Dynamics of surfactant-laden drops on liquid substrates

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ABSTRACT

We examine the surfactant enhanced spreading of liquid drops on liquid substrates. We use the lubrication theory for the droplet motion, together with advection-diffusion equations and chemical kinetic fluxes for the surfactant transport to derive a system of coupled evolution equations for the positions of the interfaces, interfacial concentrations of surfactant monomers and bulk concentrations of monomers and micellar aggregates. An additional feature of the model is that it accounts for the effects of surfactants on the moving contact line. We use a finite-element formulation to obtain numerical solutions of the evolution equations and carry out a full parametric study. Our results catalogue the various types of behaviour encountered, which range from complete spreading of the lens, to spreading followed by retraction, to sustained oscillations. We compare our findings with relevant experiments found in the literature [1], [2].

REFERENCES

[1]   R. Stocker and J. W. M. Bush, "Spontaneous oscillations of a sessile lens", *J. Fluid Mech.*, **583**, pp. 465-475, (2007).

[2]   E. A. van Nierop, A. Ajdari and H. A. Stone, "Reactive spreading and recoil of oil on water" *Phys. Fluids*, **18**, 038105, (2006).