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Cahn-Hilliard model for moving contact lines.

Continuum hydrodynamics with no-slip boundary conditions leads to a stress singularity at the moving contact line. This singularity can be either regularized by the diffusion in the Cahn-Hilliard diffuse-interface model or removed by the slip conditions in sharp-interface models. This talk discusses the basic questions underlying the Cahn-Hilliard model. Through dimensional analysis and numerical computations, we demonstrate that the Cahn-Hilliard model approaches a sharp-interface limit when the interfacial thickness is reduced below a threshold while other parameters are appropriately chosen. In this limit, the contact line has a diffusion length that is related to the slip length in sharp-interface models, and the relaxation of wall energy determines the deviation of the dynamic contact angle from the static one. From these results, we develop practical guidelines for attaining the sharp-interface limit in numerical simulations and for quantitatively reproducing experimental data on the apparent contact angle. Finally, with hints from the Cahn-Hilliard model, we show a practical way to implement the slip conditions such that the sharp-interface models can generate mesh-independent results and even fit the experimental data. (Received November 14, 2008)