Simulation of Plasmonic Nanostructures and their Applications in Hybrid Systems

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Plasmonic nanostructures gave for various reasons a tremendous impetus to the development of optical nanoscience. At first, they allow to concentrate light in spatial domains much smaller than those usually accessible with classical optical instruments. At second, field amplitudes can be largely enhanced with respect to the incident light since plasmonic nanostructures can act as resonators. And third, with suitable nanostructures sudden spatial variations of the electromagnetic field in space can be devised. These properties render plasmonic nanostructures, i.e. optical nanoantennas, prime candidates to mediate the interaction of light with other objects and materials that are fused with the optical nanoantenna to form a hybrid system.

This talk summaries the methodology we have put in place to analyze theoretically and numerically optical properties of hybrid plasmonic systems and outlines selected applications. Examples would be optical nanoantennas that tremendously enhance molecular transitions usually not accessible in free space, optical nanoantennas that enhance the up-conversion efficiency of molecules, and optical nanoantennas that boost non-linear processes. But also applications of more immediate relevance are outlined such as for the photon management in thin film solar cells.