MM 23: Topical Session Bulk Nanostrucured Materials V - Microstructure and Characterization III

Time: Tuesday 11:30–13:00 Location: H 0107

MM 23.1 Tue 11:30 H 0107

X-ray line profile analysis of in-situ tensile deformation experiments of nanocrystalline palladium thin films — •Michael Kerber[1], Patric Gruber[2], Rudolf Baumbusch[2], Jochen Lohmiller[2], Anna Castrup[3], Erhard Schafler[1], Oliver Kraft[2], Michael Zehetbauer[1], and Horst Hahn[3] — [1]University of Vienna, Physics of Nanostructured Materials, Vienna, Austria — [2]Karlsruhe Institute of Technology IAM II, Eggenstein-Leopoldshafen, Germany — [3]Karlsruhe Institute of Technology INT, Eggenstein-Leopoldshafen, Germany

X-ray line profile analysis was used to study the evolution of the microstructural parameters in Pd with grain sizes around 30nm. The Pd-films of about 1 μm thickness were produced by sputtering of Pd onto a Kapton foil. X-ray profiles were measured during the tensile deformation at the MS-beamline of the synchrotron SLS, Villigen (Switzerland) at deformation temperatures of 20° C and 60° C. The samples were loaded/unloaded in two consecutive cycles to $\epsilon \sim 0.2$ and 0.4. The evaluation of the data yielded the detailed evolution of the median m and variance σ of an assumed log-normal size-distribution, the density of dislocations ρ and their arrangement M, and the frequency of planar defects β. The changes in the diffuse background scattering, related to the number of point defects of the material, was determined. Here it was found that the deformation is still ruled by dislocation plasticity. However, grain size mediated deformation gets increasingly active, and effects from vacancies play some role. Part of the Work supported by the Austrian Science Fund project S 10403

MM 23.2 Tue 11:45 H 0107

Nano crystallization in glasses, their structure and chemistry as analyzed by anomalous small angle X-ray scattering — •Vikram Singh Raghuwanshi[1], Armin Hoell[1], Ruzha Harizanova[2], and Christian Rüssel[3] — [1]Helmholtz Zentrum Berlin für Materialian und Energie, Berlin, Germany — [2]University of Chemical Technology and Mateallurgy,Sofia,Bulgaria. — [3]Otto-Schott-Institut,Jena, Germany

Silicate glasses containing nano crystals have valuable applications in various fields. The aim is to estimate the structural parameter and composition of the nanostructure embedded in silicate glass system by SAXS and ASAXS. We have chosen two silicate systems. Firstly, glass ceramics having composition 62.9SiO2/13.6Na2O/8.5MnO/15.0Fe2O4-x (mol %) and by applying time/temperature heat treatment regime, nano-sized crystalline phase of MnxFe1-xFe2O4 is precipitated. ASAXS measurements were performed near the Fe and Mn K edge. Secondly, glass ceramics having composition 69.6SiO2/7.5Al2O3/15.0K2O/1.9Na2O/4BaF2/2BaO (mol %) shows precipitation of BaF2 nanocrystals during controlled annealing at different time/temperature scales. ASAXS measurements were performed near the Ba L3 edge. Fitting of ASAXS curve shows the formation of spherical particles surrounded with Si enriched lower electron density layer. This layer acts as a diffusion barrier and due to which, further growth of the nanoparticles is kinetically constraint. Also quantitative information and composition of the particles is evaluated.

MM 23.3 Tue 12:00 H 0107

Following deformation mechanisms in nanocrystalline Ni and PdAu using diffraction techniques — •Patric Gruber[1], Jochen Lohmiller[1], Oliver Kraft[1], Christian Braun[2], Manuel Grewer[2], Rainer Birringer[2], Kerstin Schüler[2], Aaron Kobler[3], Christian Kübel[3], and Veijo Honkimäki[4] — [1]KIT, Institute for Applied Materials, Karlsruhe — [2]Universität des Saarlandes, Saarbrücken — [3]KIT, Institute of Nanotechnology, Karlsruhe — [4]ESRF, Grenoble, France

The contribution of specific deformation mechanisms which have been proposed for nanocrystalline (nc) materials is still under heavy debate. In situ characterization is necessary in order to (i) detect reversible mechanisms and (ii) ascribe the active mechanism to the respective strain regime. Therefore in situ compression tests are conducted on nc Ni and PdAu specimens using high energy synchrotron X-ray diffraction (XRD). Alloying of Au to Pd is expected to strongly influence the different deformation mechanisms of nc Pd and consequently give new insight in the predominant deformation mechanisms of nc materials in general. Based on the in situ experiments the deformation behavior of nc Ni and PdAu can be determined to be a distinct sequence of elastic grain interaction, grain boundary sliding, grain rotation, dislocation activity and grain growth. The succession of the different deformation mechanisms leads to a specific in-plane texture which could be determined for the first time. The specific differences in deformation behavior for Ni and PdAu alloys with varying Au content will be discussed.

