MM 52: Microstructure and Phase Transformations - phase stability

Time: Wednesday 17:00–18:00 Location: IFW B

MM 52.1 Wed 17:00 IFW B

Microstructure-engineering of near-α titanium alloys — •Stefanie Sandlöbes[1,2], Zahra Tarzimoghadam[2], Sandra Korte-Kerzel[1], and Dierk Raabe[2] — [1]Institut für Metallkunde und Metallphysik, RWTH Aachen University, Aachen, Germany — [2]Max-Planck-Institut für Eisenforschung GmbH, Düsseldorf, Germany

Lean alloying of the beta-stabilizing elements Fe and Mo to titanium in combination with appropriate heat treatments enables one to manipulate the microstructure. Consequently, the mechanical properties can be tailored covering a broad range from low yield strength and high ductility to high yield strength and medium ductility. By applying multi-scale characterization of the mechanical properties and microstructures it is shown that local segregation and partitioning phenomena on the nano-scale are causing local allotropic and martensitic transformations and significantly alter the active deformation mechanisms.

MM 52.2 Wed 17:15 IFW B

The applicability of grain boundary engineering on ultrafine grained Cu-Ni alloys — •Friederike Emeis, Martin Peterlechner, Harald Rösner, Sergiy V. Divinski, and Gerhard Wilde — Institute of Materials Physics, Westfälische Wilhelms-Universität Münster, D-48149

Grain boundary engineering (GBE) is a concept used to design a thermal stable microstructure by the introduction of special grain boundaries (Σ3-, Σ9-GBs) and their conjunctions. Due to the poor thermal stability of severely deformed materials, GBE is of interest to design an ultrafine grained and thermally stable microstructure with retained enhanced properties. In the present investigation, GBE is applied to severely deformed Cu-Ni alloys (including the pure endmembers). Copper and nickel are completely miscible in the liquid and the solid state and thus the stacking fault energy (SFE) of the solid solutions also varies strongly and systematically for the different alloy compositions. The SFE is related to the tendency to undergo twinning (Σ3-GB). The annealing-induced microstructure evolution of the severely deformed Cu-Ni alloys is analyzed. Most of the concepts describing the microstructural behavior are only valid for pure materials. For the alloys, the concurrent effects from SFE and solid solution need to be considered. The data on the development of the GB structure and grain size lead to the conclusion that not only a small SFE but a second mechanism is important to prevent grain growth and to achieve a high fraction of suitable GBs. For Cu50Ni50 and Cu65Ni35 the microstructure was optimized.

MM 52.3 Wed 17:30 IFW B

Linear complexions - local phase transformation of dislocations — Alisson Kwiatkowski da Silva[1], Margarita Kuzmina[1], Dirk Ponge[1], Michael Herbig[1], •Stefanie Sandlöbes[1,2], Baptiste Gault[1], Sandra Korte-Kerzel[2], and Dierk Raabe[1] — [1]Max-Planck-Institut für Eisenforschung GmbH, Düsseldorf, Germany — [2]Institut für Metallkunde und Metallphysik, RWTH Aachen University, Aachen, Germany

Complexions are confined interface-stabilized states which differ in structure and/or composition from the bulk. They form in many ceramic materials as 2D complexions. We use correlative transmission electron microscopy / atom probe tomography to show the existence of 1D complexions in a martensitic Fe9wt%Mn alloy. Equilibrium segregation of Mn to dislocations causes transformation of dislocation cores into austenite. These austenite regions are found to be confined to the strain field of the dislocation and remain sub-critical in size even after extended tempering treatment for two weeks. This observation might give new insights into microstructure formation and deformation of metallic alloys.

MM 52.4 Wed 17:45 IFW B

Diffusion Brazing of γ-TiAl Alloys: Comparison of Microstructure Development and Mechanical Strength for Two Different Brazing Solders — •Katja Hauschildt, Andreas Stark, Norbert Schell, Florian Pyczak, and Martin Müller — Helmholtz-Zentrum Geesthacht, Geesthacht, Germany

TiAl alloys are increasingly used as light weight material, for example in aero engines, which also leads to a request for suitable repair methods. For this purpose, diffusion brazing is a promising method for the closure of cracks (in noncritical or not highly loaded areas) as it is already used for Ni-base superalloys. Therefore, two different brazing solders based on Ti-Fe and Ti-Ni were investigated for joining the alloy Ti-45Al-5Nb-0.2B-0.2C (in at. %). Tensile tests at room temperature show different mechanical strength depending on the brazing solder. Furthermore, the phases and their development and distribution over the brazing zone were investigated time and space resolved during the brazing process. Here, the two brazing solders show differences in development and fraction of the phases. These analyses were performed with high-energy X-ray diffraction using the HZG-run materials science beamline HEMS at the synchrotron radiation facility at DESY in Hamburg, Germany. In addition, analysis with electron microscopy and electron backscatter diffraction show significantly different grain sizes in the brazed region for both brazing solders. The results of phase analysis and electron backscatter diffraction can be combined to explain the different microstructure after the brazing process and thus the different mechanical strength depending on the two brazing solders.