

Announcing the Final Examination of Farnood Khalilzadeh Rezaie for the Degree of Doctor of Philosophy in Physics

Date: Tuesday, May 19, 2015

Time: 2:00 p.m.

Room: PSB 161 (Physical Sciences Building, Room 161)

Dissertation title: Mid-infrared plasmonics

Abstract:

This dissertation reports investigations into materials for, and applications of, infrared surface plasmon polaritons (SPP). SPPs are inhomogeneous electromagnetic waves that are bound to the surface of a conductor. Tight confinement of electromagnetic energy, the primary virtue of SPPs for so-called “plasmonic” applications, requires plasma frequencies for the conductor near the intended infrared operational frequencies. This requires carrier concentrations that are much less than those of usual metals such as gold and silver. I have investigated the optical properties and SPP excitation resonances of two materials having infrared plasma frequencies, namely the semimetal bismuth and the transparent conducting fluorine-doped tin-oxide (FTO). The complex permittivity spectra for evaporated films of Bi were found to be distinctly different than earlier reports for crystal or polycrystalline films, and SPP excitation resonances on Bi-coated gratings were found to be disappointingly broad. Permittivity spectra for chemical spray deposited FTO were obtained to long-wave IR wavelengths for the first time, and nano-crystalline FTO-coated silicon lamellar gratings show remarkable conformity. SPP excitation resonances for FTO are more promising than for Bi. Thus, FTO appears to be a promising SPP host for infrared plasmonics, e.g. a planer waveguide plasmonic spectral sensor, whose design was elaborated and investigated as part of my research and which requires SPP-host coating on deep vertical side walls of a trench-like analyte interaction region. Additionally, FTO may serve as a useful conducting oxide for a near-IR plasmonic spectral imager that I have investigated theoretically.

Outline of Studies:

Major: Physics

Educational Career:

M.S. in Physics, University of Central Florida, 2011

B.S. in Atomic-Molecular Physics, University of Tehran, 2009

Committee in Charge:

Dr. Robert Peale (Chair)

Dr. Masa Ishigami

Dr. Winston Schoenfeld

Dr. Reza Abdolvand

Dr. Walter Buchwald (External Committee Member)

Approved for distribution by Dr. Robert Peale, Committee Chair, on May 11, 2015.

The public is welcome to attend.