Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Buckling of cornstarch solutions after pinch-off: evidence for a jamming transition at high extensional rates MATTHIEU ROCHE, OYKU M. AKKAYA, Mechanical and Aerospace Engineering, Princeton University, HAMID KELLAY, Centre de Physique Moleculaire Optique et Hertzienne, Universite Bordeaux 1, France, HOWARD A. STONE, Mechanical and Aerospace Engineering, Princeton University — We studied the behavior of density-matched cornstarch solutions during and after pinch-off from a needle. We observed an exponential slowing down in the thinning dynamics of the bridge connecting the droplet to the needle during which the bridge adopts a cylindrical shape. At this stage, the flow is mainly extensional allowing us to explore the behavior of starch solutions at extension rates greater than 10 s^{-1}. The bridge continues to thin and then destabilizes leading to break-up in multiple parts. These parts retract on themselves and buckle. We show that this buckling behavior can be understood as a consequence of a liquid-to-solid transition of starch solutions during thinning. Using microscopy, we demonstrate that the neck is inhomogeneous during the last stages of pinch-off: the thinner sections of the neck are fluid while the thicker regions are jammed. We explain buckling by showing that the bridge deforms around its fluid sections, making this system analogous to a chain of solid links connected by fluid bridges.

Howard A. Stone
Mechanical and Aerospace Engineering, Princeton University

Date submitted: 05 Aug 2010 Electronic form version 1.4