Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Ratcheting motion of capsules on tailored substrates ANNA C. BALAZS, KURT A. SMITH, ALEXANDER ALEXEEV, ROLF VERBERG, University of Pittsburgh — We study the motion of microcapsules on attractive surfaces. The capsules, modeled as fluid-filled elastic shells, represent polymeric microcapsules or biological cells. Certain periodic surface patterns give rise to directed capsule motion for a symmetric energy input, such as an oscillatory shear flow. We use a numerical model which integrates a lattice spring representation of the capsule shell and the substrate with a lattice Boltzmann representation for the fluid regions. We consider, as a surface pattern, a series of asymmetric ramps. The minimum shear necessary to drive a capsule "forward" over one ramp is less than that needed to drive the capsule "backward" over a ramp. We show under what conditions it is possible to move the capsule forward, in a ratcheting motion, via an imposed oscillatory flow. These patterned surfaces could be used to control capsule motion precisely, based on flow and surface properties. They coud also be used to efficiently sort capsules based on their size or material properties.

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Date submitted: 28 Nov 2005 Electronic form version 1.4