University at Buffalo
Department of Electrical Engineering
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HEAT SWITCHING USING THERMOMAGNETIC DEVICES AND CARBON NANOTUBE MACROMATERIALS

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Abstract: This talk discusses two routes to develop thermal switches for improved thermal regulation. Heat switching allows electronics, batteries, sensors, and buildings to be kept at a constant temperature over a range of external thermal conditions, leading to improved energy efficiency and durability. First, I will discuss our centimeter-scale thermal switches leveraging temperature-dependent magnetic forces to passively make/break thermal contact. These thermomagnetic devices display thermal switching, thermal rectification, and thermal transistor action with moderate (~10-100x) ON/OFF ratio and room-temperature operation. Second, I will discuss the potential for solid-state thermoelectric heat switches using carbon nanotube (CNT) fibers and films. Materials with high thermal conductivity and high thermoelectric power factor offers potential for thermal switching via on-demand Peltier cooling. Our thermal measurements demonstrate that CNT fibers and films are the best existing p-type material for active thermoelectric switching, motivating further device-level demonstrations for electronic cooling and fundamental studies of thermal transport in aligned nanotube materials.

Bio: Geoff Wehmeyer is an assistant professor in Mechanical Engineering at Rice University. He received his B.S. in Mechanical Engineering from the University of Texas at Austin in 2013 and his Ph.D. in Mechanical Engineering from the University of California, Berkeley in 2018 before joining the faculty at Rice. His research interests include thermal property measurements of nanomaterials and switchable/nonlinear thermal devices for advanced thermal management. His group's research has been recognized with a NSF CAREER award and a NASA Early Career Faculty award.

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