MM 19 Nanoskalige Materialien II

Zeit: Samstag 11:00–12:30 Raum: TU H111

MM 19.1 Sa 11:00 TU H111

Der Einfluß der Mikrostruktur auf die magnetischen Eigenschaften der WC/Co Hartmetalle — •Irena Topic, Hans Georg Sockel und Mathias Göken — Lehrstuhl für Allgemeine Werkstoffeigenschaften, Friedrich-Alexander Universität Erlangen-Nürnberg, Martensstraße 5, 91058 Erlangen

Wolframkarbid-Kobalt Hartmetalle (WC/Co) sind Verbundwerkstoffe, die aus Wolframkarbidteilchen und Kobalt durch Sintern hergestellt werden. Die Kombination der harten WC-Partikel mit einer duktilen Kobaltmatrix führt zu attraktiven Werkstoffeigenschaften, wie hoher Verschleißfestigkeit und Zähigkeit. Wegen ihrer hervorragenden mechanischen Eigenschaften werden diese Werkstoffe in der Regel in der Schneidwerkzeugindustrie eingesetzt.
Bei diesen Werkstoffen wird Magnetismus häufig als einfache Qualitätssicherungsmaßnahme eingesetzt, um ihre Mikrostruktur zu charakterisieren. Eine empirische Beziehung zwischen den magnetischen Kenngrößen und den mikrostrukturellen Parametern wurde für die konventionellen und ultrafeinkörnigen Hartmetalle bestimmt. Ein starker Einfluß der WC Korngröße auf die Koerzitivfeldstärke wurde nachgewiesen. Zugleich wurde festgestellt, dass die dünnen Kobaltbereiche, die Zusammensetzung und die magnetokristalline Anisotropie des Kobalts auch einen großen Einfluß auf das magnetische Feld haben.

MM 19.2 Sa 11:15 TU H111

Grain size effect on the temperature dependence of the electric field gradient — •X.M. Li, Z.Q. Guan, H. Wolf, and Th. Wichert — Technische Physik, Universität des Saarlandes, D-66123 Saarbrücken

In many non-cubic bulk metals the temperature dependence of the electric field gradient (EFG) can be described by a $T^{3/2}$ dependence. Some theoretical models considering the electronic structure and the influence of phonons have been presented in the literature in order to explain this relation. Since it is expected that a reduction of the grain size to nanometer scale affects the electronic structure as well as the phonon spectrum, the temperature dependence of EFG might be changed in nanocrystalline non-cubic metals as well. Nanocrystalline Indium has been prepared with different particle sizes by the method of electrochemical deposition. The temperature dependence of the EFG as a function of different particles sizes (11 nm, 12, nm, 27 nm, as determined by TEM) was investigated in the temperature range of 20-300 K using the perturbed $\gamma\gamma$-angular correlation technique (PAC). The data show that the temperature dependence of the EFG in nanokristalline In still follows a $T^{3/2}$ dependence. However, the coupling constant $\nu_Q(0)$, extrapolated to zero temperature, and the slope B, quantifying the $T^{3/2}$, relation are changed compared to the respective values of the bulk material. Both parameters obviously depend on the grain size of nanocrystalline In. From the analysis of the data it is concluded that the observed changes of the EFG can completely be explained by changes of the lattice constants.
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MM 19.3 Sa 11:30 TU H111

Recrystallization effect in giant magneto resistance (GMR) systems during annealing — •Vitaliy Vovk and Guido Schmitz — Institut für Materialphysik, Universität Münster, Wilhelm-Klemm-Strasse 10, D-48149 Münster, Germany

The long-term thermal stability of giant magneto resistance (GMR) multi-layer systems is a key issue regarding their technical application. In Py/Cu and Py/Cu/Co layer systems a recrystallization is induced by annealing at temperatures in the range of 400-500°C, which leads to a transformation of the crystallographic orientation from a [111] to a [200] wire texture. The main aim is to show that this recrystallization is triggered by the minimization of the elastic energy that is caused by the lattice mismatch between the thin film layers. Therefore, the PyCu-system is chosen for the study, since the lattice mismatch can be controlled by the concentration of iron in Py (mixture of Ni and Fe). Beside, the influence of other factors like sputtering rate, Ar-gas pressure, and magnetic fields applied during sputtering is investigated and their influence on the microstructure is discussed.

