Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Deformation and Burst of a Liquid Droplet with Viscous Surface Moduli in a Linear Flow Field NATASHA SINGH, VIVEK NARSIMHAN, Purdue University — Suspensions of fluid particles with complex interfacial architecture (for instance, capsules, vesicles, lipid bilayers, and emulsions embedded with certain surface-active agents and surfactants) find an immense number of applications in industry and bioscience. Interfacial rheology plays an essential role in the dynamics of many of these systems, yet little is understood on how these effects alter droplet deformation and breakup. In this study, we present the conditions for the breakup of a single droplet with viscous surface moduli, under the assumption of weak flow and negligible Marangoni forces. The viscous interface is treated as a homogenous fluid obeying the BoussinesqScriven constitutive law. We present the drop breakup analysis in Stokes flow in the limit of small droplet deformation using the perturbation theory approach. We examine how the critical capillary number for breakup depends on the interfacial viscosity for different viscosity contrasts between the inner and outer fluid and different flow types. For all the flows considered, we observe that surface dilational viscosity is found to have a destabilizing impact on droplet breakup, whereas surface shear viscosity has a stabilizing effect. We explore the physical picture behind these observations in this work.

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Date submitted: 01 Aug 2020

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