MM 7 Symposium Severe Plastic Deformation II

Time: Monday 14:45–17:30 Room: IFW A

Keynote Talk MM 7.1 Mon 14:45 IFW A

Determination of long-range internal stresses in cyclically deformed Ni with submicro-crystalline grain structure — •Ellen Hieckmann[1], Lutz Hollang[2], and Werner Skrotzki[2] — [1]Institut für Angewandte Physik, Technische Universität Dresden, 01062 Dresden, Germany — [2]Institut für Strukturphysik, Technische Universität Dresden, 01062 Dresden, Germany

It is well accepted that, in fcc metals with a submicro- to nanocyrstalline grain structure, the typical dimensions of deformation induced dislocation arrangements are determined by the size of grains/subgrains. In this context, the long-range internal stresses considered here are assumed to be the mean stresses in grains/subgrains and in dislocation structure elements, respectively. These stresses can arise from granular constraints caused by the sample production processes and from heterogeneous plastic deformation from grain to grain during the subsequent cycling. The latter should lead to a change of the long-range internal stresses during one loading cycle. A concept is proposed to determine these stresses from their contribution to the broadening of Bragg-diffraction profiles. The basic idea is to analyse the changes of the profile shape within a mechanically stabilized loading cycle in comparison with the diffraction profile in the as-produced state of the specimen. Results of high resolution X-ray diffraction measurements are presented for Ni samples, where the submicro-crystalline grain structure is produced by equal-channel angular pressing or by electrodeposition.

MM 7.2 Mon 15:15 IFW A

Vacancy type defects in severely plastically deformed Ni — •Erhard Schafler, Gerd Steiner, Elena Korznikova, Heinrich Schindler, Michael Kerber, and Michael Zehetbauer — Institut für Materialphysik, Universität Wien, Boltzmanngasse 5, A-1090 Wien

Ni of two different purities have been deformed to different strains by high pressure torsion at room temperature using two different hydrostatic pressures. For comparison, some investigations by conventional deformation (rolling, compression) have been carried out, too. The material has been investigated by X-ray diffraction Bragg profile analysis, differential scanning calorimetry as well as residual electrical resistivity. The X-ray method gives information about the dislocation density and their arrangement, and the size and distribution of the smallest structural elements (coherently scattering domains). While the X-ray method detects the dislocations solely, the two other (annealing) methods are sensitive to both vacancies and dislocations. Therefore the proper combination of the results enables to analyse and quantify the evolution of vacancy type defects [1]. Similarly as in the case of Cu, the vacancy concentrations induced by SPD processing are definitely higher than those from conventional plastic deformation [2]. The resulting concentrations of vacancies are discussed in view of their dependencies on the deformation strain, the hydrostatic pressure and the purity of the material used.

[1] M. Zehetbauer, E. Schafler, T. Ungar, Z. Metallk., Vol 96(9) (2005) 1044-1048 [2] E.Schafler, G.Steiner, E.Korznikova, M.Zehetbauer, Mater.Sci Eng. A,410-411, (2005) 169-173.

Keynote Talk MM 7.3 Mon 15:30 IFW A

Tracing microstructure and mechanical properties evolution in ECAP: experiment vs. simulation — •Ralph J. Hellmig and Yuri Estrin — Institut für Werkstoffkunde und Werkstofftechnik, Technische Universität Clausthal, Agricolastr. 6, 38678 Clausthal–Zellerfeld

Equal channel angular pressing (ECAP) is a well–known method to produce ultra–fine grained bulk materials. In this process, a specimen is pressed through an angular channel leading to structural refinement, which results in a beneficial change of mechanical properties. Using dislocation density related constitutive modelling it is possible to trace the microstructure evolution as well as the variation of the mechanical properties during ECAP deformation. A comparison of experimental results and simulations for various materials will be given to demonstrate the capabilities of the model itself and the simulation technique applied.

Keynote Talk MM 7.4 Mon 16:30 IFW A

Texture development during equal channel angular pressing — •Werner Skrotzki — TU Dresden, Institut für Strukturphysik

Plastic deformation of polycrystalline materials is one of the main processes of texture formation which may lead to an anisotropy of properties. Therefore, texture studies on materials, which have undergone severe plastic deformation, are of particular interest from the scientific as well as technological point of view. A review will be given on the recent understanding of texture development during equal channel angular pressing (ECAP) of fcc metals. Emphasis will be put on the effect of process and material parameters like friction, temperature, starting texture and stacking fault energy. The experimental ECAP textures will be compared with simulations.

Keynote Talk MM 7.5 Mon 17:00 IFW A

Diffusion in nanocrystalline materials — •Wolfgang Sprengel — Institut für Physikalische Elektronik, Universität Stuttgart, Pfaffenwaldring 47, 70569 Stuttgart, Germany; sprengel@ipe.uni-stuttgart.de

Atomic diffusion represents a key issue for nanocrystalline materials since it controls both, their physical properties, such as plasticity, and their structural stability. Diffusion in nanocrystalline solids substantially differs from diffusion in coarse-grained or single-crystalline materials. In nanocrystalline solids the high fraction of crystallite interfaces provides paths of high diffusivity. Due to the correlation between the diffusion behavior and the interface structure, diffusion measurements can serve as an important tool to solve the controversial debate to what extent interface structures in nanostructured materials differ from those of conventional grain boundaries. An overview will be given on atomic diffusion in nanocrystalline materials prepared by various synthesis routes including crystallization, crystallite condensation and compaction, and severe plastic deformation. The role of intergranular amorphous phases and of interfacial structural relaxation will be addressed. Diffusion studies in nanocrystalline alloys which show an intergranular melting transition will be presented [1,2].

[1] M. Eggersmann et al., Interface Science **9**, 337 (2001).
[2] W. Sprengel et al., J. Appl. Phys. **98**, 074314 (2005).