MM 3: SYM Phase Transformations in Metallic Melts II

Time: Monday 11:45–12:30 Location: H 1058

MM 3.1 Mon 11:45 H 1058

Thermophysical Properties of Liquid Ternary Metallic Alloys — Ivan Egry and •Jürgen Brillo — Institut für Materialphysik im Weltraum, DLR, 51170 Köln

Thermophysical properties of liquid metals are difficult to measure, but highly relevant, both from an application and a fundamental point of view. On one hand, they are required for quantitative modelling of industrial processes such as solidification and welding; on the other, they are sensitive indicators of ordering phenomena in the liquid phase. In binary and multicomponent alloys, the so called excess quantities are of particular interest. They describe the deviation of thermodynamic and thermophysical properties from the respective ideal mixing laws. In this project we have determined surface tensions and densities of the two ternary systems Cu-Fe-Ni and Ag-Al-Cu over the entire concentration range, including the limiting binary systems. The measurements have been performed on electromagnetically levitated liquid drops using non-contact diagnostic tools, like the oscillating drop technique for surface tension and a shadowgraph technique for density measurements. A wide temperature range, including the undercooled regime, was covered by the experiments. Surface tension data were modelled by the Butler equation using available Gibbs excess free energies, and generally good agreement was found. From the density data, the excess volumes were calculated. They constitute a non negligible contribution and can have either sign.

MM 3.2 Mon 12:00 H 1058

Messungen der fest-flüssig Grenzflächenenergien in ternären Systemen — Annemarie Bulla[1], Carlos Carreno-Bodensiek[2], •Emir Subasic[1], Ralf Berger[1], Andreas Bührig-Polaczek[1] und Andreas Ludwig[3] — [1]Gießerei-Institut der RWTH Aachen, 52072 Aachen, Deutschland — [2]Department of Electromechanical Engineering, Faculty of Duitama, Duitama, Columbia — [3]Department Metallurgie, Montanuniversität Leoben, 8700 Leoben, Österreich

Die fest-flüssig Grenzflächenenergie spielt während des Erstarrungsprozesses für die Keimbildung und das Wachstum der Phasen eine zentrale Rolle. Sie geht als wichtiger Parameter in viele analytische und numerische Erstarrungs- und Reifungsmodelle ein. In der Literatur finden sich nur sehr begrenzt experimentell bestimmte Werte. Für ternäre und höherkomponentige Systeme existieren bisher keine Messungen. Die zentrale Zielsetzung der vorliegenden Arbeit bestand darin, eine geeignete Vorrichtung für die Messung der fest-flüssig Grenzflächenenergie aufzubauen und auf im Rahmen des Schwerpunktprogrammes relevante ternäre Legierungssysteme anzuwenden. Dazu wurde entsprechend den Arbeiten der Gruppe von Prof. J.D. Hunt in Oxford eine radiale Wärmeflussapparatur aufgebaut, die die Einstellung eines sehr stabilen radialen Temperaturgradienten erlaubt, indem eine zylindrische Probe entlang ihrer Achse geheizt und auf der Außenseite gekühlt wird. Durch Formanalyse von Gleichgewichtskorngrenzenfurchen und die numerische Bestimmung der lokalen Unterkühlung entlang der Korngrenzenfurchung wurde der Gibbs-Thomson-Koeffizient und daraus die fest-flüssig Grenzflächenenergie bestimmt.

MM 3.3 Mon 12:15 H 1058

Phase Equilibria of Nanoscaled Systems — •Gerhard Wilde[1], Harald Rösner[2], Peter Bunzel[2,3], and Jörg Weissmüller[2,3] — [1]Universität Münster, Institut für Materialphysik — [2]Forschungszentrum Karlsruhe, Institut für Nanotechnologie — [3]Technische Physik, Universität des Saarlandes

The impact of the morphology of the interface of matrix-encased nanoparticles on the melting transition has been investigated. To elucidate the interface contribution clearly, material of identical chemical composition has been synthesized by different processing pathways, resulting in distinctly different interface topologies. These results are discussed with respect of the mechanisms that lead to a size dependence of the melting temperature. Aside from the particle/matrix interfaces, internal heterophase interfaces necessarily occur, if multicomponent and especially multiphase materials are addressed. In multicomponent and nanoscaled alloy systems, interface segregation and interface-induced stresses are known to affect the phase boundary lines of the equilibrium phase diagrams at fixed size. Yet, already the presence of internal heterophase interfaces contributing an excess free energy is sufficient to severely modify the phase equilibrium and the associated phase transformations in nanosize alloy systems. Here, results on the constitutive behavior of binary nanoscaled model alloys obtained by modeling will be highlighted. In addition, experimental results concerning the constitutive behavior of nanoscale alloy systems and concerning a new approach for obtaining nanoscale systems with well-defined size are presented. Support by the DFG is gratefully acknowledged.