MATERIALS AND FIELDS AT THE NANOSCALE: DESIGN AND ENGINEERING OF PHOTONIC-PLASMONIC RESONANT INTERACTIONS

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The ability to design light-matter interactions using metal-dielectric nanostructures is at the heart of nanoplasmonics and nano-optics technologies. Efficient approaches for nanoscale electromagnetic field enhancement, concentration and manipulation over defined spatial-spectral bandwidths are enabled by the control of propagating and non-propagating electromagnetic fields in resonant optical nanomaterials. Recent advancements in the design, fabrication and characterization of periodic and aperiodic metal-dielectric arrays of nanoparticles offer unique opportunities to produce novel functionalities that leverage *photonic-plasmonic coupled resonances* for the demonstration of broadband linear and nonlinear nano-antennas, optical switchers, nanoscale energy concentrators, laser cavities, and optical biosensors. In this talk, I will discuss recent results on the design and engineering of sub-wavelength field localization in metallic and metal-dielectric nanostructures with enhanced optical cross sections for light emission, energy conversion, optical sensing, and nonlinear nano-optics integrated within the widespread and inexpensive silicon platform. Finally, I will introduce our recent work on the theory and engineering of Orbital Angular Momentum (OAM) of light in diffractively coupled plasmonic nanostructures, which provides a novel and powerful approach to multiplexed optical communication and cryptography.

The purpose of my talk is twofold: a) to present main concepts in the context of nano-optical device applications; b) to stimulate a broader discussion on analytical and numerical techniques for the predictive design of multi-scale optical nanostructures.

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