MM 28 Amorphous and Liquid Materials III

Time: Thursday 11:45–13:00 Room: IFW B

MM 28.1 Thu 11:45 IFW B

Phase separation in liquid and amorphous Ni-Nb-Y alloys — •Norbert Mattern[1], Uta Kuehn[1], Annett Gebert[1], Thomas Gemming[1], Andreas Schöps[2], and Ludwig Schultz[1] — [1]IFW Dresden, P.O. Box 270116, D-01171 Dresden, Germany — [2]Hasylab, Notkestr. 85, D-22603 Hamburg, Germany

Novel phase-separated Ni-Nb-Y amorphous alloys were prepared by rapid quenching from the melt. The microstructure of the as-quenched ribbons consists of two amorphous regions Nb-enriched and Y-enriched with a size distribution from micrometer dimensions down to several nanometers. The two-phase amorphous structure was proven by electron micropscopy, X-ray diffraction and differential scanning calorimetry data. Decomposition and structure formation take place in the melt prior to solidification. In situ synchrotron high temperature X-ray diffraction measurements exhibit clearly a two stage melting in agreement with DSC measurement. An assessment of the Ni-Nb-Y phase diagram (CALPHAD method) pointed out that the miscibility gap of the monotectic binary Nb-Y system extends into the ternary system up to about 70at% Ni. The microstructure as well as the thermal behavior of the two-phase amorphous alloys depend on the chemical composition of the rapidly quenched alloy. The two amorphous phases crystallize separately at different temperatures. The microstructure after crystallization from the amorphous state is completely different from that obtained by crystallization from the liquid.

MM 28.2 Thu 12:00 IFW B

Liquid phase separation in Cu-based alloys — •Matthias Kolbe[1], Jianrong Gao[2], Lorenz Ratke[1], and Dieter M. Herlach[1] — [1]Institute for Space Simulation, DLR, Cologne, Germany — [2]Key Lab of Electromagnetic Processing of Materials, Northeastern University, Shenyang 110004, China

Many Cu-based alloys as Cu-Cr, Cu-Co, Cu-Nb and Cu-Fe exhibit in the binary phase diagram a flat liquidus, which is often associated to metastable phase separation in the region of the undercooled melt: When the metastable miscibility gap is entered, the homogeneous alloy separates into a Cu-rich and a Cu-poor liquid. Due to undercooling, the melt solidifies rapidly and properties of the metastable liquids are frozen in the solidified microstructure. We studied metastable phase separation and phase growth by electromagnetic levitation (EML), drop tube experiments and splat cooling of metallic melts. In addition, samples have been processed and solidified in the TEMPUS facility during parabolic flights under low gravity conditions. Compared to processing in EML on ground, the fluid flow is reduced in TEMPUS by an order of magnitude. The solidified microstructures show the influence of the different convection levels in the liquid on phase growth. The results are discussed within current models of liquid phase growth.

MM 28.3 Thu 12:15 IFW B

Microstructure and thermal behavior of Ni-Nb-Y alloys with additions of Sn and B — •Uwe Siegel, Uta Kühn, Norbert Mattern, Annett Gebert, and Ludwig Schultz — IFW Dresden, P.O. Box 270116, D-01171 Dresden, Germany

Ni-Nb-Y alloys with additions of Sn and B were prepared by melt-spinning and copper mold casting technique to achieve different cooling rates. The microstructure of the samples were investigated by means of X-ray diffraction and SEM and the thermal behavior was analysed by DSC measurements. The $Ni_{58.5}Nb_{20.25}Y_{21.25}$ alloy is known for its two phase amorphous microstructure obtained by rapid quenching [1]. Lower cooling rates, e.g. copper mold casting of this alloy, lead to a fully crystalline structure. Additions of Sn and B usually increase the glass forming ability of the Ni-Nb alloy system [2]. Based on these results the two-amorphous phase alloy was modified with different Sn and/or B contents in order to increase the glass forming ability and, therefore, to obtain bulk samples with a two amorphous phase microstructure. However, for the specific alloy composition, witch also contains Y, the formation of solid solutions is favoured what results in the precipitation of different crystalline phases during the solidification process at lower cooling rates. In contrast, using the melt spinning technique, decomposition of the amorphous phase was also obtained for Ni-Nb-Y-Sn alloys.

