Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Dehydration induced phase transitions in a microfluidic droplet array for the separation of biomolecules CHRIS NELSON, SHELLEY ANNA, Carnegie Mellon University — Droplet-based strategies for fluid manipulation have seen significant application in microfluidics due to their ability to compartmentalize solutions and facilitate highly parallelized reactions. Functioning as micro-scale reaction vessels, droplets have been used to study protein crystallization, enzyme kinetics, and to encapsulate whole cells. Recently, the mass transport out of droplets has been used to concentrate solutions and induce phase transitions. Here, we show that droplets trapped in a microfluidic array will spontaneously dehydrate over the course of several hours. By loading these devices with an initially dilute aqueous polymer solution, we use this slow dehydration to observe phase transitions and the evolution of droplet morphology in hundreds of droplets simultaneously. As an example, we trap and dehydrate droplets of a model aqueous two-phase system consisting of polyethylene glycol and dextran. Initially the drops are homogenous, then after some time the polymer concentration reaches a critical point and two phases form. As water continues to leave the system, the drops transition from a microemulsion of DEX in PEG to a core-shell configuration. Eventually, changes in interfacial tension, driven by dehydration, cause the DEX core to completely de-wet from the PEG shell. Since aqueous two phase systems are able to selectively separate a variety of biomolecules, this core shedding behavior has the potential to provide selective, on-chip separation and concentration.

Chris Nelson
Carnegie Mellon University

Date submitted: 02 Aug 2013 Electronic form version 1.4