MM 49: Phase Transitions VI

Time: Friday 11:45–12:45 Location: H 0107

MM 49.1 Fri 11:45 H 0107

Comparative investigation of nucleation undercooling of Zirconium using the electromagnetic and electrostatic levitation technique — •Stefan Klein[1,2] and Dieter M. Herlach[1] — [1]Institut für Materialphysik im Weltraum, Deutsches Zentrum für Luft- und Raumfahrt, 51170 Köln, Germany — [2]Institut für Festkörperphysik, Ruhr-Universität Bochum, 44780 Bochum, Germany

Containerless processing techniques are applied to deeply undercool metallic melts by avoidance of heterogeneous nucleation on container walls. In this work we investigate the nucleation undercooling of Zirconium processed by the electromagnetic and the electrostatic levitation. While in the first case the samples are processed within ultra high purity inert gas atmosphere, the electrostatic levitation allows to process the melts in ultra high vacuum.

We achieved large melt undercoolings of up to 400 K. A statistical analysis of the maximum undercooling observed within a modified model by Skripov gives information about the nucleation mechanism.

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MM 49.2 Fri 12:00 H 0107

Investigation of the reverted austenite phase in carbon free stainless maraging steel after long term heat treatment — •Stefan Höring, Daniel Abou-Ras, Nelia Wanderka, and John Banhart — Hahn-Meitner-Institut Berlin, Berlin

The main aim of this work was to investigate the microstructure evolution of the carbon free stainless maraging steel Corax after long term heat treatment at 798 K. The mechanical properties of maraging steels are influenced by the amount of reverted austenite. Therefore, the volume fraction, the grain size and the location of the reverted austenite was determined by X-ray diffraction (XRD), scanning electron microscopy (SEM) and electron backscatter diffraction (EBSD). Results of all investigations confirmed that even after long aging time (3000 h) the volume fraction of the austenite is still nearly unchanged. The correlation between crystal orientation of martensite- and the austenite phases is studied by means of EBSD measurements. The austenite grains reached sizes up to 0.05 mm. Long term annealing leads to the formation of new phases located mainly at the grain boundaries. The results of micro-hardness measurements of Corax steel are correlated with the evolution of the microstructure.

MM 49.3 Fri 12:15 H 0107

Formation of Amorphous Domains and Crystalline Precipitates in Precursor Derived Si-C-N-Ceramics — •Wolfgang Gruber and Harald Schmidt — TU Clausthal, Institut für Metallurgie, AG Materialphysik

Precursor derived ceramics of the system Si-C-N are prepared by solid state thermolysis of pre-ceramic polymers at temperatures of about 1100 °C. The materials are free of sinter additives and exhibit a good high-temperature stability and oxidation resistance making them attractive for applications in various branches of technology. As-thermolized ceramics are already separated in silicon rich and carbon rich amorphous phases. Annealing in nitrogen atmosphere at temperatures above the temperature of thermolysis leads to a coarsening of the amorphous phases and at length to the formation of micro crystalline silicon nitride and nano crystalline silicon carbide. According to the phase diagram of the system Si-C-N carbon and silicon nitride are in equilibrium at a nitrogen partial pressure of 1 bar and at temperatures below 1484 °C. At higher temperatures silicon nitride reacts with carbon and silicon carbide and gaseous nitrogen are formed. This reaction and therefore the micro structure of the ceramic strongly depends on temperature and on the nitrogen partial pressure. In this study we investigated the formation kinetics of amorphous domains and crystalline precipitates at different nitrogen partial pressures using small angle X-ray scattering (SAXS) and X-ray diffractometry (XRD).

MM 49.4 Fri 12:30 H 0107

Phase-field simulations of cubic-cubic phase transformations under external load (application to nickel-based superalloys) — •guillaume boussinot[1,2], alphonse finel[1], and yann le bouar[1] — [1]Laboratoire d'Etude des Microstructures, ONERA/CNRS, 92320 Chatillon, France — [2]Institut fur Festkörperforschung, Theorie 3, Forschungszentrum, 52425 Jülich, Germany

In the case of solid-solid transformations involving cubic phases with negative anisotropy (2 C44 > C11 - C12), the three (100)-type directions are equivalent and are the directions perpendicular to which plate-like precipitates minimize the elastic energy (soft directions-Khachaturyan 1983).

When an external uniaxial stress or strain is applied, the equivalence of the (100)-type directions is broken. In superalloys, where an intermetallic phase is dispersed in a disordered matrix, this symmetry breaking leads to an anisotropic coarsening of the microstructure known as rafting. This phenomenon is of great importance in understanding the macroscopic mechanical properties of these systems (via dislocation motion which is almost restricted to the disordered phase).

We will present phase-field simulations of elastically-driven rafting (rafting can be also plastically-driven), requiring the elastic inhomogeneity between the two phases to be taken into account. Different types of rafting are then obtained, which are understood by analyzing the soft directions within an approximation of small inhomogeneity (good for superalloys).