MM 2: SYM Phase Transformations in Metallic Melts I

Time: Monday 10:15–11:15 Location: H 1058

Invited Talk MM 2.1 Mon 10:15 H 1058

Phase Formation in Multicomponent Monotectic Aluminum Alloys — Djordje Mirković, Joachim Gröbner, and •Rainer Schmid-Fetzer — Institute of Metallurgy, Clausthal University of Technology, Germany

Alloys with a miscibility gap in the liquid state are potential materials for advanced bearings in automotive and other applications. While binary alloys, such as Al-Pb or Al-Bi, are well known, the information available for ternary monotectic Al-alloys is scarce. However, the phase formation in multicomponent alloys is not only more challenging from a scientific aspect, it is also a prerequisite for a focused development of advanced alloys. This motivated our detailed study of monotectic Al-Bi-Cu-Sn alloys including both experimental and computational thermodynamic methods. Based on the initially established systematic classification of monotectic ternary Al-alloys, the first promising monotectic reaction was observed in the ternary Al-Bi-Zn system. Further ternary systems Al-Cu-Sn, Al-Bi-Sn, Al-Bi-Cu and Bi-Cu-Sn were investigated as basis for quaternary Al-Bi-Cu-Sn alloys. Experimental investigations of phase equilibria, enthalpies and solidification microstructures were combined with thermodynamic modeling. The results demonstrate that the developed precise thermodynamic description is vital to reveal the distinct multicomponent monotectic features of pertinent phase diagrams. The solidification paths of ternary monotectic alloy systems, Al-Bi-Zn, Al-Sn-Cu and Al-Bi-Cu, were also studied using thermodynamic calculations, revealing specific details of phase formation during solidification of selected alloys.

MM 2.2 Mon 10:45 H 1058

Liquid-liquid interfacial tension in multicomponent immiscible Al-based alloys — •Walter Hoyer[1] and Ivan Kaban[2] — [1]Technische Universität Chemnitz, Institut für Physik, 09107 Chemnitz — [2]Technische Universität Chemnitz, Institut für Physik, 09107 Chemnitz

Liquid-liquid interfacial tension and density difference of the coexisting phases have been determined in wide temperature and composition ranges in binary Al-Bi, ternary Al-Bi-Cu, Al-Bi-Si, Al-Bi-Sn and quaternary Al-Bi-Cu-Sn alloys.

It is found that the interfacial tension between Al-rich and Bi-rich liquid phases increases when either Cu or Si is added and it decreases when Sn is added. Simultaneous addition of Cu and Sn in equal quantity results in a decrease of the interfacial tension at low temperature and in its increase at high temperature. Temperature dependences of the interfacial tension in all alloys studied are well described by the function $\sigma_{\alpha\beta} = \sigma_0(1 - \mathcal{T}/\mathcal{T}_C)^\mu$ with a constant σ_0 and the critical point exponent $\mu = 1.3$.

MM 2.3 Mon 11:00 H 1058

Gefügemorphologien gerichtet erstarrter monotektischer Legierungen — Martin Seifert und •Lorenz Ratke — Institut für Materialphysik im Weltraum, DLR, Cologne, Germany

Bei der gerichteten Erstarrung von Legierungen mit exakt monotektischer Zusammensetzung werden abhängig von der Erstarrungsgeschwindigkeit v und dem Temperaturgradienten G an der monotektischen Reaktionsfront verschiedene Morphologien beobachtet. Fasern bei hohen Gradienten und kleinen Geschwindigkeiten, perlschnurartige Gebilde bei mittleren Gradienten und größeren Erstarrungsgeschwindigkeiten. Bei kleinen Temperaturgradienten treten immer irreguläre Tropfenanordnungen auf. Die Mechanismen der Bildung der verschiedenen Gefügemorphologien sind nicht verstanden. Der Vortrag präsentiert Experimente an den Systemen Al-In, Al-Bi, Al-Pb bei denen systematisch v in Bereichen von 0,5 μm bis 5 μm und G im Bereich von 3 bis 8 K/mm variiert wurden. Die verschiedenen Gefügetypen werden charakterisiert und ihre Entstehung im Rahmen neuerer Theorien zum konvektionsbeeinflussten Wachstum an der monotektischen Front diskutiert.