MM 2: Topical Session: TEM-Symposium - Joint Session with MI I

Time: Monday 10:15–11:30 Location: H4

Topical Talk MM 2.1 Mon 10:15 H4

The potential of valence electron energy-loss spectroscopy to probe local optical properties and band structure information in scanning transmission electron microscopy — •Rolf Erni — Electron Microscopy Center, Empa, Swiss Federal Laboratories for Materials Science and Technology, CH-8600 Dübendorf, Switzerland

Valence electron energy-loss spectroscopy (VEELS) in scanning transmission electron microscopy (STEM) offers the possibility to measure band structure information and in particular band gap and transition energies of materials with (sub-)nanometer spatial resolution. Although the technique has been used to reliably identify dielectric information of various bulk and nanomaterials, VEEL spectra contain a wealth of spectral contributions which can complicate the extraction of the desired information. Retardation effects, such as Cerenkov losses, or the excitation of guided light modes as well as surface and finite-size effects can alter the bulk dielectric function contained in VEEL spectra. The dielectric theory describing these effects has been known for a long time, but the incorporation of these effects into routine simulations has not yet become standard. For materials of known dielectric function, it is possible to analyze the origin of individual spectral signatures. This allows for predicting possible spurious effects of unknown materials. The present contribution provides an overview of the applicability of VEELS for the study of nanomaterials, interface and surface effects, combining experiments with simulations which are adequate to address spectral signatures that are not describable by the common energy-loss function of bulk materials.

Topical Talk MM 2.2 Mon 10:45 H4

Application of Electron Energy-Loss Spectroscopy to Study Nanostructures and Interfaces — •Christina Scheu — Department of Chemistry & Center for NanoScience, Ludwig-Maximilians-University of Munich, 81377 Munich, Germany

Electron energy-loss spectroscopy (EELS) in the transmission electron microscope (TEM) provides information on the optical properties, the chemical composition and the electronic structure of materials down to the nanometer regime or even below. These informations are obtained by analyzing the spectral features occurring in the low-loss region (up to energy-losses of around 50 eV) or with the help of the element-specific ionization edges which are found in the core-loss region (above 50 eV). In this talk the different features are discussed under the impact of possible interface and nanostructure investigations. It will be shown that the band gap of individual semiconducting oxide nanosheets can be obtained by comparing experimental data acquired with a monochromated TEM to density functional theory calculations. Furthermore, electronic structure changes occurring at strained oxide-oxide interface will be presented. These changes can be investigated by analyzing the electron energy-loss near-edge structure which is associated with each element-specific ionization edge and which contains information on e.g. bonding characteristics and nominal oxidation states of the probed interfacial atoms.

MM 2.3 Mon 11:15 H4

Effect of lens aberrations on strain measurements from Convergent Beam Electron Diffraction patterns — •Christoph Mahr[1], Knut Müller[1], Andreas Rosenauer[1], Marco Schowalter[1], Daniel Erben[1], Josef Zweck[2], and Pavel Potapov[3] — [1]Universität Bremen — [2]Universität Regensburg — [3]GlobalFoundries, Dresden

This presentation deals with the effect of lens aberrations in a transmission electron microscope (TEM) on strain measurements in semiconductor heterostructures using Strain Analysis by Nano-Beam Electron Diffraction (SANBED). As this method is based on the analysis of disc positions in a series of Convergent Beam Electron Diffraction (CBED) patterns, strain measurements could be inexact e.g. due to lens aberrations of the projection system. The distortion field is detected by comparing the disc positions in an experimental CBED pattern obtained from a substrate region of the specimen with theoretical ones. Based on this field, we show how the distortions in all CBED patterns of a series can be corrected. Subsequently the effect of the correction on the strain measurements is investigated. It is found that the averaged difference between strain from uncorrected patterns and strain from corrected patterns is in the order of $10^{-3}\,\%$. This difference is one order less than the precisions of contemporary strain measurement techniques, such as SANBED, which has a precision of $(7-9)\cdot 10^{-2}\,\%$. Consequently, the effect of distortions in a diffraction pattern can be neglected at the moment. The effect could become more evident, when the precision of strain measurements is improved.