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Droplet impact on a porous substrate: a capillary tube model
HANG DING, THEO THEOFANOUS, CRSS, University of California, Santa Barbara — The dynamics of impacting (spreading, penetrating) a droplet on a porous substrate, modeled by an array of capillary tubes, is studied numerically using diffuse interface methods. The absorption rate depends on the diameter ratio of the capillary tube to the droplet, wettability, and liquid properties. The flow dynamics is resolved by solving the Navier-Stokes equations and interface capturing is governed by the Cahn-Hilliard equation. Contact-angle hysteresis is included (Ding&Spelt 2008) and the stress singularity at moving contact lines is relieved using a diffuse interface model (Seppecher 1996; Jaqcmin 2000). The model is validated by studying the evolution of a droplet initially resting on a porous substrate and by comparison to drop-impact experiments involving just one capillary tube (Kogan et al 2008). Comparisons with analytical solutions and results available in the literature (e.g. Hilpert & Ben-David 2009) are presented. Through parametric simulations over relevant ranges of Reynolds and Ohnesorge numbers and contact angles, impact regime maps are derived.

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