STABILITY OF A VISCOELASTIC FILM FLOWING OVER A SUBSTRATE WITH SINUSOIDAL CORRUGATIONS

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ABSTRACT

Viscoelastic film flows driven by a body force can be encountered in various engineering applications which range from coating applications in microelectronics to biomedical flows and biofilms. In the literature elastic phenomena are often overlooked since most theoretical works consider the case of Newtonian liquids. The effects of fluid elasticity, though, can play an important role in applications where a viscoelastic liquid is involved as in the case of a polymeric coating solution. In this study, we perform a linear stability analysis for a liquid, that follows the PTT constitutive equation, flowing over a substrate with sinusoidal corrugations. We develop a 2D finite element model and employ Floquet theory to predict the stability of periodic disturbances of arbitrary wavelengths over deep substrate structures. We will present detailed flow stability maps over a wide range of parameters and discuss about the mechanisms through which elasticity affects the present system. We will also discuss about the stability of the flow when it is subjected to 3D disturbances.

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