MM 44: Quasicrystals II

Time: Thursday 14:00–15:00 Location: IFW B

MM 44.1 Thu 14:00 IFW B

In situ observation of the formation of the metastable decagonal quasicrystalline D-phase in Al-Ni melts — •Dirk Holland-Moritz[1], Olga Shuleshova[2], Wolfgang Löser[2], Guillaume Reinhart[3], and Thomas Buslaps[4] — [1]Institut für Materialphysik im Weltraum, Deutsches Zentrum für Luft- und Raumfahrt (DLR), 51170 Köln, Germany — [2]Leibnitz-Institut für Festkörper- und Werkstoffforschung (IFW) Dresden, 01171 Dresden, Germany — [3]ESA External Research Fellow, ESRF / ILL, 38042 Grenoble, France — [4]ESRF, 38043 Grenoble, France

The phase selection during solidification of undercooled Al-Ni melts is investigated by time-resolved in situ measurements using a combination of electromagnetic levitation technique and energy dispersive diffraction of synchrotron radiation. For the investigated alloys in the composition range of 18 - 31.5 at.% Ni undercooling below the liquidus temperature does not influence the selection of the primary solid phase even at highest levels of undercooling. If the semi-solid samples are cooled to lower temperatures we were able to undercool the peritectic reaction during which under equilibrium conditions Al_3Ni is formed. If a sufficient undercooling below the peritectic temperature is obtained a metastable phase is formed, that is identified as the decagonal quasicrystalline D-phase. It subsequently transforms and can only be conserved up to room temperatures if sufficiently high cooling rates are applied. Financial support from the European Commission EU within the IMPRESS Integrated Project under contract FP6-500635-2 and the provision of beamtime by ESRF are gratefully acknowledged.

MM 44.2 Thu 14:15 IFW B

Mechanical behavior of Al-based metal matrix composites reinforced with Al-Cu-Fe quasicrystalline particles — •Fahad Ali[1], Sergio Scudino[1], Gang Liu[2], Kumar Babu Surreddi[1], Mira Sakaliyska[1], Vikas C. Srivastava[3,4], Volker Uhlenwinkel[4], and Jürgen Eckert[1,5] — [1]IFW Dresden, Institut für Komplexe Materialien, Dresden, Germany — [2]State Key Laboratory for Mechanical Behavior of Materials and School of Materials Science and Engineering, Xian Jiaotong University, China — [3]Metal extraction & Forming Division, National Metallurgical Laboratory, Jamshedpur, India — [4]Institut für Werkstofftechnik, Universität Bremen, Bremen, Germany — [5]TU Dresden, Institut für Werkstoffwissenschaft, Dresden, Germany

Al-based metal matrix composites reinforced with Al62.5Cu25Fe12.5 quasicrystalline particles have been produced by powder metallurgy. Composites with different volume fractions of reinforcement have been consolidated into highly dense bulk specimens by hot extrusion and the resulting effects on mechanical properties and microstructure have been examined in detail. Considerable increase in compressive strength and Young modulus has been observed in the composites samples as compared to pure Aluminum. Finally, the elastoplastic deformation of the composites containing different volume fractions of quasicrystalline particles have been modeled by using the self-consistent effective medium approach.

MM 44.3 Thu 14:30 IFW B

Charge transfer as well as hybridization effects in amorphous AlCuLi to optimize phase formation — Michael Lang and •Peter Häussler — Chemnitz University of Technology, Institute of Physics, 09107 Chemnitz

We report on structure-forming processes in ternary amorphous AlCuLi which also forms at higher temperatures a quasicrystalline phase, without transition metals involved as in many other quasicrystalline alloys. In those quasicrystals with transition elements we could show earlier that a phase-stabilizing effect based on self-organized resonances between the electronic system and the static atomic structure exists (Peierls-, Hume-Rothery-like), with subsequent pseudogaps at the Fermi edge and hence strong electronic transport anomalies. The resonance was found to be enhanced by hybridization effects of the Al-p-states with the empty e.g. Fe-d states in i-AlCuFe.

Due to the lack of transition elements in the system under consideration, we were looking for other stabilizing effects than a hybridization-enhanced resonance. And indeed, for AlCuLi due to the lithium there exists an enhancement of the resonance stabilization by charge transfer causing ionic bonding features. But, in addition, indications exist that even for the present alloys hybridization effects may exist. We report on the static atomic structure as well as electronic transport over a large range of composition.

MM 44.4 Thu 14:45 IFW B

Mechanical milling of single-phase Al-Cu-Fe quasicrystals — •S. Scudino[1], F. Ali[1], V.C. Srivastava[2,3], N.K. Mukhopadhyay[4], K.B. Surreddi[1], M. Sakaliyska[1], V. Uhlenwinkel[3], and J. Eckert[1,5] — [1]IFW Dresden, Institut für Komplexe Materialien, Dresden, Germany — [2]Metal extraction & Forming Division, National Metallurgical Laboratory, Jamshedpur, India — [3]Institut für Werkstofftechnik, Universität Bremen, Bremen, Germany — [4]Centre of Advanced Study, Department of Metallurgical Engineering, Banaras Hindu University, Varanasi, India — [5]TU Dresden, Institut für Werkstoffwissenschaft, Dresden, Germany

The effect of milling intensity on the microstructure of spray-deposited Al62.5Cu25Fe12.5 quasicrystals has been investigated. The first stages of milling are characterized by a strong decrease of the grain size and by the introduction of lattice strain. This effect increases with increasing the milling time and in the material milled for longer time the quasicrystals transform into a nanoscale bcc phase. At this stage, the quasicrystals are no longer observable, indicating a complete transformation of the quasicrystals into the bcc phase. The hardness of the milled powders decrease with increasing the milling time, most likely as a consequence of the increased volume fraction of the bcc phase. Finally, the bcc phase formed during milling is metastable and transforms back to the quasicrystalline phase during the heat treatment, which suggests that a composite material with optimized mechanical properties can be produced by an appropriate thermo-mechanical treatment.