

Al-Ni-Zr (Aluminum-Nickel-Zirconium)

V. Raghavan

The review of [1991Nas] gave a partial liquidus projection for Ni-rich alloys and isothermal sections at 1100, 1000, and 800 °C. A number of ternary compounds have been reported, see [1991Nas] for a listing. Recently, the solidification features of Ni-rich alloys of this ternary system were characterized by [1999Miu] and [2001Miu].

Binary Systems

The Al-Ni phase diagram [1993Oka] shows five intermediate phases: NiAl₃ (*D0*₁₁, Fe₃C-type orthorhombic), Ni₂Al₃ (*D5*₃-type hexagonal), NiAl (*B2*, CsCl-type cubic), Ni₅Al₃ (*Ga*₃Pt₅-type orthorhombic), and Ni₃Al (*L1*₂, AuCu₃-type cubic, denoted γ'). The Al-Zr phase diagram [Massalski2] depicts ten intermediate phases: Al₃Zr, Al₂Zr, Al₃Zr₂, AlZr, Al₄Zr₅, Al₃Zr₄, Al₂Zr₃, Al₃Zr₅, AlZr₂, and AlZr₃. The Ni-Zr phase diagram [Massalski2] has a number of intermediate compounds: Ni₅Zr, Ni₇Zr₂, Ni₃Zr, Ni₂₁Zr₈, Ni₁₀Zr₇, Ni₁₁Zr₉, NiZr, and NiZr₂. For crystal structure data on the Al-Zr and Ni-Zr compounds, see [Pearson3].

Liquidus Projection

With starting metals of 99.99 wt.% Al, 99.95 wt.% Ni, and 99.6 wt.% Zr, [2001Miu] arc melted six Al-Ni binary alloys and three ternary alloys with Zr and Al contents up to 13 and 20 at.%, respectively. The phase equilibria were studied with differential thermal analysis at a heating/cooling rate of 5 to 10 °C/min, wavelength dispersive spectroscopy, and x-ray diffraction. By combining their results with the earlier study of [1999Miu], [2001Miu] constructed a partial liquidus projection shown in Fig. 1. A temperature maximum C was observed on the univariant line L + Ni₅Zr + (Ni). The final solidification at the Ni end is through the ternary eutectic reaction E: L \leftrightarrow (Ni) + Ni₅Zr + Ni₃Al. Constant temperature contour lines are shown in the (Ni) primary region [2001Miu].

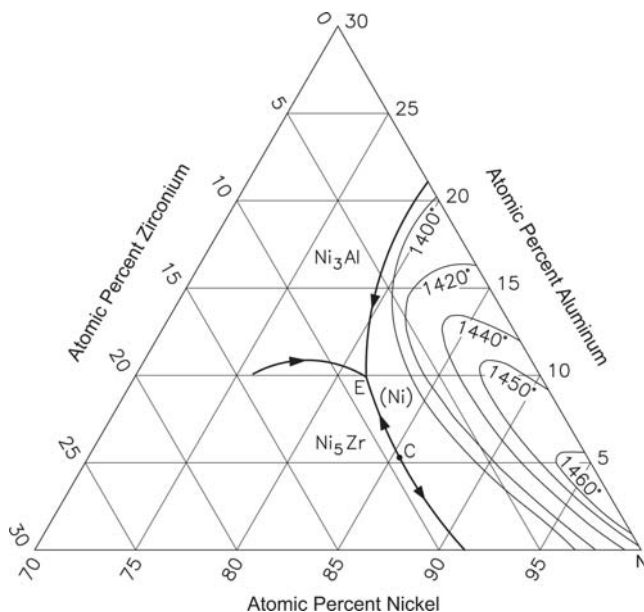


Fig. 1 Al-Ni-Zr partial liquidus projection for Ni-rich alloys [2001Miu]

References

- 1991Nas: P. Nash and Y.Y. Pan, The Al-Ni-Zr (Aluminum-Nickel-Zirconium) System, *J. Phase Equilibria*, 1991, **12**(1), p 105-113
- 1993Oka: H. Okamoto, Al-Ni (Aluminum-Nickel), *J. Phase Equilibria*, 1993, **14**(2), p 257-259
- 1999Miu: S. Miura, Y.M. Hong, T. Suzuki, and Y. Mishima, Liquidus and Solidus Temperatures of Ni-Solid Solution in Ni-Al-X (X: Ti, Zr, and Hf) Ternary Systems, *J. Phase Equilibria*, 1999, **20**(3), p 193-198
- 2001Miu: S. Miura, H. Unno, T. Yamazaki, S. Takizawa, and T. Mohri, Reinvestigation of Ni-Solid Solution/Liquid Equilibria in Ni-Al Binary and Ni-Al-Zr Ternary Systems, *J. Phase Equilibria*, 2001, **22**(4), p 457-462