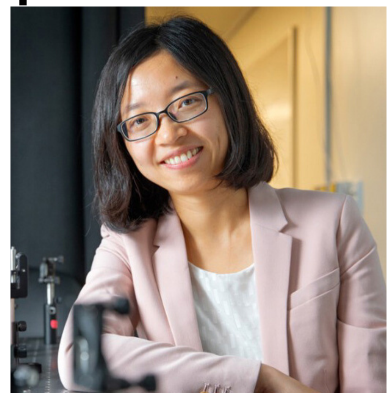
MAE COLLOQUIUM

Fundamental understanding of nanoscale thermal transport for thermal conductivity manipulation

Zhiting Tian

Assistant Professor
The Sibley School of Mechanical and Aerospace Engineering
Cornell University



Monday, November 11, 4:00 pm | 206 Upson

Abstract: Understanding and manipulating heat transfer to our advantages are essential to intentionally design energy-efficient devices and systems and limit deleterious effects of high or low temperatures on system performance. Nano-engineering offers unique opportunities to obtain previously unachievable properties for diverse applications, ranging from thermoelectric energy conversion and thermal insulation that demands ultra-low thermal conductivity to micro-electronics cooling that, in contrast, desires ultra-high thermal conductivity. Meanwhile, nano-engineering also imposes challenges in scientific understanding because continuum theories break down at such small length scales. Despite significant effort, in-depth knowledge of basic thermal transport processes at the nanoscale is limited, impeding the development of novel thermal applications. In this talk, I will present my research group's efforts to deepen our fundamental understanding of nanoscale thermal transport processes and unveil their direct impacts on macroscopic thermal conductivity. To push the lower boundary of thermal conductivity, I will show our experimental work on hybrid perovskites and their analogues using inelastic x-ray scattering. In search of high thermal conductivity materials, I will describe our experiment on cubic boron arsenide using inelastic x-ray scattering as well as our computational work on boron suboxide based on first-principles calculations. Besides pushing lower and higher limits of thermal conductivity, I will also discuss our recent work towards tunable thermal materials, which holds promise for thermal diodes and switches for dynamical thermal management. I will illustrate two novel phenomena we discovered in polymers –thermal rectification in asymmetric polymers and thermal switching in thermoresponsive polymers using molecular dynamics simulations and transient grating measurements, respectively.

Bio: Dr. Zhiting Tian joined the Sibley School of Mechanical and Aerospace Engineering at Cornell University as an assistant professor, Eugene A. Leinroth Sesquicentennial Faculty Fellow in 2018. Between 2014 and 2018, she was an assistant professor of Mechanical Engineering at Virginia Tech. Zhiting obtained her Ph.D. in Mechanical Engineering at MIT in 2014, M.S. in Mechanical Engineering at Binghamton University in 2009, and B.E. in Engineering Physics at Tsinghua University in 2007. Zhiting's recent awards include Office of Naval Research (ONR) Young Investigator Award, NSF CAREER Award, ACS Petroleum Research Fund Doctoral New Investigator Award, 3M Non-Tenured Faculty Award, ACS Polymeric Materials Science and Engineering (PMSE) Young Investigator Award, and MIT Technology Review 35 Innovators under 35 China.

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