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Dynamic Morphologies of Microscale Droplet Interface Bilayers
CHARLES COLLIER, JONATHAN BOREYKO, Oak Ridge National Laboratory, PRACHYA MRUETUSATORN, STEPHEN SARLES, DOUGLAS HAYES, University of Tennessee Knoxville — Droplet interface bilayers (DIBs) are a powerful platform for studying the dynamics of synthetic cellular membranes; however, very little has been done to exploit the unique dynamical features of DIBs. Here, we generate microscale droplet interface bilayers (μDIBs) by bringing together femtoliter-volume water droplets in a microfluidic oil channel. By varying the initial conditions of the system, we identify three distinct classes of dynamic morphology. *(1) Buckling and Fission*: When forming μDIBs using lipids initially in the oil, lipids in the shrinking monolayers continually pair together and slide into the bilayer to conserve their mass. As the bilayer continues to grow, it becomes confined, buckles, and eventually fissions one or more vesicles. *(2) Uniform Shrinking*: When using lipids initially in the aqueous phase to form μDIBs, lipids uniformly transfer from the monolayers and bilayer into vesicles contained inside the water droplets. *(3) Stretching and Unzipping*: Finally, when the droplets are pinned to the wall(s) of the microfluidic channel, the droplets become stretched during evaporation, culminating in the unzipping of the bilayer and droplet separation. These findings offer a better understanding of the dynamics of coupled lipid interfaces.

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