Nanophotonics: Searching for new phenomena and devices

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Scaling of nanophotonic components to their ultimate dimensions, new phenomena and device concepts for a potentially wide range of applications will be discussed. I will focus in particular on devices based on optical antennas, nanowires and coupled waveguides.

A new class of devices called *near-field laser antennae* consisting of metallic nanostructures defined on the facet of a semiconductor laser will be discussed. We have directly observed the highly localized enhancement of the laser intensity produced by surface plasmons in the nanometric gap of the antenna using apertureless NSOM. These active optical antennas have potentially wide ranging applications such as ultrahigh density optical recording, high-resolution spatially resolved imaging and spectroscopy, and laser assisted processing and repair of masks and circuits.

Imaging and spectroscopy of novel nanowire photonic crystal structures with engineered artificial defects demonstrate localized emission and light suppression in the region of the photonic crystal. One-dimensional photonic crystal cavities have been used to improve the reflectivity of the nanowire end facets and nanowire racetrack resonators have been implemented. Next I will discuss the fabrication and characterization of free standing gold nanowires. These nanowires are made by a novel fabrication technique that combines photolithography, thin-film metal deposition, and thin-film sectioning and produces nanowires with high aspect ratio cross-sections. This method allows one to reproducibly make high aspect ratio nanowires without requiring the use of e-beam lithography.

In the last part of the talk calculations of the forces arising from then overlap between the guided waves of parallel nanophotonic waveguides are presented. Both repulsive *and* attractive forces, determined by the choice of the relative input phase are found. Using realistic parameters for a silicon-on-insulator material system, we have estimated that the forces are large enough to cause observable displacements, making them suitable for a broad class of optically tunable microphotonic devices such as new optical routers.

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