

527a Finite Element Computations of Surfactant-Mediated Spreading on Solid Surfaces

Srinath Madasu and Ali Borhan

Liquid spreading on a smooth solid surface is numerically studied for a drop that is initially covered with an insoluble monolayer of surfactant with uniform concentration. The drop spreads over the solid surface under the action of gravity and a dynamic contact angle larger than the equilibrium contact angle. As the drop spreads, the adsorbed surfactant is constantly redistributed along the deforming interface by advection and diffusion, leading to nonuniformities in interfacial tension along the interface. The resulting Marangoni stresses, in turn, affect the time evolution of the drop shape and the spreading rate. A Galerkin finite element formulation is used to solve the Navier-Stokes and continuity equations for the flow field, in conjunction with the unsteady surface convective-diffusion equation for the monolayer concentration distribution. The moving interface is tracked using the method of spines, a power-law dependence of the contact line velocity on the dynamic contact angle is assumed, and the Langmuir adsorption framework is adopted for the surfactant monolayer. Computational results are compared to existing results for spreading in the lubrication limit [1]. The effect of dimensionless parameters such as Reynolds number, Bond number, Peclet number, and capillary number on the spreading rate of the liquid will be presented.

1. Chan, K.-Y. and Borhan, A., *J. Colloid Interface Sci.* 287, 233-248, 2005.