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Al-Cr-Pt (Aluminum-Chromium-Platinum)

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A partial isothermal section at 1350 °C for Pt-rich alloys was reported for this ternary system by [2001Hil].

Binary Systems

The Al-Cr phase diagram [1998Mur] has at least six intermediate phases: $CrAl_7$ (V_7Al_{45}-type monoclinic), Cr_2Al_{11} (monoclinic), $CrAl_4$ (monoclinic), αCr_4Al_9 (Cu_4Al_9-type cubic), and αCr_5Al_8 ($D8_{10}$-type rhombohedral). None of the above phases are stable at the temperature of interest here (1350 °C). The Al-Pt phase diagram [1986McA] depicts nine intermetallic phases: Pt_5Al_{21} (cubic), Pt_8Al_{21} (tetragonal), $PtAl_2$ (CaF_2-type cubic), Pt_2Al_3 (hexagonal), PtAl (FeSi-type cubic), β (52-56 at.% Pt; $B2$-type cubic), Pt_5Al_3 (Ge_3Rh_5-type orthorhombic), Pt_2Al ($PbCl_2$-type orthorhombic above 1060 °C, Pt_2Ga-type orthorhombic below 1060 °C), and Pt_3Al ($AuCu_3$-type cubic and low-temperature form Pt_3Ga-type tetragonal). The Cr-Pt phase diagram [Massalski2] has three intermediate phases: Cr_3Pt ($A15$, Cr_3Si-type cubic), CrPt ($L1_0$, AuCu-type tetragonal), and $CrPt_3$ ($L1_2$, $AuCu_3$-type cubic). The existence of CrPt needs clarification. About 70 at.% Cr dissolves in Pt. $CrPt_3$ forms congruently from (Pt) at 1130 °C [Massalski2].

Ternary Isothermal Section

With starting metals of purity ≥99.9%, [2001Hil] melted about 10 Pt-rich ternary alloys in an arc furnace. The samples were annealed at 1350 °C for 96 h, followed by furnace cooling. This temperature was selected as a target operating temperature for potential high-temperature alloys. [2001Hil] admitted that the phase compositions in furnace-cooled samples do not represent true isothermal conditions, but they were more concerned with simulating the structure that develops after extended operation in practice. The phase equilibria were studied by optical and electron metallography, energy dispersive spectroscopy, and x-ray diffraction. The partial "isothermal section" for Pt-rich alloys at 1350 °C constructed by [2001Hil] is redrawn in Fig. 1. As the phase boundaries in the accepted Al-Pt diagram are tentative, no attempt is made here to modify the locations of the phase boundaries along the Al-Pt side. In Fig. 1, Cr additions increase the width of the Pt_3Al field by shifting the Pt-poor boundary to lower Pt levels. The (Pt) solid solution extends along the Pt-Cr side up to at least 50 at.% Cr. The width of the two-phase (Pt) + Pt_3Al field becomes extremely narrow (~1 at.%) above 25 at.% Cr. This limits the possibility of the production of a two-phase microstructure in Pt-based alloys, akin to the (γ + γ') structure in Ni-rich alloys.

References

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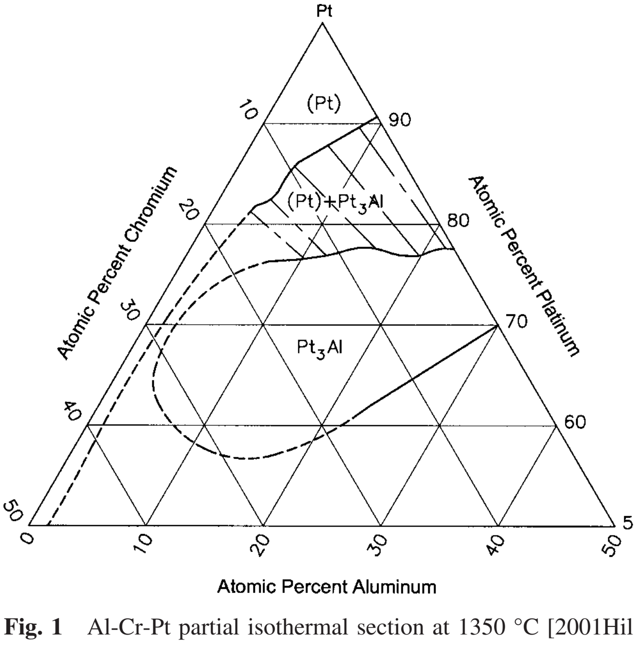

Fig. 1 Al-Cr-Pt partial isothermal section at 1350 °C [2001Hil]