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A Cahn-Hilliard framework for spreading in the partial-wetting regime AMIR PAHLAVAN, MICHAEL CHEN, LUIS CUETO-FELGUEROSO, GARETH MCKINLEY, RUBEN JUANES, Massachusetts Inst of Tech-MIT — When a liquid puddle spreads on a solid surface in the complete-wetting regime, gravity is the dominant driving force and it has been shown that the dynamics close to the contact line has no influence on the rate of spreading. In the partial-wetting regime however, the spreading puddle transitions away from the gravity-dominated regime, slows down, and finally comes to an stop when it reaches the compactly-supported equilibrium state. Therefore, the contact-line dynamics cannot be neglected in the partial-wetting regime. The existing models (i.e. Cox-Voinov) for contact line dynamics compare well with experimental observations in the capillary-dominated regime, but when gravity is the main driving force, the spreading dynamics deviates from that in the capillary-dominated regime. In this work, we develop an energetic description for the system that leads to the Cahn-Hilliard framework and a generalized thin-film equation. The contact line dynamics emerges naturally as part of the solution in our model and is therefore coupled with the bulk flow. We further show that the developed model compares well with our large-scale puddle spreading experiments in the partial-wetting regime.

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