MM 40: Topical Session Bulk Nanostrucured Materials IX - Functional Properties II

Time: Wednesday 16:30–17:45 Location: H 0106

MM 40.1 Wed 16:30 H 0106

Crack formation during dealloying of Au25Cu75 — •Yi Zhong[1], Haijun Jin[2], and Jörg Weissmüller[1,3] — [1]Helmholtz Zentrum Geesthacht, Institut für Werkstoffforschung, Werkstoffmechanik, Germany — [2]Institute of Metal Research, Chinese Academy of Sciences, Shenyang, China — [3]Technische Universität Hamburg-Harburg, Institut für Werkstoffphysik und Technologie, Germany

Alloy corrosion has recently evolved into a method for making nanoporous metal materials. The dealloying process, however, often produces cracks which develop during the concurrent shrinkage. Here, we explore a new strategy to reduce the volume shrinkage while retaining small structure size. The idea is to start with a master alloy (e.g., Au25Cu75) which has smaller lattice spacing than that of the nanoporous product (Au), expecting that the lattice expansion during dealloying will compensate the shrinkage. Most interestingly, unlike the monotonically increase of shrinkage with increasing dealloying potential as observed in Au25Ag75, the copper-based system has a maximum volume shrinkage and the highest density of cracks for dealloying at intermediate potentials. Besides, other pretreatment procedures such as High Pressure Torsion (HPT) or cancellation of recovery heating could also effectively eliminate the cracks which usually propagate along grain boundaries. Therefore, at high dealloying potentials one obtains samples with almost no crack and concurrently smaller structure size, offering a unique opportunity to develop new nanoporous materials with combined high functionality.

MM 40.2 Wed 16:45 H 0106

About strain homogeneity at HPT in ufg and nc Pd — •Lilia Kurmanaeva[1], Yulia Ivanisenko[1], Aaron Weis[1], Christian Kübel[1], Delphine Chassaing[1], and Hans-Jörg Fecht[1,2] — [1]Institute of Nanotechnology (INT), Karlsruhe Institute of Technology, Germany — [2]Institute of Micro and Nanomaterials, University of Ulm, Ulm, Germany

It is known that ufg and nc are prone to the localization of deformation, which leads to the lack of ductility in tension. However, strain inhomogeneity also takes place during torsion straining. Since high pressure torsion is very important method to produce nanostructured samples, here we studied deformation homogeneity at HPT of ultrafine-grained and nanocrystalline Pd and Pd alloys in radial direction. Disk samples were cut at a middle of radius. On the electrolytically polished cut surface a fine grid was produced by FIB. Then samples were HPT strained. We observed an obvious strain localisation on the deformed grid in ufg samples. For a further investigation plane-view TEM samples were cut from the area of the grid. The obtained results of TEM microstructure of Pd and Pd alloys are discussed.

MM 40.3 Wed 17:00 H 0106

Diffusion in α-titanium after severe plastic deformation — •Jochen Fiebig[1], Sergiy Divinski[1], Yuri Estrin[2], Ruslan Valiev[3], and Gerhard Wilde[1] — [1]Institute of Materials Physics, Westfälische Wilhelms University of Münster, Wilhelm-Klemm-Str. 10, 48149 Münster — [2]Institute of Physics of Advance Materials, Ufa State Aviation University, 12 K. Marx Street 450000 Ufa, Russian Federation — [3]Department of Materials Engineering, Monash University, Clayton, Victoria 3800, Australia

In the present study we focus on the diffusion and mechanical properties of severely deformed α-titanium produced by equal channel angular pressing (ECAP), including continuous ECAP, and high-pressure torsion. The radiotracer method in combination with parallel sectioning was used to study the self-diffusion (^{44}Ti radioisotope) and solute diffusion of silver (^{110m}Ag radioisotope). The diffusion data were analyzed with regard to the different production methods of ultrafine grained Ti and their potential for generating a special, "non-equilibrium" state of general high-angle grain boundaries. Such interfaces should exhibit a higher diffusivity than general high-angle grain boundaries in coarse grained Ti. The microhardness and its variation with temperature were measured to analyze the stability of the microstructure of the material. The microstructure was studied by TEM and SEM analyses, including EBSD measurements.

MM 40.4 Wed 17:15 H 0106

Irradiation tolerance of bulk nanocrystalline alloys — •Askar Kilmametov[1], Kay Potzger[2], Christoph Gammer[3], Mohammad Ghafari[1,4], Ruslan Valiev[5], and Horst Hahn[1,4] — [1]Institute of Nanotechnology, Karlsruhe Institute of Technology, Karlsruhe, Germany — [2]Institute of Ion Beam Physics and Materials Research, Helmholz-Zentrum Dresden-Rossendorf, Dresden, Germany — [3]University of Vienna, Physics of nanostructured materials, Vienna, Austria — [4]Institute for Materials Science, Joint Research Laboratory Nanomaterials, Darmstadt, Germany — [5]Institute of Physics of Advanced Materials, Ufa State Aviation Technical University, Ufa, Russia

Radiation effects in nanostructured materials have attracted increasing interest in materials science. Bulk ordered nanocrystalline TiNi and FeAl alloys were processed using high pressure torsion. Fully-dense nanocrystalline and coarse-grained counterparts possessing a long-range ordering studied by X-ray diffraction and Mössbauer spectroscopy to examine irradiation effects on the stability or degradation of crystal superlattice. Comparative analysis of long-range disordering and amorphisation kinetics revealed essentially enhanced irradiation resistance of nanocrystalline intermetallic alloys. It was shown that at the equal damage dose nanocrystalline samples are able to retain a long-range ordering while the coarse-grained counterparts were substantially disordered or amorphised. The present experimental studies verify that fully-dense ordered intermetallic alloys are promising candidate materials for radiation environments.

MM 40.5 Wed 17:30 H 0106

Short-Circuit Diffusion in Ultrafine-Grained Copper Processed by High Pressure Torsion — •Matthias Wegner[1], Jörn Leuthold[1], Martin Peterlechner[1], Daria Setman[2], Michael Zehetbauer[2], Sergiy Divinski[1], and Gerhard Wilde[1] — [1]Institut für Materialphysik, WWU Münster, Wilhelm-Klemm-Straße 10, D-48149 Münster, Germany — [2]Physics of Nanostructured Materials, Faculty of Physics, University of Vienna, Boltzmanngasse 5, A-1090 Wien, Austria

Short-circuit diffusion paths in ultrafine-grained copper processed by High Pressure Torsion are investigated by the radiotracer method. *Ultra fast* diffusion rates in addition to *conventional* rates of grain boundary (GB) diffusion are observed. The *ultra fast* diffusion is related to a so-called *non-equilibrium* state of GBs. According to existing models of grain refinement by severe plastic deformation, the abundance of lattice dislocations created during the severe straining serves to modify the structure of high angle GBs towards a non-equilibrium state with an enhanced excess free energy density. The kinetic and structural properties of these *non-equilibrium* GBs are thoroughly investigated and compared with previous results obtained on Cu and Cu alloys deformed by Equal Channel Angular Pressing. Furthermore, a network of percolating porosity is observed. This unexpected feature resembles previously discovered porosity in ECAP processed Cu. A strong dependence of the volume fraction of the porosity on the processing parameters is elucidated. The anisotropy of the percolating porosity is examined with respect to the shear direction.