Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Asymmetric Instability, Symmetric Instability, and Pearling of a Vesicle in Extensional Flow[1] ANDREW SPANN, VIVEK NARSIMHAN, ERIC SHAQFEH, Stanford University — A vesicle placed in extensional flow can undergo a transition where the vesicle forms a dumbbell shape connected by a thin long neck. We will examine cases where the vesicle shows either symmetric or asymmetric behavior depending on the flow conditions. We present 3D boundary integral simulations for vesicles in planar and uniaxial extensional flows. For high reduced volumes (at least 0.745 for matched inner/outer viscosity vesicles), a stable steady state shape exists for the vesicle at extensional flows of any capillary number, and furthermore this steady state shape approaches an ellipse as capillary number is increased. For lower reduced volume vesicles the equilibrium shape becomes non-convex and there exists a critical capillary number above which odd perturbations to the vesicle shape drive an asymmetric elongation transition. For vesicles with reduced volume below 0.6, a symmetric elongation transition exists where the neck thins continuously and the vesicle has no steady shape above a critical capillary number. At sufficiently high capillary number we can see the formation of pearls along the neck of the elongating vesicle. We demonstrate that the rate at which flow is increased can affect the number and position of pearls in this phenomenon.

[1]This work was supported by the US Army High Performance Computation Research Center (AHPCRC) and the National Science Foundation (Grant No. CBET-1066263).

Andrew Spann
Stanford University

Date submitted: 01 Aug 2013 Electronic form version 1.4