JPEDAV (2008) 29:179
DOI: 10.1007/s11669-008-9256-5
1547-7037 ©ASM International

Al-Cu-In (Aluminum-Copper-Indium)

V. Raghavan

Ternary alloys having a four-phase monotectic reaction can possess interesting properties, with two different solidified liquids in the microstructure. In their search for ternary monotectic aluminum alloys, [2005Gro] computed the liquidus surface of this system.

Binary Systems

The Al-Cu phase diagram [1998Liu] depicts a number of intermediate phases: $CuAl_2$ (*C*16-type tetragonal, denoted θ), CuAl (η_1, orthorhombic) CuAl (η_2, monoclinic), Cu_5Al_4(LT) (ζ, orthorhombic), ε_2 (*B*8$_2$, Ni_2In-type hexagonal), ε_1 (bcc), Cu_3Al_2 (δ, rhombohedral), Cu_9Al_4(HT) (γ_0, *D*8$_2$, Cu_5Zn_8-type cubic), Cu_9Al_4(LT) (γ_1, *D*8$_3$-type cubic), and Cu_3Al (β, bcc). In the above, HT = high-temperature and LT = low-temperature. The Al-In phase diagram [Massalski2] depicts a liquid miscibility gap with the critical temperature at 875 °C. The monotectic reaction L′↔(Al) + L″ occurs at 639 °C. The In-rich liquid L″ solidifies to (Al) + (In) at 156 °C. In the Cu-In system [Massalski2], the intermediate phases β-CuIn (bcc), γ-CuIn (cubic), and η-CuIn (hexagonal) take part in the solid-liquid equilibria.

Liquidus Projection

In their thermodynamic calculation, [2005Gro] employed the binary interaction parameters from the published literature. The liquidus projection shown in Fig. 1 was computed by extrapolation of the binary data, without introducing any new parameters. A number of intermediate phases from the Al-Cu side and the Cu-In side are intersecting the liquid miscibility gap giving rise to six four-phase invariant reactions. The coexisting liquid compositions of the five of these are indicated in Fig. 1. At 527 °C, the ternary monotectic reaction M occurs. The other reactions occur at successively higher Cu contents at 567, 604, 725, 699, and 582 °C, respectively [2005Gro]. The β phases of the Al-Cu system and the Cu-In system are both bcc and form a single field of primary crystallization. Not all arrows on the liquidus lines in the direction of decreasing temperature were indicated by [2005Gro].

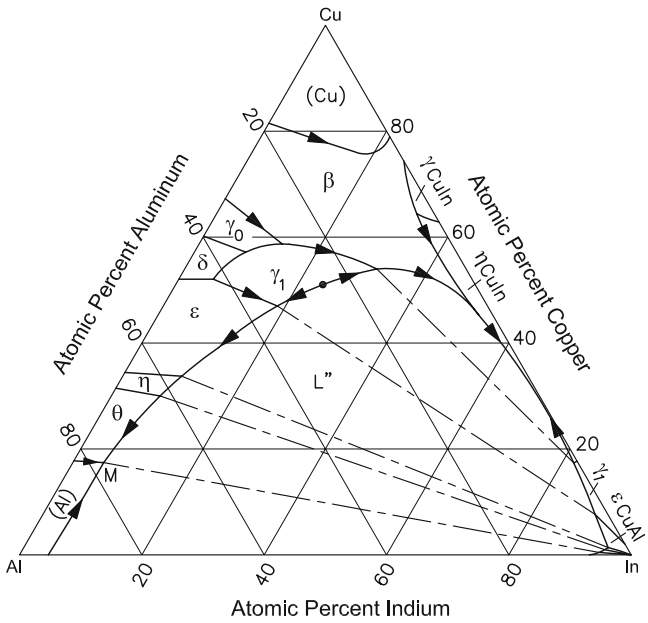

Fig. 1 Al-Cu-In computed liquidus projection [2005Gro]

References

1998Liu: X.J. Liu, I. Ohnuma, R. Kainuma, and K. Ishida, Phase Equilibria in the Cu-Rich Portion of the Cu-Al Binary System, *J. Alloys Compd.*, 1998, **264**, p 201-208

2005Gro: J. Grobner and R. Schmid-Fetzer, Phase Transformations in Ternary Monotectic Aluminum Alloys, *JOM*, 2005, **57**(9), p 19-23