MM 27: Liquid and Amorphous Metals II

Time: Wednesday 15:45–17:00 Location: H 0107

MM 27.1 Wed 15:45 H 0107

Synthesis and mechanical properties of Al-Ni-La alloys prepared by hot extrusion and spark plasma sintering of gas atomized powders — •Kumar Babu Surreddi[1], Hoang Viet Nguyen[2], Mira Sakaliyska[1], Sergio Scudino[1], Mihai Stoica[1], Markus Wollgarten[3], Ji-Soon Kim[2], and Jürgen Eckert[1] — [1]IFW Dresden, Institut für Komplexe Materialien, Postfach 270116, D-01171 Dresden, Germany — [2]Research Center for Machine Parts and Materials Processing, University of Ulsan, Namgu Mugeo 2-Dong, San 29, Ulsan 680-749, Republic of Korea — [3]Hahn-Meitner-Institut Berlin, Glienicker Straße 100, D-14109 Berlin, Germany

Bulk nanocrystalline Al87Ni8La5 specimens were prepared by in-situ devitrification and consolidation of gas atomized glassy powders. Consolidation was carried out at different temperatures by hot extrusion as well as by spark plasma sintering (SPS). Both techniques lead to highly dense bulk specimens with a microstructure consisting of an fcc-Al phase together with several intermetallic compounds. The powders consolidated by SPS display the highest compression strength, which depends on the consolidation temperature and ranges between 900 and 1000 MPa, together with plastic strains not exceeding 10 %. The extruded samples are characterized by a maximum strength of about 800 MPa but generally show larger plastic strains that can reach values of about 20 %. These results indicate that the mechanical properties of the samples can be tuned within a wide range of strength and ductility as a function of the consolidation technique and parameters used.

MM 27.2 Wed 16:00 H 0107

Phase formation and mechanical properties of $Cu_{50}Zr_{50-x}Ti_x$ ($2.5 \leq x \leq 7.5$) glass matrix composites — •Simon Pauly, Jayanta Das, and Jürgen Eckert — IFW Dresden

The microstructure and elastic/plastic properties of $Cu_{50}Zr_{50-x}Ti_x$ ($2.5 \leq x \leq 7.5$) glass matrix composites have been investigated. The presence of austenitic (Pm-3m)/martensitic phases (P21/m and Cm) with different length scales embedded in a glassy matrix enhances the plastic deformability significantly. These composites show high yield strength (up to 1753 MPa) and large plastic strain (over 15 %). The high strength scales with the volume fraction of glassy matrix and the ability of these alloys to undergo an austenite-martensite transformation is believed to be beneficial for increasing the intrinsic ductility of the BMGs.

Furthermore, the evolution of phases upon annealing ribbons of the aforementioned compositions has been studied and the crystallization kinetics has been determined using Kissinger and Johnson-Mehl-Avrami analysis. The fragility parameter of different compositions has been correlated with their plastic behavior as well as the Poisson's ratio.

MM 27.3 Wed 16:15 H 0107

Study of complex elastic moduli of metallic glasses during relaxation processes and in confined geometry — •Dennis Bedorf[1], Thomas Koeppe[1], Konrad Samwer[1], and Ranko Richert[2] — [1]I. Physikalisches Institut, Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany — [2]Department of Chemistry and Biochemistry, Arizona State University, Tempe AZ 85287- 1604, USA

Measuring the complex elastic constants in a metallic glass enables us to study relaxation processes especially during the first heating run of a glass. The first increase of storage modulus far below the alpha process can be linked to a beta process. The different rate dependence of both can be used to estimate the merging temperature [1]. Dynamical heterogeneities are known to have spatial dimension of several nm. To get experimental data of loss spectra in confined geometry we measure thin films of PdCuSi on a double-paddle-oscillator (DPO). Change of resonance frequency and Quality factor are used to determine the complex shear modulus of the film. Preparation and characterizations were performed in situ under UHV conditions. Precise measurements of early relaxations above RT were also performed by using thin cantilevers of a metallic glass. All results are discussed in the model of a potential energy landscape as described in [2]. This work was supported financially by DFG, SFB 602 and Leibniz Programm.

[1] J. Hachenberg et al., to be published

[2] J. S. Harmon, M. D. Demetriou, W. L. Johnson and K. Samwer, Phys. Rev. Lett. 99, 135502 (2007)

MM 27.4 Wed 16:30 H 0107

Dynamics of Shear Transformation Zones in Metallic Glasses — •Max Neudecker and S. G. Mayr — I. Physikalisches Institut, Georg-August-Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany

Dynamical heterogeneities in metallic glasses are investigated for the model glass, $Cu_{50}Ti_{50}$, with the help of classical molecular dynamics computer simulations. By rapid quenching from melt at various cooling rates (comprising 5 orders of magnitude), differently relaxed amorphous cells are prepared. During a subsequent shearing, macroscopic properties (particularly the stress-strain curve) are linked to microscopic dynamics. We find the global shearing is composed of highly localized shear events, termed shear transformation zones (STZs), which occur spatially and temporally inhomogeneously. A detailed analysis focuses on the origins and implications of STZ formation.

Financial support by SFB 602 (project B3) is gratefully acknowledged.

MM 27.5 Wed 16:45 H 0107

Strain- and Temperature-induced Glass-to-Crystal Transformations in Al-Ni-La Glass — •Jens Vierke[1], Gerhard Schumacher[1], Ingwer A. Denks[1], Nelia Wanderka[1], Markus Wollgarten[1], John Banhart[1], Ivo Zizak[2], Vitaly P. Pilyugin[3], Martin Balog[4], Juray Nagy[4], and František Simančik[4] — [1]Hahn-Meitner-Institute Berlin, Germany — [2]BESSY Berlin, Germany — [3]Ural Branch of the Russian Academy of Sciences, Yekaterinburg, Russia — [4]Slovak Academy of Sciences, Bratislava, Slovakia

Helium-atomized amorphous Al85Ni10La5 powders were consolidated using uni-axial pressing, equal channel angular pressing (ECAP) and high pressure torsion (HPT) at temperatures ranging from room temperature to 400°C. The samples were investigated by scanning electron microscopy (SEM), in-situ angle-dispersive (AD) and ex-situ energy-dispersive (ED) X-ray diffractometry (XRD) and differential scanning calorimetry (DSC). As-atomized powders show a glass transition and a subsequent simultaneous crystallization of fcc-Al and intermetallic phases upon continuous and isothermal heating. Samples consolidated below the crystallization temperature show only fcc-Al nanocrystals and a residual amorphous phase. They exhibit no glass transition upon continuous heating. The amount of fcc-Al nanocrystals increases with strain and processing temperature as revealed by ED XRD measurements along the disc radius of a HPT-sample and by AD XRD along the pressing direction of ECAP-samples stopped halfway in the ECAP-die. The results indicate that the primary precipitation of fcc-Al is strain-induced and possibly athermal.