Stevens Institute of Technology

Nanotechnology Graduate Program

Optimal design of advanced plasmonic materials for subwavelength optics

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The interaction of light with noble metal nanoparticles and with arrays thereof has inspired scientists for several centuries and continues to offer new and fascinating questions for fundamental research along with new opportunities for applications in nanoscience and nanotechnology. In modern nanophotonics, such particles are widely researched for applications ranging from novel sensors and medical diagnostics through enhanced solar cells and nonlinear light sources to single molecule spectroscopy and 3D atom probe technology. Among several intriguing questions in this research is the long-standing problem of controlling light below the subdiffraction limit aiming for optical nanodevices and nanoscaled coherent sources operating in the visible region of spectrum, and also for understanding of fundamentals of near fields and their interaction with atoms and molecules. In this talk I will cover various physical aspects of nanoplasmonics. First, I will introduce the phase-polarization control technique to control pathways of electromagnetic energy propagation through multiple nanoarray intersections. Next, I will illustrate the possibility of light trapping and funneling in plasmonic crystals. I will demonstrate how an optimal control approach based on multiple parameter genetic algorithms can be applied to the design of plasmonic nanoconstructs with pre-determined optical properties. I will also present several future research directions such as optical control of quantum systems via plasmon driven near-fields, surface- and tip-enhanced Raman spectroscopies, and the design of nanoscale light sources with controllable coherence and polarization properties that could serve for coherent control of molecular and electronic dynamics in the nanoscale.

Professor Maxim Sukharev received his Ph.D. Degree in Physics from the General Physics Institute of the Russian Academy of Sciences (Moscow, Russia) in 2000. Prior to joining the Arizona State University this year, he held research positions at the Fiber Optics Research Center (Moscow, Russia), the Laboratory of Molecular Photophysics in the University of Paris South (Orsay, France), and Northwestern University. He joined Arizona State University as an assistant professor of physics in August 2008. In 2007 Dr. Sukharev received the Department of Energy Innovative and Novel Computational Impact on Theory and Experiment (INCITE) award.

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