MM 16: Microstructure and Phase Transformations I

Time: Monday 15:45–17:00 Location: H 1029

MM 16.1 Mon 15:45 H 1029

Deep liquid undercooling and nucleation in higher melting fcc metals — •Joachim Bokeloh, Marcel Heeger, and Gerhard Wilde — Institut für Materialphysik Münster

Since the melting enthalpy of fcc metals and therefore the driving force for crystallization scales with the melting temperature (T_m), one prediction of the classical nucleation theory (CNT) is that the onset of homogeneous nucleation for all fcc metals should be at about the same relative undercooling ($\Delta T/T_m$). While this was initially supported by experiments by Turnbull that showed a relative undercooling in the range of 0.17 to 0.18, the homogeneous nature of the nucelation was always questioned since CNT predicts a deeper undercooling before the onset of homogeneous nucleation. In a recent publication (PRL 107, 145701), new evidence was found that the crystallization of Nickel at a relative undercooling of 0.18 is indeed caused by homogeneous nucleation. Thus, the undercoolability of several fcc metals (Au, Cu, Co, Ni) is revisited by nucleation rate measurements with an heretofore unprecedented accuracy obtained by a statistical analysis of several thousand single crystallization events. Funding by the DPG (SPP1296) is greatfully acknowleged.

MM 16.2 Mon 16:00 H 1029

Crystallization behavior of an amorphous matrix with embedded heterogeneously distributed preexisting crystals: Geometric crystallization simulations and the Johnson-Mehl-Avrami analysis — •Martin Peterlechner[1], Thomas Waitz[2], and Gerhard Wilde[1] — [1]Institute of Materials Physics, Westfälische Wilhelms-University, Münster, Germany — [2]Physics of Nanostructured Materials, Faculty of Physics, University of Vienna, Vienna, Austria

Nanocrystalline materials can be processed via crystallization of an intermediate amorphous phase. Controlling the grain size and thus the functional properties requires thorough knowledge of the kinetics of the crystallization processes. Probably the most widely applied kinetic model for crystallization reactions by nucleation and growth is the Johnson-Mehl-Avrami (JMA) model. The JMA model is analytical but based on rather strict assumptions such as a homogeneous distribution of nuclei with zero initial volume. To account for preformed heterogeneously distributed crystals that can strongly impact the crystallization behavior the present work focuses on simulations. A two-dimensional geometric model was used to systematically analyze the spatial distribution and initial volume fraction of preexisting crystals on the crystallization behavior. Using a constant nucleation and growth rate, it can be shown that with heterogeneously distributed preexisting crystals a bimodal structure after crystallization develops. The influence on the amount of heterogeneity and the number of preexisting crystals on the kinetic analysis using JMA is discussed.

MM 16.3 Mon 16:15 H 1029

Melting point depression of embedded Bi nano particles in Zn synthesized by rapid solidification — •Tae-Eun Song, Joachim Bokeloh, Martin Peterlechner, and Gerhard Wilde — Westfälische Wilhelms-Universität,Institute für Materialphysik, Wilhelmklemm-straße 10 D-48149 Münster, Germany

The melting point depression of embedded Bi nano particles in a Zn matrix synthesized by rapid solidification was analyzed using Differential scanning calorimetry (DSC), Scanning electron microscope (SEM) and Transmission electron microscopy (TEM). SEM and TEM results reveal the Bi particle size distribution of the as prepared state and after annealing at the relevant temperature. DSC results reveal the embedded Bi particles are solidified at two different undercooling levels. Some Bi particles are solidified at a small undercooling with a number of exothermic peaks. Other Bi particles are solidified with a broad exothermic peak at a larger undercooling level. During repeated heating and cooling through the early melting peak, the enthalpy for solidification gradually decreases. The possible explanations based on thermodynamics or based on coarsening kinetics will be discussed.

MM 16.4 Mon 16:30 H 1029

Effect of quenching rate on the clustering behavior of Al-Mg-Si alloys — •yong yan[1], meng liu[1,2], cynthia chang[1], julian kühn[1], and john banhart[1,2] — [1]Technische Universität Berlin, Materials Science and Technology, Hardenbergstr. 36, 10623 Berlin, Germany — [2]Helmholtz Center Berlin for Materials and Energy, Applied Materials, Hahn-Meitner-Platz, 14109 Berlin, Germany

In order to investigate the effect of quenching rate on the clustering kinetics during natural aging (NA), high purity Al-Mg-Si alloys are quenched to different temperature and media. In-situ Positron Annihilation Lifetime Spectroscopy (PALS) and In-situ resistivity measurements at room temperature were then performed. It is found that four stages of changes in positron lifetime are directly observed. The quenching rate influences the first decrease of the lifetime during NA. The influence is larger for samples with lower solute content. On the other hand, a first decrease in the resistivity is observed in all alloys before the increase that is due to clustering of solute atoms. The amplitude of the decrease is more significant for samples with lower solute content and lower quenching rate. The first decrease in the positron lifetime and resistivity is discussed in terms of the interaction of vacancy and solute atoms.

MM 16.5 Mon 16:45 H 1029

Solidification along liquid-liquid interfaces in syntectic systems — •Claas Hüter[1], Guillaume Boussinot[1,2], Efim Brener[2], and Robert Spatschek[1] — [1]MPIE, Düsseldorf, Germany — [2]PGI, Forschungszentrum Jülich, Germany

Syntectic transformations belong to transitions which exhibit three-phase equilibria in binary alloys, and we consider solidification along the interface in undercooled demixed liquids. The formulation of the steady-state problem is obtained in terms of boundary integrals . The focus of our investigation is on the scaling relations which we obtain in the regime of small deviations from solutions which show symmetric interface shapes.