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Al-Y-Zn (Aluminum-Yttrium-Zinc)

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The previous study of this ternary system by [1993Gan] presented a composite isothermal section drawn at 300 °C for the Y-lean region and at 500 °C for the region richer in Y. Recently, [2008Liu] developed a thermodynamic model and computed two isothermal sections at 500 and 300 °C and a liquidus projection.

Binary Systems

The Al-Y phase diagram [2006Liu, Massalski2] depicts the following intermediate phases: Y_2Al ($C23$, Co_2Si-type orthorhombic), Y_3Al_2 (Zr_3Al_2-type tetragonal), YAl (B_f, CrB-type orthorhombic), YAl_2 ($C15$, $MgCu_2$-type cubic), αYAl_3 ($D0_{19}$, Ni_3Sn-type hexagonal), βYAl_3 (stable between 980 and 645 °C; $BaPb_3$-type rhombohedral). In the Al-Zn system, solidification occurs through a eutectic reaction at 381 °C yielding (Zn) and (Al). On solidification, (Al) has more than 60 at.% of dissolved Zn. At lower temperatures, this solid solution exhibits a miscibility gap, with a critical temperature at 351.5 °C and a monotectoid reaction at 277 °C: $(Al)' \leftrightarrow (Al) + (Zn)$. The Y-Zn system [2008Liu, Massalski2] depicts a number of intermediate compounds: YZn ($B2$, CsCl-type cubic), βYZn_2, αYZn_2 ($CeCu_2$-type orthorhombic), YZn_3 (YZn_3-type orthorhombic), Y_3Zn_{11} (La_3Al_{11}-type orthorhombic), $Y_{13}Zn_{58}$ ($Gd_{13}Zn_{58}$-type hexagonal), YZn_5 ($ErZn_5$-type hexagonal), Y_2Zn_{17} (Th_2Ni_{17}-type hexagonal) and YZn_{12} ($D2_b$, $ThMn_{12}$-type tetragonal).

Computed Ternary Phase Equilibria

For the Y-Zn binary system, [2008Liu] carried out their own thermodynamic optimization. For the Al-Zn and Al-Y systems, they used literature assessments. The experimental data of [1993Gan] on this ternary system were used as input for the ternary optimization. The liquid, fcc, bcc and cph phases were modeled as subregular solutions. The binary intermetallic phases were treated as stoichiometric compounds with no third component solubility. The exception was YZn, which dissolves a few percent of Al [1993Gan].

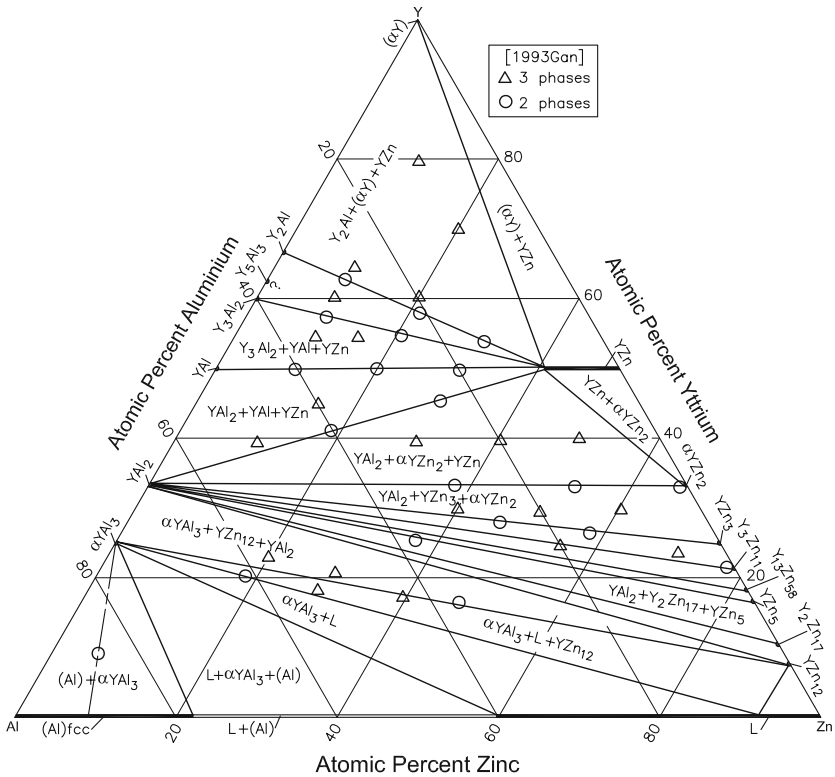

Fig. 1 Al-Y-Zn computed isothermal section at 500 °C [2008Liu]. Narrow two-phase regions are omitted

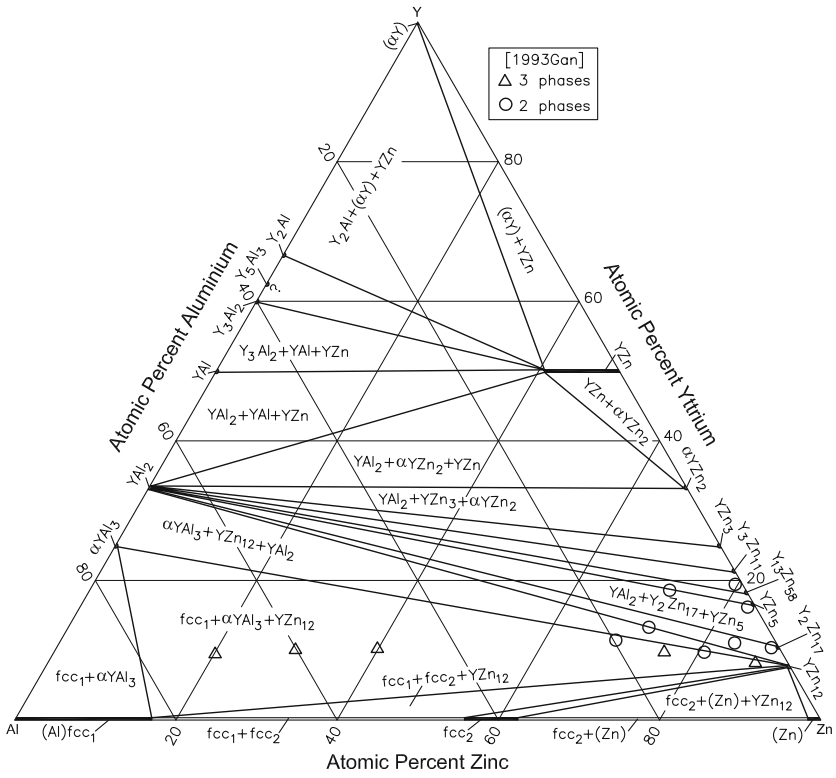

Fig. 2 Al-Y-Zn computed isothermal section at 300 °C [2008Liu]. Narrow two-phase regions are omitted

This solubility was taken into account in the modeling by [2008Liu]. [2008Liu] computed two separate isothermal sections at 500 and 300 °C for the entire composition range and compared them with the experimental data of [1993Gan]. The agreement is satisfactory, as seen in Fig.1 (500 °C) and Fig. 2 (300 °C). Also, [2008Liu] computed a liquidus projection (not shown here) and listed the temperatures and compositions of the coexisting phases in the invariant reactions during solidification. No experimental data are available for comparison with the computed liquid-solid equilibria.

References

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