Abstract Submitted
for the DFD07 Meeting of
The American Physical Society

Lattice Boltzmann Simulation of Directed Assembly in Nano-Colloidal Systems MOHAMMAD ABUZAID, YING SUN, SUNY at Binghamton — Suspensions of nano-sized colloids have received great attention for their broad applications in printable electronics, photonics, thin film processing, thermal management, etc. The properties of colloidal suspensions are often influenced by the interplay of the electrostatic repulsion, van der Waals attraction, depletion forces, hydrodynamic interaction, Brownian motion, diffusion, and gravity. In many applications, it is desirable to have ordered nanostructures, which can be achieved by electro-hydrodynamically directed particle assembly. In this paper, a Lattice Boltzmann scheme is used for direct numerical simulation of particle-particle and particle-field interactions in nano-colloidal systems under flow and electric fields. The interaction between particles and fluid is simulated via a mass conserving second-order bounce-back scheme. The aggregation rate of colloidal suspensions is investigated as a function of the fluid velocity and pressure, electric potential, electrode geometry, particle size and volume fraction, temperature, sedimentation effect, and other properties of both the particles and the carrier fluid. The influence of colloid size on various interaction forces is examined in detail. The design protocols for tuning colloidal suspensions under different electro-hydrodynamic field conditions are discussed for nanocrystalline thin film processing and nanofluids for thermal management.

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Date submitted: 07 Aug 2007 Electronic form version 1.4