MM 10: Liquid and amorphous materials IV

Time: Monday 16:15–17:30 Location: H4

MM 10.1 Mon 16:15 H4

Structure and electronic transport of a-$Ni_x(Ti_{50}Al_{50})_{100-x}$ — •Jan Rauchhaupt, Thomas Raubold, and Peter Häussler — Chemnitz University of Technology, Institute of Physics, 09107 Chemnitz, Germany

An approach to understand the development of any crystalline structure from the initial disordered state is to investigate stabilization processes in amorphous phases as precursors of any ordered structure. Amorphous thin films are ideal to do so because they exist in just one phase, can be prepared in exactly the right composition and the development of their structure and electronic transport properties dependent on the composition and temperature are easy to measure. In order to minimize their global energy many different alloys organize themselves under the influence of a resonant interaction between the valence electrons as one subsystem and the static structure as the other one. These resonances were observed in many systems, from simple metals and semiconductors to ionic glasses and TM-containing alloys (TM=transition metal). We discuss the results of the measurements as a hybridization effect of the Al-p-electrons with the empty d-states of the TM. Amorphous ternary alloys of Ni, Ti and Al were prepared in situ at T=4 K in a HV-cryostate and were annealed up to the crystalline state. The static structure, by means of electron diffraction, the resistivity and the thermopower were measured as a function of temperature and composition. Additionally quantitative *White Lines* measurements were performed to prove the predicted hybridization effects.

MM 10.2 Mon 16:30 H4

FeNbB bulk metallic glass with high boron content — •Mihai Stoica[1], Khalil Hajlaoui[2], Jayanta Das[1], Jürgen Eckert[1], and Alain Reza Yavari[2] — [1]IFW Dresden, Institute for Complex Materials, P.O. Box 270016, D-01171 Dresden, Germany — [2]LTPCM-CNRS, I.N.P. Grenoble, 1130 Rue de la Piscine, BP 75, F-38402 University Campus, France

Fe-based alloys able to form magnetic bulk metallic glasses (BMGs) are of the type transition metal – metalloid and often contain 5 or more elements. Usually, the metalloid content is around 20 atomic %. Very recently, the Fe66Nb4B30 alloy was found to be able to form BMG by copper mold casting technique, despite its high metalloid content. Several composition with boron contents around 30 at. % or even higher were calculated since 1993 as possible compositions of the remaining amorphous matrix after the first stage of nanocrystallization of Finemet-type Fe77Si14B9 glassy ribbons with 0.5 to 1 atomic % Cu and a few percent Nb addition. Melt-spun ribbons of all calculated compositions were found to be glassy. The composition of the ternary Fe-based BMG investigated in the present study resulted as an optimization of all possibilities. The alloy is ferromagnetic with glass transition temperature Tg = 845 K, crystallisation temperature Tx = 876 K, liquidus temperature Tliq = 1451 K and mechanical strength of 4 GPa. The coercivity of as-cast samples is very low, around 1.5 A/m. The present contribution aims at discussing the thermal stability, mechanical and magnetic properties of the Fe66Nb4B30 BMG.

MM 10.3 Mon 16:45 H4

Microstructure of rapidly quenched amorphous Ni100-2xNbxYx alloys — •Norbert Mattern[1], Uta Kuehn[1], Thomas Gemming[1], Guenter Goerigk[2], and Juergen Eckert[1] — [1]Leibniz-Institut IFW Dresden, Helmholtzstr.20,01069 Dresden — [2]Haysylab at DESY,Notkestr.85,22603 Hamburg

Two-phase amorphous Ni-Nb-Y alloys can be prepared by rapid quenching from the melt[1]. The structure formation takes place in the phase separated undercooled liquid. Recent experimental and thermodynamical assessment of the Ni-Nb-Y phase diagram shows an extension of miscibility gap in the melt of the monotectic binary Nb-Y system up to 60 at% Ni content into the ternary Ni-Nb-Y system.The microstructure of the as-quenched ribbons consists of two amorphous regions Nb-enriched and Y-enriched exhibiting features of self-similarity with a size distribution from micrometer dimensions down to several nanometers. Small-angle X-ray diffraction confirms the fractal microstructure. For Ni contents > 60at% (critical composition) a "homogeneous" amorphous microstructure is observed by transmission electron microscopy (TEM) in accordance with thermodynamic calculations which are based on the regular solution model for the liquid. On the other hand, small-angle X-ray diffraction data indicate clearly chemical inhomogeneities within the nm-range. From the inhomogeneous amorphous precursors ultrafine nanocrystalline microstructure can be formed upon annealing as the first step of crystallization.

[1]N. Mattern, U. Kuehn, A. Gebert, T. Gemming, M. Zinkevich, H. Wendrock, L. Schultz, Scripta Mater., 53 (2005) 271

MM 10.4 Mon 17:00 H4

Cold rolling induced amorphization and nanocrystallization processes studied by positron lifetime and 2-dimensional Doppler broadening measurements — •Wolfgang Lechner[1], Werner Puff[1], Herbert Rabitsch[1], Gerhard Wilde[2], and Roland Würschum[1] — [1]Institut für Materialphysik, Technische Universität Graz, Petersgasse 16, 8010 Graz, Austria — [2]Institut für Materialphysik, Universität Münster

In order to contribute to an atomistic understanding of the interfacial structure and processes during amorphization and nanocrystallization, the present work deals with studies of interfacial free volumes by means of positron-annihilation-spectroscopy. In addition to positron lifetime spectroscopy, coincident Doppler broadening of the positron-electron annihilation photons is applied as novel technique for studying the chemistry of interfaces. To study the amorphization process, pure foils of Cu and Zr with a nominal composition of $Cu_{60}Zr_{40}$ were mechanically intermixed by cold rolling. Starting from the constituent pure metals, a nanoscale multilayer structure of elemental layers and amorphous interlayers develops in an intermediate state of folding and rolling, where free volumes with a Zr-rich environment occur that are presumably located in the hetero-interfaces between the various layers or in grain boundaries of the Cu-layers. To analyze the nanocrystallization reaction that occurs in marginal glass formers, pure foils of Al and Sm with a composition of $Al_{92}Sm_8$ were produced by the abovementioned synthesis route. Specific modifications of free volumes and their chemical environment could be observed for various strain levels.

MM 10.5 Mon 17:15 H4

Nanocrystallisation of amorphous Al85Ni10La5 powder induced by severe plastic deformation — •Jens Vierke[1], Vitaly Pilyugin[2], Ingwer Denks[1], Nelia Wanderka[1], Markus Wollgarten[1], and John Bahnhart[1] — [1]Hahn-Meitner-Institute Berlin, Glienicker Str. 100, 14109 Berlin, Germany — [2]Russian Academy of Sciences, Institute of Metal Physics, Kovalevray street 18, 620219 Yekaterinburg, Russia

The nanocrystallisation behaviour of Helium-atomised amorphous Al85Ni10La5 powder subjected to high pressure torsion (HPT) at room temperature and thermal treatments have been studied by differential scanning calorimetry (DSC), wave- and energy-dispersive X-ray diffraction and scanning and transmission electron microscopy. DSC experiments combined with X-ray diffraction analysis show a joint precipitation of α-Aluminium and intermetallic phases at an onset temperature of 276°C, using a heating rate of 40 °C/min. On the contrary, a primary precipitation of α-Aluminium was observed in powders which were deformed by HPT at room temperature. X-ray diffraction analysis of HPT-discs shows that a rising shear deformation leads to a growing number of Al-nanocrystals in the amorphous matrix. The presented results are discussed regarding the development of the microstructure during the consolidation of this powder.