

Energy Dissipation for Moving Contact Line on Patterned Surfaces

Xiao-Ping Wang

DEPARTMENT OF MATHEMATICS, HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY, HONG KONG
mawang@ust.hk

We simulate the moving contact line in two-dimensional chemically patterned channels using a diffuse-interface model with the generalized Navier boundary condition. The motion of the fluid-fluid interface in confined immiscible two-phase flows is modulated by the chemical pattern at the top and bottom surfaces, leading to a stick-slip behavior of the contact line. The extra dissipation induced by this oscillatory contact-line motion is fairly significant and increases rapidly with the wettability contrast of the pattern. A critical value of the wettability contrast is identified above which the effect of diffusion becomes important, leading to the interesting behavior of fluid-fluid interface breaking. Near the critical value, the time-averaged extra dissipation scales as U , the displacement velocity which is significantly larger than the usual viscous dissipation on the homogenous surface.

This is a joint work with TZ Qian and P. Sheng