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Surfactant effects on drop breakup and tip streaming CHARLES EGGLETON, Dept. of Mechanical Engineering, UMBC, KATHLEEN STEBE, Dept. of Chemical and Biomolecular Engineering, Johns Hopkins University —
Whenever one fluid is to be dispersed in another, the interface between the fluids are stretched and deformed. The dispersing fluid breaks into smaller droplets under the effects of viscous stresses exerted by the continuous fluid. For immiscible fluids with surfactant-free interfaces, there is generally good agreement between observed and predicted deformations and breakup modes. Surfactants are commonly added to reduce the surface tension, and hence the work required to create new interface. In a flowing system, surfactants distribute themselves non-uniformly on drop interfaces, thereby creating complex interfacial boundary conditions that depend on the amount of surfactant adsorbed, the mass transfer dynamics of that surfactant and the equation of state relating the surface tension to the local surfactant concentration. Droplet deformation is simulated as a function of these physicochemical parameters resulting in a wide variety of responses. Surfactants can cause a drop to break under flow conditions where they would otherwise be stable and cause the tip streaming mode of drop breakup. Compared to the insoluble case, as surfactant mass transfer rates are increased the drop is first destabilized, breaking up at lower rates of strain; then stabilized breaking up at higher rate of strain in a different mode.

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