物質科学セミナー　2026/2/19 17:00 総合研究棟 B310

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**Title:** Controlling Heat Conduction in Graphene and Carbon Nanomaterials by Strain and Isotope Engineering

**Abstract:** Efficient control of heat flow is important for electronics, batteries, and thermal energy systems. Carbon nanomaterials such as graphene and ultrathin graphite are attractive because they can combine very high thermal conductivity with low density and flexible design. In this seminar, I will show how heat conduction in these materials can be controlled by two main approaches: mechanical strain and isotopic composition, and how this understanding supports the design of three-dimensional carbon architectures. First, I will introduce measurements of graphene-coated copper under uniaxial tensile strain using optothermal Raman thermometry and a new thermal model that includes convection, radiation, and substrate effects. These results show how strain and the graphene–metal interface change the effective thermal conduction of a thin coating. Second, I will discuss isotope engineering in ultrathin graphite, where changing the $^{12}C/^{13}C$ ratio modifies phonon scattering and clarifies when isotope control is an effective tool for adjusting thermal conductivity. Finally, I will briefly describe graphene and ultrathin-graphite foams as three-dimensional conductive networks that use this understanding to improve heat transport in phase-change materials and battery electrodes. This seminar is presented in connection with the JSPS Invitational Fellowship for Research in Japan and is intended to support discussions, lectures, and new collaborative ties with Japanese colleagues, including future joint experiments and related exchange activities.

**Biography:** Dr. Michael T. Pettes is a Deputy Group Leader and Staff Scientist at the Center for Integrated Nanotechnologies, a U.S. Department of Energy Nanoscale Science Research Center user facility. His research develops fundamental understanding of structure–property relationships in condensed matter and nanomaterials to enable new functionality for energy, optical, mechanical, and quantum technologies. He earned a B.S. in Mechanical Engineering from Duke University and an M.S. and Ph.D. in Mechanical Engineering from The University of Texas at Austin. Selected honors include the Japan Society for the Promotion of Science Short-term Invitational Fellowship (2025), Fellow of the American Society of Mechanical Engineers (2023), the U.S. Department of Energy LDRD Early Career Research Award (2019), the National Science Foundation CAREER Award (2016) and Graduate Research Fellowship (2006), and selection to the National Academy of Engineering US–EU Frontiers of Engineering (2019) and Frontiers of Engineering Education (2016) symposia. In 2019, he was also an invited participant in the Young Leaders Program of the 16th Science and Technology in Society (STS) forum in Kyoto, Japan, as one of approximately a dozen early-career researchers representing the United States.