8th International Conference on Physical and Numerical Simulation of Materials Processing (ICPNS)

14–17 October 2016

Seattle, Washington | Hosted by Purdue University

SESSION 8: POSTER, GRAND PACIFIC BALLROOM
SUNDAY, OCTOBER 15, 2016

Thermodynamic calculation of the liquidus surface projection of multi-component aluminum alloys

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ABSTRACT

Most aluminum alloys used in industrial manufacturing are multi-component systems. Unfortunately, multi-component systems lack systematic research. The lack of research is especially evident for the liquidus surface projection of the multi-component system where most of the projections are currently drawn by hand. Based on the A1–Cu–Fe–Mg–Si thermodynamic database previously established by Yong Du's group, thermodynamic calculations were performed for the Al–Cu–Fe–Mg, Al–Cu–Fe–Si, Al–Cu–Mg–Si, Al–Fe–Mg–Si quaternary systems, and the A1–Cu–Fe–Mg–Si quinary systems. The temperatures and compositions of the liquidus invariant reactions in the A1-rich corner for all of the above systems were calculated and compared with the experimental data. The liquidus surface projections in the Al-rich corner for A1–Cu–Fe–Mg, A1–Cu–Fe–Si, Al–Cu–Mg–Si, and A1–Fe–Mg–Si quaternary systems were constructed. The calculated results are in good agreement with the literature data. Furthermore, the liquidus surface projections for the A1–Cu–Fe–Mg–Si quinary system in the Al–Cu, Al–Si, and Al–Mg sides were presented. The current work provides a straightforward and accurate expression for the liquidus surface projections of multi-component systems. The expressions will facilitate the understanding of the multi-component alloy systems that are frequently used in industrial applications.