MM 8: Liquid and Amorphous Metals II

Time: Monday 14:30–15:30 Location: IFW D

MM 8.1 Mon 14:30 IFW D

First measurements of the diffusion coefficient in shear bands — •Joachim Bokeloh, Sergiy Divinskiy, Gerrit Reglitz, and Gerhard Wilde — Institut für Materialphysik, WWU Münster

Although the occurrence of shear bands during plastic deformation of metallic glasses was discovered early on and in spite of the extensive research done on the formation of shear bands and their behaviour during plastic deformation, they remain a fairly unknown entity. A key factor in this is the difficulty in accessing the actual physical properties of the shear bands. This is reflected in the very limited number of publications that report experimental data on shear band properties as opposed to the large number of publications that approach shear bands from simulation. In this presentation, experimental data on the diffusion in shear bands has been obtained using the radiotracer method that is conventionally utilized for determining grain boundary diffusion coefficients. Utilizing the tracer method on the post-deformed specimen serves analysing a lower bound of the diffusivity that was present during the shear band formation, i.e. during plastic deformation. Yet, the experimental results indicate unambiguously that even in the post-deformation state the diffusivity is largely enhanced as compared to the volume diffusion in metallic glasses.

MM 8.2 Mon 14:45 IFW D

Thermophysical properties and medium-range order of liquid Ni-Si alloys — Yongjun Lü and •Peter Entel — Faculty of Physics and Center for Nanointegration, CeNIDE, University of Duisburg-Essen, 47048 Duisburg, Germany

The thermophysical properties of liquid Ni-Si alloys as a function of silicon concentration are investigated using molecular dynamics simulations. The temperature dependent enthalpy and density indicate the occurrence of crystallization in Ni-5%Si and Ni-10%Si and glass transitions for 20% and 25%. With the Si concentration increasing from 5 to 25%, the self-diffusivities decrease and viscosities increase with more non-Arrhenius temperature dependences in the low-temperature region, suggesting fragile characteristics of these alloys. Moreover, a shoulder peak emerges between the first and second peak in all radial distribution functions before crystallization or glass transition. Positions of shoulder, second and third peaks relative to the nearest neighbor peak are consistent with a global packing model [1], showing the incompact local translational symmetry. The atomic arrangement prefers a special bond angle distribution and displays orientational order. Therefore, the medium-range order of liquid Ni-Si can be described as a combination of local translational and orientational orders. This local packing structure becomes more compact with addition of more Si atoms, suppressing the formation of crystalline order.

[1] X. J. Liu et al. Phys. Rev. Lett. 105, 155501(2010)

MM 8.3 Mon 15:00 IFW D

The effect of quenching on the mechanical properties of Ti40Zr10Cu34Pd14Sn2 bulk metallic glass — •Na Zheng[1], Mihai Stoica[1], Mariana Calin[1], Norbert Mattern[1], and Jürgen Eckert[1,2] — [1]IFW Dresden, Institute for Complex Materials, P.O. Box 27 01 16, D-01069 Dresden, Germany — [2]TU Dresden, Institute of Materials Science, D-01062 Dresden, Germany

Ti40Zr10Cu34Pd14Sn2 bulk metallic glass (BMG) exhibits large glass forming ability and good mechanical properties. Upon compression tests, it was found that the plastic strain is 3.5% and the corresponding fracture stress is around 2050 MPa. Annealing at elevated temperatures followed by rapid quenching is an effective way to tailor the microstructure of BMG and then change the mechanical properties. In this work, Ti40Zr10Cu34Pd14Sn2 BMG with the diameter of 2 mm was obtained by suction casting. Differential Scanning Calorimetry (DSC) investigations preformed at 20 K/min heating rate reveal the glass transition temperature (Tg) of 673 K and the first onset temperature of crystallization (Tx1) of 726 K. After annealing at temperatures slightly before Tg and in the supercooled liquid region (Tg-Tx1), the BMG samples were quenched in water. The aim is to study the effect of quenching on the mechanical properties of Ti40Zr10Cu34Pd14Sn2 BMG. Additionally, the fracture morphology of these samples is also investigated.

MM 8.4 Mon 15:15 IFW D

The influence of d- and f-states on structure formation - amorphous alloys containing Rare Earths as model systems — •Martin Stiehler, Michael Pleul, and Peter Häussler — Chemnitz University of Technology, 09126 Chemnitz, Germany

Amorphous phases as precursors of the crystalline state are interesting for investigating fundamental structure forming processes and the related evolution of electronic transport. During the last years we were able to show that many different classes of alloys organize themselves under the influence of a resonance-like interaction between the global subsystems of the electrons and the static structure. Especially for binary Al-TM alloys (TM: the transition metals of the 4th period (Sc,Ti,V,Cr,Mn,Fe,Co,Ni,Cu) we reported recently on an electronic influence on phase stability driven by hybridization effects between the Al-p- and the TM-d-states, showing an interesting systematics depending on the number of unoccupied TM-d-states reflected in different properties. Currently we are about to extend those investigations to systems with transition metals of the 5th and 6th period. Embedded in this class of elements are the so-called Rare Earth metals (Sc, Y, La, and the Lanthanoids). These elements exhibit very similar chemical properties although some of them (the Lanthanoids) contain f-electrons. This provides the possibility of studying the influence of localized magnetic moments (f-states) on structure formation. In this contribution we report on results concerning the static structure, the electrical resistivity and the Hall effect of the binary systems Al-Y and Al-Ce.