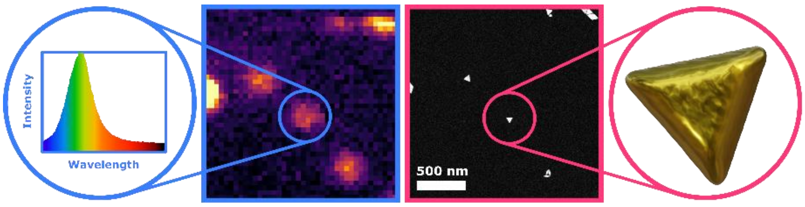
Hybrid Nanosystems (AMOLF)

Dr. Wiebke Albrecht

w.albrecht@amolf.nl, website



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: Single-particle scattering and luminescence spectroscopy

Supervisor: Wiebke Albrecht

When metal and semiconductor nanoparticles are brought in close vicinity, the charge carriers in the coupled system can interact with each other, potentially leading to charge and energy transfer. Smart manipulation of this process cannot only boost efficiencies for solar harvesting applications but is also relevant for quantum information processing. The interaction between metal and semiconductor nanoparticles can be measured by their optical scattering and luminescence properties. Since the interaction is dependent on the exact morphology of the coupled NPs, the optical measurements need to be performed on a single-particle basis to avoid averaging over a large ensemble of particle configurations. In this internship, you will build a suitable single-particle scattering and luminescence setup for performing such measurements. You will help with the planning of the setup and the assessment of its performance.

Project 2: Single nanoparticle temperature measurements

Supervisor: Wiebke Albrecht and Freddy Rabouw (Utrecht University)

Metal nanoparticles can act as local heat sources, which is particularly relevant for biomedical and catalytic applications, where controlled local heat can either destroy surrounding tumour cells or enhance local catalytic reaction rates. This internship is a collaborative project between AMOLF and Utrecht University. You will measure the local temperature around metal nanoparticles by making use of luminescent $NaYF_4$:Yb,Er nanothermometers. On the same sample, you will combine cathodoluminescence (AMOLF) and optical (UU) temperature measurements to gain more insight into controlling and measuring nanoscale heating, which can eventually be utilized in catalytic reactors.

Project 3: Reliable tomographic reconstruction of small interparticle gaps

Supervisor: Wiebke Albrecht

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. Moreover, the limited dynamic contrast of electron microscopy makes it challenging to image materials with very different densities at the same time. Hence, it is not straightforward to accurately determine the size of very small gaps and the 3D shape of hybrid nanoparticles with various components. 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 nanosystems consisting of more than one nanoparticle and reconstruct them with different reconstruction algorithms. Depending on your interest, you can perform electron tomography experiments of hybrid nanosystems to test your simulated findings.

If your interest does not fit one of the projects, feel free to contact us about alternative projects.