Abstract Submitted
for the DFD05 Meeting of
The American Physical Society

Hole Dynamics in Polymer Langmuir Films J. ADIN MANN, JR., JAMES ALEXANDER, Case Western Reserve University, ANDREW BERNOFF, Harvey Mudd College, LU ZOU, ELIZABETH MANN, Kent State University —
We develop a model for the closing of a gaseous hole in a liquid domain within a two-dimensional fluid layer, a Langmuir film, coupled to a fluid bulk substrate. This model is compared to experiments that follow hole dynamics in a polymer Langmuir film. Closure of such a hole in a fluid layer is driven by the difference in spreading 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 spreading pressure in the surface-gas phase 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 invloves 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.

J. Adin Mann, Jr.
Case Western Reserve University

Date submitted: 11 Aug 2005 Electronic form version 1.4