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Al-Cu-Rh (Aluminum-Copper-Rhodium)

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Partial isothermal sections at 900 and 800 °C were determined by [2000Gru] in the Al-rich region of this ternary system. A decagonal quasicrystalline ternary phase D is stable at these temperatures.

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 ($B8_1$, NiAs-type hexagonal), ε_1(bcc), Cu_3Al_2 (δ, rhombohedral), Cu_9Al_4(HT) (γ_0, cubic), Cu_9Al_4(LT) (γ_1, $D8_3$-type cubic), and Cu_3Al (β, bcc). In the above, HT = high-temperature and LT = low-temperature. The Al-Rh phase diagram [2006Kho] (see Fig. 1 under Al-Pd-Rh) depicts the following intermediate phases: Rh_2Al_9 ($D8_d$, Co_2Al_9-type monoclinic), $Rh_{1\text{-}x}Al_3$ (orthorhombic, denoted O_1 or ε_{16}), $RhAl_3$ (orthorhombic, denoted O_2 or ε_6), Rh_2Al_5(c) (space group $Pm\bar{3}$, cubic, denoted C), Rh_2Al_5(h) ($D8_{11}$, Co_2Al_5-type hexagonal, denoted H), Rh_3Al_7 (monoclinic, denoted V), and RhAl (*B*2, CsCl-type cubic). The structurally related orthorhombic phases, ε_6 and ε_{16}, have two identical lattice parameters, with a differing third parameter and occur close to the composition $RhAl_3$. Cu and Rh form a continuous face-centered cubic (fcc) solid solution, with a miscibility gap below 1150 °C. In the following text and figures, the symbols O_1, O_2, C, H, V, and B2 are used to denote the phases.

Ternary Isothermal Sections

[2000Gru] induction-melted under Ar atm about 20 ternary Al-rich alloys. The alloys were annealed at 900 °C for 70-120 h or at 800 °C for 90-1400 h and quenched in water. The phase equilibria were studied with x-ray powder diffraction, scanning and transmission electron metallography and differential thermal analysis at a heating/cooling rate of 20 °C per min. The local phase compositions were determined by energy dispersive x-ray analysis. The partial isothermal section at 900 °C constructed by [2000Gru] is shown in Fig. 1. The range of the RhAl (*B*2) phase extends upwards to 55 at.% Al. The binary phases C and O_2 dissolve up to 13 and 11 at.% Cu, whereas H dissolves less than 0.5 at.% Cu. At its low Al-end range, C exhibits a superstructure marked C_1 in Fig. 1, with a doubling of the cubic lattice parameter. The decagonal phase D has a composition centered around $Al_{64.5}Cu_{16.8}Rh_{18.7}$. It coexists with the liquid, O_2, *B*2 and C/C_1 phases. The partial isothermal section at 800 °C constructed by [2000Gru] is shown in Fig. 2. A U-type transition reaction D + L ↔ O_2 + *B*2 occurs between 900 and 800 °C.

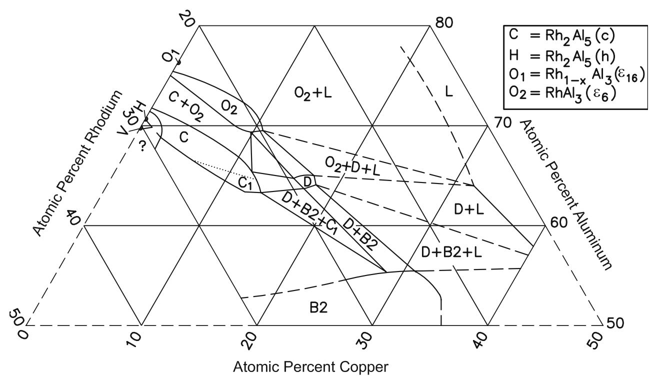

Fig. 1 Al-Cu-Rh partial isothermal section at 900 °C [2000Gru]

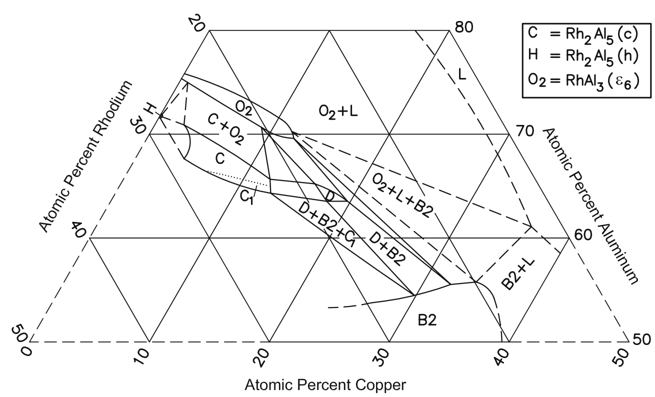

Fig. 2 Al-Cu-Rh partial isothermal section at 800 °C [2000Gru]

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