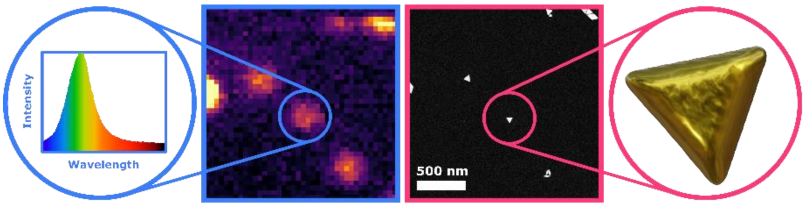
Hybrid Nanosystems (AMOLF)



Dr. Wiebke Albrecht

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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: Optical tomography by polarization-resolved single-particle scattering spectroscopy
Supervisor: Mees Dieperink and Wiebke Albrecht

Plasmonic nanoparticles (NPs) have intriguing optoelectronic properties and are used in many applications (e.g. in coatings, fabrics, and solar cells). Since the nanoscale morphology directly defines these properties, the need for single particle studies becomes more prominent. Moreover, non-isotropic plasmonic NPs have different optical responses as a function of incoming light polarization. This dependence can be used to obtain information on the NP's morphology, thereby beating the optical diffraction limit. Your project will be to incorporate polarized illumination into our confocal dark-field spectroscopy setup and to measure polarization-dependent scattering spectra of single plasmonic NPs. You will learn the ins and outs of our setup and verify your findings by correlation to transmission electron microscopy, and complement the results with electromagnetic simulations.

Project 2: Charge transfer in plasmonic dimers studied by correlating optical spectroscopy and electron microscopy

Supervisor: Francesca Scalerandi and Wiebke Albrecht

Hybrid plasmonic-semiconductor systems have the potential to combine the high absorption cross section of a plasmonic metal NP with the extended life time of high energy hot carriers in a semiconductor, if the charge carriers can be efficiently injected from the metal to the semiconductor. Direct charge transfer as a consequence of plasmon decay has been shown to be the most efficient way to do so. Would you like to deeply understand the mechanism involved in plasmon damping to ultimately optimize direct charge transfer in hybrid systems? In this project you will have the opportunity to combine sample preparation, synthesis and experimental characterization techniques with electromagnetic simulations. You will work with an advanced dark-field optical microscope to measure the optical properties of single NPs and correlate their optical response to the exact 3D morphology obtained by electron tomography.

Project 3: Monitoring heat generation of plasmonic nanoparticles within a hollow-core optical fiber
Supervisor: Patrick Spaeth and Wiebke Albrecht

Photochemistry can potentially provide a sustainable solution in chemical synthesis by using (sun) light to drive chemical reactions. We want to use plasmonic NPs, that can focus light into subwavelength volumes in order to increase the photochemical reaction rates through local heat generation. Your master project is conducted within an EU-wide project with the aim to develop a chemical reactor inside a hollow-core optical fiber. Your task will be to precisely monitor the local temperature surrounding plasmonic NPs, using state of the art optical microscopy, within the hollow-core fiber reactor. Do you like to work with an advanced optical microscope that can measure the optical spectroscopic response of single nanoparticles and measure their thermal properties? Then do not hesitate to contact us!