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Thermal and Electron Transport in Van der Waals Solids

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ABSTRACT:

Van der Waals (VdW) Solids, such as graphene and transition metal dichalcogenides, have shown tremendous potentials as novel electronic and quantum materials. Research of our group centers around characterizing thermal and electron transport in VdW solids with ultrafast laser spectroscopy. For thermal transport measurement, a picosecond laser acts as a heating pulse to increase the sample surface temperature, another continuous wave laser monitors the surface temperature change with time, from which thermal conductivity can be determined. Using our home-built transient thermoreflectance (TTR) spectrometer, we studied the change of thermal conductivity of MoS2 under extreme strain, and observed ~8 times enhancement under 9% compressive strain. A grating imaging technique was also developed to measure the in-plane thermal conductivity. For electron transport characterization, a femtosecond laser excites electrons from valence band to conduction band, and another femtosecond laser monitors the surface reflectivity change with femtosecond time resolution, from which details of ultrafast carrier dynamics can be revealed. I will present a couple of case studies in MoSe2 and ReS2. A similar grating imaging technique has been implemented to measure carrier diffusion in graphene.

BIOGRAPHY:

Dr. Yaguo Wang is currently an Associate Professor and Walker Scholar at Walker Department of Mechanical Engineering at UT Austin. Yaguo Wang received her Bachelor's degree from the University of Science and Technology of China (USTC) in 2005 and her Ph.D. degree from the Department of Mechanical Engineering, Purdue University, Indiana, in 2011. After one-year's postdoctoral experience at Purdue University, she joined the faculty of UT Austin in 2013. Dr. Wang received the NSF Career Award in 2014. Dr. Wang is devoted to promoting an interdisciplinary experimental approach to address fundamental scientific problems in the areas of thermal sciences, ultrafast optics and material science. Dr. Wang's research interests include developing and utilizing time-resolved laser spectroscopy to study interactions among photons, phonons and electrons, as well as to characterize macroscopic electrical and thermal properties in a wide-range of materials, including metal films, semiconductor nanostructures and 2D materials. Results from her research advance the understanding of fundamental physics of electron/phonon transport in these materials and facilitate the development of high-performance next-generation electronic devices with improved thermal stability. Dr. Wang has published more than 40 articles in prestigious journals and conference proceedings, including Physical Review Letters, Advanced Materials, NPJ 2D Materials and Applications (a nature partner journal), Advanced Optical Materials, and Optics Letters. Two provisional patents have been filed based on the laser spectroscopic tools developed in her research group. Dr. Wang is very active in serving her research community by organizing conference sessions and reviewing proposals for the federal government (NSF, DOE, ARO, NASA, etc) and private foundations. Dr. Wang has tremendous enthusiasm in promoting the next-generation of women/minority scholars in engineering and science. She has advised three female graduate students and 16 female undergraduate students on research projects. Her research group has developed two educational models to teach K-12 students and teachers about the nature of light and basic optical principles.