Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Liquid-liquid separation in high porosity inverse opals[1] SOEREN BRANDT, JOANNA AIZENBERG, Harvard Univ — Oil-water mixtures pose significant industrial and environmental challenges in wastewater treatment. Submicron porosity membranes could provide the foundation of new low-cost separation techniques as local nucleation surfaces. However, membrane separation faces major roadblocks: aging of the membrane through surface fouling and pore blockage limits long-term applicability, and there is a general lack of understanding of the mechanism of separation. Inverse opals provide a structured, porous material with a reproducible, highly interconnected, bimodal pore structure that exhibits unique wetting behavior, based on which we can study the separation of oil-water mixtures in a thin, porous film using fluorescence microscopy. To understand the mechanism of liquid-liquid separation in inverse opals, we have devised an integrated microfluidic system to observe Darcy flow along the principal directions of the porous lattice. We find the pressure drop associated with surface drag to be small, and demonstrate control over the capillary pressure associated with infiltration of the porous matrix by changing the local surface chemistry. Additionally, we are able to achieve de-emulsification at low flow velocities regardless of surface chemistry.

[1]NSF - DMREF: 1533985

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Date submitted: 11 Nov 2016 Electronic form version 1.4