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Linear Stability analysis of a Newtonian film flowing over a substrate with topographical features[1] YIANNIS DIMAKOPOULOS, DIONISIS PETTAS, GEORGE KARAPETSAS, JOHN TSAMOPOULOS, University of Patras — In a typical coating process, liquid flows under the action of a body force and coats a substrate of variable topography leaving a thin film on it. The wetting state of the substrate is highly dependent on its geometric characteristics and the liquid properties. The liquid may fully wet (Wenzel state), not wet (Cassie state) or partially wet it. It is important to determine the prevailing steady flow patterns and their stability. The former has been studied by examining the 2D steady flow over a structured surface either by solving the 2D NS equations or by using the lubrication approximation. In this work, we consider the stability of the 2D steady solution by performing a linear stability analysis subjected to 2D and 3D perturbations. We employ the finite element method to solve the full NS equations to examine cases where the lubrication approximation is not applicable and investigate the stability of all flow configurations: Wenzel, Cassie, and partially wetted states. It is shown that the fully wetted state in the lubrication limit is stable in line with previous studies. Moving away from the lubrication limit, though, we find that the flow becomes unstable for finite Re, when long- or short-wave instabilities arise. The stability of partially wetting states will also be discussed.

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