JPEDAV (2006) 27:392
DOI: 10.1361/154770306X116333

Al-La-Ni (Aluminum-Lanthanum-Nickel)

V. Raghavan

Recently, [2001God] determined a liquidus surface for Al-rich alloys of this system and a vertical section at 90 at.% Al.

Binary Systems

The Al-La phase diagram [Massalski2] depicts seven intermediate phases: αLa_3Al_{11} (orthorhombic), βLa_3Al_{11} ($D1_3$, Al-deficient Al_4Ba-type tetragonal), $LaAl_3$ ($D0_{19}$, Ni_3Sn-type hexagonal), $LaAl_x$ ($C32$, AlB_2-type hexagonal), $LaAl_2$ ($C15$, $MgCu_2$-type cubic), LaAl (CeAl-type orthorhombic), and La_3Al ($D0_{19}$, Ni_3Sn-type hexagonal). 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 La-Ni phase diagram [Massalski2, 2002Oka] shows a number of intermediate phases: $LaNi_5$ ($D2_d$, $CaCu_5$-type hexagonal), La_2Ni_7 (Ce_2Ni_7-type hexagonal), $LaNi_3$ ($PuNi_3$-type rhombohedral), $LaNi_2$ ($C15$, $MgCu_2$-type cubic), La_2Ni_3 (orthorhombic), LaNi (B_f, CrB-type orthorhombic), La_7Ni_3 ($D10_2$, Fe_3Th_7-type hexagonal), and La_3Ni ($D0_{11}$, Fe_3C-type orthorhombic).

Ternary Phases

Three ternary compounds of this system are listed in the compilation by [1995Vil]. AlLaNi and Al_3LaNi_2 are orthorhombic. Al_5LaNi_2 has the Al_5Ni_2Pr-type orthorhombic structure. Two other phases $AlLaNi_4$ and $Al_{25}La_{17}Ni_{58}$ [1995Vil] lie on the extension of the binary phase $LaNi_5$ into the ternary region at constant La content.

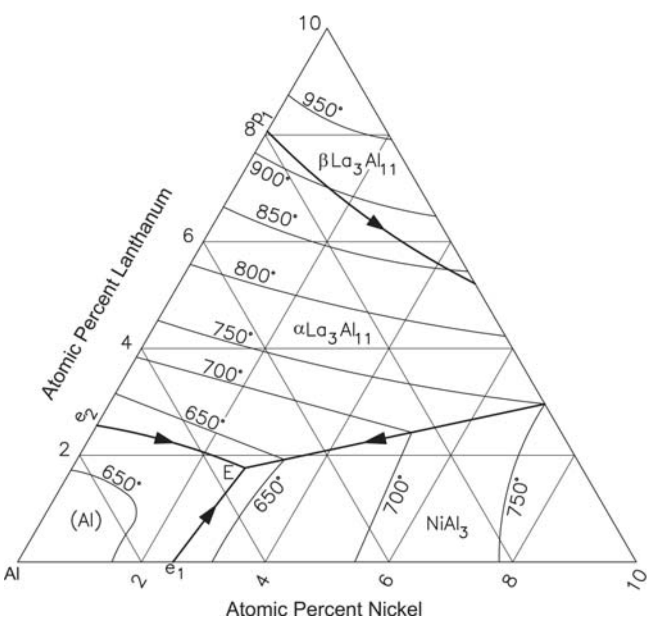

Fig. 1 Al-La-Ni liquidus projection for Al-rich alloys [2001God]

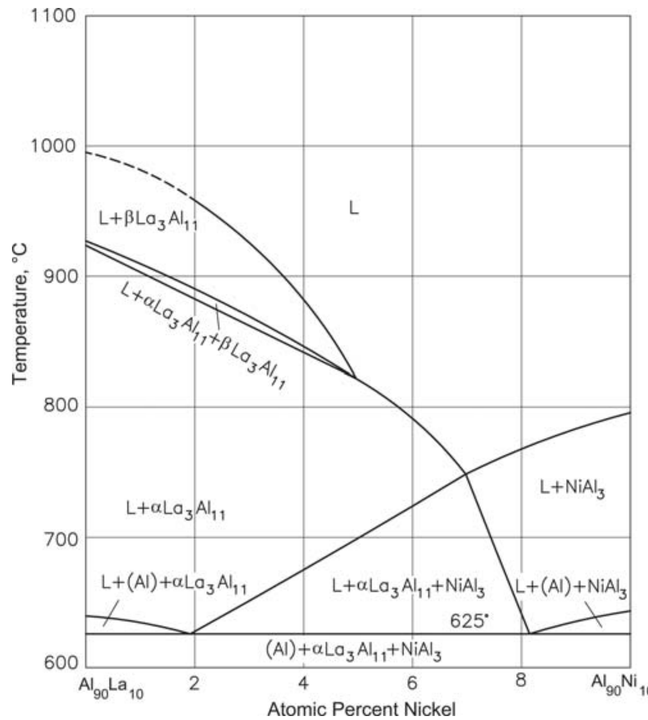

Fig. 2 Al-La-Ni vertical section at 90 at.% Al [2001God]

Ternary Phase Equilibria

Starting with high-purity metals, [2001God] melted 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 determined by [2001God] is redrawn in Fig. 1. The solidification of the Al-rich alloys is through the ternary eutectic reaction E: L $\leftrightarrow$ (Al) + $NiAl_3$ + αLa_3Al_{11} at 625 °C. A vertical section constructed by [2001God] along the $Al_{90}La_{10}$-$Al_{90}Ni_{10}$ join is shown in Fig. 2.

References

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

1995Vil: P. Villars, A. Prince, and H. Okamoto, Al-La-Ni, *Handbook of Ternary Alloy Phase Diagrams,* Vol 4, ASM International, 1995, p 3836-3837

2001God: 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

2002Oka: H. Okamoto, La-Ni (Lanthanum-Nickel), *J. Phase Equilibria,* 2002, **23**(3), p 287-288