MM 26: Microstructure and Phase Transformations

Nucleation and Wetting

Time: Tuesday 11:45–13:00 Location: TC 010

MM 26.1 Tue 11:45 TC 010

Study on Temperature Rise in Pulsed Laser Atom Probe via Laser-Induced Interface Reactions in Al-Li alloy — •Muna Khushaim[1,2], Ryota Gemma[3], and Talaat Al-Kassab[2] — [1]Department of Physics, Faculty of science, Taibah University, PO Box 344, Medina, Kingdom of Saudi Arabia — [2]Division of Physical Sciences and Engineering, King Abdullah University of Science and Technology (KAUST), Thuwal, Saudi Arabia — [3]Department of Material Science, Tokai University, Kanagawa 259-1292 - Japan

The influence of tuning the laser pulse energy during the analyses on the resulting microstructure in a specimen utilizing an ultra-fast laser assisted atom probe was demonstrated. The decomposition parameters, such as the size, number density, volume fraction, and composition of δ' precipitates, were carefully monitored after each analysis. A simple model was employed to estimate the corresponding specimen temperature for each value of the laser energy. The results indicated that the corresponding temperatures for the laser pulse energy in the range of 10 to 80 pJ are located inside the miscibility gap of the binary Al-Li phase diagram and fall into the metastable equilibrium field. In addition, the corresponding temperature for a laser pulse energy of 100 pJ was in fairly good agreement with reported range of δ' solvus temperature, suggesting a result of reversion upon heating due to laser pulsing. This study proposed one simple method to estimate real specimen temperatures via laser-induced interface reactions during a laser-APT analysis.

MM 26.2 Tue 12:00 TC 010

Surface preparation by laser treatment for liquid phase epitaxy — •David Uebel, Roman Bansen, Christian Ehlers, Thomas Teubner, and Torsten Boeck — Leibniz-Institut für Kristallzüchtung

Bulk-based silicon solar cells consume much more raw silicon than electrically necessary. Therefore we grow crystalline silicon on glass just to the necessary thickness in a two-step process. First, amorphous silicon is applied by PVD to form a seed layer. Afterwards, a polycrystalline layer is deposited from a tin solution, supersaturated with silicon. To improve the growth on the seed, it is treated by a pulsed UV-laser directly before growth. Areal scanning heats up the surface and disruptive silicon oxides react with the chamber atmosphere. We will present a detailed model of the interaction process.

MM 26.3 Tue 12:15 TC 010

Study of the nucleation behavior and solid-liquid interfacial energy of pure metals — •Manoel da Silva Pinto, Martin Peterlechner, and Gerhard Wilde — Institute of Material Physics, Münster, Germany

We examine the liquid-solid transformation of selected pure metals and Germanium. The solid-liquid interfacial energy is of special interest due to its importance in the solidification process and other metallurgical phenomena. Various models suggest a correlation of this energy with bulk properties, e.g. the heat of fusion, which presents a more easily accessible quantity. Yet, so far experimental data of sufficient accuracy that allow for quantitative comparison with the model predictions are missing. In this work, data sets of the undercooling of Gold, Nickel, Copper, Cobalt and Germanium were acquired through calorimetric measurements. For statistical significance, datasets in the range of 100 to 1000 crystallization events were recorded for each material. The statistical analyses of these data yield a quantitative description of nucleation kinetics. The data also yield the solid-liquid interface energy and allows comparing the experimental results with theoretical predictions.

MM 26.4 Tue 12:30 TC 010

Reactive wetting behavior of SnPb micro-solder on Cu and Ni capillary tracks — •Samuel Griffiths, Patcharawee Jantimapornkij, and Guido Schmitz — Institute of Materials Science, Stuttgart, Germany

Micro-solder technologies are ubiquitous in modern electronics industries. And although these industries have pushed practical advancements in solder technologies, little is understood about the flow kinetics and thermodynamic theory which predicts solder flow behavior. This work quantifies and analyzes the capillary flow behavior of eutectic Sn-Pb micro-solder on microstructured linear Cu and Ni conductive tracks for multiple track widths. Solder-flow experiments have been conducted at 350°C in a reducing flux environment. We aim to quantitatively link parameters such as the equilibrium solder-flow distance, wetting/contour angles, and conductive track width. It is shown that, the relationship between the equilibrium solder-flow distance and track width behaves inversely for the Cu and Ni conductive tracks. Additionally, traditional contact angle control measurements are used to draw comparisons with the equilibrium angles of the solder fronts, which are the dimensionally unrestricted wetting angles of the solder-flow experiments. Electron microscopic imaging and chemical analysis as well as theoretical modelling based on surface energy minimization are applied to support our conclusions.

MM 26.5 Tue 12:45 TC 010

Melting and solidification of embedded particles at high heating and cooling rates — •Mark Stringe, Christian Simon, Harald Rösner, Martin Peterlechner, and Gerhard Wilde — Institute of Materials Physics, University of Münster, D-48149 Münster

During solidification of metallic particles embedded in a surrounding matrix, nucleation events take place at different sites and thus can depend on the morphology of the interface between particle and matrix. Moreover, the melting behavior of these particles is also different compared to bulk samples due to possible size, shape and pressure effects. In the present work, metallic particles were embedded in a higher melting matrix by the melt spinning technique. The microstructure was analyzed via x-ray diffraction and transmission electron microscopy. The metallic particles are of different sizes ranging from nanometer sized particles in the matrix grain interiors to micron sized particles at the grain boundaries. Using differential scanning calorimetry (DSC) the melting and solidification behavior was examined. Fast scanning calorimetry based on sensor chips for sample dimensions in the range of 100 microns allows measurements with heating and cooling rates which are by four orders higher than for conventional DSC. This method delivers new insight into the kinetics upon melting and solidification of these particles suggesting different kinetics of the transformations.