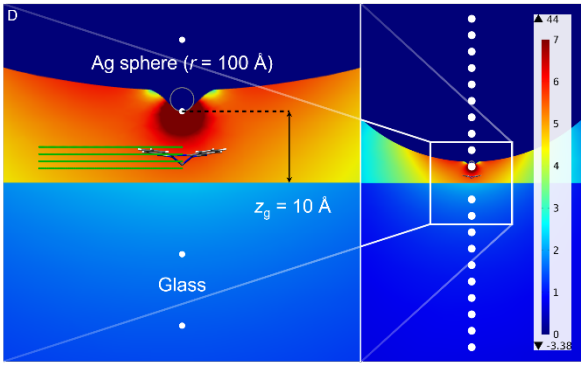
Plasmonic hybrid systems in external light fields: from high-resolution sensing to plasmonic catalysis

Content

The excitation of collective electron dynamics inside the metallic nanoparticles induced by external light fields leads to strongly re-shaped electromagnetic nearfields with a complex spatial and temporal profile. The interaction of these modified and enhanced nearfields with systems located in close vicinity to the metallic nanoparticle is the origin of many astonishing physical and chemical phenomena, such as the formation of new quasi-particles, new mechanisms for chemical reactions or the ultra-high spatial resolution and selectivity in molecular detection.
Besides being of fundamental interest, this interplay between nearfields and molecules promises great potential on the application side, potentially enabling breakthrough in new emerging technologies in a broad range of research fields, such as nanophotonics, energy and environmental research, biophotonics, light-harvesting energy sources, highly sensitive nano-sensors etc. This necessitates a solid theoretical understanding and simulation of these hybrid systems.
For the theoretical description of such plasmonic hybrid systems in external light fields, it is necessary to describe both the electromagnetic interaction and the more chemical effects equally. In this talk, I will introduce our recent results on the theoretical description of these systems, with particular emphasis on spectroscopic applications, e.g., in the context of tip-enhanced Raman scattering spectroscopy: several recent experiments provide evidence for an extremely high spatial resolution of this setup on the nanometer or even sub-nanometer scale. Our calculations show pronounced changes of the Raman spectrum under non-resonant and resonant conditions and support the possibility of sub-nanometer spatial resolution.

References:

[1] K. Fiederling, M. Abasifard, M. Richter, V. Deckert, S. Gräfe, S. Kupfer, "A Full Quantum Mechanical Approach Assessing the Chemical and Electromagnetic Effect in TERS", Nanoscale, 2020, 12, 6346-6359.
[2] F. Latorre, S. Kupfer, T. Bocklitz, D. Kinzel, S. Trautmann, S. Gräfe, V. Deckert, „Spatial resolution of tip-enhanced Raman spectroscopy – DFT assessment of the chemical effect", Nanoscale 2016, 8, 10229 – 10239



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