Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

**Modeling the Dynamics of Micron-Scale Objects in Flow Over Nano-Textured Surfaces** RANOJOY DUFFADAR, JEFFREY DAVIS, Department of Chemical Engineering, MARIA SANTORE, Department of Polymer Science and Engineering, University of Massachusetts Amherst — The manipulation of dynamic particle adhesion in flow over heterogeneous collecting surfaces is an important aspect of microfluidic sensing technologies. Selective tuning of the sizes, surface densities, and chemistries of 10-nanometer scale heterogeneities on planar surfaces that interact with micron- scale particles in shear flow at low Reynolds number allows control of the particle dynamics and selective adhesion. Adhesion is reversible in a substantial portion of parameter space, and surface features can give rise to particle skipping and rolling on the surfaces. These dynamics are captured by a new model that incorporates hydrodynamic forces and the spatially varying physicochemical interactions between the particles and heterogeneous surfaces. The adhesion behavior is reminiscent of pattern recognition, although the patch distribution on the collector is random. Spatial fluctuations in the patch density are shown to play a critical role in the dynamic adhesion, rolling, and skipping (e.g., allowing adhesion on a net-repulsive surface), which prevents this behavior from being predicted by a mean-field approach. Good agreement is found between model predictions and experimental results.

Jeffrey Davis
Department of Chemical Engineering,
University of Massachusetts Amherst

Date submitted: 05 Aug 2006 Electronic form version 1.4