186a Dynamics and Breakup of Stretching Bridges of Surfactant-Laden Liquids

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A liquid bridge is a filament of liquid held captive between two solid surfaces. The thinning and breakup of liquid bridges are important in extensional rheometry, particle agglomeration, and drop and jet breakup. Studies of liquid bridges span the whole gamut of size ranges, including recent experimental reports on pinch-off of nanoscopic bridges in carbon nanotubes. Here we report an experimental and computational analysis of the deformation and breakup of stretching bridges of surfactant-laden liquids. We have carried out experiments in which either an insoluble surfactant monolayer is deposited on the surface of a bridge or a soluble surfactant is dissolved in the bridge liquid prior to the start of stretching. The dynamics of bridge deformation and breakup are recorded by high-speed digital imaging. In the computations, we solve by high-accuracy Galerkin/finite element methods either the full equations governing the fluid mechanics and surfactant transport for both insoluble and soluble surfactants (2d computations) or, in the case of insoluble surfactant, a slender-jet approximation of the governing equations (1d computations). The 2d computations are shown to be in excellent agreement with experiments. Regions of the parameter space are identified where 1d computations can be used with confidence. Detailed results will also be reported on the scaling behavior near pinch-off of surfactant-laden interfaces as a function of initial surfactant loading and activity.