# MM 16: Microstructure and Phase Transformations III - Precipitaion hardening/ Alloying elements

Time: Monday 15:45–17:15 Location: IFW B

MM 16.1 Mon 15:45 IFW B

**Atom Probe Tomography Analyses of Precipitation in the AA2195 Aluminum Lithium Alloy** — •Muna Khushaim[1], Torben Boll[1], Ferdinand Haider[2], and Talaat Al-Kassab[1] — [1]King Abdullah University of Science and Technology (KAUST), Division of Physical Sciences and Engineering, Thuwal 23955-6900. Saudi Arabia — [2]University Augsburg, Inst. f. Physik, D-86159 Augsburg, Germany

One of the primary materials used for structural components of aircrafts are aluminum-lithium alloys. These alloys exhibit an enhanced strength-weight ratio which makes them an attractive material for weight critical applications. This study focuses on the alloy 2195 (a member of a series of high strength Al-Li-Cu alloys known as Weldalite), which owes its superior mechanical properties to a thermo-mechanical treatment termed T8. The presence of different micro-alloying elements and an adequate heat treatment causes the precipitation of different phases such as $T_1$ ($Al_2CuLi$), $\theta'$($Al_2Cu$) and $\beta'$($Al_3Zr$). Utilizing the laser assisted wide angle tomographic atom probe (LAWATAP) and local electrode atom probe (LEAP) allowed the characterization of the different precipitates that dominate the microstructure of this functional material and identify their role in the hardening process. Additionally, the effect of the microstructure on the mechanical properties of the alloy was estimated by measuring its micro-hardness.

MM 16.2 Mon 16:00 IFW B

**Analysis of The Melting Process of Indium Nanoparticles Embedded in An Aluminium Matrix** — •Mostafa Mohamed, Martin Peterlechner, and Gerhard Wilde — Institute of Materials Physics, Münster,Germany

We have successfully prepared nanocrystalline particles Indium embedded in an Aluminum matrix by rapid quenching using the melt-spinning technique. The microstructures and the melting temperature and freezing of the embedded nanoparticles were investigated by transmission electron microscopy (TEM) and differential scanning calorimetry (DSC). The microstructure analysis exhibited two distributions of (In) particles embedded in the Al-matrix, one at the grain boundaries and the other within the Al matrix. DSC experiments have shown broad melting and crystallization peaks. The crystallization temperature of the embedded particles shifted to remarkable low temperature. Analyses of TEM images and DSC measurements were done to investigate the impact of the particle-matrix interface and interface modifications on the melting behavior of the embedded nanoparticles.

MM 16.3 Mon 16:15 IFW B

**Phase transformation in Nb-H thin film** — •Vladimir Burlaka, Stefan Wagner, and Astrid Pundt — Universität Göttingen, Institut für Materialphysik, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany

Physical properties of nano-sized metal hydrogen systems strongly change with mechanical stress, evolving during hydrogen loading and phase transition. For very thin films stress relaxation processes are expected to be much less efficient compared to thick films. Thus the systems will stay in a high-stress state. This changes the system*s thermodynamics and kinetics [1,2].

In this in-situ STM study we use epitaxial Nb-H thin films of thicknesses with less than 50nm as a model system. By performing constant pressure hydrogen loading sequences on films of different thickness we address differences in hydride precipitation and growth during the phase transformation. To approve and study the role of mechanical stresses conservation, the in-situ STM results are completed by in-situ XRD results providing a macroscopic overview of the sample*s lattice structure during the hydrogen uptake.

Financial support by the DFG via project PU131/12-1 is gratefully acknowledged. Beamtime is kindly provided by the DESY, at PETRA beamline P08.

[1] K. Nörthemann, A. Pundt, Phys. Rev. B, Vol.78, (2008), 014105.
[2] K.Nörthemann K, A. Pundt , Phys. Rev. B 83, (2011), 155420

MM 16.4 Mon 16:30 IFW B

**Neue massive beta-Ti-Nb-In Legierungen für Knochenimplantatanwendungen** — •Arne Helth[1,2], Stefan Pilz[1,2], Mariana Calin[1], Annett Gebert[1] und Jürgen Eckert[1,2] — [1]Leibniz-Institut für Festkörper- und Werkstoffforschung Dresden — [2]Institut für Werkstoffwissenschaft, TU Dresden

Der zunehmende Einsatz Ti-basierter Werkstoffe für nicht-degradable Knochenimplantate erfordert eine ständige Weiterentwicklung der biofunktionellen Werkstoffeigenschaften. Hierbei liegt der Fokus zum einen auf der Einstellung einer hohen Dauerfestigkeit, zur Verhinderung von Ermüdungsfrakturen und zum anderen auf der Anpassung der elastischen Eigenschaften an die des kortikalen Knochens, um *stress shielding* zu vermeiden.

