Nanophotonics: From light manipulation to quantum levitation at the nanoscale

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Surface plasmon polaritons (SPPs) allow one to achieve concentration of light into sub-wavelength regions, thus opening up rich new directions in physical optics and photonics.

A wide range of phenomena and applications enabled by SPPs and bridging several fields, are currently being investigated by our group and will be presented in this talk:

(a) plasmonic collimators that make it possible to dramatically reduce the divergence of semiconductor lasers, creating exciting opportunities in beam engineering and opening the door to wave-front engineering of a broad variety of light sources;

(b) plasmonic polarizers for arbitrary control of laser polarization;

(c) new light sources, such as plasmonic laser antennas, capable of creating intense nanospots for spatially resolved chemical imaging and ultra-high-density optical storage;

(d) antenna arrays for surface-enhanced Raman scattering;

(e) frequency-selective surfaces enabled by new soft lithography techniques;

(f) optomechanical forces between waveguides at sub-wavelength distances.

Finally, at this distance scale forces arising from quantum fluctuations of the electromagnetic field cannot be neglected. They give rise to both attractive and repulsive Casimir forces. The latter, recently measured by us for the first time, could lead to mechanical devices based on quantum levitation that would exhibit ultra-low friction.

A unifying theme of this talk will be the new device and system functionalities brought about by nanophotonics and nanomechanics to go beyond the traditional application confines of photonics and electronics.