MM 6 Symposium Complex Metallic Alloys I

Zeit: Freitag 11:00–12:15 Raum: TU H1058

MM 6.1 Fr 11:00 TU H1058

Syntesis and crystal growth of Complex Metallic Alloys (CMA) — •Wolf Assmus[1], Stefan Brühne[1], Michael Feuerbacher[2], Guido Kreiner[3], and Eckhard Uhrig[1] — [1]Physikalisches Institut, Johann Wolfgang Goethe-Universität, Robert-Mayer-Str. 2-4, D-60054 Frankfurt am Main — [2]Institut für Mikrostrukturforschung, Forschungszentrum Jülich GmbH, D-52425 Jülich — [3]MPI für Chemische Physik fester Stoffe, Nöthnitzer Str. 40, D-01187 Dresden

In the Virtual Integrated Laboratory A (VIL A – Materials Design and Synthesis) a number of european labs are working in a NoE on materials design, synthesis and crystal growth of CMA. All methods which are necessary for this research field as e.g. DTA, EMPA, X-ray analysis; especially for materials preparation and crystal growth techniques as arc-melting, melt-spinning, zone-melting, Czochralski, Bridgman or flux growth are available. Some examples of recent research in VIL A are discussed: Icosahedral and periodic Mg-Zn-*RE* alloys and a variety of periodic, huge unit cell Mg-Zn, Al-Pd, Al-Mg and related ternary CMA have been grown. For the growth of such complex alloys information about the phase-diagram must be available. It is important to know whether the phase is formed by direct cooling of the melt (congruent melting behaviour) or by peritectic or peritectoidic reaction. As another example in the Mg-Pd system it is shown that the phase width of Mg_6Pd (cF396) can be well understood from correlated disorder of only two atom sites in the $a \approx 2$ nm cubic unit cell.

MM 6.2 Fr 11:15 TU H1058

Structure-Property Relationships of Complex Intermetallic Phases — •Walter Steurer — Laboratory of Crystallography, Department of Materials, ETH Zurich, CH-8093 Zurich, Switzerland

It is amazing how sensitive some physical properties are to slight variations in the chemical composition of a complex intermetallic phase and its thermal history. Experiments on the most complex intermetallic phases, the quasicrystals, have shown that even annealing times of several thousand hours at two third of the melting temperature may be not sufficient to reach the equilibrium state. Non-equilibrium defects such as dislocations and nanodomain structures as well as chemical disorder may locally break the symmetry. In particular, cluster-based structures with a high-degree of pseudosymmetry tend to form orientationally twinned domain structures with rather low interfacial energy.

Materials creation and design crucially depends on materials characterization. Measurements of physical properties are only meaningful if they are reproducible. The results can only be reasonably interpreted and contribute to the understanding of a material if its chemical composition, crystal and defect structure are accurately known. On a few examples, the importance of materials analysis as function of composition, temperature and pressure is demonstrated.

MM 6.3 Fr 11:30 TU H1058

VIL C: Physical properties of complex metallic alloys — •Hans-Rainer Trebin — Institut für Theoretische und Angewandte Physik, Universität Stuttgart, Pfaffenwaldring 57, 70550 Stuttgart

The physical properties of complex metallic alloys are dominated by the interplay of two length scales: that of the local coordination polyhedra and that of the lattice constants. Expressed differently, a long range translational order is competing with a short range disorder. The consequences are, for example, backfolded energy bands which together with disorder induced scattering inhibit electronic and heat transport. Anharmonic flip motions are coupled to harmonic modes. Alternative atomic and cluster positions allow structural rearrangements and lead to new plastic modes and stress-induced phase transitions. The Virtual Integrated Laboratory C of the NoE-CMA will investigate these properties theoretically and experimentally within three workpages. A report will be given on state of the art, methods, and expectations.

MM 6.4 Fr 11:45 TU H1058

Surface physics, chemistry and nanoscience of complex metallic alloys — •Ronan McGrath[1], Marie-Geneviève Barthés-Labrousse[2], Karsten Horn[3], and Guy Tréglia[4] — [1]Dept. of Physics, the University of Liverpool, UK — [2]CNRS Vitry, France — [3]Fritz-Haber Institute, Berlin, Germany — [4]CNRS Marseilles, France

The surface physics, chemistry and nanoscience of complex metallic alloys (CMAs) presents many new challenges. For many existing experimental and theoretical techniques, the investigation of the large unit cell periodic alloys are on the borderline of what is feasible, especially with quantitative structural probes. It seems likely that many of the modifications of these techniques developed for the study of the aperiodic quasicrystal surfaces will be useful for these materials. The scientific study of these materials will break new ground, and the work will focus on three areas. The first is the understanding of the clean surface structure and properties of representative CMAs. Here there is especial interest in the study of the electronic structure close to the Fermi edge to compare with studies on related simple metal and quasicrystal phases. The second area is the investigation of the use of these surfaces as templates for the formation of low dimensional nanostructures, i.e. quantum dots and ultra-thin films. and of particular interest is how the cluster sub-structure will influence growth mechanisms for these materials. The third area of interest is the investigation of the properties of these materials in ambient environments. The results of these studies will form a crucial input to the design of potential devices based on CMAs.

MM 6.5 Fr 12:00 TU H1058

Advanced technologies for the preparation of coatings containing complex metallic alloys — •Constantin Vahlas[1] and Witold Gulbinski[2] — [1]Centre Interuniversitaire de Recherche et d Ingenierie des Materiaux (CIRIMAT-CNRS), Toulouse, France — [2]Physics Department, Faculty of Mechanical Engineering, Technical University of Koszalin, Poland

The development of advanced technologies for the processing of CMA-based coatings presents a major interest for numerous application domains. Indeed such technologies are widely recognized to be key underpinning and critically enabling areas of R&D on which most industrial sectors and fields of technology application, directly or indirectly depend. The presentation will introduce the state of the art in this field and the projected research within the CMA Network of Excellence. The use of selected PVD and MOCVD techniques will allow for processes and materials optimization with regard to the aimed application (e.g. hard and/or low friction coatings). To face problems arising from the multi-element nature and the often extremely narrow composition domain of CMAs, multisource coating methods as an alternative of deposition from alloy targets, and selected combinations of organometallic precursors will be studied. Dedicated reactors, appropriate operating conditions, state of the art diagnostics and characterization techniques will also be investigated.