MM 4: Liquid and amorphous materials II

Time: Monday 11:45–13:00 Location: H4

MM 4.1 Mon 11:45 H4

Devitrification, consolidation and mechanical properties of ball milled Al-Y-Ni-Co glassy ribbons — •Kumar Babu Surreddi[1], Sascha Sager[2], Mira Sakaliyska[1], Sergio Scudino[1], and Jürgen Eckert[1] — [1]IFW Dresden, Institut für Komplexe Materialien, Postfach 27 01 16, D-01171 Dresden, Germany — [2]FG Physikalische Metallkunde, FB 11 Material- und Geowissenschaften, Technische Universität Darmstadt, Petersenstraße 23, D-64287 Darmstadt, Germany

In this work, glassy powders have been obtained by ball milling of Al-Y-Ni-Co glassy ribbons. The pulverization of the melt-spun ribbons was achieved by using proper milling conditions, i.e. interval-milling at low intensity, corresponding to a rather low kinetic energy, and performed at cryogenic temperature in order to retain their glassy structure and to avoid sticking of the material to the milling tools due to the high ductility of the ribbons. Due to the controlled milling conditions, the ball milled ribbons display a strikingly similar structure and crystallization behavior compared to the parent as-spun sample. The crystallization behavior and the temperature dependence of the viscosity of the as-spun and the milled ribbons were studied in order to select the proper consolidation parameters. Fully glassy and glassy-Al composite powders were then consolidated through uniaxial hot pressing and hot extrusion and finally the mechanical properties of the bulk specimens were evaluated via room temperature compression tests.

MM 4.2 Mon 12:00 H4

Crystallization behavior and consolidation of ball milled Zr60Ti5Ag5Cu12.5Ni10Al7.5 glassy powders — •Sergio Scudino, Shankar Venkataraman, Mira Sakaliyska, Kumar Babu Surreddi, and Jürgen Eckert — IFW Dresden, Institut für Komplexe Materialien, Postfach 27 01 16, D-01171 Dresden, Germany

Devitrification and consolidation of Zr60Ti5Ag5Cu12.5Ni10Al7.5 glassy powders produced by ball milling of intermetallic compounds have been investigated. The crystallization behavior is characterized by the formation of a nanoscale quasicrystalline phase along with a minor amount of tetragonal Zr2Cu phase during the first stage of the crystallization process. In the second crystallization event the metastable QC transform into the tetragonal Zr2Cu phase. The viscous flow of the supercooled liquid was studied by parallel plate rheometry, showing a distinct viscosity drop related to the glass transition, corroborating the results from DSC measurements. Consolidation of the glassy powders was performed by uniaxial hot pressing. The consolidation parameters were properly selected in order to obtain partially crystallized bulk samples with a composite microstructure characterized by the contemporary presence of glassy, quasicrystalline and tetragonal Zr2Cu phases. Hardness measurements reveal a Vickers hardness of 4.61 GPa and an estimated yield strength of 1.53 GPa. These results show that powder metallurgy methods are suitable for the production of Zr-based alloys characterized by a composite microstructure consisting of glassy, quasicrystalline and crystalline phases with mechanical properties similar to materials prepared by other techniques.

MM 4.3 Mon 12:15 H4

Metallurgical considerations in the development of ferromagnetic Fe-based metallic glasses — •Giovanni Mastrogiacomo and Jörg Löffler — Laboratory of Metal Physics and Technology, Department of Materials, ETH Zurich, Wolfgang-Pauli-Str. 10, 8093 Zurich, Switzerland

Despite intense research activity concerning the glass-forming ability of metallic alloys, the crucial metallurgical parameters for improving glass-forming ability are still not well understood. Considering the crystallization of several bulk metallic glasses which decompose in the deeply undercooled liquid region, we developed Fe-based bulk metallic glasses by a further destabilization of the Fe–Cr–Co system. This system tends to decompose in iron-rich and chromium-rich b.c.c. phases [1]. The liquidus temperature was systematically reduced by alloying elements which satisfy the empirical rules suggested by Hume-Rothery and destabilize the high temperature austenitic phase. The resulting metallic glasses of composition $(Fe_{0.582}Co_{0.418})_{80}Cr_{10}Zr_{10}$ and $[(Fe_{0.582}Co_{0.418})_{0.81}Cr_{0.1}Zr_{0.07}Ti_{0.02}]_{90}B_{10}$ reveal unexpected magnetic properties, as, for example, inverted major and exchange-biased minor hysteresis loops [2,3]. These results are discussed considering the decomposing tendency of the Fe–Cr–Co system.

[1] F. Zhu, P. Haasen, and R. Wagner, Acta Metall. **34**, 457 (1986).
[2] G. Mastrogiacomo *et al.*, J. Appl. Phys. **99**, 023908 (2006).
[3] G. Mastrogiacomo *et al.*, J. Appl. Phys. **100**, 12xxxx (2006).

MM 4.4 Mon 12:30 H4

Self-assembly of monatomic complex crystals and quasicrystals with a double-well potential — •Michael Engel and Hans-Rainer Trebin — Universität Stuttgart, Institut für Theoretische und Angewandte Physik, 70550 Stuttgart

For the study of crystal growth and dynamics a simple two-dimensional monatomic model system with three parameters is introduced. Depending on the value of the parameters several complex crystals, a decagonal quasicrystal, and a dodecagonal quasicrystal are stabilized in thermal equilibirum. They show up in the phase diagram of the system, which we calculate using molecular dynamics simulations. The observed crystals can have unit cells larger than the interaction radius. When growing the complex (quasi-)crystals from the liquid state, a continuous amelioration of the structure by diffusion processes is observed. This is accomplished by discrete atomic jumps over well-defined jump distances. For the investigation an interactive virtual lab is used, that allows a direct observation and control of the simulation dynamics.

MM 4.5 Mon 12:45 H4

Phason flips and solitons in the dynamic Fibonacci chain — •Hansjörg Lipp, Steffen Sonntag, Michael Engel, and Hans-Rainer Trebin — Universität Stuttgart, Institut für Theoretische und Angewandte Physik, 70550 Stuttgart

Quasicrystals possess the phason degree of freedom which manifests itself in correlated atomic flip motions. To get insight into the microscopic dynamics of the flips, we studied one dimensional model systems: periodic and quasiperiodic anharmonic chains, in particular the quasiperiodic Fibonacci chain.

Here we present approximate analytic solutions of the equations of motion in such systems as well as results from molecular dynamics simulations. The chains show localized modes interacting with phonons. There are both breathers and kink solitons. Propagating solitons appear in two forms: The low energy form resembles standard solitons in anharmonic chains; the high energy form contains propagating flips. We discuss their stability and their contribution to energy transport.