Abstract Submitted
for the DFD06 Meeting of
The American Physical Society

Reversible Control of Anisotropic Electrical Conductivity Using Colloidal Microfluidic Networks PRADIPKUMAR BAHUKUDUMBI, Department of Mechanical Engineering, Texas A&M University, MICHAEL BEVAN, ALI BESKOK, Department of Chemical Engineering, Texas A&M University — In this talk, we present controllable electrical conductivity changes in thin-films using the directed assembly of metallic colloidal particles suspended in microfluidic circuits. Our preliminary experiments have shown that for a given concentration of colloidal particles in the microfabricated device with interdigitating electrodes, we can effectively and reversibly tune colloidal interactions to yield various steady-state configurations, by navigating the AC frequency-amplitude phase space. The device has two operation modes: 1) variable capacitor, and 2) variable resistor, and it can reversibly and rapidly switch between the two modes. Growth of colloidal wires spanning the gap between the two electrodes, establishes a conductive network circuit, and variable resistance can be realized by controlling the growth of colloidal wire interconnects. A variable capacitive circuit can be realized by concentrating colloidal particles in between the electrodes, and forming a vertically spanning colloidal network, that changes the effective spacing between the electrodes, and thereby the capacitance. A scaling analysis that includes gravity, Brownian motion, electrokinetic and electrohydrodynamic forces is used to interpret the relative influence of each force on the equilibrium response of the colloidal system.

Pradipkumar Bahukudumbi
Department of Mechanical Engineering, Texas A&M University

Date submitted: 06 Aug 2006 Electronic form version 1.4