Abstract Submitted
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Surfactant-induced superspreading of liquid drops on solid substrates[1] GEORGE KARAPETSAS, RICHARD CRASTER, OMAR MATAR, Imperial College London — The mechanisms driving surfactant-enhanced superspreading of droplets on solid substrates are investigated. Lubrication theory for the droplet motion, and advection-diffusion equations as well as chemical kinetic fluxes for the surfactant transport, lead to coupled evolution equations for the drop thickness, interfacial concentrations of surfactant monomers and bulk concentrations of monomers and micellar aggregates. The surfactant is allowed to adsorb on the substrate either directly from the bulk monomer concentrations or from the liquid-air interface through the contact line. The evolution equations are solved numerically using the finite element method. The results show that basal adsorption of surfactant plays a crucial role in the spreading process: the continuous removal of surfactant from the liquid-air interface, due to the adsorption at the solid surface, is capable of inducing high Marangoni stresses, close to the droplet edge, driving very fast spreading. In many of the cases studied, the droplet radius, R, grows with time, t, with power laws of unity or even higher, close to the reported experimental values for superspreading. The spreading rates depend non-monotonically on the initial surfactant concentration also in accordance with experimental observations. In certain cases, the spreading droplet forms a rim at its leading edge, or creates a "secondary" front separated from its main body.

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Omar Matar
Imperial College London

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