JPEDAV (2006) 27:403-404
DOI: 10.1361/154770306X116360
1547-7037/$19.00 ©ASM International

Al-Nd-Ni (Aluminum-Neodymium-Nickel)

V. Raghavan

In a previous investigation of this system, [1979Ryk] reported an isothermal section at 600 °C for the Nd-poor region, which exhibits a number of ternary compounds. Recently, [2001God1] determined a liquidus projection, two isothermal sections, and two vertical sections for Al-rich alloys.

Binary Systems

The Al-Nd phase diagram [1998Cac, 2001God1] depicts seven intermediate compounds: Nd_3Al ($D0_{19}$, Ni_3Sn-type hexagonal), Nd_2Al ($C23$, Co_2Si-type orthorhombic), NdAl (ErAl-type orthorhombic), $NdAl_2$ ($C15$, $MgCu_2$-type cubic), $NdAl_3$ ($D0_{19}$, Ni_3Sn-type hexagonal), βNd_3Al_{11} ($D1_3$, Al-deficient Al_4Ba-type tetragonal), and αNd_3Al_{11} (αLa_3Al_{11}-type orthorhombic). 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), NiAl (CsCl-type cubic), Ni_5Al_3 (Ga_3Pt_5-type orthorhombic), and Ni_3Al ($L1_2$, $AuCu_3$-type cubic; also denoted γ'). The Nd-Ni phase diagram [Massalski2, 1998Oka] has seven intermediate phases: $NdNi_5$, Nd_2Ni_7, $NdNi_3$, $NdNi_2$, NdNi, Nd_7Ni_3, and Nd_3Ni.

Ternary Compounds

[1979Ryk] reported a number of ternary compounds in this system. For a summary of the known structural details, see [Pearson3]. Among the Al-rich ternary compounds are $NdNi_2Al_7$ (denoted τ_1; structural details not known) and $NdNiAl_4$ (denoted τ_2, $NiYAl_4$-type orthorhombic).

Ternary Phase Equilibria

Starting with high-purity metals, [2001God1] melted about 20 Al-rich alloy compositions in an arc furnace under Ar atmosphere. The phase equilibria were studied using differential thermal analysis, x-ray diffraction, and optical and scanning electron metallography. The liquidus surface constructed by [2001God1] for Al-rich alloys is redrawn in

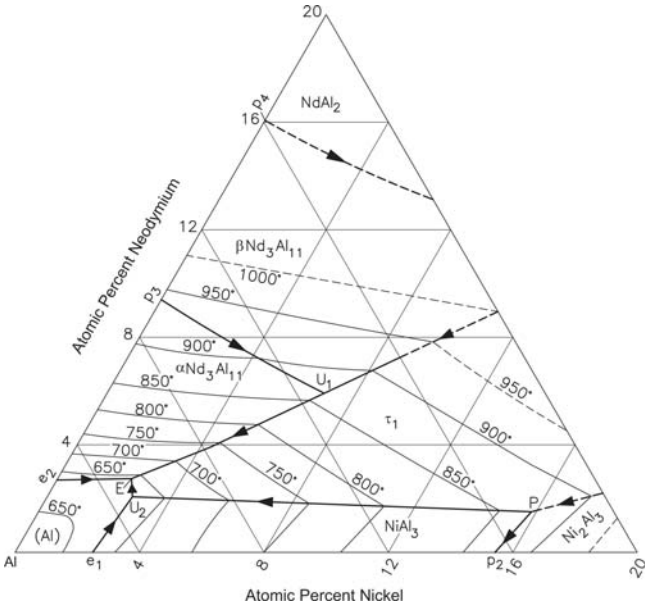

Fig. 1 Al-Nd-Ni liquidus projection for Al-rich alloys [2001God1]

