The Department of Mechanical Engineering/College of Engineering and Applied Sciences
Stony Brook University

Mechanical Engineering Seminar
Faculty Candidate

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Benjamin Levich Institute for Physico-Chemical Hydrodynamics
City College of New York, CUNY

Lecture Title: Multiscale Strategies for Transport Processes: Challenges and Opportunities for Novel Thermo-Fluid Systems

Tuesday, April 23, 2013 at 2PM, Room 173 Light Engineering Building

Abstract

The advent of nanotechnology has exposed fundamental limitations of classical macroscopic models for (mass/thermal/chemical) transport processes. Classical transport equations rely on constitutive relations—e.g., Fick's diffusion, Fourier conduction, Newtonian stress—which break down when there is no clear separation between macroscopic and microscopic scales. Extended models—based on microscopic descriptions and statistical physics—predict non-Fickian diffusion, non-Newtonian fluid behavior, and other nontrivial phenomena. In this talk, I will describe how these phenomena, due to bulk and interfacial effects, arise in thermo-fluid systems relevant to energy and materials science. In particular, I will demonstrate that effects unpredicted by classical transport equations can enable novel devices for cross-cutting applications such as mass/thermal sensing, energy harvesting and conversion, and synthesis of functional nanomaterials. In addition, I will discuss analytical and computational (multiscale) strategies that allow microscopic-level models (e.g., molecular dynamics) to perform system-level analyses (e.g., parametric continuation) that are critical for the engineering design and optimization of thermo-fluid systems.

Biography

I joined The Benjamin Levich Institute for Physico-Chemical Hydrodynamics at CCNY in January 2012 within the NSF-PREM (NSF Partnership for Research & Education in Materials Science). Previously, I held a postdoctoral appointment at the Chemical & Biological Engineering Department of Princeton University, after receiving a PhD in Mechanical Engineering at Boston University. My research work has involved theoretical and computational modeling, as well as experimental analysis, of multiscale transport phenomena in diverse systems (e.g., turbulent flows, multiphase microfluidics, complex fluids) where thermodynamics and fluid mechanics are intrinsically coupled.

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