Wetting and dewetting with oblique contact lines

Emmanuelle Rio, Jacco Snoeijer, Laurent Limat, Adrian Daerr, Bruno Andreotti

Matière et Systèmes Complexes, Univ. Paris 7
Physique et Mécanique des Milieux Hétérogènes, ESPCI,
10 rue Vauquelin, 75231 Paris

Abstract:

The contact angle of a moving liquid meniscus on a partially wetting substrate is known to depend on the speed of wetting or dewetting, although the physical understanding of this dependency is still subject to debate. Current experimental, numerical and theoretical investigations focus on the situation of a straight contact line moving perpendicularly to itself. But common flows often involve contact lines which are oblique to the direction of (de)wetting. In order to propose a more general boundary condition at contact lines, we studied the dynamic contact angle and flow field all around drops sliding down an incline. The fluid velocity is found to be normal to the contact line everywhere, which indirectly proves that viscous stresses efficiently damp motion tangential to the contact line. The dynamic contact angle is found to be a function only of the capillary number based on the local liquid velocity, which leads to a universal boundary condition for smooth moving contact lines. Near singularities the flow field also has simple properties: in the vicinity of the corner appearing at the rear of a moving drop, we were able to show that the flow field is self- similar.