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Plasmonic Properties of Metallic and Hybrid Nanostructures

Nanophotonics has become a very active interdisciplinary research field during the past decades. With the development of new advent technologies, a deep understanding of the optical, electronic, thermal, and chemical properties of materials at the nanoscale became crucial. Furthermore, recent advances in the control of bottom-up and top-down nanofabrication techniques allow for the synthesis of novel materials, geometries, and devices at the nanoscale, thus revealing new physical effects and pushing away the limits of the *Terra Incognita* in nanosciences. The development of theoretical models, and the use of advanced numerical simulations and modeling, is necessary not only to correctly understand these new properties but also to guide experimentalists in the design of the future nanostructures and in the tailoring of new physical properties. Here, I will present some recent work on plasmonic nanosystems and their use for localized surface plasmon resonance sensing, electron-based and surface-enhanced spectroscopies (EELS, CL, SERS, TERS, and SHG), plasmon-enhanced chemistry, control of light, optoelectronic applications. Along the way, I will present some state-of-the-art studies of fundamental physical processes in hybrid nanostructures such as plasmon-vibration and plasmon-exciton couplings and novel computational and theoretical models and methods in EELS.

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