MM 19.4 Sa 11:45 TU H111

selective synthesis of nano-meter-sized clusters: size and structure determination — •M. Suleiman[1], C. Borchers[1], M. Guerdane[1], N. M. Jisrawi[2], M. T. Reetz[3], R. Kirchheim[1], H. Teichler[1], and A. Pundt[1] — [1]Institute fuer Materialphysik, Uni. Goettingen — [2]Department of Physics, Birzeit University, Palestine — [3]Max-Planck-Institut fuer Kohlenforschung, Muelheim

Using electrochemical technique [[1]] we will show that not only the clusters size can be selectively prepared but also the structure. Palladium clusters are prepared in a simple two-electrode cell in which surfactant is used as electrolyte and stabiliser. The obtained cluster sizes depend on the preparation parameters, such as: current density, temperature, type of solvent and distance between the electrodes. Using XRD and TEM analysis show a narrow size distribution ((± 0.5 nm)). The cluster size is evaluated from the XRD data and TEM images. It will be shown that a Fourier transform of the XRD pattern gives a fairly accurate value of the cluster size. XRD and HREM analysis revealed that the structure of the Pd clusters is size dependent. The critical size for the structural transition from icosahedral to cubic structure was found to be 4.8 nm. This result is in good agreement with the critical size value obtained from MD-simulation for a model Pd clusters [[2]]. First results on preparing Ni, Co and core shell clusters using this electrochemical technique will be presented.

This work is supported by the DFG via SFB 602 [[1]] M. T. Reetz, W. Helbig, J. Am. Chem. Soc., 11 ((1994)) 7401 [[2]] N. M. Jisrawi, A. Pundt, M. Guerdane, H. Teichler accepted in Acta Mater.

MM 19.5 Sa 12:00 TU H111

Nanoparticles of intermetallic phases extracted from Ni-base alloys — •Giancarlo Pigozzi, Debashis Mukherji, and Gernot Kostorz — ETH Zürich, Institute of Applied Physics, CH-8093 Zürich, Switzerland

Single crystalline nanoparticles of Ni alumides and silicides have been produced by an electrochemical process based on selective dissolution of the matrix phase of a two-phase alloy containing an intermetallic precipitate phase. The precipitates were grown to less than 50 nm mean size by an isothermal aging treatment. Electrochemical potentiometric experiments were performed to determine the appropriate process parameters for the extraction of the nanoparticles. The collection of nanoparticles after the extraction poses a serious challenge. Ultrasonic vibration and centrifuge are employed for separating the nanoparticles from the sample surface and from the liquid bath. Results are presented on characterisation of the microstructure of the alloy and the extracted particles by SEM, TEM, and XRD. The composition control and the control of homogeneity of multicomponent nanoparticles is relatively easy, in this technique. The process is demonstrated presently only at the laboratory scale and even at this scale, only a tiny amount of material (in mg) is obtained when the particles are less than 50 nm in size. Work is in progress to increase the yield.

MM 19.6 Sa 12:15 TU H111

Phase Formation During Solidification of a Ti-Based, In-Situ, Nanostructured Matrix Composite — •Thomas Woodcock[1], Germán Alcalá[1], Sonia Mato[1], Wolfgang Löser[1], Annett Gebert[1], Jürgen Eckert[2], and Ludwig Schultz[1] — [1]IFW Dresden, P.O. Box 270016, 01171 Dresden, Germany — [2]TU Darmstadt, FB Material- und Geowissenschaften, FG Physikalische Metallkunde, Petersenstraße 23, 64287 Darmstadt, Germany

Ti-based, in-situ formed, nanostructured matrix composites such as Ti60Cu14Ni12Sn4Ta10 combine the high yield stress of nanocrystalline materials with the plasticity and toughness of conventional alloys. The remarkable mechanical properties arise from a microstructure, formed after Cu-mould casting, which consists of micron-scale dendrites of β-Ti solid solution in a nanoscale eutectic matrix. Detailed characterisation of the phases in the eutectic matrix has shown that they are β-Ti solid solution and the intermetallic NiTi which contains significant amounts of Cu in solution. Comparison with the ternary Ti-Cu-Ni system established that the eutectic in the composite forming alloy is metastable due to kinetic exclusion of the equilibrium phase at such compositions, CuTi2. The understanding of the solidifcation processes of such materials is important for alloy development and may lead to new materials suitable for a wider range of potential applications.