MM 2 Flüssige und amorphe Metalle I

Zeit: Freitag 10:30–11:30 Raum: TU H111

MM 2.1 Fr 10:30 TU H111

Electrochemistry and biocompatibility of Zr-based Bulk Metallic Glasses — •Stefano Buzzi[1], Kaifeng Jin[1], Samuele Tosatti[2], Isabel Gerber[3], Peter J. Uggowitzer[1], and Jörg F. Löffler[1] — [1]Laboratory of Metal Physics and Technology, ETH Zürich, 8093 Zürich, Switzerland — [2]Biomedical Interfaces Team, Laboratory for Surface Science and Technology, ETH Zürich, Switzerland — [3]Institute of Cell Biology, ETH Zürich, Switzerland

Bulk metallic glasses are promising materials for medical applications because of their high strength and elasticity. In order to determine their biocompatibility as a function of sample preparation, a selected group of these materials was characterized by XPS and electrochemical methods (potentiodynamic measurements and solution analysis). Their cytotoxicity was also analyzed by measuring the viability and metabolic activity of a mouse fibroblast cell line. The results indicate that pitting corrosion takes place in the presence of chloride-ion concentrations comparable to body conditions. Furthermore, it was shown that plasma treatment stabilizes the natural ZrO2 adlayer, and that the cells are able to grow on the Zr-based glasses with good viability and metabolic activity. Among the Zr-based alloys, the most metabolic activity was observed in a Ni-free alloy developed by our group. In contrast, the cells cultured on the Cu-Ti-based metallic glasses hardly grew at all.

MM 2.2 Fr 10:45 TU H111

Reversible formation and disappearance of free volumes in a bulk metallic glass — F. Ye[1,2], •W. Sprengel[1], R.K. Wunderlich[3], H.-J. Fecht[3], H. Dosch[2], and H.-E. Schaefer[1] — [1]Universität Stuttgart, Institut für Theoretische und Angewandte Physik, Stuttgart, Germany — [2]Max-Planck-Institut für Metallforschung, Stuttgart, Germany — [3]Universität Ulm, Materials Division, Ulm, Germany

In the bulk metallic glass $Zr_{57}Cu_{15.4}Ni_{12.8}Nb_5Al_{10}$ the reversible formation and disappearance of free volumes have been detected by time-differential dilatometry studies in analogy to the observation of thermal vacancy formation in B2-intermetallics (H.-E. Schaefer et al., PRL **82**, 948 (1999)). After an initial long-term annealing of the bulk amorphous system at 593 K cycles of fast temperature changes have been carried out below the glass temperature $T_g = 672$ K and subsequent time-dependent reversible elongation after fast heating or shrinking after fast cooling has been observed by isothermal interferometric dilatometry. During these processes no changes of the amorphous structure were detected. This demonstrates that free volumes are reversibly formed or disappear in a deeply metastable structure. The kinetics of the time-dependent process indicate that an entire ensemble of atoms is involved in the thermal formation of free volumes in the bulk amorphous solid.

MM 2.3 Fr 11:00 TU H111

Bulk Metallic Glass Formation in ZrCuFeAl alloys — •K.F. Jin and J. F. Löffler — Laboratory of Metal Physics and Technology, ETH Zürich, 8093 Zürich, Switzerland

We present a series of Ni-free Zr-based bulk metallic glasses where the critical casting thickness (in rod-shape) reaches values of up to 13 mm in diameter. The glass-forming region of this family of alloys is very extensive, and nearly 15 percent of their Zr or Cu content may be varied while still maintaining a critical casting thickness of 1 mm. The alloys were investigated via x-ray diffraction (XRD), small-angle neutron scattering (SANS) and differential scanning calorimetry (DSC). XRD and SANS confirm a glassy structure, while DSC determines a calorimetric glass transition between 665 K and 687 K and an undercooled liquid region extending up to 86 K. Mechanical tests performed on the glassy alloys reveal a tensile yield strength of 1.7 GPa and an elastic limit of 2.25 percent. In addition, crystallization studies show the formation of a nanometer-sized icosahedral phase with a quasilattice constant of 4.76 angstrom. The superior properties of these bulk metallic glasses, their glassy structure and the fact that they are Ni free, make them interesting candidates for biomedical applications.

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MM 2.4 Fr 11:15 TU H111

Transformations near the glass transition in Pd-based bulk metallic glasses — •Shantanu V. Madge, Harald Rösner, and Gerhard Wilde — Institute of Nanotechnology, Forschungszentrum Karlsruhe, P.O.B. 3640, D-76021 Germany.

One reason for the current interest in bulk metallic glasses (BMGs) is the complexity that often underlies crystallisation in these alloys, which can involve various metastable phases. Phase separation in the undercooled liquid is an issue that has seen much attention in recent years in order to explain the counter-intuitive nanocrystallisation that occurs in some BMGs. In the present work, a series of Pd-based BMGs has been prepared by suction-casting. The transformations in certain glasses on heating above the glass-transition temperature are investigated $in-situ$ and $ex-situ$ by complementary techniques such as modulated-temperature calorimetry, X-ray diffraction or transmission electron microscopy, including the analysis of the initial crystallization products in the early stages of devitrification. The results are discussed in the light of possible amorphous phase separation that has been suggested to occur in many BMGs including some Pd-rich systems.