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Optical techniques to study electronic transport in solids HUI ZHAO, University of Kansas — In most transport studies, currents are generated and detected by electrical techniques. Although these techniques can have superior sensitivities and high spatial resolution, most of them require contacts and device fabrications, can only study steady-state transport, and are insensitive to spin. I will present three optical techniques based on ultrafast lasers that are complementary to these traditional techniques, and can overcome some of the limitations. First, a coherent control technique by utilizing quantum interference between multiple interband transitions can be used to generate ballistic charge and spin currents. Second, by incorporating a differential detection scheme in transient absorption microscopy, we can monitor transport of electrons with sub-nanometer spatial resolution and femtosecond time resolution, even with micrometer-sized laser spots. Third, we use nonlinear optical effects induced by currents to achieve non-invasive and non-destructive detection of charge and spin currents in real time. By combining these techniques, we have recently studied intrinsic spin Hall effect, plasma oscillation, optical effects of spin currents in GaAs, and charge carrier diffusion in several nanoscale materials.

Hui Zhao
University of Kansas

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