Princeton University

Department of Electrical Engineering

Optical and Optoelectronic Engineeering

Speaker: Gennady Shvets, PHD University of Texas at Austin

Date: Wednesday, June 13, 2007

Time: **3:00pm**

Room: B205 ~ Equad

Title: Sub-wavelength imaging in mid-infrared: from superlensing to plasmonic endoscopes

Abstract:

Mid-infrared is one of the most important segments of the optical spectrum because it contains the "fingerprints" of most biological molecules. An explosion of near-field techniques (e.g., spectroscopy with sub-cellular resolution, labels-free detection) motivates the development of new sub-wavelength imaging tools. Experimental demonstration of a near-field super-lens in the mid-infrared (around 11 microns) range will be described. The lens is implemented using crystalline SiC films that have remarkable infrared properties: they support surface polaritons with less damping than most metals. Two demonstrations of super-lensing with /20 spatial resolution will be demonstrated: (a) using FTIR microscopy [1], and (b) by direct near-field probing with NSOM [2]. Both amplitude and phase-sensitive imaging is demonstrated. It is also demonstrated that super-lensing can be used for sub-surface imaging. Applications to biologically-relevant imaging through water in nanofluidic channels will be discussed. In the second half of the talk, I will describe a novel imaging tool in IR/THZ: tapered multi-wire coaxial endoscope. Using a conventional coaxial waveguide (the ultimate sub-wavelength element!) as an inspiration, I will demonstrate how two types of nanoscale imaging applications are enabled: image magnification and radiation focusing. In the first scenario, the tapered wire array acts as a multi-pixel TEM endoscope by capturing a detailed electromagnetic field profile created by deeply sub-wavelength objects at the endoscope's tip and magnifying it for observation. The resulting imaging method is superior to the conventional scanning microscopy because of the parallel nature of the image acquisition by multiple metal wires. In the second scenario, the image of a large mask at the endoscope's base can be projected into a much smaller image at the tip, paving the way to novel lithographic techniques.

[1] D. Korobkin, Y.Urzhumov, and G.Shvets, "Enhanced Near-Field Resolution in Mid-Infrared Using Metamaterials", JOSA B **23,** 467 (2006).
[2] T. Taubner, D.Korobkin, Y.Urzhumov, G.Shvets, and R.Hillenbrand, "Near-field microscopy through a SiC superlens", Science **313,** 1595 (2006).