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Steady-states of thin film droplets on chemically heterogeneous substrates.

The spreading and dewetting of thin liquid films subject to van der Waals interactions can be described by a nonlinear fourth-order parabolic PDE. Subject to no-flux boundary condition, the steady-state thin film is governed by a second order ODE. The bifurcation of steady-state thin films on homogeneous substrates has been previously studied by Bertozzi et al (2001). We extend the previous studies by presenting results on the steady-state thin fluid films on chemically heterogeneous substrates. Specifically, we use phase planes to study the bifurcation of thin films on stepwise-patterned substrates and develop asymptotic approximation for the steady-state solutions. We find a new bifurcation branch of solutions, characterizing droplets pinned at the interface of heterogeneity, which arises as a consequence of wettability contrast of the substrate. In addition, we discuss an effective measure of the fluid leakage for films in presence of an increasing heterogeneity contrast and show through asymptotic analysis that the leakage is inversely proportional to the heterogeneity contrast. Last, we show all of the analysis in 1-D can be easily extended to axisymmetric solutions in 2-D. (Received September 14, 2019)