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Al-Pd-Re (Aluminum-Palladium-Rhenium)

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Recently, [2004Bal] determined an isothermal section at 1000 °C for Al-rich alloys of this system, which depicts a stable icosahedral phase I.

Binary Systems

The Al-Pd phase diagram [2001Yur] depicts the following intermediate phases: $PdAl_4$ (hexagonal, space group $P6_322$), $PdAl_3$ (denoted ε_6, orthorhombic), ε_{28} ($\sim PdAl_3$, orthorhombic), Pd_8Al_{21} (Pt_8Al_{21}-type tetragonal), Pd_2Al_3 (denoted δ, $D5_{13}$, Ni_2Al_3-type hexagonal), PdAl ($B2$-type cubic and two low-temperature forms: rhombohedral and $B20$-type cubic), Pd_5Al_3 (Rh_5Ge_3-type orthorhombic), Pd_2Al ($C23$, Co_2Si-type orthorhombic), and Pd_5Al_2 (Pd_5Ga_2-type orthorhombic). In Al-rich alloys at 1000 °C, only PdAl is stable. The Al-Re system [2001Sch] has the following intermediate phases: $ReAl_{12}$ (WAl_{12}-type cubic), $ReAl_6$ ($D2_h$, $MnAl_6$-type orthorhombic), Re_8Al_{33-x} (triclinic), $ReAl_4$ (hexagonal), Re_4Al_{11} (Mn_4Al_{11}-type triclinic), ReAl (CuTi-type tetragonal), and Re_2Al ($C11_b$, $MoSi_2$-type tetragonal). Additionally, [2004Bal] found a monoclinic phase $ReAl_3$, listed in [Massalski2]. The Pd-Re phase diagram is a simple peritectic system.

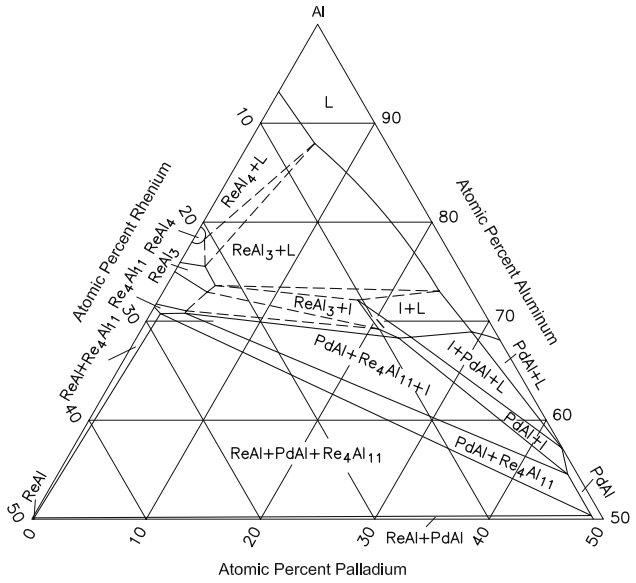

Fig. 1 Al-Pd-Re isothermal section at 1000 °C [2004Bal]

Ternary Isothermal Section

With starting metals of 99.999% Al, 99.95% Pd and 99.95% Re, [2004Bal] levitation-melted 33 alloy compositions in the Al-rich region, by first making binary master alloys. The alloys were annealed at 1000 °C for 68-2640 h and quenched in water. The phase equilibria were studied with scanning and transmission electron microscopy, x-ray diffraction and electron probe microanalysis. Differential thermal analysis was done at heating rates of 5-50 °C per min. The isothermal section constructed by [2004Bal] at 1000 °C is shown in Fig. 1. The icosahedral phase I, first reported by [1990Tsa], is present with a homogeneity region bounded by the points $Al_{68.8}Pd_{23.9}Re_{7.3}$, $Al_{69.5}Pd_{20.4}Re_{10.0}$ and $Al_{72.5}Pd_{17.5}Re_{10.0}$.

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