Hybrid Nanosystems (AMOLF)

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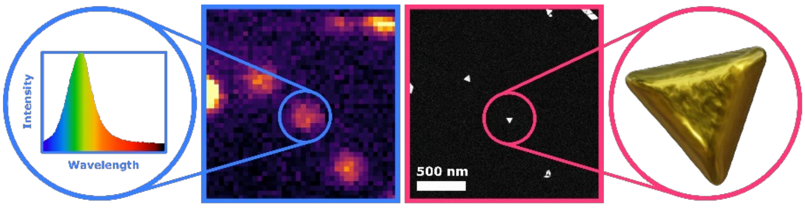

Research theme The *Hybrid Nanosystems* group combines single-particle optical and advanced electron microscopy to answer fundamental questions about the complex interaction between different classes of nanomaterials. We also explore new architectures for creating functional and smart hybrid nanosystems.

Project 1: Morphological dynamics of single core-shell bimetallic nanoparticles
Supervisor: Mees Dieperink, Ethan Kensett and Wiebke Albrecht

Plasmonic metal (e.g. Au) nanoparticles have intriguing optoelectronic properties and are used in many applications, e.g. metrology, data storage, biosensing, and catalysis. Catalytically active metal nanoparticles (e.g. Pd), however, are often poor plasmonic materials. In this project, we aim to combine plasmonically and catalytically active materials in one nanoparticle, e.g. in a core-shell configuration and study the optical properties on a single nanoparticle level with our home-built confocal scattering setup. The optical properties are then correlated to the morphology and composition of the nanostructure by performing electron microscopy on the exact same particle. In addition, you will investigate the stability of such nanoparticles *in situ* under relevant conditions.

Project 2: Interface engineering in hybrid plasmonic-semiconductor systems
Supervisor: Francesca Scalerandi and Wiebke Albrecht

Hybrid plasmonic-semiconductor systems have the potential to combine the high absorption cross section of a plasmonic metal nanoparticle with the extended lifetime of high energy hot carriers in a semiconductor if the charge carriers can be efficiently injected from the metal to the semiconductor. The quality of the interface between the two components plays a crucial role in the efficiency of charge transfer. In this project, you will work on how to engineer the interface in gold-perovskite hybrid systems either by tuning synthesis parameters or post-synthesis by ultrafast laser welding. You will use our unique Transmission Electron Microscope (TEM) equipped with light incoupling capabilities to study the process *in situ*. In this project you will have the opportunity to combine sample preparation, synthesis, and experimental characterization techniques with electromagnetic simulations. You will measure dark field scattering, time resolved photoluminescence, transient absorption spectroscopy and UV-visible absorbance and correlate the optical properties of single hybrid system to its morphology and structure.

Project 3: Correlation of particle morphology to catalytic activity
Supervisor: Loriane Monin, Devin O'Neill and Wiebke Albrecht

This project aims at investigating whether a correlation can be established between the morphology of gold nanoparticles and their catalytic activity by performing single particle structure-property correlation. Defects are expected to play a prominent role in the efficiency of catalytic reactions. In this project, you will investigate whether a correlation can be made between atomic defects and catalytic efficiencies. First, you will use laser induced heating to induce crystalline defects in gold nanoparticles. Then, you will study the catalytic activity of these different morphologies by monitoring the Resazurin to Resorufin conversion. This process can be monitored because it gives a fluorescence burst upon excitation with a 532 nm laser after conversion but before desorption. Finally, the morphology of the gold nanoparticles will be determined with electron microscopy.