Selected Stories of the Hot and Small: Nanofabricated Tools for Thermal Measurements

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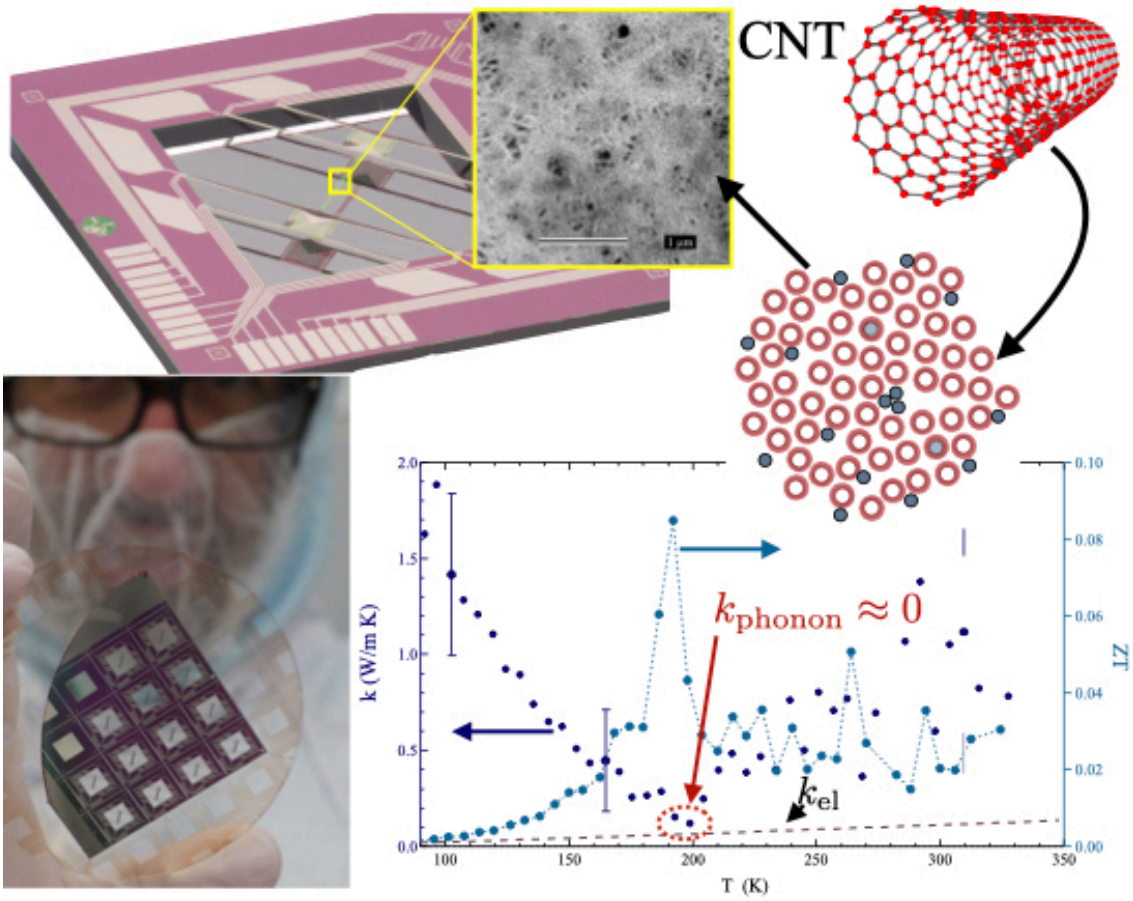
Abstract:
Management of heat is increasingly important in advancing technology, and is particularly critical for nanoelectronics and green energy. Desire to reduce heating or use unwanted heat to generate useful work continues to drive research into materials for heat management and thermoelectric systems that convert waste heat to electricity. Nanoscale engineering of these materials bring both tremendous promise and serious fundamental measurement challenges. In this talk I will motivate these challenges, and show how unique approaches using micro- and nanomachining can produce tools capable of probing fundamental thermal physics and materials properties of thin films and nanostructures. Growth and patterning of thin silicon-nitride membranes are central to our approach to measuring nanoscale thermal properties. I will overview fabrication techniques for these suspended structures, and give examples and key results ranging from carbon nanotube networks for energy harvesting, to pure spin currents in metallic nanostructures, to surprisingly suppressed heat conductivity in thin gold and copper films.



Prof. Barry L. Zink leads a research group at the University of Denver focusing on measurements of heat, charge, and spin transport in thin films and nanostructures. These measurements are often enabled by micro- and nanomachined thermal isolation platforms that use free-standing silicon-nitride membranes. Barry completed his PhD at UC San Diego in 2002, and has earned honors including the Piercy Distinguished Visiting Professorship (U. Minnesota), the NSF CAREER award and the NRC Post-doc. Current projects he and his team of graduate and undergraduate researchers are exploring range from developing new materials for small-scale cooling and energy conversion to understanding how spin travels in antiferromagnetic systems. His group's research has to date been supported by the National Science Foundation (DMR and EECS), the Nanoelectronics Research Initiative, the Petroleum Research Fund, and others.