ICFO Colloquium Series: Plasmonic hybrid systems in external light fields

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12:00
ICFO Auditorium

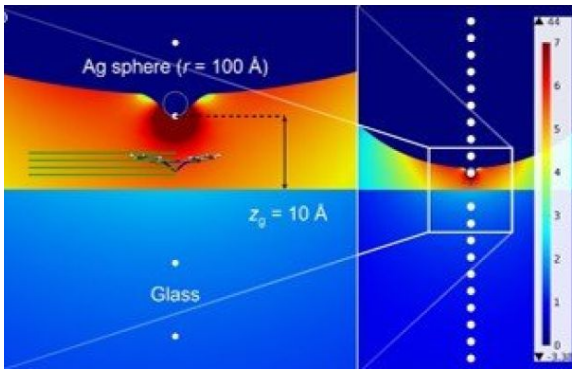
Profile:
Stefanie Grafe holds the Chair of Physical and Theoretical Chemistry, with affiliations in the Faculties of Chemistry and Physics at the Friedrich Schiller University Jena. She is also an associate member of the scientific directorate of the Fraunhofer Institute for Applied Optics and Precision Engineering in Jena since 2021. Before, she was Professor of Theoretical Chemistry and, at 34, the youngest regular professor in Jena. Previously, she had worked as a fellow at the Institute for Theoretical Physics at the Vienna University of Technology and at the Steacie Institute for Molecular Sciences of the National Research Council in Canada. She completed her PhD at the University of Würzburg under Prof. Volker Engel in 2005 at the ag of 25. Both her diploma thesis and her doctoral dissertation were awarded the Faculty Priz of the Faculty of Chemistry and Pharmacy at the University of Würzburg. The research

f Stefanie Grafe is focused on the highly interdisciplinary field of light-matter interaction. T e highlight of her research activities is the acquisition of a prestigious and highly endowed E C Consolidator Grant in 2017 for the theoretical investigation and description of light-induc d complex dynamics of molecular-plasmonic hybrid systems (QUEM-CHEM). Since 2019, she i , together with Prof. Ulf Peschel, co-speaker of the Collaborative Research Center NOA - Nonlinear Optics down to Atomic scales. Stefanie Grafe is also active in several internation l research and steering committees, including in the COST Action "Attosecond Chemistry", t e Board of the Atomic and Molecular Physics Division of the European Physical Society, and t e US-German Initiative on Solar Fuels Research.

Abstract:
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. Grafe, S. Kupfer, i¿½A Fu l Quantum Mechanical Approach Assessing the Chemical and Electromagnetic Effect n TERSi¿½Nanoscale, **2020**, 12, 6346-6359.
[2] F. Latorre, S. Kupfer, T. Bocklitz, D. Kinzel, S. Trautmann, S. Grafe, V. Deckert, ?Spatial resolution of tip-enhanced Raman spectroscopy - DFT assessment of the chemical effecti¿½, Nanoscale **2016**, 8, 10229 - 10239

Hosted by: Prof. Jens Biegert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