MM 38 Nanostructured Materials II

Time: Thursday 16:30–18:00 Room: IFW D

MM 38.1 Thu 16:30 IFW D

Charge induced reversible magnetization in nanocrystalline transition metal alloys — •Sadhan Ghosh[1], Christian Lemier[1], and Jörg Weissmüller[1,2] — [1]Forschungszentrum Karlsruhe, Institut für Nanotechnologie, Karlsruhe — [2]Technische Physik, Universität des Saarlandes, Saarbrücken

Ferromagnetism is fundamentally related to the electronic density of states. Therefore, it is interesting to study how far one can modify the magnetic order of solids by changing their electron density. While this is usually done by alloying, one can also change the charge density by inducing space-charge regions at the metal surfaces. This is particularly interesting in nanostructured materials, since the high surface to volume ratio maximizes the effect of the local property changes on the macroscopic scale [1]. Here we intend to explore possibility of changing the magnetic properties of transition metal alloys by using the concept of Helmholtz double layer space charging at the metal-electrolyte interface. Since charging also leads to volumetric strain in the nanoporous materials [2] the effect of resulting pressure on magnetism [3] has also been considered.

[1] Gleiter H., Weissmüller J., Wollersheim O., Würschum R. Acta mater. 49 (2001), 737. [2] Weissmüller, J., Viswanath, R.N., Kramer, D., Zimmer, P., Würschum, R., Gleiter, H. Science 300 (2003), 312. [3] Lemier C., Ghosh S., Weissmüller J., Viswanath R. N., MRS Symp. Proc. 876E R2.6 (2005)

MM 38.2 Thu 16:45 IFW D

Size Effect on the Néel Temperature of NiO nanoparticles — •X. M. Li, Z. Q. Guan, H. Wolf, and Th. Wichert — Technische Physik, Universität des Saarlandes, D-66041 Saarbrücken

Nanocrystalline NiO with different particle sizes has been prepared by electrochemical deposition followed by thermal treatment. The particle sizes ranged from 7 nm to 26 nm as determined by XRD and TEM. Using the method of perturbed $\gamma\gamma$-angular correlation (PAC), the antiferromagnetic order of nanocrystalline NiO as a function of temperature was studied for different particle sizes. The results show that the Néel temperature decreases with decreasing particle size. For the Néel temperature T_N as a function of the particle size d a relation of $(T_N(\text{bulk})\text{-}T_N(\text{nano})) \sim d^{-\lambda}$ has been obtained yielding for the exponent $\lambda = 3.45(1)$. A similar relation was obtained in nano-crystalline Gd for the Curie temperature as a function of the particle size by D. Michel [1]. The exponent $\lambda = 1.07$, however, is significantly smaller than that in the present case of nanocrystalline NiO.

supported by the Deutsch Forschungsgemeinschaft (SFB277).

[1] D. Michel, Thesis, Universität des Saarlandes, Saarbrücken, Germany(2005).

MM 38.3 Thu 17:00 IFW D

Nanoporous Metals Obtained by Dealloying and their Charge-dependent Strain — •Dominik Kramer[1], Smrutiranjan Parida[1], and Jörg Weissmüller[1,2] — [1]Forschungszentrum Karlsruhe, Institut für Nanotechnologie, Karlsruhe — [2]Universität des Saarlandes, Fachrichtung Technische Physik, Saarbrücken

It has been suggested recently [1] to use nanostructured metals obtained by dealloying for actuator applications: Dealloying by the selective dissolution of the less noble component(s) of an alloy, is an important and convenient route to prepare nanoporous metal and alloy samples of arbitrary size and shape, and it ensures that all the pores are filled with electrolyte solution. Due to the dependence of the surface stress on the surface charge, it is possible to use nanostructured metals in an electrolyte as actuator materials, by using a counter electrode in the same electrolyte [1].

We present a study of the dealloying of silver-gold-platinum and palladium alloys, and a dilatometer investigation of the reversible strain of the resulting structures in various electrolytes. The strain measured is discussed as a function of potential, and of the structure size and composition of the different samples.

