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Experimental Methods to Observe Asymmetric Instability of Intermediate-Reduced-Volume Vesicles in Extensional Flow JOANNA DAHL, University of California, Berkeley, VIVEK NARSIMHAN, Stanford University, BERNARDO GOUVEIA, SANJAY KUMAR, University of California, Berkeley, ERIC SHAQFEH, Stanford University, SUSAN MULLER, University of California, Berkeley — Vesicles provide an attractive model system to understand the deformation of living cells in response to mechanical forces. These enclosed lipid bilayer membranes are suitable for complementary theoretical and experimental analysis. A recent study (Narsimhan et al., J. Fluid Mech. 750: 144-190, 2014) predicted that intermediate-aspect-ratio vesicles break up asymmetrically in extensional flow. Upon infinitesimal perturbation to its shape, the vesicle stretches into an asymmetric dumbbell. In this work, we present preliminary results from cross-slot microfluidic experiments observing this instability. The onset of breakup depends on two non-dimensional parameters: reduced volume (vesicle asphericity) and capillary number (ratio of viscous to bending forces). We will present strategies for accurately measuring these quantities in order to plot a stability diagram. Specifically, we will describe our synthesis of floppy, intermediate-reduced-volume vesicles and our measurement of their bending moduli by analyzing membrane thermal fluctuations. We will discuss coupling particle-image velocimetry (PIV) with cross-slot trapping of vesicles to ensure that breakup occurs at the stagnation point. A preliminary phase diagram for asymmetric breakup will be reported.

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