Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Forward, halted, and reverse motion of an active particle atop a finite liquid layer[1] SAEED JAFARI KANG, Michigan Tech, JONATHAN ROTHSTEIN, University of Massachusetts Amherst, HASSAN MASOUD, Michigan Tech — We examine the mobility of a chemically active particle straddling the interface between a liquid layer of finite depth and a semi-infinite layer of gas. A surface-active agent is released asymmetrically from the particle that locally lowers the liquid surface tension. It is commonly presumed that the uneven distribution of surface tension and the associated Marangoni flow lead to the propulsion of the active particle opposite to the release direction, where the surface tension is higher. This is considered forward motion. However, our recent theoretical analysis (in the limits of negligible inertia and diffusion-dominated transport of the active agent) has shown that this trend may be reversed for certain particle shapes and shallow enough liquid layers. Advancing beyond the Stokes regime, here, we numerically study the Marangoni-driven motion of oblate spheroidal particles for a wide range of release rates and subject to various degrees of confinement, represented by the thickness of the liquid film. We show that the particle can undergo a forward, backward, or an arrested motion, and identify the link between these modes of mobility and the vortical flow structure in the vicinity of the particle. Our results are corroborated by concurrently performed experimental measurements.

[1]Financial support from the National Science Foundation under Grant Nos. CBET-1749634 (H.M.) and CBET-1705519 (J.P.R) is acknowledged.

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Date submitted: 29 Jul 2019 Electronic form version 1.4