THE MATERIALS SCIENCE AND ENGINEERING DEPARTMENT WINTER COLLOQUIUM SERIES PRESENTS:

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Understanding and Engineering Electron and Phonon Transport in Thermal and Thermoelectric Materials

This talk will discuss our recent work aiming to understand and engineer electron and phonon thermal and thermoelectric transport in different materials via simulation and experiments. First principles simulation of phonon transport has revealed wide spectrum of phonon mean free path distributions, which can be probed via recently developed optically-based phonon mean free path spectroscopy techniques. These simulations have led to new discoveries of high thermal conductivity materials, such as our recent reports of BAs and isotopically enriched cubic BN with record high thermal conductivities. Phonon hydrodynamic transport has been predicted and verified in graphite over 100K, which is an order magnitude higher in temperature than past reports. Inroads have also been made on first-principles simulation of electron-phonon and electron impurity interactions for thermoelectric transport, leading to detailed understanding of electron scattering mechanisms in single crystals and alloys. I will especially highlights chemical insights we gained on the reasons behind the high thermoelectric power factor in half-heusler and the effects of electronegativity on electron mobility that are important for electronics and for thermoelectric energy conversion.

Gang Chen is the Carl Richard Soderberg Professor of Power Engineering at Massachusetts Institute of Technology (MIT). He served as the Department Head of the Department of Mechanical Engineering at MIT from 2013 to 2018, and as the director of the "Solid-State Solar-Thermal Energy Conversion Center (S3TEC Center)" - an Energy Frontier Research Center funded by the US Department of Energy from 2009 to 2019. He obtained his PhD degree from the Mechanical Engineering Department at UC Berkeley. He was a faculty member at Duke University and UCLA, before joining MIT in 2001. He received an NSF Young Investigator Award, an R&D 100 award, an ASME Heat Transfer Memorial Award and an ASME Frank Kreith Energy Award, a Nukiyama Memorial Award by the Japan Heat Transfer Society, a World Technology Network Award in Energy, an Eringen medal from the Society of Engineering Science, and the Capers and Marion McDonald Award for Excellences in Mentoring and Advising from MIT. He is a fellow of American Association for the Advancement of Science, APS, ASME, the Guggenheim Foundation, and the American Academy of Arts and Sciences. He is an academician of Academia Sinica and a member of the US National Academy of Engineering.

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