MM 28: Topical session: In-situ Microscopy with Electrons, X-Rays and Scanning Probes in Materials Science II - Atomic structure and defects I

Time: Wednesday 10:15–11:45 Location: H38

Topical Talk MM 28.1 Wed 10:15 H38

In-situ diffraction during complex — •Steven van Petegem[1], Ainara Irastorza[1,2], Antoine Guitton[1], Manas Upadhyay[1], Tobias Panzner[1], Daniel Grolimund[1], Antonio Cervellino[1], and Helena Van Swygenhoven[1,2] — [1]Paul Scherrer Institut, CH-5232 Villigen, Switzerland — [2]École Polytechnique Fédérale de Lausanne, CH-1015 Lausanne, Switzerland

A major challenge in metallurgy is to understand the relation between the microstructure of a metal and its behaviour under an applied load or temperature. This requires a detailed characterization of the evolution of the microstructure at different length scales through the determination of the crystal structure, defect density, grain size distribution, texture etc. During last decade in-situ mechanical testing at the synchrotron/neutron source has become a widespread tool to investigate the evolution of the microstructure of single and polycrystals during deformation. Many such in-situ deformation tests are performed during continuous or interrupted uniaxial tensile and/or compression tests. While such tests have proven to be very useful, for further refinement of crystal plasticity models it is crucial to perform in-situ experiments while changing the strain path. In this work we highlight two such experiments i) in-situ cyclic shear of Cu single crystals, where the formation of a channel-vein structure can be tracked and visualized and ii) in-situ x-ray and neutron diffraction during multiaxial testing.

MM 28.2 Wed 10:45 H38

In situ investigation of the microstructure in friction stir welded steels using high-energy X-ray diffraction — •Malte Blankenburg, Peter Staron, Torben Fischer, Norbert Schell, 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. Due to the high brilliance of the source and a fast PerkinElmer area detector, the investigation of the ferrite and austenite content of a small gauge volume ($0.5mm^3$) with image rates up to 10Hz was possible. Two different steels (S355, 1.4410) were welded using different welding parameters. The results of the Rietveld refinement deliver a spatially resolved insight to the phase transformations taking place in a short distance behind the welding tool ($<$10mm) and show a correlation to the welding power.

MM 28.3 Wed 11:00 H38

Single-shot full strain tensor and texture determination of micron-sized samples with white x-ray microbeams — •Ali Abboud[1], Christoph Kirchlechner[2], Tuba Conka-Nurdan[3], Lothar Streuder[4], and Ullrich Pietsch[1] — [1]University of Siegen, Siegen, Germany — [2]Max-Planck-Institut fur Eisenforschung, Dusseldorf, Germany — [3]Turkisch-Deutsche Universitat, Istanbul, Turkey — [4]PNSensor GmbH, Munchen, Germany

Conventional three dimensional structure determination and the characterization of strain states in a single crystal require either a series of measurements at different orientations or the use of a tunable X-ray source. Here we report on the experimental procedure to determine structure and strain tensor by single shot exposure on micron level using focused white synchrotron radiation. X-ray diffraction Laue patterns are collected from a micro-sized Copper pillar along the bending axis using focused synchrotron radiation. Taking advantage of an energy dispersive 2D camera (pnCCD) we reconstructed the 3D structure of the crystal at each step. At the same time, both the deviatoric and hydrostatic parts of the strain tensor were determined. As an outlook, we show an extension of the developed procedure to be applied in the study of inter- and intra- granular interactions in polycrystalline Nickle samples.

MM 28.4 Wed 11:15 H38

Microstructural Evolution in severely deformed Cu-Ni alloys — •Friederike Emeis, Yulia Buranova, Vitalij Schmidt, Jörn Leuthold, Harald Rösner, and Gerhard Wilde — Institute of Materials Physics, Westfälische Wilhelms-Universität Münster, D-48149

The microstructure evolution of Cu-Ni alloys with different compositions was investigated after severe plastic deformation using high pressure torsion (HPT) with different number of turns followed by annealing. The microstructure evolution is influenced by the stacking fault energy (SFE), which indicates how easily dislocations can form and, therefore, how likely a material is to undergo twinning. The SFEs of the different compositions were experimentally determined by the dissociation width of the present dislocation using high resolution transmission electron microscopy. Twin grain boundaries and especially their conjunction to $\Sigma3$-$\Sigma3$-$\Sigma9$-triple junctions are expected to give more thermal stability to materials. The presence of twins (especially nano-scale twins) was analyzed and grain boundary distributions, grain size distributions and hardness were characterized using electron backscatter diffraction (EBSD), TEM and Vickers Hardness measurements. The obtained results are discussed concerning the impact of the SFE on microstructure evolution during severe plastic deformation.

15 min. coffee break