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Marangoni-Driven Flow Oscillations during the Dissolution of Surfactant Powders OREST SHARDT, HYOUNGSOO KIM, HASSAN MASOUD, HOWARD STONE, Princeton University — When particles of surface-active compounds are deposited on a liquid surface, they exhibit a variety of motions, such as the classic erratic movement of camphor on water. We investigate the unsteady motion of a water surface covered with surfactant particles and find that a rapid longitudinal oscillation occurs as the particles dissolve. This phenomenon happens with several common surfactant powders, but it is particularly striking with calcium propionate, an organic salt that decreases the surface tension of water. We examine the effects of several parameters on the characteristics of the oscillation by using particle image velocimetry (PIV). Due to the short period of the oscillation (on the order of 0.1 s) compared to the timescale of surfactant diffusion, we neglect diffusion and model this phenomenon by considering the evolution of variations in surfactant concentration along a liquid surface. This surfactant concentration is advected by the flow that is driven by Marangoni stress due to non-uniform surfactant and therefore surface tension distributions. We examine the critical conditions for and characteristics of the oscillation in this model through theory and simulations.

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