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Domain Relaxation in Polymer Langmuir Layers ANDREW J. BERNOFF, Department of Mathematics, Harvey Mudd College, JAMES C. ALEXANDER, Department of Mathematics, Case Western Reserve University, ELIZABETH MANN, Department of Physics, Kent State University, J. ADIN MANN, JR., Department of Chemical Engineering, Case Western Reserve University, JACOB M. PUGH, Department of Physics, Harvey Mudd College, LU ZOU, Department of Physics, Kent State University — We report on an experimental, theoretical and computational study of a molecularly thin polymer Langmuir layer on the surface of a subfluid. When stretched (by a transient stagnation flow), the monolayer takes the form of a bola consisting of two roughly circular reservoirs connected by a thin tether. This shape relaxes to the minimum energy configuration of a circular domain. The tether is never observed to rupture, even when it is more than a hundred times as long as it is thin. We model these experiments by taking previous descriptions of the full hydrodynamics (primarily those of Stone & McConnell and Lubensky & Goldstein), identifying the dominant effects via dimensional analysis, and reducing the system to a more tractable form. The result is a free boundary problem where motion is driven by the line tension of the domain and damped by the viscosity of the subfluid. The problem has a boundary integral formulation which allows us to numerically simulate the tether relaxation; comparison with the experiments allows us to estimate the line tension in the system.

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