Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Surface tension gradient enhanced thin film flow for particle deposition[1] JAMES GILCHRIST, KEDAR JOSHI, TANYAKORN MUANGNAPOH, MICHAEL STEVER, Lehigh University — We investigate the effect of varying concentration in binary mixtures of water and ethanol as the suspending medium for micron-scale silica particles on convective deposition. By pulling a suspension along a substrate, a thin film is created that results in enhanced evaporation of the solvent and capillary forces that order particles trapped in the thin film. In pure water or pure ethanol, assembly and deposition is easily understood by a simply flux balance first developed by Dimitrov and Nagayama in 1996. In solvent mixtures having only a few percent of ethanol, Marangoni stresses from the concentration gradient set by unbalanced solvent evaporation dominates the thin film flow. The thin film profile is similar to that found in "tears of wine" where the particles are deposited in the thin film between the tears and the reservoir. A simple model describes the 10x increase of deposition speed found in forming well-ordered monolayers of particles. At higher ethanol concentrations, lateral instabilities also generated by Marangoni stresses cause nonuniform deposition in the form of complex streaks that mirror sediment deposits in larger scale flows.

[1]We acknowledge funding from the NSF Scalable Nanomanufacturing Program under grant No. 1120399

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Date submitted: 29 Jul 2015 Electronic form version 1.4