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Coating and Crumpling of ParticleCoated Bubbles in Confined Geometries[1] SHELLEY ANNA, CHARLES SHARKEY, ZIXIAN CUI, Carnegie Mellon University — We examine bubble flow in a capillary filled with a suspension of surface-active particles. Silica nanoparticles are rendered surface active when mixed with cationic CTAB surfactant, which adsorbs to the silica surface in a glycerol-water mixture. Bubbles are dispensed via a co-flow nozzle at varying bubble lengths and capillary numbers. Fluid film thickness is measured along the length of the bubble. The measurements are compared with bubble flow through surfactant solutions and with predictions from a Bretherton-type model. The adsorbed particle-surfactant complexes form an evolving rigid layer at the trailing end of the bubble. Two critical bubble lengths are observed. Above the first critical length, the bubble contains two distinct film thicknesses. The thickened film at the trailing end arises from the rigid particle layer on the interface. Above the second critical length, the trailing bubble cap crumples and collapses. Crumpling occurs soon after the bubble is dispensed into the capillary, and the critical length varies with bubble velocity. These results allow us to infer rheological and mechanical properties for the interface that are associated with the crumpling phenomenon.

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Shelley Anna
Carnegie Mellon University

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