MM 23.4 Tue 12:15 H 0107

Elemental distribution and solid solubility of nanocrystalline near-equilibrium Fe and Cu alloys — •Thomas Riedl[1], Alexander Kirchner[1], Konrad Eymann[1], Ralf Schlesiger[2], Ahmed Shariq[3], and Bernd Kieback[1] — [1]Institut für Werkstoffwissenschaft, TU Dresden, 01062 Dresden, Germany — [2]Institut für Materialphysik, Univ. Münster, Wilhelm-Klemm-Str. 10, 48149 Münster, Germany — [3]Fraunhofer-Center für Nanoelektronische Technologien, Königsbrücker Str. 180, 01099 Dresden, Germany

Nanocrystalline (nc) alloys exhibit a large volume fraction crystallite interface regions, notably grain boundaries (GBs) [1]. Owing to the reduced atom density GBs can offer favourable sites for solute atoms. In the present work we investigate the solid solubility of nc near-equilibrium bcc Fe and fcc Cu matrices for conventionally immiscible solutes. As preparation route the mechanical alloying technique followed by annealing was selected. Atom probe tomography analyses show that Mg and C solute atoms are enriched in the GBs of 12nm grain sized Fe. From that, segregation strengths and solute interaction parameters are derived. Complementary to the experimental study thermodynamic calculations of solid solubilities have been performed [2,3].

[1] H. Gleiter: Prog. Mater. Sci. 33 (1989) 223
[2] A. Kirchner and B. Kieback: Scr. Mater. 64 (2011) 406
[3] Financial support by the Deutsche Forschungsgemeinschaft via the Emmy-Noether program is appreciated.

MM 23.5 Tue 12:30 H 0107

Metallic Nanoglasses: Structure, Stability and Mechanical Properties — Karsten Albe[1], •Yvonne Ritter[1], Daniel Sopu[1], and Herberg Gleiter[2] — [1]TU Darmstadt, FB Material- und Geowissenschaften, FG Materialmodellierung, Petersenstr. 32, D-64287 Darmstadt — [2]KIT, Institut für Nanotechnologie, 76344 Eggenstein-Leopoldshafen

Grain boundaries are defined as 2-dimensional planar defects in crystalline materials. For the case of glasses, in contrast, there is no established concept of grain boundaries. If one considers, however, that a high degree of short- and medium-range order is also found in glassy materials, the definition of a grain boundary in a glass as an internal interface enclosing a domain of atoms becomes conceivable. Moreover, in bulk metallic glasses (BMGs) it is a well proven fact that planar defects do exist, namely in form of shear bands (SBs) induced by plastic deformation. Consequently, the existence of planar defects in metallic glasses introduced by other means than deformation is possible. In this contribution, we present a detailed analysis of the structure, stability and topology of interfaces in nanoglasses by means of molecular dynamics computer simulations. We address the role of free volume, short-range order and thermal stability and study the mechanical properties of nanoglasses. Moreover, analogies of the properties of interfaces and shear-bands will be addressed.

MM 23.6 Tue 12:45 H 0107

Chemical disordering in intermetallic FeAl induced by cold rolling and folding — •Anna Findeisen[1,2], C. Gammer[1], C. Rentenberger[1], J. Eckert[2], and H.P. Karnthaler[1] — [1]University of Vienna, Physics of Nanostructured Materials, Wien, Austria — [2]Inst. of Complex Materials, IWF Dresden, Germany

Cold rolling and folding is used for the severe plastic deformation of the B2 ordered intermetallic compound FeAl. The structural changes induced by this deformation are studied by transmission electron microscopy (TEM) methods in combination with differential scanning calorimetry (DSC) and magnetic measurements. The TEM study re-

veals the formation of a nanocrystalline structure that is accompanied by a reduction of the long range order. The process of chemical disordering causes a transition from the initial paramagnetic state to a ferromagnetic one. DSC and magnetic measurements show that the reduction of order increases with increasing deformation. This leads to a state of saturation of strongly reduced chemical order that is formed by homogeneously distributed chemically ordered domains with a size of about 2 nm as revealed by TEM images. This structure containing a high density of defects is rather unstable as it starts to relax even at room temperature. The results of the transitions occurring upon heating of both the magnetic state and the process of re-ordering are compared with those of FeAl severely deformed by high pressure torsion [1,2,3]. [1] C. Mangler et al. Acta Mater. 58, 5631 (2010). [2] C. Mangler et al. J. Alloys and Comp. 509, Suppl. 1, 389 (2011) [3] C. Gammer et al. Scripta Mater. 65, 57 (2011).