

Free Surface Flows with Complex Interfaces

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Abstract

Free surface flows, including those that occur in coating processes, have been extensively analyzed by computer-aided theory. However, most work has been limited to pure interfaces, at which the surface stress is isotropic and fully defined by the interfacial tension and interface curvature. When surface-active molecules and particles collect at fluid-fluid interfaces, a complex microstructure may arise and render a nonlinear mechanical response. Such complex interfaces may present viscous and elastic behavior leading to a complex stress state that may change the dynamics of the interface deformation and associated free surface flows. In this work, we extend the analysis of steady-state slot coating flows to include the effect of interface rheology. We examine the effect of interface viscosity and elasticity on the flow pattern and process limits.

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