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Influence of surfactant solubility on the deformation and breakup of a bubble or thread in a viscous fluid MICHAEL BOOTY, YUAN-NAN YOUNG, MICHAEL SIEGEL, New Jersey Institute of Technology, JIE LI, Cambridge University — In a previous paper (JFM 594, 307-340, 2008) we studied effects of insoluble surfactant on the pinch-off of an inviscid bubble surrounded by a viscous fluid theoretically and numerically. In the present study the surfactant solubility is included. The adsorption-desorption kinetics of surfactants is assumed to be in the diffusion-dominated regime, and equations governing the evolution of the interface and surfactant concentration in zero-Reynolds-number flow are derived using a long wavelength approximation. Results of the long wavelength model are compared against numerical simulations of the full Navier-Stokes equations, performed using an accurate arbitrary Lagrangian-Eulerian method. The presence of insoluble surfactant significantly retards pinch-off (JFM 594, 307-340, 2008): This is due to the development of a long, slender, quasi-stable cylindrical thread at the location of minimum radius, where the destabilizing influence of capillary pressure is balanced by the internal pressure. For soluble surfactant, depending on parameter values, a thin thread forms first but pinches off later due to the exchange between bulk and surface surfactants. In some cases the collapsing of bubble is completely inhibited by the soluble surfactant.

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