Extreme Manipulation of Light with Plasmonics and Metamaterials

Wenshan Cai, Ph.D.
Postdoctoral Scholar
The Geballe Laboratory for Advanced Materials
Stanford University

Abstract: Metallic nanostructures have provided us with a unique opportunity to manipulate light in an unconventional manner. They have enabled both new fundamental physics and fascinating practical applications. Collectively, subwavelength metallic structures serve as building blocks for optical metamaterials with properties that were not observed or even speculated about in the past. Individually, metallic structures can be crafted into plasmonic nanodevices that enable routing, concentration, and active control of light beyond the conventional diffraction limit. This is a very exciting frontier in optics and materials science, with the promising goal of yielding better solar cells, faster computer chips, ultrasensitive biochemical detectors, and even invisible devices. In this talk I will present my recent work on both plasmonics and metamaterials. Topics to be discussed on metamaterials include experimental demonstrations of the first magnetic metamaterial across the entire visible spectrum, and the world’s first negative-index material at optical frequencies. The unique flexibility in tailoring material properties rendered by metamaterial research allows us to control electromagnetic waves using a tool called transformation optics, with optical cloaking being a prominent example. As for individual plasmonic devices, I will discuss passive routing elements using three-dimensional metallic slot waveguides as well as active plasmonic electrooptic modulators. Finally I will show an extreme case of light creation and manipulation in plasmonics: electrically controlled nonlinear harmonic generation of light in a metallic nanocavity.

Monday, February 14, 2011
11:00 a.m.
Bryan Hall, Room 305
(Light refreshments will be served.)

Host: Arye Nehorai

Bio: Dr. Wenshan Cai is currently a postdoctoral scholar at the Geballe Laboratory for Advanced Materials at Stanford University. His scientific research is in the area of nanophotonic materials and devices, in which he has made major impact to the evolving field of plasmonics and metamaterials. Dr. Cai has published approximately 30 papers in peer-reviewed journals, and the total citations of his recent papers have exceeded 1,500 within the past five years. He is a reviewer of over 20 scientific journals. In addition, he is the lead author of the book Optical Metamaterials: Fundamentals and Applications (ISBN: 978-1-4419-1150-6, Springer, 2009) which is now used as a textbook or a major reference in many universities around the world.

A native of China, Wenshan Cai received his B.S. and M.S. degrees in Electronic Engineering from Tsinghua University, Beijing, in 2000 and 2002, respectively, and his Ph.D. in Electrical and Computer Engineering from Purdue University in 2008. His honors include the 2006 Nanotech Briefs Nano 50 Award, the 2007 Chinese Government Award for Outstanding Students Abroad, and the 2008 Optical Society of America New Focus/Bookham Student Award.