PURDUE UNIVERSITY

MECHANICAL ENGINEERING SEMINAR

Wednesday March 28, 2018 11:00 AM Room ME 2054

School of Mechanical Engineering

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Exploring New Fundamentals and Applications of Nanofluidics

Abstract:

Nanofluidics, a research field focused on studying fluid transport in/around nanoscale confinements, has grown rapidly over the last twenty years and has opened up new avenues for bio- and energy- related applications. Yet, there are still a variety of unique nanofluidic transport phenomena that have not been explored or well understood due to the lack of accurate measurement methods. This has significantly limited the development of existing/new applications that exploits the advantages of these nanofluidic transport. In this talk, I will present my group's recent efforts on exploring new fundamentals and applications of three nanofluidic transport phenomena.

First, I will present a study of fast water transport in graphene nanochannels which holds great promise for water desalination, nanofiltration and energy conversion but has remained controversial. My group has developed a new flow measurement method based on capillary filling and a novel hybrid channel design that can accurately measure hydraulic resistance of single graphene nanochannels. I will show how we use this method to discover a wide range of water slippage in graphene nanochannels and explain what cause these variations.

Second, I will discuss how we can also use the hybrid channel design to explore kinetic-limited ultimate water evaporation from single nanochannels and nanopores. I will demonstrate that the ultimate evaporation fluxes can break down the kinetic limits predicated by the classical Hertz-Knudsen equation by an order of magnitude. The strong dependence of the kinetic-limited evaporation flux on confinement, temperature and humidity and the implication of achieving the kinetic limits on electronic cooling and membrane distillation will be discussed.

Finally, I will introduce our latest work on investigating electrokinetic trapping of single nanoparticles and discuss the potential applications of this new trapping mechanism on nanoparticle characterization and manipulation as well as reusable biosensing.

Bio:

Dr. Chuanhua Duan earned his B.S. and M.S. degrees in Engineering Thermophysics from Tsinghua University in 2002 and 2004, respectively. He obtained his Ph.D. in Mechanical Engineering from the University of California at Berkeley in 2009 under the guidance of Prof. Arun Majumdar. After staying in Berkeley for two more years as a postdoctoral researcher at the Lawrence Berkeley National Laboratory, Dr. Duan joined the Department of Mechanical Engineering at Boston University as an assistant professor in 2012. He is currently leading the Nanoscale Energy-Fluids Transport Laboratory at BU ME. Among his honors, Dr. Duan received the National Science Foundation Early Faculty Career Development Award (CAREER) in 2017 and the American Chemistry Society Petroleum Research Fund Doctoral New Investigator award in 2013. His research focuses on the study of micro- and nanofluidic transport phenomena and the development of new fluidic devices/approaches for applications in healthcare, energy systems, and thermal management.

Faculty Host: Professor Xiulin Ruan If you would like to meet Dr. Duan please contact secretary Maggie at hao41@purdue.edu for scheduling assistance.