[1] Mattern, N. Kühn, U., Gebert, A., Gemming, T., Zinkevitch, M., Wendrock, H., and Schultz, L., Scripta Mater. 53, 271 (2005). [2] Choi-Yim, H., Xu, D. H., and Johnson, W. L., Appl. Phys. Lett. 82(7), 1030 (2003)

MM 28.4 Thu 12:30 IFW B

Cooling rate controlled microstructure and magnetic properties of metastable $Fe_{20}Nd_{80}$ alloys — •Jürgen Eckert[1], Golden Kumar[2,3], Jürgen Eckert[1], Annett Gebert[2], Ludwig Schultz[2], and Albrecht Wiedenmann[4] — [1]Darmstadt University of Technology, Petersenstr. 23, D-64287 Darmstadt, Germany — [2]IFW Dresden,PF 270016, D-01171 Dresden, Germany — [3]Present address: NIMS, 1-2-1 Sengen, Tsukuba 305-0047, Japan — [4]Hahn-Meitner Institut Berlin, Glienickerstr. 100, D-14109 Berlin, Germany

The microstructures and magnetic properties of as-cast and annealed $Fe_{20}Nd_{80}$(hypereutectic) alloys were studied. Depending on the cooling rate the $Fe_{20}Nd_{80}$ alloys solidify into various metastable eutectic-like structures, which present a wide range of coercivity values varying from 0.2 to 0.48 T measured at room temperature. The alloys cooled at rates faster than 50 K/s display fine eutectic-like regions of Nd + A_1 and are hard magnetic. Transmission electron microscopy (TEM) studies clearly show that the hard magnetic A_1 regions are microscopically inhomogeneous. The alloys cooled slower than 25 K/s show a discontinuous rod-type eutectic of Nd + $Fe_{17}Nd_2$ and, consequently, exhibit a soft magnetic behaviour. The correlations between the cooling rate, the microstructure, and the coercivity of the $Fe_{20}Nd_{80}$ alloys are discussed. This work was supported by the German Science Foundation (DFG) via the DFG priority program "Phasenumwandlungen in mehrkomponentigen Schmelzen" under grant Ec 111/11.

MM 28.5 Thu 12:45 IFW B

On the plasma resonance of binary amorphous Al-TM alloys — •Martin Stiehler, Uta Giegengack, Jose Barzola-Quiquia, Jan Rauchhaupt, Steffen Schulze, and Peter Häussler — Chemnitz University of Technology, Institute of Physics, 09107 Chemnitz, Germany

Amorphous phases are ideal systems for investigating the mechanisms of structure formation. During the last years we reported about measurements of structure, electrical resistivity, thermopower, Hall-effect and thermal stability of binary a-AlTM alloys with 3d TM elements. The results were interpreted in a hybridization enhanced Hume-Rothery model with a composition-dependent valency of the TM.

Here we report on a unique systematics in the plasma resonance data of binary a-AlTM alloys. Conveniently, plasma resonance signals are used to determine the electron density of materials. For amorphous semiconductors we could apply this method in excellent agreement to the free electron model by calculating the electron density using the valencies of the elements from the periodic table. In a-AlTM alloys with 3d TM, the situation is different. Here such a simple approach fails. But with the valency of Al from the periodic table, in all this systems the 3d TM, including Ni, Co, Fe, Mn, Cr, V, Ti, and even Ca, seem to exhibit the same valency over the complete concentration range with no respect to the above mentioned hybridization effects. This result may be explained in a refined hybridization model.