

Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Surface dilatational rheology during phase coexistence of insoluble surfactants HARISHANKAR MANIKANTAN, University of California, Davis, TODD SQUIRES, University of California, Santa Barbara — Surfactants – molecules and particles that preferentially adsorb to fluid interfaces – play a ubiquitous role in industrial and biological flows involving fluid interfaces. Beyond reducing surface tension, surfactants may modify fluid flow by exerting Marangoni and/or surface rheological stresses. Additional complexities often arise when insoluble surfactants exhibit non-trivial morphologies, for example, forming condensed phases with liquid crystalline order that coexist with disordered phases. Here, we show that the dynamic growth of liquid crystalline domains at the expense of the continuous phase upon compression gives rise to a frequency-dependent viscoelastic behavior. We treat the dynamic ‘freezing’ and ‘melting’ of insoluble surfactant domains as a 2D analog of classic works on dynamic adsorption and desorption of soluble surfactants. Notably, our model predicts that liquid crystalline domains grow freely and the surfactant exerts no additional surface stresses upon asymptotically slow compression. However, rate-dependent surface elasticity and surface viscosity emerge when the compression rate is comparable to phase change rate.

Harishankar Manikantan
University of California, Davis

Date submitted: 01 Aug 2019

Electronic form version 1.4