Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Stability of a chemically active floating disk VAHID VANDADI, University of Nevada, Reno, SAEED JAFARI KANG, Michigan Tech, JONATHAN ROTHSTEIN, University of Massachusetts, Amherst, HASSAN MASOUD, Michigan Tech — We theoretically study the translational stability of a chemically active disk located at a flat liquid-gas interface. The initially immobile circular disk uniformly releases an interface-active agent that locally changes the surface tension and is insoluble in the bulk. If left unperturbed, the stationary disk remains motionless as the agent is discharged. Neglecting the inertial effects, we numerically test whether a perturbation in the translational velocity of the disk can lead to its spontaneous and self-sustained motion. Such a perturbation gives rise to an asymmetric distribution of the released factor that could trigger and sustain the Marangoni propulsion of the disk. An implicit Fourier-Chebyshev spectral method is employed to solve the advection-diffusion equation for the concentration of the active agent. The solution, given a linear equation of state for the surface tension, provides the shear stress distribution at the interface. This and the no-slip condition on the wetted surface of the disk are then used at each time step to semi-analytically determine the Stokes flow in the semi-infinite liquid layer. Overall, the findings of our investigation pave the way for pinpointing the conditions under which interface-bound active particles become dynamically unstable.

Hassan Masoud
Michigan Tech

Date submitted: 27 Jul 2017 Electronic form version 1.4