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Multiscale level-set method for accurate modeling of two-phase immiscible flow with deposited thin-films on solid surfaces MOTAZ ABU ALSAUD, Stanford Univ, AMIR RIAZ, University of Maryland, College Park, HAMDI TCHELEPI, Stanford Univ, UNIVERSITY OF MARYLAND, COLLEGE PARK COLLABORATION, STANFORD UNIVERSITY TEAM — We developed a multiscale sharp interface method based on the level-set for two-phase immiscible flow with pre-existing thin-films on solid surfaces. The lubrication approximation theory is used to model the thin- film equation efficiently. The incompressible Navier-Stokes, level-set, and thin-film evolution equation are coupled sequentially to capture the physics occurring at multiple length scales. The proposed multiscale method is validated through comparison with the augmented Young-Laplace equation that includes the Van der Waals intermolecular force for a static meniscus in a capillary tube. The viscous bending in the advancing interface over precursor film problem is captured by the numerical method and agrees with the Cox-Voinov theory. The problem of a moving-bubble inside a capillary tube is modeled, and the results compare well with both theory and experiments. In addition, the performance of the new approach is assessed by studying the spurious currents for capillary-dominated flows at low capillary numbers. The method is applicable for flows with a capillary number as low as $Ca = 10^6$.

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