北京大学量子材料科学中心
International Center for Quantum Materials, PKU

Seminar

Thermal conduction in solids: playing with it as a materials physicist

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Venue: Room W563, Physics Building, Peking University

地点：北京大学物理楼 西563

Abstract

Heat transfer in solids provides a window for scientific study of 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 physicists' perspective would result in new discovery, new insight and new potential applications.

In this talk, I will show our recent work on understanding novel charge dynamics of VO_2 by investigating its electronic thermal conductivity across its metal-insulator phase transition. An unusually low electronic thermal conductivity is found, and different from previously established conduction mechanisms, it is a signature of absence of quasiparticles in a strongly correlated electron fluid where heat and charge diffuse independently. We have used similar approach to investigate heat transfer physics of 2D materials, such as Bi_2Te_3, black phosphorus, and TaS_2.

I will also share another story of ion-write micro-thermotic platform. We demonstrate a monolithic material structure on which nearly arbitrary microscale thermal metamaterial patterns can be written and programmed. It is based on a single, suspended crystalline membrane whose thermal conductivity is locally, continuously and reversibly engineered over a wide range and with fine spatial resolution by focused ion irradiation. Our thermal cloak and thermal rectifier demonstrations show how the platform can be used to create thermal metamaterials that control heat flow at the microscale, akin to what nanofluidics does for fluids.

About the Speaker

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 for work on nitride semiconductors and highly mismatched semiconductor alloys. He did postdoctoral research at Harvard University on phase transitions in transition metal oxide nanomaterials. He began his faculty appointment in the Department of Materials Science and Engineering at UC Berkeley in 2006. 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, and the Bakar Faculty Fellows Award. He is currently the Chair of the Applied Science and Technology Graduate Group at UC Berkeley, and holds joint appointment at the Lawrence Berkeley National Laboratory, and adjunct professorship at Peking University and the Tsinghua-Berkeley Shenzhen Institute.

The Wu group explores novel properties and applications of strongly correlated electron materials, phase transitions at the nanoscale, and optoelectronic, thermal and thermoelectric properties of semiconductor alloys and interfaces. Prof. Wu has published over 200 widely cited papers in these fields. More information can be found at http://www.mse.berkeley.edu/~jwu