# NANOPLASMONICS – FROM FUNDAMENTAL STUDIES TO NOVEL FUNCTIONALITIES

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Surface plasmon polaritons (SPP's) were "discovered" by Ritchie[1] in the 50's, while Localized Surface Plasmons (LSP's) have been known, in practice, since ancient times. Both phenomena involve collective excitations of conduction electrons in a confined metal volume through resonant coupling to an external optical field. In contrast to bulk plasmons, surface plasmons are bound to the metal surface. This means that the electromagnetic field that accompanies the collective electron motion is in general of near-field (evanescent) character, and that special requirements need to be fulfilled in order couple far-field radiation to or from surface plasmons. Furthermore, because of their spatial confinement, plasmonic fields are enhanced compared to the excitation field. It is the resonantly enhanced near-field that make surface plasmons the key element for *nano-optics* and the basis for the emerging field of *plasmonics*. Surface plasmons in metal nanostructures are therefore of high current interest due to a range of potential applications, including miniaturized photonic circuits, surface-enhanced spectroscopy, nanoscale biosensors and metamaterials.

In this presentation, I will discuss some of our recent work on localized plasmons in gold and silver nanostructures manufactured through electron-beam lithography, colloidal lithography and focused ion-beam etching. I will describe how to tune the plasmon resonance and it's associated optical near field through a variation in the size and shape of a single nanoparticle or nanohole[2] and through a variation of the electromagnetic interaction between nearby particles[3]. The latter effect may lead to a large enhancement of the induced electric field, which is crucial for Surface-enhanced Raman Spectroscopy[4], or of the induced magnetic field[5], which may be a route towards metamaterials that exhibit negative refraction. I will also discuss the possibility to use isolated or coupled nanoplasmonic structures for molecular biosensing[6]. Finally, I will discuss the possibility to manipulate individual plasmonic nanoparticles using optical forces[7].

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