MM 6: Topical Session TEM II

Time: Monday 14:30–15:30 Location: IFW A

Topical Talk MM 6.1 Mon 14:30 IFW A

Excitation of Surface Plasmon Resonances in Metallic Nanostructures — •Peter van Aken[1], Wilfried Sigle[1], Burcu Ögüt[1], Nahid Talebi[1,2], Christoph Koch[1], and Ralf Vogelgesang[3] — [1]Stuttgart Center for Electron Microscopy, Stuttgart, Germany — [2]Photonics Research Laboratory, University of Tehran, Iran — [3]Max-Planck-Institute for Solid State Research, Stuttgart, Germany

In this contribution, the dielectric responses of metallic particles, like triangular Ag nanoprisms, of nanoholes and of rectangular slits in thin Ag films, drilled by using a focused ion beam, are studied by acquiring energy-filtering transmission electron microscopy (EFTEM) series on a 2k x 2k CCD camera using a 0.2 eV energy selecting slit for both the monochromator and the imaging energy filter with an acquisition time between 20 s and 30 s per image using the Zeiss SESAM microscope. We map surface plasmon resonances (SPRs) at optical wavelengths on single triangular silver nanoprisms, where extra multipolar SPRs on these nanoparticles could be detected. EFTEM images from the nanoholes in a thin Ag film were obtained at energy losses in the range from 0.6 eV to 2.8 eV. We observe localized SPRs as very pronounced intensity maxima visible in the image series. The length scale of some features is as small as 10-20 nm which can presently not be imaged by other besides electron microscopy techniques. We find two resonances that are typical for single, isolated holes. A comparison with calculations based on the discrete dipole approximation (DDSCAT) shows that these are dipolar and quadrupolar resonances.

MM 6.2 Mon 15:00 IFW A

Aberration-corrected imaging of binary metal nanoparticles — •Darius Pohl, Björn Bieniek, Elias Mohn, Ludwig Schultz, and Bernd Rellinghaus — IFW Dresden, Helmholtzstr. 20, D-01156 Dresden, Germany.

Aberration-corrected high resolution transmission electron microscopy (HRTEM) is used to study the lattice structure of single crystalline FePt and FeNi nanoparticles. Due to the delocalization-free imaging a direct and precise measurement of atom positions and lattice constants even at the very surface layers becomes feasible. For a wide range of particle sizes and morphologies, metallic nanoparticles of binary alloys are found to show an expansion of the lattice in the surface layers. In order to gain insight into the origin of the observed surface-near lattice expansion, molecular dynamics (MD) simulations were performed. A comparison of the experimental HRTEM images with the relaxed model structures clearly reveals that segregation phenomena are responsible for the dilated lattice at the particle surface.

In order to investigate the influence of oxygen on the surface-near lattice expansion, oxidation sensitive systems need to be investigated. Since FeNi is less noble and thus more susceptible to oxidation than FePt, the effect of structural changes due to oxidation should be much more pronounced in the former. From a comparison of un-oxidized and oxidized FeNi nanoparticles, the influence of oxygen on the surface-near lattice constant of the metallic particle core is determined to be almost negligible.

MM 6.3 Mon 15:15 IFW A

Metadislocations in Complex Metallic Alloys: A High-Resolution Scanning Transmission Electron Microscopy Study — •Marc Heggen, Lothar Houben, and Michael Feuerbacher — Ernst Ruska Centre for Microscopy and Spectroscopy with Electrons, Forschungszentrum Juelich GmbH, D-52425 Juelich, Germany

Metadislocations are highly complex defects which involve several hundreds of atoms in their core. We present a microstructural investigation on Metadislocations using aberration-corrected high-resolution scanning transmission electron microscopy. A novel and highly complex deformation mechanism is found which is based on the movement of a metadislocation core mediating strain and separate escort defects [1]. Upon deformation, the escort defects move along with the metadislocation core and locally transform the material structure. This mechanism implies the coordinated movement of hundreds of atoms per elementary step. Although the mechanism is very complex, it can be described by a simple jigsaw-puzzle-like rearrangement of basic structural subunits.

[1] M. Heggen, L. Houben, M. Feuerbacher, Nature Materials 9 (2010) 332.