MM 13: Microstructure and Phase Transformations III

Time: Monday 15:45–16:45 Location: H 0106

MM 13.1 Mon 15:45 H 0106

X-ray nanodiffraction with in situ load and pressure — •Christina Krywka[1], Angelika Zeilinger[2], Jozef Keckes[2], and Martin Müller[1] — [1]Helmholtz-Zentrum Geesthacht, Max-Planck-Straße 1, Geesthacht D-21502 — [2]Montan-Universität Leoben, Dep. Materialphysik, Jahnstraße 12/I, A-8700 Leoben

Scanning X-ray nanodiffraction (SXND) is an excellent tool for materials science. It readily serves structural information with submicrometer spatial resolution from crystalline and semi-crystalline materials, suitable to retrieve residual stress microprofiles or crystal structure. Provided a sufficiently high energy and long focal distance, SXND experiments can be performed on metallic samples and in extended sample environments, making SXND of course a highly desirable method for materials science.

SXND experiments were performed with a beam size of 350 nm * 250 nm with in situ high pressure application and with in situ nanoindentation, using homebuilt sample environments and the conditions at the Nanofocus Endstation of beamline P03 (PETRA III, Hamburg). A hydrostatic pressure cell was used in combination with a 19 keV nanobeam for the first time in order to record spatially resolved data from a fractured silver sample at (truly isotropic) hydrostatic conditions below 1 GPa. The nanoindentation setup on the other hand was used to apply directed strains of similar magnitude onto microstructured Ti-Al hard coatings at 15 keV in order to observe processes inducing fracture of the coating.

MM 13.2 Mon 16:00 H 0106

Illuminating Correlative Research using X-ray and Electron Microscopy — •Lars-Oliver Kautschor[1], Arno P. Merkle[2], Jeff Gelb[2], and Lorenz Lechner[2] — [1]Carl Zeiss Microscopy GmbH, Oberkochen, Germany — [2]Carl Zeiss X-ray Microscopy, Inc., Pleasanton, CA USA

X-ray tomography has emerged as a new powerful imaging technique that obtains 3D structural information from opaque samples under a variety of conditions and environments. It has rapidly become an accepted laboratory technique offering quantitative information in the materials sciences. We present ways in which non-destructive 3D volumetric information, obtained via laboratory nanoscale and sub-micron X-ray microscopy (XRM) are increasingly used to probe scientific questions as a complement to Electron- and Light-based microscopy methods. These correlative methods, relating to XRM, provide an opportunity to study materials evolution at multiple length scales in 3D and utilize this information to inform or guide postmortem analysis to be most efficient.

In materials research, the motivation to correlate XRM information with postmortem EM stems from different primary reasons. XRM is used as a 3D navigation system ("Google Earth" in 3D) for targeting and finding specific buried structures of interest for extraction or cross sectional imaging. We demonstrate several examples, including energy materials, automotive applications and metals, upon which the use of XRM and FIB/SEM information on the same specimen has contributed to a more complete understanding of a materials system.

MM 13.3 Mon 16:15 H 0106

In situ investigation of the microstructure in friction stir welded steels usind high-energy X-ray diffraction — •Malte Blankenburg, Peter Staron, Andreas Stark, Torben Fischer, Daniel Laipple, Norbert Schell, Jakob Hilgert, Luciano Bergmann, Jorge F. dos Santos, Norbert Huber, Andreas Schreyer, and Martin Müller — Helmholtz-Zentrum Geesthacht, Institute of Materials Research, Max-Planck-Straße 1, 21502 Geesthacht, Germany

Thermo-mechanical treatments of engineering metallic materials yield non-equilibrium microstructures, which potentially reduce strength and toughness of a joint. As a solid state joining process, friction stir welding reduces the heat input and increases the mechanical properties of the weld. The intermediate stages of phase transformations in the weld zone *during* the joining process can only be studied by *in situ* experiments. Therefore, *in situ* diffraction measurements using a transportable friction stir welding system (FlexiStir) were performed at the HZG high-energy material science beamline (HEMS) at DESY. With a fast area detector, time-resolved measurements with image rates up to 10 Hz were possible, delivering detailed insight to the time development of the ferrite and austenite content of small gauge volumes at different positions relative to the welding tool. Post-mortem EBSD analysis of weld profiles were performed to confirm the results of the *in situ* welding experiments. Additionally, the phase transformations in the steels used for friction stir welding were studied with a dilatometer (DIL805 A/D) in the synchrotron beam.

MM 13.4 Mon 16:30 H 0106

Thermodynamics of point defects and diffusion mechanisms in B2-ordered compounds — •Michael Leitner — Heinz Maier-Leibnitz Zentrum (MLZ), Technische Universität München, Lichtenbergstr. 1, 85748 Garching, Germany

A scheme to classify the point defect thermodynamics in B2 compounds by way of two non-trivial energy parameters is presented, which is rigorously valid for small defect concentrations in both stoichiometry and off-stoichiometry. It is applied to published ab initio defect formation energies, and the variety of resulting phenomena is demonstrated. Further, by introducing model assumptions the consequences for the active diffusion mechanisms are deduced. It is shown that particularly for the case of off-stoichiometry, the assumed prevalence of either the six-jump cycle or the triple defect mechanism has to be reconsidered, as two qualitatively different mechanisms emerge as likely candidates for the dominant effect.