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Dynamic wetting at the nanoscale[1] GUSTAV AMBERG, Dept of Mechanics, Linné FLOW center, KTH, Stockholm, Sweden, YOSHINORI NAKAMURA, Dept of Mechanical Eng, the University of Tokyo, Japan, ANDREAS CARLSON, Dept of Mechanics, Linné FLOW center, KTH, Stockholm, Sweden, JUNICHIRO SHIOMI, Dept of Mechanical Eng, the University of Tokyo, Japan —
Although the capillary spreading of a drop on a dry substrate is well studied, the physical mechanisms that govern the dynamics remain challenging. Here we study the dynamics of spreading of partially wetting nano-droplets, by combining molecular dynamics and continuum simulations. The latter accounts for all the relevant hydrodynamics, i.e. capillarity, inertia and viscous stresses. By coordinated continuum and molecular dynamics simulations, the macroscopic model parameters are extracted. For a Lennard-Jones fluid spreading on a planar surface, the liquid slip on the substrate is found to be crucial for the motion of the contact line. Evaluation of the different contributions to the energy transfer shows that the liquid slip generates dissipation of the same order as the bulk viscous dissipation or the energy transfer to kinetic energy. We also study the dynamics of spreading on a substrate with a periodic nanostructure. Here it is found that a nanostructure with a length scale commensurate with molecular size completely inhibits the liquid slip. This reduces the spreading speed by about 30%.

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