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Stability of Couette flow past a viscoelastic solid ANDREW HESS, TONG GAO, Michigan State University — Soft materials such as polymer gels have been widely used in engineering applications such as microfluidics, micro-optics, and active surfaces. It is important to obtain fundamental understandings of the dynamics of various soft materials when interacting with fluid. Here we investigate the material behavior of a viscoelastic solid film immersed in a simple Newtonian Couette flow. An Eulerian formulation of the Zener model is used to model the solid phase with the surface tension effect. A linear stability analysis is first performed to predict the material instabilities induced by the shear flow field, and provide an analytical basis to the numerical results. The nonlinear fluid/elastic structure interactions are further explored by using the direct numerical simulations. Phase tracking is accomplished through the use of a generalized Cahn-Hilliard model for the surface tension between the gel-like material and the ambient fluid. The coupled Cahn-Hilliard/Navier-Stokes/Zener equations are then solved on a staggered grid through a finite difference method. The results are compared with previous studies for both the hyperelastic and viscoelastic materials.

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