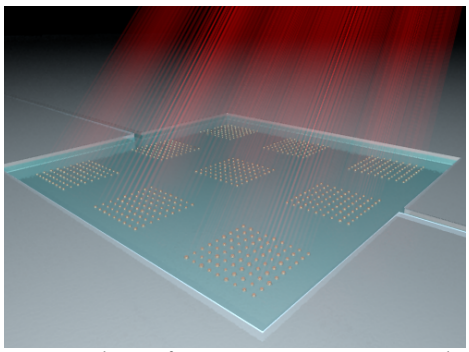
Master Thesis Project in Single Nanoparticle Characterization in Catalysis

Background



Characterization of nanoparticles is often performed by measurements averaging over large groups of particles. This can be problematic since each individual particle will be unique and important information can be lost by averaging. To alleviate this, methods capable of investigating individual nanoparticles have been developed and are today used extensively. In this context, plasmonic nanospectroscopy can be used to optically probe individual particles and has during the past decade been used to extract single particle information in several fields including studies by our group of Pd nanoparticle phase transitions (*1*), Cu oxidation (*2*) and Cu during catalytic reactions (*3*).

Thesis Scope

This project will be focused on studying how individual particles change during the course of catalytic reactions. The experimental approach used to study the particles is based on plasmonic nanospectroscopy and imaging, where nanoparticles are imaged by an optical microscope. Your job will be to develop an improved method used for data extraction that enables analysis of several thousands of particles in parallel. The goal is to be able to identify common trends and unique features among large numbers of nanoparticles.

Methods

The work will involve analysis of experimental data generated by optical microscopy and thus come in the form of images. To extract information stemming from individual particles, the raw data will have to be processed using different approaches that include image stabilization, particle tracking, data extraction and noise reduction. The end goal is to have a software package that works for different types of experimental data and various applications. Preferably, coding is done either in MATLAB or in Python.

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1. S. Alekseeva *et al.*, Grain boundary mediated hydriding phase transformations in individual polycrystalline metal nanoparticles. *Nat. Commun.* **8**, 1084 (2017).
2. S. Nilsson, D. Albinsson, T. J. Antosiewicz, J. Fritzsche, C. Langhammer, Resolving single Cu nanoparticle oxidation and Kirkendall void formation with in situ plasmonic nanospectroscopy and electrodynamic simulations. *Nanoscale*. **11**, 20725–20733 (2019).
3. D. Albinsson *et al.*, Copper catalysis at operando conditions—bridging the gap between single nanoparticle probing and catalyst-bed-averaging. *Nat. Commun.* **11**, 4832 (2020).