Al-Ni-W (Aluminum-Nickel-Tungsten)

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The review of this ternary system by [2005Kor] included, among others, the studies of [1983Nas], [1991Udo], and [1994Jia]. Recently, [2008Pop] obtained new experimental data on the phase equilibria in Ni-rich alloys at 1100, 1000, and 900 °C and computed three isothermal sections at these temperatures.

Binary Systems

The Al-Ni phase diagram [1993Oka] shows five intermediate phases: $NiAl_3$ ($D0_{11}$, Fe_3C-type orthorhombic), Ni_2Al_3 ($D5_{13}$-type hexagonal, denoted δ), NiAl ($B2$, CsCl-type cubic, denoted β), Ni_5Al_3 (Ga_3Pt_5-type orthorhombic), and Ni_3Al ($L1_2$, $AuCu_3$-type cubic, denoted γ′). The Al-W phase diagram [Massalski2] has at least three intermediate compounds: WAl_4 (monoclinic, space group Cm), WAl_5 (hexagonal, space group $P6_3$), and WAl_{12} (WAl_{12}-type cubic). The details of other possible high temperature phases are not known. The Ni-W phase diagram [Massalski2] depicts three compounds: Ni_4W ($D1_a$, $MoNi_4$-type tetragonal), NiW (MoNi-type orthorhombic), and NiW_2 (tetragonal).

Ternary Isothermal Sections

With starting metals of purity of 99.9-99.99%, [2008Pop] induction-melted under Ar atm three Ni-rich alloys that lie

in the (γ + γ′) region. The alloys were annealed at 1100, 1000, and 900 °C for 10, 100, and 1300 h respectively and quenched in water. The phase equilibria were studied with scanning and transmission electron microscopy and energy
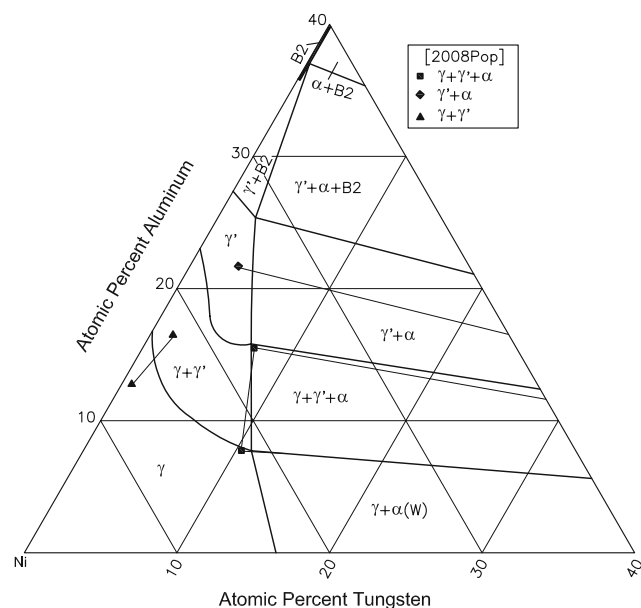

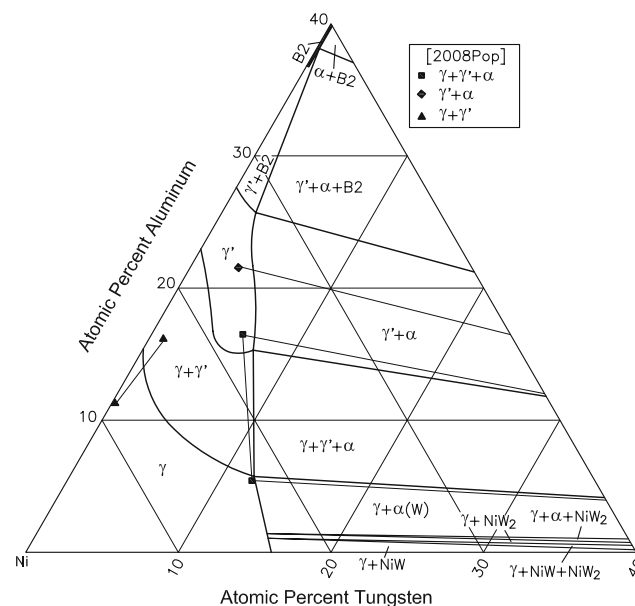**Fig. 2** Al-Ni-W computed isothermal section at 1000 °C for Ni-rich alloys [2008Pop]

Fig. 1 Al-Ni-W computed isothermal section at 1100 °C for Ni-rich alloys [2008Pop]

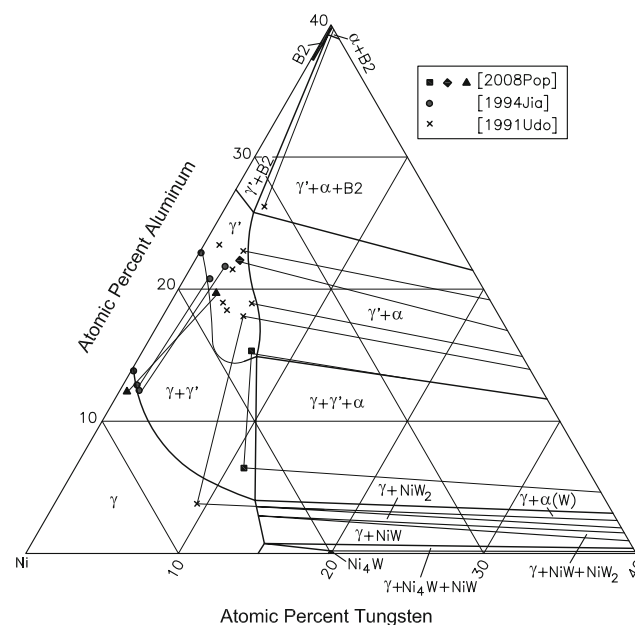**Fig. 3** Al-Ni-W computed isothermal section at 900 °C for Ni-rich alloys [2008Pop]

dispersive x-ray analysis. Combining their new results with literature data, they optimized the thermodynamic interaction parameters using the CALPHAD approach. To account for the experimental results, [2008Pop] found it necessary to modify some of the thermodynamic parameters of [2001Dup] for Ni-base superalloys. The modified parameters were listed. The computed isothermal sections at 1100, 1000, and 900 °C [2005Bro, 2008Pop] shown in Fig. 1-3 are compared with the experimental results. The agreement is satisfactory.

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