Department of Systems Engineering
香港城市大學
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# Alternative Routes for Solid-State Cooling

Micron-scale on-chip cooling, heat management, and precise temperature control are crucial as we continue to advance toward nanoscale transistors, compact electronics, wearables, and portable thermostats. Mechanical refrigerators with moving parts are unsuitable because they cannot be scaled down. Instead, solid-state solutions with no moving parts that rely on passive and active heat transfer are needed. In this talk, I will review our work on designing micro-nano scale solid-state coolers, which are alternatives to traditional thermoelectric ones, focusing on controlling heat using electric and magnetic fields. We have recently demonstrated enhanced Peltier cooling at the nanoscale using geometrical constriction. This nozzle structure leads to electron expansion under an applied bias, which in turn results in additional cooling, which is additive to Peltier cooling. Next, I will discuss Thomson cooling and material design, wherein large Thomson coefficients are achievable under structural, electronic, or magnetic phase transitions. Finally, I will present our recent study of metallic alloys for active cooling applications.

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10:30AM

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Speaker
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Mona Zebarjadi is an Associate Professor of Electrical and Computer Engineering and Materials Science and Engineering Departments at the University of Virginia, where she is leading the Energy Science, Nanotechnology, and Imagination Lab (ESNAIL). Prior to her current appointment, she was an assistant professor in the Mechanical Engineering Department at Rutgers University. Her research interests are in electron and phonon transport modeling; materials and device design, fabrication, and characterization; with emphasis on energy conversion systems such as thermoelectric, thermionic, and thermomagnetic power generators, and heat management in high-power electronics and optoelectronic devices. She received her bachelor's and master's degrees in physics from Sharif University and her Ph.D. in EE from UCSC in 2009, after which she spent 3 years at MIT as a postdoctoral fellow working jointly with electrical and mechanical engineering departments. She is the recipient of the 2017 NSF Career Award, 2014 AFOSR Young Investigator Award, 2015 A.W. Tyson Assistant Professorship Award, MRS Graduate Student Gold Medal, and SWE Electronics for imaging scholarship. She co-authored more than 100 publications (book chapters and peer-reviewed journal papers) and has delivered more than 70 invited talks.

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