MM 21: Topical Session: TEM-Symposium - HR Imaging & Analytic II

Time: Tuesday 11:45–13:00 Location: H4

MM 21.1 Tue 11:45 H4

Energy dispersive X-ray spectroscopy using silicon drift detectors in TEM; state and prospects — •Meiken Falke — Bruker Nano GmbH, Berlin, Germany

Energy dispersive X-ray spectroscopy (EDS) in the electron microscope uses characteristic X-rays for element identification, which are generated during the interaction of electrons with the sample. To detect a suitable amount of the X-rays generated by a small amount of matter is a challenge for EDS technology. Measures such as low dose techniques or low voltage and the demand for very fast analysis make the problem even more complicated. One part of the solution is to increase the solid angle for X-ray detection. Various approaches have been implemented. The better a sphere around the sample can be resembled, the more X-rays can be captured. Data from single and multiple chip EDS systems will be presented. Another solution for chemical analysis on the nanoscale and below is to combine the EDS-system development with adjustments in pole piece and EDS port geometry as well as in beam current quality and sample holder design. We will demonstrate that this approach can enable a solid angle of up to 1sr but also single atom X-ray spectroscopy even at a relatively low solid angle of 0.1sr using 60keV accelerating voltage to avoid radiation damage in graphene [1].

[1] T. C. Lovejoy et al., Appl. Phys. Lett.100, 154101 (2012).

MM 21.2 Tue 12:00 H4

Electron microscopy study of Y-doped BSCF — •Matthias Meffert[1], Philipp Müller[1,3], Heike Störmer[1], Christian Niedrig[2], Stefan F. Wagner[2], Ellen Ivers-Tiffée[2,3], and Dagmar Gerthsen[1,3] — [1]Laboratorium für Elektronenmikroskopie, KIT, Karlsruhe, Germany — [2]Institut für Werkstoffe der Elektrotechnik, KIT, Karlsruhe, Germany — [3]DFG Center for Functional Nanostructures, KIT, Karlsruhe, Germany

Mixed ionic-electronic conducting ceramic membranes are well suited for oxygen separation. The cubic phase of perovskite $Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$ (BSCF) has received particular attention due to its high oxygen permeability. However long-term phase stability at application relevant temperatures (700 - 800 °C) is still an issue to be solved. Oxidation of the B-site cation cobalt and a concurrent decrease of ion radius cause a slow decomposition of the cubic BSCF phase. Beside the hexagonal phase precipitates with plate-like morphology are formed which consist of a mixture of different phases.

To improve the stability of the cubic BSCF phase doping with yttrium was investigated using analytical transmission electron microscopy and scanning electron microscopy. Y-doping suppresses the formation of cobalt oxide precipitates which serve as nucleation centers for plate-like precipitates and the hexagonal phase in undoped BSCF. Hence, the hexagonal phase is only formed at grain boundary triple points (800 °C) and decorates most grain boundaries at 700 °C. Samples annealed at elevated temperatures ($\geq$900 °C) are free of secondary phases in contrast to undoped material.

MM 21.3 Tue 12:15 H4

Understanding magnetic domains of Ni-Mn-Ga films by TEM — •Christian Behler[1,2], Karin Vogel[3], Daniel Wolf[3], Sebastian Sturm[3], Anett Diestel[1], Anja Backen[1], Ludwig Schultz[1,2], Hannes Lichte[3], and Sebastian Fähler[1,2] — [1]IFW Dresden, Institute for Metallic Materials, P.O. Box 270116, 01171 Dresden, Germany — [2]Institute for Solid State Physics, Department of Physics, Dresden University of Technology, 01062 Dresden, Germany — [3]Triebenberg Laboratory, Institute of Structure Physics, Technische Universität Dresden, 01062 Dresden, Germany

Due to the high strain up to 10% magnetic shape memory alloys are of particular interest for magnetic microactuators. On the surface of suitable epitaxial, 14M modulated Ni-Mn-Ga films a magnetic stray field contrast perpendicular to twin boundaries is observed by means of magnetic force microscopy [1]. However, different domain configurations are suggested to result in such a stray field image. To determine the real magnetic domain structure within the whole films first several crosscuts of two different orientations were prepared using focused ion beam milling. Then the micromagnetic structure of these lamellas were studied using lorentz microscopy (fresnel imaging mode) and off-axis electron holography. As result we observe a magnetic domain pattern, in which the direction of magnetization follows the magnetic easy axis (c_{14M}) as well as containing 180° domain walls within one variant. This work is supported by SPP 1239, www.MagneticShape.de. [1] Anett Diestel et. al., Scripta Mat. 67 (2012),423-426

Topical Talk MM 21.4 Tue 12:30 H4

Surface plasmon coupling studies through near-field mapping of electromagnetic modes in electron microscopy — Burcu Ögüt[1], Nahid Talebi[1], Wilfried Sigle[1], Ralf Vogelgesang[2], and •Peter A. van Aken[1] — [1]Stuttgart Center for Electron Microscopy, Max-Planck Institute for Intelligent Systems, Stuttgart, Germany — [2]Institut für Physik, Carl von Ossietzky Universität Oldenburg, Oldenburg, Germany

Miniaturization technology in optics has become an emerging field with the aim of overcoming the obstacle of the diffraction limit of light. Plasmons which are coherent collective oscillations of quasi-free electrons in a metal volume or surface provide exciting new options for information transfer in channels smaller than this diffraction limit. This presentation concentrates on different plasmonic phenomena which are observed in a TEM in combination with EELS and EFTEM. Plasmonic coupling behaviour of electromagnetic fields at metallic nano-structures were investigated. The experimental results are cross-checked by different simulation techniques based on discrete dipole approximation, finite element method, and 3D finite-difference time-domain methods unveiling the precise electromagnetic field distribution. The hybridization of electromagnetic fields of closely spaced rectangular nanoslits was analysed in the framework of Babinet*s principle, and the presence of toroidal modes in a metal ring formed by an oligomer of holes was demonstrated for the first time. Resonant wedge plasmon modes in a triangular nanoprism were observed, and symmetry breaking concepts are thoroughly discussed.