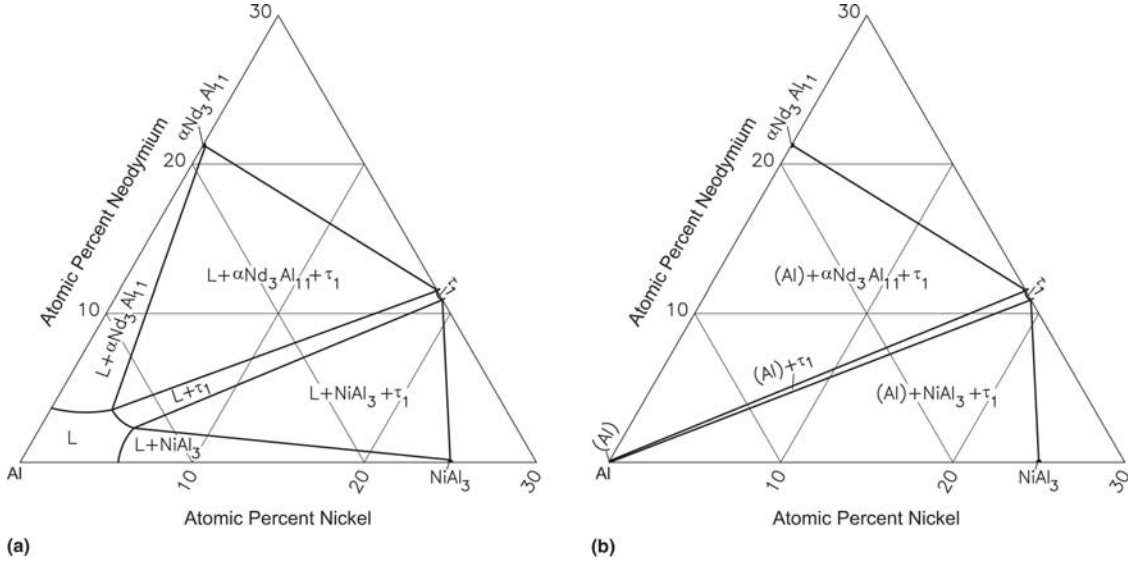

Fig. 2 Al-Nd-Ni isothermal sections at (a) 700 °C and (b) 600 °C [2001God1]

Fig. 1. The primary phases of crystallization in this region are: (Al), $NiAl_3$, Ni_2Al_3, αNd_3Al_{11}, βNd_3Al_{11}, $NdAl_2$, and τ_1. There are two U-type transition reactions: U_1 at 860 °C and U_2 at 629 °C. The binary phase $NiAl_3$ forms at 877 °C through the peritectic reaction P in the ternary region. The final solidification near the Al corner is through the ternary eutectic reaction E at 626 °C. Two isothermal sections for Al-rich alloys at 700 and 600 °C determined by [2001God1] are shown in Fig. 2.

[2001God2] studied the metastable solidification of Al-rich alloys of this system in the as-cast samples. They found that the ternary eutectic in the as-cast samples comprises (Al) + $NiAl_3$ + αNd_3Al_{11}, instead of (Al) + τ_1 + αNd_3Al_{11} seen in the stable diagram (Fig. 1).

References

1979Ryk: R.M. Rykhal, O.S. Zarechnyuk, and T.I. Yanson, Isothermal Section at 600 °C of Neodymium-Nickel-Aluminum Ternary System in the Range of 0-33.3 At.% of Neodymium, *Dopov. Akad. Nauk Ukr. RSR, Ser. A, Fiz. Matemat. Tekhn. Nauki,* 1979, **41**(12), p 1057-1059, in Ukrainian

1993Oka: H. Okamoto, Al-Ni (Aluminum-Nickel), *J. Phase Equilibria,* 1993, **14**(2), p 257-259

1998Cac: G. Cacciamani, G. Borzone, and R. Ferro, System Al-Nd, *COST 507 Thermo-chemical Database for Light Metal Alloys,* I. Ansara, A.T. Dinsdale, and M.H. Rand, Ed., Eur. Comm. EUR 18499 EN, Luxembourg, 1998, p 75-78

1998Oka: H. Okamoto, Nd-Ni (Neodymium-Nickel), *J. Phase Equilibria,* 1998, **19**(3), p 290

2001God1: T. Godecke, W. Sun, R. Luck, and K. Lu, Phase Equilibria of the Al-Nd and Al-Nd-Ni Systems, *Z. Metallkd.,* 2001, **92**(7), p 723-730

2001God2: T. Godecke, W. Sun, R. Luck, and K. Lu, Metastable Al-Nd-Ni and Stable Al-La-Ni Phase Equilibria, *Z. Metallkd.,* 2001, **92**(7), p 717-722