Ausgangspunkt der vorliegenden Arbeit ist die binäre beta-Ti-Legierung Ti-40Nb. Sie weist neben einer exzellenten Korrosionsbeständigkeit Druckfestigkeiten von bis zu 1400 MPa und einen E-Modul von ˜60 GPa auf. Ziel war es, durch die Zulegierung von Indium den E-Modul weiter abzusenken. Durch eine thermomechanische Behandlung sollen die mechanischen Eigenschaften im Sinne der Biofunktionalität optimiert werden.

Durch die Addition von 5 m.% Indium konnte ein minimaler E-Modul von 49 GPa erreicht werden. Im Rahmen der thermomechanischen Prozessierung wurde die mittlere Korngröße maßgeblich abgesenkt und eine Festigkeitssteigerung von über 10 % im Vergleich zum Gusszustand erreicht. Durch eine anschließende Stufenglühung konnten Festigkeit von über 550 MPa eingestellt werden.

MM 16.5 Mon 16:45 IFW B

**Phase transformations in Ti-Fe and Ti-Fe-Nb alloys by in situ X-ray diffraction** — •Olga Shuleshova[1], Ivan Kaban[1,2], Dirk Holland-Moritz[3], Jan Gegner[3], Fan Yang[3], Jozef Bednarcik[4], Junhee Han[1], Norbert Mattern[1], and Jürgen Eckert[1,2] — [1]IFW Dresden, Institute for Complex Materials, 01171 Dresden, Germany — [2]TU Dresden, Institute of Materials Science, 01062 Dresden, Germany — [3]DLR, Institut für Materialphysik im Weltraum, 51170 Köln, Germany — [4]DESY Photon Science, 22607 Hamburg, Germany

In this work the solid-liquid phase transformations, as well as phase equilibria in the binary Ti-Fe and ternary Ti-Fe-Nb systems are studied by means of in situ X-ray diffraction of the synchrotron radiation. To avoid contamination the reactive titanium alloys have been processed containerlessly, using electrostatic levitator. Levitated samples were repeatedly heated from the room temperature above their liquidus temperatures and subsequently cooled down to undergo solidification. Analysis of the lattice constants shows that below approx. 800°C solid-state diffusion is negligible and samples are only subjected to thermal expansion. On heating above this temperature near-equilibrium conditions are reached before the onset of melting. These data have been used to verify the binary Ti-Fe phase diagram and to map solidus and liquidus surfaces in Ti-rich corner of the ternary Ti-Fe-Nb system. On cooling the liquid melts were subjected to considerable undercooling. Detailed evolution of the lattice parameters of the samples solidified under non-equilibrium conditions is presented. Financial support by DFG under project No. SH 578/1-1 is gratefully acknowledged.

MM 16.6 Mon 17:00 IFW B

**Droplet size distribution in liquid phase separated Cu75Co25-xMx (M = Fe, Ni) alloys with low M content** — •Yikun Zhang[1,2], Zhikang Wu[1], Meimei Wang[1], Jianrong Gao[1], Chao Yang[1], and Gerhard Wilde[2] — [1]Key Laboratory of Electromagnetic Processing of Materials (Ministry of Education), Northeastern University, Shenyang 110004, China — [2]Institute of Materials Physics, University of Münster, Wilhelm-Klemm-Straße 10, D-48149 Münster, Germany

Liquid phase separation in metallic alloys has been investigated over the past sixty years. One of the most intensively studied systems is the binary Cu-Co system, which is a simple peritectic system, but has a metastable miscibility gap in the undercooled region because of a positive heat of mixing. A recent study indicated that a Zr addition can modify the surface energies and/or the wetting behavior in a peculiar way in the ternary Co-Cu-Zr system at low Zr content. In the present work, the effect of small amounts of an Fe/Ni addition on the liquid phase separation behavior in undercooled Cu75Co25-xMx (M = Fe, Ni and x = 1, 5) alloys has been studied by using the glass fluxing method. All the samples show a bimodal droplet size distribution, the center of the first peak position shifts to a larger radius gradually with increasing undercooling in Cu75Co24Ni. The Fe addition can promote the liquid phase separation behavior, but in contrast the Ni addition can suppress it effectively. The present results may provide valuable information for understanding the microstructure evolution in undercooled Cu-Co alloys.