SHELL SEMINAR SERIES
CHEMICAL & BIOLOGICAL ENGINEERING

Driving particles and fluids using chemical fluxes

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ABSTRACT Suspensions of micron-scale particles and drops are ubiquitous in complex fluid formulations — foods, consumer products, pharmaceuticals, paints, coatings, and other materials and precursors. A number of equilibrium interactions have long been exploited to stabilize these suspensions and tune the properties of the materials. Here, we describe a set of non-equilibrium, chemical phenomena that allow particle migration to be directed and controlled over significantly longer ranges than is possible with equilibrium interactions. Examples will build upon somewhat classic pictures of diffusiophoresis or solvophoresis, wherein fluxes of various chemical species quite generically drive fluid flows and particle migration. We will lay out a conceptual, intuitive framework to understand, design, and manipulate these chemical fluxes — and illustrate with systems that drive particles into or out of dead-end pores; where particles might 'find' targets hidden within a maze, and where structures may collect specific suspended particles from millimeters away.

We will additionally describe new techniques we have developed to sculpt chemical micro-environments in space and time, and interferometric methods to visualize these concentration fields as they evolve. We will illustrate with direct, dynamic measurements of physical and reactive absorption of vapor-phase solutes into ionic liquids, reagent depletion during interfacial polymerization reactions, and diffusion of associative solutes through hydrogels.

BIO **Dr. Todd Squires** earned dual B.S./B.A. degrees in Physics and Russian Literature at UCLA, then spent a year as a Churchill Scholar at Cambridge University. He earned his Ph.D. in Physics from Harvard in 2005, spent three years as a Postdoctoral Fellow at Caltech, and joined UCSB's Chemical Engineering Department in 2005. His research group studies small-scale fluid mechanics and soft materials, both experimentally and theoretically, focusing on microfluidic systems, surfactant function and dysfunction in the lungs and in the field, and the manipulation of charges and particles in fluid environments. Honors include the NSF CAREER award, the Beckman Young Investigator, the Camille and Henry Dreyfus Teacher-Scholar award, the inaugural GSOFT Early Career Award, and Fellowship in the APS.

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