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Polymer Stress-Gradient Induced Migration in Thin Film Flow Over Topography[1] SOPHIA TSOUKA, YIANNIS DIMAKOPOULOS, JOHN TSAMOPOULOS, Laboratory of Fluid Mechanics and Rheology, Dep. of Chemical Engineering, University of Patras — We consider the 2D, steady film flow of a dilute polymer solution over a periodic topography. We examine how the distribution of polymer in the planarization of topographical features is affected by flow intensity and physical properties. The thermodynamically acceptable, Mavrantzas-Beris two-fluid Hamiltonian model is used for polymer migration. The resulting system of differential equations is solved via the mixed FE method combined with an elliptic grid generation scheme. We present numerical results for polymer concentration, stress, velocity and flux of components as a function of the non-dimensional parameters of the problem (Deborah, Peclet, Reynolds and Capillary numbers, ratio of solvent viscosity to total liquid viscosity and geometric features of the topography). Polymer migration to the free surface is enhanced when the cavity gets steeper and deeper. This increases the spatial extent of the polymer depletion layer and induces strong banding in the stresses away from the substrate wall, especially in low polymer concentration. Macromolecules with longer relaxation times are predicted to migrate towards the free surface more easily, while high surface tension combined with a certain range of Reynolds numbers affects the free surface deformations.

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