CCMX-ScopeM Advanced Course
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In-situ Electron Microscopy

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Abstract

State-of-the-art transmission electron microscopes are equipped with aberration correctors and provide images of atomic arrangements at sub-Ångstrom resolution. Due to various interactions between the electron beam and the observed material, it is possible to locally identify atomic species and even their chemical state using different detectors and spectroscopic tools. One of the drawback of using strongly interacting particles for imaging and structural analysis is the requirement of a good vacuum in the column of the microscope. This is a severe limitation in cases were the interaction of a sample with a specific environment is of interest, as for example, in catalysis or corrosion science. In order to be able to study materials under the influence of an external physical or chemical stimulus, we need to apply *in situ* techniques.

In the lecture, I will present some recent developments in the field of in-situ electron microscopy.

The focus will be on the investigation of gas phase- and temperature-induced dynamics, ranging from chemical vapor deposition growth of 2D films to growth of nanowires and observation of catalytic reactions. Tools and experimental set-ups, as well as limitations and possible pitfalls will be discussed. Since observation at ultimate lateral resolution is only sensible if the speed of the detectors is higher than atomistic dynamics, we will also consider the benefits of *in situ* experiments that are performed at reduced magnification in the chamber of a scanning electron microscope and discuss the potential of the combination of different *in situ* methods.

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