

Theoretical investigation of collective resonances in metallic nano-antennas

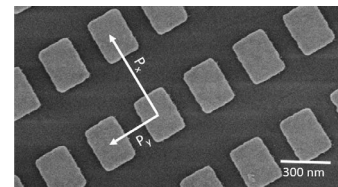
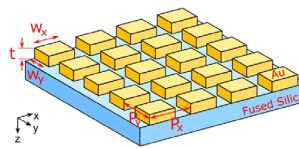
Theme / Problem definition:

The optical behavior of metals is of primary interest due to some peculiar features. Indeed, the strong coupling between photons and electrons –generating hybrid waves called plasmons– strongly affects the light propagation, yielding both a strong sub-wavelength confinement and a huge field enhancement. In this context, collective resonances involving metallic nano-antennas – dubbed Surface Lattice Resonances (SLRs) - are a novel way to achieve high Q-factors in plasmonic metastructures. The aim is to design new man-made materials with highly tunable characteristics for nonlinear optics, optical sensing, and so on.

Tasks / Aim:

We are looking for a motivated and self-driven candidate who will work in the area of plasmonics. The task is to investigate how SLRs can be enhanced by covering the metallic period structures with a layer of dielectric material.

- Learn to use a commercial numerical solver based upon the Finite Element Method (COMSOL).
- Finding the linear response of a periodic bidimensional lattice made of nano-bars.
- Repeating the computation inserting a dielectric layer on the top of the bars.
- Addressing theoretically the presence of bound states in the continuum and their influence on the observed spectra.
- The candidate is expected to have basic knowledge in optics.
- Knowledge in Python or any other programming language is highly desirable.



Left Side: sketch of a periodic distribution of metallic nano-antennas (bar shaped) deposited on a transparent substrate. Right side: SEM image of one of the metastructures realized in our laboratories.

Contact:

Dr Alessandro Alberucci
 Prof Stefan Nolte
 Ultrafast Optics, Institute of Applied Physics
 Albert-Einstein-Str. 15, 07745 Jena
alessandro.alberucci@uni-jena.de, stefan.nolte@uni-jena.de

Literature:

- Trinh, Q.T., Nguyen, S.K., Nguyen, D.H., Tran, G.K., Le, H.L., Nguyen, H.-S., and Le-Van, Q. 2022. Coexistence of surface lattice resonances and bound states in the continuum in a plasmonic lattice. *Optics Letters*, 47(6), pp. 1510-1513.
- Gour, J., Beer, S., Alberucci, A., Zeitner, U.D., and Nolte, S., 2022. Enhancement of third harmonic generation induced by surface lattice resonances in plasmonic metasurfaces. *Optics Letters*, 47(22), pp.6025-6028.
- Beer, S., Gour, J., Alberucci, A., David, C., Nolte, S., and Zeitner, U.D. , 2022. Second harmonic generation under doubly resonant lattice plasmon excitation. *Optics Express*, 30(32), pp. 40884-40896.