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Hole dynamics in polymer Langmuir films LU ZOU, ELIZABETH K. MANN, Department of Physics, Kent State University, JAMES C. ALEXANDER, Department of Mathematics, Case Western Reserve University, J. ADIN MANN JR., Department of Chemical Engineering, Case Western Reserve University, ANDREW J. BERNOFF, Department of Mathematics, Harvey Mudd College — This article develops a model for the closing of a gaseous hole in a liquid domain within a two-dimensional fluid layer, coupled to a fluid bulk substrate, and compares this model to experiments following hole dynamics in a polymer Langmuir monolayer. Closure of such a hole in a fluid layer is driven by the difference in pressure within the hole and far outside it, and by the line tension. The observed rate of hole closing is close to that predicted by our model and the line tension measured by other means, assuming that the pressure in the gas is negligible. This result both supports the model and suggests an independent means of determining the line tension. Unlike most previous hydrodynamics models of Langmuir films, the closing of a hole necessarily involves vertical motion of the underlying incompressible fluid: that fluid is dragged along with the liquid monolayer towards the center of the hole, and must plunge away from the surface. An explicit expression is found for this vertical fluid flow in the bulk substrate.

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