Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Pore Dynamics of Lipid Vesicles under Light-Induced Osmotic Shock VINIT KUMAR, JIE FENG, University of Illinois at Urbana-Champaign — Lipid vesicles play a key role in understanding fundamental biological processes involving cell plasma membrane, and they have also been used as cargo vehicles in various biomedical applications. Therefore, resolving the non-equilibrium dynamics of lipid vesicles remains a canonical research question in modeling cell mechanics as well as designing vesicle-based delivery system. Recent experiments have shown that a light-induced osmotic shock could cause a vesicle to explode and fragment as opposed to the well-characterized swell-burst-reseal behavior, yet the explanatory mechanism is unknown. In our previous work, we developed a comprehensive model to capture the vesicle evolution in the bifurcation dynamics. In this talk, we will present the phase diagram for the pore dynamics integrating the photo-reactions. Various regimes, including no pore formation, short/long-lived pores and irreversible explosion, are identified by solving the dynamical equations numerically. We further discuss the dependence of the regime boundaries on the key parameters, including the membrane permeability, membrane bending rigidity, line tension of pore edge, vesicle size and chemical kinetics. Our work not only advances the fundamental understanding for mechanical responses of osmotically stressed vesicles, but also aides in selection of lipid substrates and appropriate chemical reactions for desired release properties in artificially constructed vesicles for drug delivery.

Vinit Kumar
University of Illinois at Urbana-Champaign

Date submitted: 31 Jul 2020 Electronic form version 1.4