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Al-Pt-Ti (Aluminum-Platinum-Titanium)

V. Raghavan

A partial section at 1350 °C for Pt-rich alloys was reported for this ternary system by [2001Hil]. Another partial section for Pt-poor alloys at 950 °C was given by [2000Din].

Binary Systems

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; *B*2-type cubic), Pt_5Al_3 (Ge_3Rh_5-type orthorhombic), Pt_2Al ($PbCl_2$-type orthorhombic above 1060 °C and Pt_2Ga-type orthorhombic below 1060 °C), and Pt_3Al ($AuCu_3$-type cubic and low-temperature Pt_3Ga-type tetragonal). An updated version of Al-Ti system appears in this issue. The intermediate phases in the Pt-Ti system are: $PtTi_3$ (Cr_3Si-type cubic), PtTi (high-temperature CsCl-type cubic and low-temperature AuCd-type orthorhombic), Pt_5Ti_3-type (orthorhombic), Pt_3Ti (Ni_3Ti-type hexagonal), γ (75-81 at.% Pt; $AuCu_3$-type cubic), and Pt_8Ti ($D1_a$-type tetragonal) [Massalski2].

Ternary Compounds

[2000Din] reported three ternary compounds in this system at 950 °C: τ_1 (Ti,Pt,Al) with the Cu-type face-centered cubic (fcc) structure (a = 0.39577 nm) around the composition $Ti_{26}Pt_7Al_{67}$, τ_2 [$(Ti,Al)_6(Ti,Pt,Al)_{23+1}$] with the filled $Mn_{23}Th_6$-type cubic structure (a = 1.21921 nm) close to the composition $TiPtAl_2$, and τ_3 [$(Ti,Pt)(Ti,Pt,Al)_2$] with the $MgZn_2$-type hexagonal structure (a = 0.51309 nm and c = 0.82691 nm) around the composition $Ti_{44}Pt_{14}Al_{42}$. In the above compounds, a complicated multiatom substitution is seen, without a specific site-atom association known in the given structure types. Detailed structural data are listed by [2000Din]. [2001Hil] found a ternary phase (denoted τ here) at the composition $Ti_{18}Pt_{63}Al_{19}$ with an unknown structure.

Isothermal Sections

With starting metals of purity ≥99.9%, [2001Hil] melted about 10 Pt-rich 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 temperature for potential high-temperature alloys. [2001Hil] admitted that the phase compositions in furnace-cooled samples do not

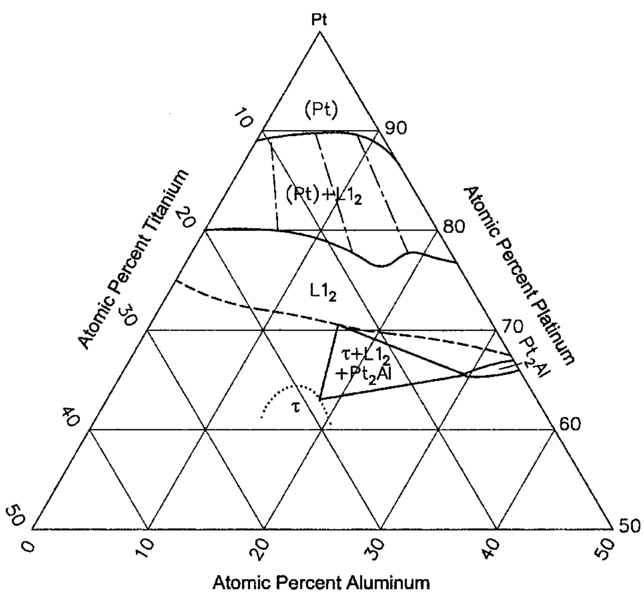

Fig. 1 Al-Pt-Ti partial isothermal section at 1350 °C near the Pt corner [2001Hil]

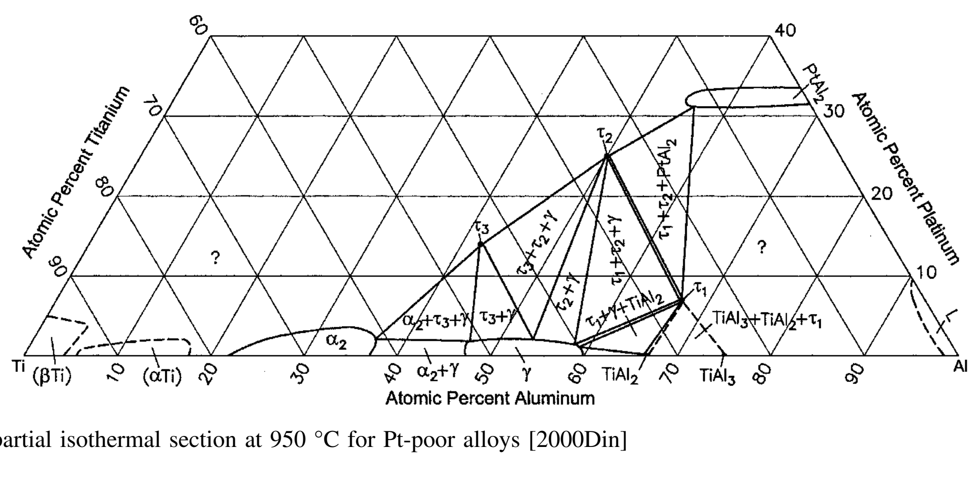

Fig. 2 Al-Pt-Ti partial isothermal section at 950 °C for Pt-poor alloys [2000Din]

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 "isothermal section" constructed by [2001Hil] at 1350 °C is redrawn in Fig. 1. The main feature of this section is the presence of a continuous solid solution of the $L1_2$, $AuCu_3$-type between the cubic form of Pt_3Al and the γ phase of the Pt-Ti system. At lower Pt contents, a tie-triangle was identified between the continuous solid solution, Pt_2Al, and a ternary phase τ.

With starting metals of >99.9% purity, [2000Din] arc melted or induction melted about 20 ternary alloy compositions with the Pt content up to 25 at.%. The final anneal was at 950 °C for 240 h, followed by water quenching. The phase equilibria were studied by metallography, x-ray powder diffraction and electron probe microanalysis. The partial isothermal section constructed by [2000Din] at 950 °C is redrawn in Fig. 2 to agree with the accepted binary data. The three ternary compounds τ_1, τ_2, and τ_3 have small homogeneity regions around the composition shown in Fig. 2. The solubility of Pd in Ti-Al phases is up to 2.0 at.%. TiAl (γ) forms tie-lines with all the three ternary compounds.

References

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