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**Steady film flow over 2D topography with air inclusion formed inside the trench.**[1] JOHN TSAMOPOULOS, STYLIANOS VARCHANIS, YANNIS DIMAKOPOULOS, University of Patras — Liquid film flow along an inclined, solid substrate featuring periodic rectangular trenches may either completely wet the trench floor (Wenzel state) or pin on the entrance and exit corners of the trench (Cassie state) or assume any other configuration in between these two extremes. In the intermediate cases a second gas-liquid interface inside the trench is formed, which adheres to the walls of the trench forming two three-phase contact lines, and encloses a different amount of air under different physical conditions. The Galerkin finite element method is used to solve the Navier-Stokes equations in a physical domain, which is adaptively re-meshed. Multiple steady solutions, connected by turning points and transcritical bifurcations as well as isolated solution branches, are revealed by pseudo arc-length continuation. Two possible cases of a single air inclusion inside the trench are examined. The penetration of the liquid inside the trench is enhanced primarily by increasing either the wettability of the substrate or the capillarity or by decreasing the flow rate. Flow hysteresis may occur when the liquid does not penetrate deep enough inside the trench leading to different flow patterns. The interplay of inertia, viscous, gravity and capillary forces along with substrate wettability determines the volume of the air encapsulated in the trench and the extent of free surface deformation.

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