Hybrid Nanosystems (AMOLF)

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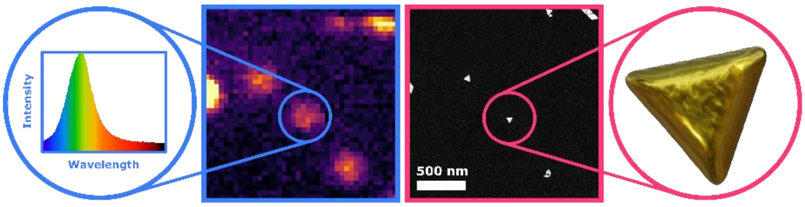

Research theme The *Hybrid Nanosystems* group combines single-particle optical and advanced electron microscopy to answer fundamental questions about the complex interaction between different classes of nanomaterials. We also explore new architectures for creating functional and smart hybrid nanosystems.

Project 1: Quantitative single-particle scattering spectroscopy
Supervisor: Patrick Spaeth, Mees Dieperink and Wiebke Albrecht

The optical properties of metal nanoparticles are very sensitive to morphological differences in size and shape. This interconnection offers an opportunity to extract structural information of an investigated nanoparticle from the optical fingerprint. In order to do so, the measuring setup needs to be fully calibrated and understood. In this project, you will measure scattering spectra of single metal nanoparticles and quantify (relative) cross sections by carefully calibrating the scattering setup and comparing the measured spectra to simulated ones. For the latter, the morphological information needed for the simulations will be obtained by correlated electron microscopy of the same nanoparticle (see image above as inspiration). Moreover, you will explore the optical response of single metal nanoparticles as a function of incident light polarization direction. The results of the project can enable a complete optical characterization of morphological features, which are much smaller than the diffraction limit of light.

Project 2: Tuneable charge transfer between metal nanoparticles through temperature sensitive molecules
Supervisor: Francesca Scalerandi and Wiebke Albrecht

When two metal nanoparticles are in close proximity, charge can be transferred from one particle to another. The efficiency of the transfer depends on the interparticle distance and composition of the gap. In this project, you will explore whether the distance between two metal nanoparticles can be dynamically manipulated by temperature-sensitive molecules in the gap. You will synthesize nanoparticle dimers with temperature-sensitive molecules between them and manipulate the interparticle distance by local laser excitation, making it possible to switch from a classical to a quantum regime. You will determine the interparticle distance of the fabricated dimers by high-resolution electron microscopy. If interested, you can furthermore investigate the optical response of the coupled dimers by optical spectroscopy and couple the experimental findings to electromagnetic simulations.

Project 3: Reliable tomographic reconstruction of small interparticle gaps
Supervisor: Wiebke Albrecht, possible collaboration with CWI

The interaction between nanoparticles depends on the three-dimensional morphology and the distance between them. Electron tomography can provide these morphological parameters but is suffering from the ‘missing wedge’ artefact, caused by the limited tilt range of tomography holders. Hence, it is not straightforward to accurately determine the size and shape of (sub-)nanometer gaps. The goal of this internship project is to find the best way to accurately determine these morphological parameters from electron tomography. To this end, you will simulate tomographic data sets of nanoparticles in close proximity and reconstruct them with different reconstruction algorithms. Depending on your interest, you can perform electron tomography experiments yourself to test your simulated findings.