Mechanical Engineering Department Seminar

3:35pm November 12, 2014
1130 Mechanical Engineering
111 Church Street SE, Minneapolis, MN 55455

Thermal Transport in Polymer and Fullerene-Derivative Thin Films and Nanoscale Thermal Phenomena in Heat-Assisted Magnetic Recording

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Part I: Organic semiconducting polymers can exhibit low thermal conductivities while maintaining electrical conductivities on the order of that of lightly doped silicon, suggesting they may be potential candidates for thermoelectric power generation and refrigeration. We report on the thermal conductivities of four common semiconducting polymers as both a function of temperature and film thickness via time domain thermoreflectance. The thermal conductivities of these polymers span nearly an order of magnitude at room temperature, and some represent the lowest ever reported for any fully dense solid.

Part II: Heat-Assisted Magnetic Recording (HAMR) uses a near-IR laser to heat a small area of a magnetic recording medium in order to reduce its coercivity below that of the magnetic field generated by the recording head. In this presentation we will introduce thermo-optical models employed to study the thermal response of an NFT and recording media during HAMR operation. Within these models a collection of nanoscale thermal phenomena can be accounted for, including experimentally determined size-dependent thermal conductivities, measured metal-dielectric and metal-metal interface resistances, two-carrier electron-phonon transport, and the ballistic transport of hot electrons.

Transducer Cross-Section

Bio: Dr. John C. Duda received his B.S. in Mechanical Engineering from Villanova University in 2007 and his Ph.D. in Mechanical and Aerospace Engineering at the University of Virginia (U.Va.) in 2012, where his doctoral thesis focused on phonon transport in chemically ordered alloys. Following the completion of his Ph.D., John worked as a post-doctoral fellow in the Department of Mechanical and Aerospace Engineering at U.Va. where he employed ultrafast pump-probe thermometry techniques to characterize the thermal properties of semiconducting polymers and fullerene derivatives. Since 2008, John has authored or co-authored more than 50 peer-reviewed journal publications and conference proceedings, many of them appearing in some of the premier physics, engineering, and materials science journals currently in print, including Physical Review Letters, Nano Letters, and Nature Materials. At present, John is a Staff Engineer at Seagate Technology, where he designs advanced transducers for use in heat-assisted magnetic recording heads, a technology that should pave the way for the next generation of data storage solutions.