THE MATERIALS SCIENCE AND ENGINEERING DEPARTMENT SPRING COLLOQUIUM SERIES PRESENTS:

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When quantum materials get hot: anomalous thermal conduction and radiation

Heat conduction in and radiation from solids provides a unique window to probe solid state physics, and also plays a pivotal role for a wide range of industry applications. Although it is a traditional research focus in mechanical engineering, study of heat transfer from materials scientists' perspective would result in new discovery, new insight and new applications.

In this talk, I will show our recent work on understanding novel charge dynamics and electron-phonon interactions of quantum materials with electronic phase transitions. An unusually low electronic thermal conductivity is found in metallic vanadium dioxide, and is a signature of absence of quasiparticles in a strongly correlated electron fluid where heat and charge diffuse independently. An unusual, temperature-independent lattice thermal conductivity is found in crystalline tantalum disulfide, which is attributed to strong electron-phonon coupling that dominates over the conventional phonon-phonon scattering.

I will also discuss how we engineer these materials for novel thermal applications. By grading or meta-structuring the metal-insulator phase transition, we demonstrate temperature-indepdendent thermal radiation which is used for a superior infrared camouflage and decoy, as well as switchable thermal radiation which is used for smart radiative cooling.

Professor Junqiao Wu received a B.S. from Fudan University and a M.S. from Peking University, China. He obtained a Ph.D. degree from the University of California, Berkeley, and did postdoctoral research at Harvard University. He is currently a professor at the Department of Materials Science and Engineering, and the Chair of the Applied Science and Technology Graduate Group at UC Berkeley, and also holds joint appointment at the Lawrence Berkeley National Laboratory. His honors include the 29th Ross N. Tucker Memorial Award, the US-NSF Career Award, the US-DOE Early Career Award, the Presidential Early Career Award for Scientists and Engineers (PECASE) from the White House, the Outstanding Alumni Award from Peking University China, and the Fellow of APS. The Wu group explores novel properties and applications of nanomaterials, phase transitions at the nanoscale, and optoelectronic, thermal and thermoelectric properties of electronic materials. Prof. Wu has published over 200 widely cited papers in these fields.

Tuesday, April 9 • 4 pm | Tech L361

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