# MM 34: Liquid and Amorphous Metals I

Time: Wednesday 10:15–11:15 Location: H5

MM 34.1 Wed 10:15 H5

**Structural Behavior of Cu-based Bulk Metallic Glasses under Compression** — •Gang Wang[1], Norbert Mattern[1], Josef Bednarčik[2], Simon Pauly[1], JinMan Park[1], Yue Zhang[1], Jun-Hee Han[1], and Jürgen Eckert[1,3] — [1]Institute of complex materials, IFW-Dresden, 01069 Dresden, germany — [2]HASYLAB at DESY, Notkestr. 85, D-22603 Hamburg, Germany — [3]Institute of Materials Science, TU Dresden, D-01062 Dresden, Germany

The structural behavior of Cu-Zr binary bulk metallic glass (BMG) family under stress was investigated by means of in-situ high energy X-ray synchrotron diffraction. The components of the strain tensor were determined from the shifts of the maxima of the structure factor in reciprocal space as well by the atomic pair correlation function (PDF) in real space. The analysis of the PDF versus stress shows the occurrence of changes in short-range orders of the glass during elastic deformation. The number density of Cu-(Zr,Cu) and Zr-Zr nearest-neighbor atomic pairs becomes oriented along the loading direction. During plastic deformation the dominating volume fraction of the BMG exhibits the yield strain. The local deformation in shear bands can not be seen in the volume averaged PDFs. After unloading even in the plastically deformed state, the PDFs are identical to the as-cast state are within the error limits, which suggests that this anisotropic rearrangement of atoms under stress is a reversible process. The contribution of the plastically deformed regions localized within the shear bands are too low and therefore not visible in the diffraction patterns.

MM 34.2 Wed 10:30 H5

**Study of structural anisotropy in Zr-Cu bulk metallic glasses under uniaxial compression by computer simulations** — •Yue Zhang[1], Nobert Mattern[1], Gang Wang[1], and Jürgen Eckert[1,2] — [1]IFW Dresden, Institute for Complex Materials, Helmholtzstr.20, D-01069 Dresden, Germany — [2]Institute of Materials Science, TU Dresden, D-01062 Dresden, Germany

The atomic structures of Zr35.5Cu64.5 and Zr50Cu50 bulk metallic glasses (BMGs) under uniaxial compression are studied by reverse Monte Carlo (RMC) and molecular dynamic simulations. The data obtained from in-situ high energy synchrotron diffraction were fitted using RMC simulation. The dynamic structural change during uniaxial compression is studied from both the short range order (SRO) and medium range order (MRO) aspects. The structural anisotropy is characterized by performing Voronoi tessellation, common neighbor and Honeycutt-Anderson analyses to the resulting atomic configurations. Finally, the relationship between MRO and the distribution of icosahedra is discussed.

MM 34.3 Wed 10:45 H5

**Distribution of oxides in a Zr-Cu-Ni-Al-Nb-Si bulk metallic glass** — •Jochen Heinrich[1], Frank Mueller[2], Ralf Busch[1], and Stefan Huefner[2] — [1]Chair of Metallic Materials, Saarland University, PO Box 151150, 66041 Saarbrücken, Germany — [2]Chair of Experimental Physics, Saarland University, PO Box 151150, 66041 Saarbrücken, Germany

The course of oxide presence with distance from the sample surface and bonding partner was studied for the bulk metallic glass with the nominal composition Zr57.9Cu15.4Ni12.7Al10.2Nb2.8Si1 (at%) by X-ray photoelectron spectroscopy (XPS). Investigated specimens are taken from vacuum quench-cast rods subjected to oxidation at room temperature and atmosphere. Binding energies were determined in various depths using ion beam ablation of up to 100 nanometers. XPS spectra confirm oxidation primarily of the pure zirconium and aluminum constituents, all other peaks correspond to metallic bonds. While the surface area shows a passivating zirconia layer a few nanometers thick, oxygen is bonded predominantly with aluminum inside the bulk. Since the concentration of oxygen is a crucial factor in the crystallization behavior of bulk metallic glass forming liquids on basis of oxygen affine metals, so far only high purity materials were thought to be suitable. The findings in this study, however, are promising for alloys with industrial grade elements with sufficient glass forming ability. Comparisons of the alloy with differing oxygen content support the conclusion that aluminum acts as an appropriate scavenger for both adsorbed and large amounts of intrinsic oxygen in zirconium based amorphous metals.

MM 34.4 Wed 11:00 H5

**Heterogeneous Gd-Hf-Co-Al metallic glasses by liquid-liquid phase separation** — Jun Hee Han[1,2], Norbert Mattern[1], and •Jürgen Eckert[1,2] — [1]IFW Dresden, Institute for Complex Materials, Dresden, Germany — [2]TU Dresden, Institute of Materials Science, Dresden, Germany

The unique microstructures of phase separated metallic glasses can lead to enhanced properties of materials with its heterogeneity. Phase separated metallic glasses were prepared in Gd-Hf-Co-Al system by rapid quenching of the melt. The compositions were chosen by the combination of Gd-Co-Al and Hf-Co-Al alloys showing high glass forming ability. Strong positive enthalpy of mixing ($\Delta$Hmix)between the principal elements Gd and Hf leads to a heterogeneous microstructure of Gd-Hf-Co-Al glassy alloys consisting of two amorphous phases Gd-enriched and Hf-enriched. The length scale of spherical shaped heterogeneities ranges from a few nanometers to tens of micrometers. For clearly phase separated composition with nano-meter scale (~100nm) secondary phase separation is observed in each amorphous phase. Furthermore, thermal behaviour of Gd-Hf-Co-Al phase separated metallic glasses was investigated in order to analyze the composition dependence of glass transition temperature (Tg) and crystallization temperature (Tx), as well as phase sequences upon heating. Funded by DFG Ma1531/10.