[1] D. Kramer, R. N. Viswanath, J. Weissmüller, Nano Lett. 4 (2004) 793

MM 38.4 Thu 17:15 IFW D

Ductile ultrafine eutectic in Ti-Fe-base alloys — •J. Das[1,2], K. B. Kim[1], F. Ettinghausen[1], W. Xu[1], W. Löser[2], and J. Eckert[1] — [1]FG Physikalische Metallkunde, FB 11 Material- und Geowissenschaften, Technische Universität Darmstadt, Petersenstraße 23, D-64287 Darmstadt, Germany — [2]Leibniz-Institut für Festkörper- und Werkstoffforschung Dresden, Helmholtzstraße 20, D-01069 Dresden, Germany

A Ti67.79Fe28.36Sn3.85 ternary alloy has been prepared through arc-melting and solidification at a cooling rate of 40-10 K/s. The as-prepared microstructure of the button-shape ingot exhibits a two phase ultrafine eutectic consisting of FeTi (Pm3m, B2) and beta-Ti (Im3m, A2) phases. The mechanical properties (maximum strength = 1939 MPa, strain to fracture = 13.5%) are considerably improved compared to the Ti70.5Fe29.5 binary eutectic alloy (maximum strength = 1733 MPa, strain to fracture = 3.4%). The improvement of the strength and plastic deformability is assessed in terms of a detailed investigation of the microstructure and fractographic studies. The presence of Sn is believed to boost the ease of slip transfer across the interface between the A2/B2 phases due a higher lattice mismatch between the structures. This work was funded by European Union within the framework of the Research Training Network on "ductile bulk metallic glass composites" (MRTN-CT-2003-504692) and by Alexander-von-Humboldt Foundation.

MM 38.5 Thu 17:30 IFW D

The influence of interfaces on the properties of nanostructured materials considering the different melting behaviour of Al-Pb composites — •Harald Rösner, Jörg Weissmüller, and Gerhard Wilde — Forschungszentrum Karlsruhe in der Helmholtz-Gemeinschaft, Institut für Nanotechnologie

Al-Pb composites composed of nanometre-sized Pb particles embedded in a polycrystalline Al matrix serve as a model system for size-dependent melting studies. Depending on the processing pathway, i.e. ball-milling or melt-spinning, the Pb nanoparticles either display a faceted morphology or are spheroidical with curved interfaces. The faceted and spheroidical particles were observed to melt at temperatures above and below the melting temperature of bulk Pb, respectively. However, the observed difference in melting behaviour cannot be explained purely by the different morphologies exhibited by the particles. Recent high-resolution TEM investigations showed that two types of misfit dislocations are present at the interfaces in both types of particles. Based on these results we present a new model that accounts for the different melting behaviour by considering the different mobility of atoms at curved and faceted Al-Pb interfaces.

MM 38.6 Thu 17:45 IFW D

Diffusion of oxygen in nanocrystalline $ZrO_2{\cdot}Y_2O_3$ — •Harald Drings, Anthony Madubuonu, Gregor Knöner, and Hans-Eckhardt Schaefer — Universität Stuttgart, Institut für Theoretische und Angewandte Physik, 70550 Stuttgart, Germany

Zirconia-based materials are known to have oxygen transport properties which give rise to many applications, such as gas sensors or solid electrolytes for fuel cells. It has been recently shown that the oxygen diffusivity in the grain boundaries of nanocrystalline $ZrO_2{\cdot}Y_2O_3$ is strongly enhanced [1] compared to the volume diffusion. Due to the large amount of interfaces in nanocrystalline materials, this should significantly enhance the oxygen diffusion current. This could lower the operating temperature e.g. of solid oxide fuel cells (SOFC) and reduce material deterioration. The samples were prepared by gas phase synthesis of metallic nanoparticles that were oxidized, compacted and sintered to a fully dense oxide specimen. Here, we report on reducing the grain size in n-$ZrO_2{\cdot}Y_2O_3$ by Al doping in order to increase the diffusion current.

[1] G. Knöner et. al. , PNAS **100**, 3870 (2003)