MM 57: Microstructure and Phase Transformations - transformation kinetics

Time: Thursday 10:15–11:15 Location: IFW B

MM 57.1 Thu 10:15 IFW B

Capturing the evolution of fractal abnormal grains in nanocrystalline $Pd_{90}Au_{10}$ — •Raphael Zeller[1], Harms Fey[1], Christian Braun[2], Philipp Romberger[1], Rainer Birringer[2], and Carl Krill[1] — [1]Institute of Micro and Nanomaterials, Ulm University, Germany — [2]Experimental Physics, Saarland University, Germany

During abnormal grain growth, a bimodal size distribution is established by the rapid growth of a few grains to much larger sizes than their neighbors. Usually, such abnormal grains expand in all directions at roughly the same speed, but in nanocrystalline $Pd_{90}Au_{10}$, they appear to send out "tentacles" into the surrounding matrix, which ultimately results in highly irregular, fractal-like grain shapes. Exploiting the fast heating and cooling capabilities of a salt-bath furnace, we have investigated the evolution of fractal grain morphologies in nano-$Pd_{90}Au_{10}$, finding two surprises: higher temperatures sometimes lead to smaller grains, and longer annealing times do not necessarily promote further grain growth (but they can affect the fractal dimension of the grain shape). We discuss these results in the framework of standard growth models supplemented by ideas from nucleation theory.

MM 57.2 Thu 10:30 IFW B

Extracting the kinetics of grain growth in Al-based polycrystals from 4D measurements — •Mingyan Wang[1], Jules Dake[1], Jette Oddershede[2], Henning Sørensen[3], Søren Schmidt[2], and Carl Krill[1] — [1]Ulm University, Germany — [2]Technical University of Denmark, Denmark — [3]University of Copenhagen, Denmark

Conventional studies of grain growth rely on 2D micrographs, which reveal that curved grain boundaries (GBs) tend to migrate toward their centers of curvature. From bicrystal experiments we learn that the reduced mobility (the product of GB mobility and energy) depends not only on curvature but also on boundary misorientation and inclination. Using 3D x-ray diffraction (3DXRD) microscopy, we have investigated the latter dependency in Al-based polycrystalline materials following a novel 4D protocol. From a series of 3D snapshots separated by isothermal annealing intervals, we have extracted the morphology, misorientation and migration rate of more than ten thousand GBs in a single sample, forming the basis for a robust statistical analysis of local growth kinetics. In one particular specimen, the observed dependency of reduced mobility on misorientation and inclination is consistent with behavior expected of normal grain growth, but in another case we find evidence for abnormal boundary migration that does not fit standard models.

MM 57.3 Thu 10:45 IFW B

Steady state structure of the moving faceted grain boundaries — •Sherri Hadian, Blazej Grabowski, and Jörg Neugebauer — Department for Computational Materials Design, Max-Planck-Institut fu*r Eisenforschung GmbH, Max-Planck-Str. 1, 40237 Du*sseldorf, Germany

Migration of grain boundaries in metals plays an important role in the evolution of the microstructure. To gain insight on dynamics of grain boundaries in realistic materials, we have studied the motion of grain boundaries of general orientations. These boundaries have been observed to facet on different length scales. We have studied the finite facet length effects on the mobility of grain boundaries using MD simulations and analytical models. Grain boundaries were run under different driving forces at a wide range of forces/temperatures and their kinetics and mechanisms of motion were thoroughly investigated. The results imply that for high driving forces the steady state structure of the moving boundaries differs from their static equilibrium structure.

MM 57.4 Thu 11:00 IFW B

Analysis of the melting and solidification behavior of Pb nanoparticles embedded in Al matrix with Ga addition — •Martin Peterlechner, Harald Rösner, and Gerhard Wilde — Institute of Materials Physics, WWU Münster, Germany

Melting and crystallization solidification of nanoparticles are of academic interest due to size effects. Nanoparticles embedded in a matrix show contributions to their melting behavior caused by the coherency of the interfaces and pressure of the matrix. In the present study, nanoparticles of the low melting point material Pb was were processed as nanoparticles embedded in an coarse grained Al matrix where with Ga contents up to 9 at% was addedin order to vary the misfit and thus the coherency of the interfaces. The embedded nanoparticles show a decreasing melting and solidification temperatures with increasing Ga contents, due to an atomistically flat decoupling wetting layer at the Al-Pb interface. In the present work, the Transmission electron microscopy (TEM) analysis is supported by multislice image simulations, showing a signal broadening of the TEM analysis at the interface. A reduced melting enthalpy is in agreement with a the observed layering effect. The results are discussed with respect to current models. reducing the effective volume of the melting species.