Mapping Charge Distribution in Nanometer-Scale Materials by Electron Holography

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Off-axis electron holography (OAEH) is a method applied in transmission electron microscopy (TEM) in order to reconstruct the phase of an electron wave after it has traversed through a thin sample. When applied at nanometer scale spatial resolution, the reconstructed phase enables to extract both electrostatic and magnetic fields.

For this talk, I will focus on the measurement of electrostatic potentials as a tool to map charge redistribution at the nanoscale in semiconducting and insulating materials. I will describe the experimental setup and methods for data analysis.

I will demonstrate advantages and limitations of OAEH by examples from research on nanoscale structures with emphasis on interfaces: PbS-CdS multipod heterostructures, Si nanowires and nanoscale granular $MgO{\cdot}Al_2O_3$ spinel. These examples can also demonstrate the capability of TEM to complement OAEH with additional characterization methods of the same nanostructures, such as spectroscopy (electron energy-loss, energy dispersive X-ray) for composition and chemical binding states, and high-resolution (phase-contrast) imaging for the crystallographic and interface structure.