MM 62: Topical session: X-ray and neutron scattering in materials science IV - High Energy Single Grain Diffraction

Time: Thursday 17:30–18:45 Location: BAR 205

Topical Talk MM 62.1 Thu 17:30 BAR 205

High Energy Single Grain Diffraction — •Ulrich Lienert — Deutsches Elektronen-Synchrotron, Hamburg, Germany

Over the last decade methodologies have been developed that enable the assignment of diffraction spots from multigrain diffraction patterns to individual grains. High energy synchrotron radiation has been employed for the investigation of polycrystalline bulk materials during thermo-mechanical processing. From an experimental point of view, the techniques can be classified according to the sample-to-detector distance which governs the real and reciprocal space coverage and resolutions. The grain boundary topology and orientation gradients have been evaluated from diffraction patterns observed in close proximity to the sample. Large area detectors positioned further away from the sample can still capture several complete diffraction rings and complete lattice strain tensors, center-of-mass grain positions, and volumes have been evaluated. Finally, area detectors have been placed very far behind the sample increasing reciprocal space resolution on cost of coverage. The formation and evolution of subgrain structure has been observed and radial peak profiles have been analyzed in terms of inter- and intra-subgrain strains. The basic principles will be reviewed and selected case studies will be presented.

MM 62.2 Thu 18:00 BAR 205

In situ investigation of phase transformations in friction stir welded steels using high-energy X-ray diffraction — •Malte Blankenburg, Peter Staron, Andreas Stark, Torben Fischer, 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 influence important mechanical properties. An example is friction stir welding as a solid state joining process. Occurring non-equilibrium phases potentially reduce strength and toughness of a joint and are thus important to be studied. The intermediate stages of phase transformations in steels *during* the joining process can only be registered 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. Additionally, the phase transformations occurring in the steels used for friction stir welding were studied using a dilatometer in the synchrotron beam. With a fast area detector, time-resolved measurements with image rates up to 10 Hz were possible for both setups. The results on the phase content as a function of time obtained from the diffraction data in combination with the dilatometer signal improves the understanding of the processes occurring during friction stir welding of the investigated steels.

MM 62.3 Thu 18:15 BAR 205

Diffusion brazing of γ-TiAl alloys: Investigations of the joint by electron microscopy and XRD — •Katja Hauschildt, Andreas Stark, Uwe Lorenz, Norbert Schell, Florian Pyczak, and Martin Müller — Helmholtz-Zentrum Geesthacht, Institut für Werkstoffforschung, Geesthacht, Deutschland

Diffusion brazing is a potential method to repair parts made from TiAl-alloys. In this work the phase constituent and microstructure of the brazed zone for Ni- and Fe-based braze alloys are investigated. For this scanning electron microscopy including energy dispersive X-ray and electron backscattered diffraction were employed. In addition the distribution of phases and changes in lattice parameters in the brazed zone were identified by diffraction with high energy X-rays at the DESY synchrotron in Hamburg, Germany. The braze zone itself is composed of two to three transitional layers reassembling the phase constitution of a TiAl-alloy near the substrate and a microstructure similar to α/β-titanium alloys in the middle of the joint. Besides γ, α_2 and ω, additional phases, which are related to the presence of nickel or iron are also found. The brazed zone microstructure changes significantly during heat treatment, showing that the as-brazed state is far from thermodynamical equilibrium.

MM 62.4 Thu 18:30 BAR 205

Strain profile of magnetoelectric interfaces studied by X-ray diffraction methods — •Madjid Abes[1], Christian Koops[1], Stjepan Hrkac[1], Adrian Petraru[2], Hermann Kohlstedt[2], Bridget Murphy[1], and Olaf Magnussen[1] — [1]Institut für experimentelle und angewandte Physik, CAU Kiel, Germany — [2]Institute of Electrical and Information Engineering Nanoelectronic, CAU Kiel, Germany

Understanding the coupling at the interface between piezoelectric (PE) and magnetostrictive (MS) components in magnetoelectric (ME) composites is essential for the optimization of these composites for sensor applications. A large ME response is only obtained if the lattice deformation induced by an external magnetic field in the MS material can be transferred efficiently to the PE material. To study the coupling at the buried ME composite interface we measured the lattice deformation in $PbZr_{0.52}Ti_{0.48}O_3$ (PZT)/ $CoFe_2O_4$ (CFO) composites. These in situ grazing incidence [1] and high resolution X-ray diffraction were carried out in an applied magnetic or electric field. Surprisingly, the coupling between the components is not perfect for these epitaxial composite systems. We attribute to this to additional strain relaxation at grain boundaries reducing the strain transfer at the interface between the crystal lattices of both components. The authors thank the DFG SFB 855 for financial support.

[1] M. Abes et al., Appl. Phys. Lett., 102, 011601 (2013)