Al-Nb-Ni-Ti (Aluminum-Niobium-Nickel-Titanium)

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Recently, [2002Tom] determined the Ni_3Al-Ni_3Nb-Ni_3Ti pseudoternary section of this system at 1000 °C.

Binary Systems

For brief descriptions of the Al-Nb, Al-Ti, and Nb-Ti systems, see the Al-Nb-Ti update in this issue. The Al-Ni and Ni-Ti descriptions are given in the Al-Ni-Ti update [2005Rag]. For an update of the Nb-Ni system, see [1998Oka].

Ternary Systems

An update of the Al-Nb-Ti system appears in this issue. See [2005Rag] for the Al-Ni-Ti update. A recent thermodynamic assessment of the Al-Nb-Ni system by [2003Du], presented a computed liquidus projection, computed isothermal sections at 1300, 1200, 1140, 1080, 1027, and 900 °C, a pseudobinary section along the Ni_3Al-Ni_3Nb join, and a reaction scheme. The computed phase equilibria were compared with the available experimental data. The pseudobinary section along the Ni_3Al-Ni_3Nb join computed by [2003Du] is shown in Fig. 1. [1991Gup] reviewed the Nb-Ni-Ti system and presented a schematic liquidus projection and two isothermal sections at 1000 and 900 °C for the Ni-NiNb-NiTi region.

Quaternary Phase Equilibria

With starting metals of 99.99% Al, 99.9% Nb, 99.9% Ni, and 99.9% Ti, [2002Tom] arc-melted 23 quaternary alloys under Ar atmosphere. The samples were annealed at 1000 °C for 10 days and were quenched in water. The phase equilibria were studied by optical microscopy, x-ray powder diffraction, and scanning electron microscopy with wavelength-dispersive spectroscopy. The structurally related intermetallic phases Ni_3Al ($L1_2$, $AuCu_3$-type cubic), Ni_3Nb ($D0_a$, βCu_3Ti-type orthorhombic), Ni_3Ti ($D0_{24}$-type tetragonal), and $Ni_3Nb_{0.3}Ti_{0.7}$ ($D0_{19}$, Ni_3Sn-type hexagonal) are present at 1000 °C. No new phases were found in the quaternary region. The pseudoternary section at 1000 °C determined by [2002Tom] is redrawn in Fig. 2. Most of the Ti atoms in Ni_3Ti are substituted by Al and Nb atoms in the quaternary region. [2002Tom] correlated the extent of the phase fields to the electron-to-atom ratio and the atomic size ratio of the constituent atoms.
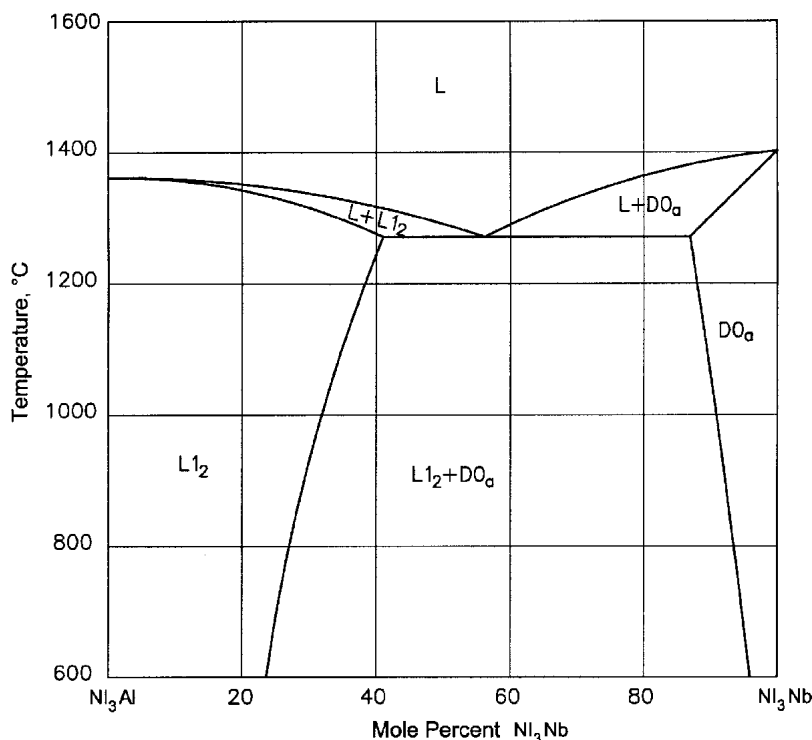

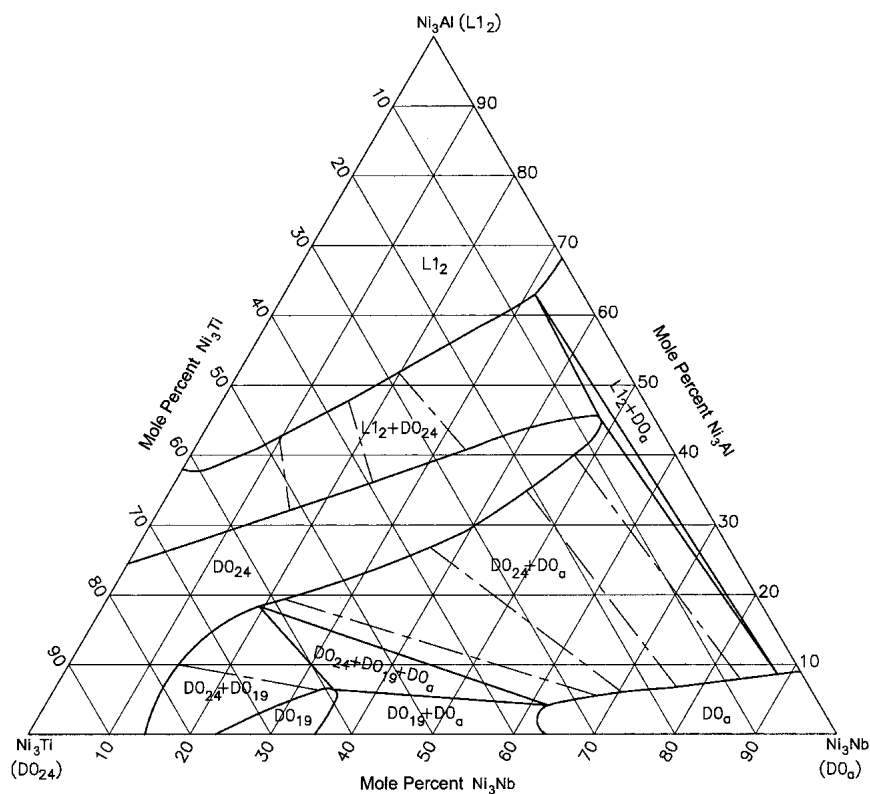**Fig. 1** Al-Nb-Ni-Ti pseudobinary section along the Ni_3Al-Ni_3Nb join [2003Du]

Fig. 2 Al-Nb-Ni-Ti pseudoternary section on the Ni₃Al-Ni₃Nb-Ni₃Ti plane at 1200 °C [2002Tom]

References

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1998Oka: H. Okamoto, Nb-Ni (Niobium-Nickel), *J. Phase Equilib.*, Vol 19 (No. 3), 1998, p 289

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