGE, DAN PORTER, Cornell University, MARCO CAGGIONI, PATRICK SPICER, Procter and Gamble — We investigate droplet breakup of a thermotropic liquid crystal in the smectic, nematic, and isotropic phases. The experiment consists of varying the ambient temperature to control the liquid crystalline phase and imaging breakup using a fast video camera. We find breakup of the smectic phase is well described by existing theory for a shear thinning power-law fluid. These theories predict the stress/strain dependence measured in bulk rheology coincides with the minimum radius dependence on time to breakup. For the nematic and isotropic phases, we find the minimum radius dependence on time to breakup does not agree with bulk rheological measurements that indicate Newtonian behavior. Instead, breakup occurs in two stages, with extensional thickening preceding extensional thinning. Finally, we will comment on a possible flow induced ordering mechanism and make comparisons to two other rod-like systems exhibiting similar behavior.

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