

# Al-Cr-Ni-Ru (Aluminum-Chromium-Nickel-Ruthenium)

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[1985Cha] determined two isothermal sections for this quaternary system at 1250 and 1000 °C and at 75 at.% Ni.

## Binary Systems

For brief descriptions of the Al-Cr, Al-Ni, and Cr-Ni binary phase diagrams, see [2006Rag]. For descriptions of Al-Ru and Ni-Ru systems, see the Al-Ni-Ru update in this issue. In the Cr-Ru phase diagram [Massalski2], Cr dissolves up to 32 at.% Ru and Ru dissolves 52 at.% Cr. The  $\sigma$  ( $\text{Cr}_2\text{Ru}$ ) phase ( $D8_b$ , CrFe-type tetragonal) forms via a peritectoid reaction at 1580 °C and decomposes through a eutectoid reaction at 800 °C.  $\text{Cr}_3\text{Ru}$  ( $A15$ ,  $\text{Cr}_3\text{Si}$ -type cubic) is stable between 1000 and 750 °C.

## Ternary Systems

For an update of the Al-Cr-Ni system, see [2006Rag]. An update of the Al-Ni-Ru system appears in this issue. [2000Com] derived a liquidus surface for the Al-Cr-Ru system by examining as-cast alloys. [1985Cha] discusses the possible phase relationships in the Cr-Ni-Ru system by considering the binary subsystems.

## Quaternary Phase Equilibria

With starting metals of ~99.99% Al, ~99.9% Cr, 99.99% Ni, and ~99.9% Ru, [1985Cha] arc melted four quaternary alloys under Ar atm, with a constant Ni content of ~75 at.%. The average measured Ni content of the manufactured alloys was 75.9 at.%. The alloys were annealed at 1250 and 1000 °C for 1 and 2 weeks, respectively, and quenched in iced water. The phase equilibria were studied by optical and electron microscopy, electron probe microanalysis, and x-ray powder diffraction. The isothermal sections constructed by [1985Cha] on the 75 at.% Ni plane at 1250 and 1000 °C are redrawn in Fig. 1. The location of the four investigated alloys is indicated in the figure.

## References

- 1985Cha:** S. Chakravorty, H. Hashim, and D.R.F. West, The  $\text{Ni}_3\text{Al-Ni}_3\text{Cr-Ni}_3\text{Ru}$  Section of the Ni-Cr-Al-Ru System, *J. Mater. Sci.*, 1985, **20**, p 2313-2322
- 2000Com:** D.N. Compton, L.A. Cornish, and M.J. Witcomb, Characterization of the Al-Cr-Ru System, *Proc. Micros. Soc. South Africa*, 2000, **30**, p 9
- 2006Rag:** V. Raghavan, Al-Cr-Ni (Aluminum-Chromium-Nickel), *J. Phase Equilib. Diffus.*, 2006, **27**(4), p 381-388

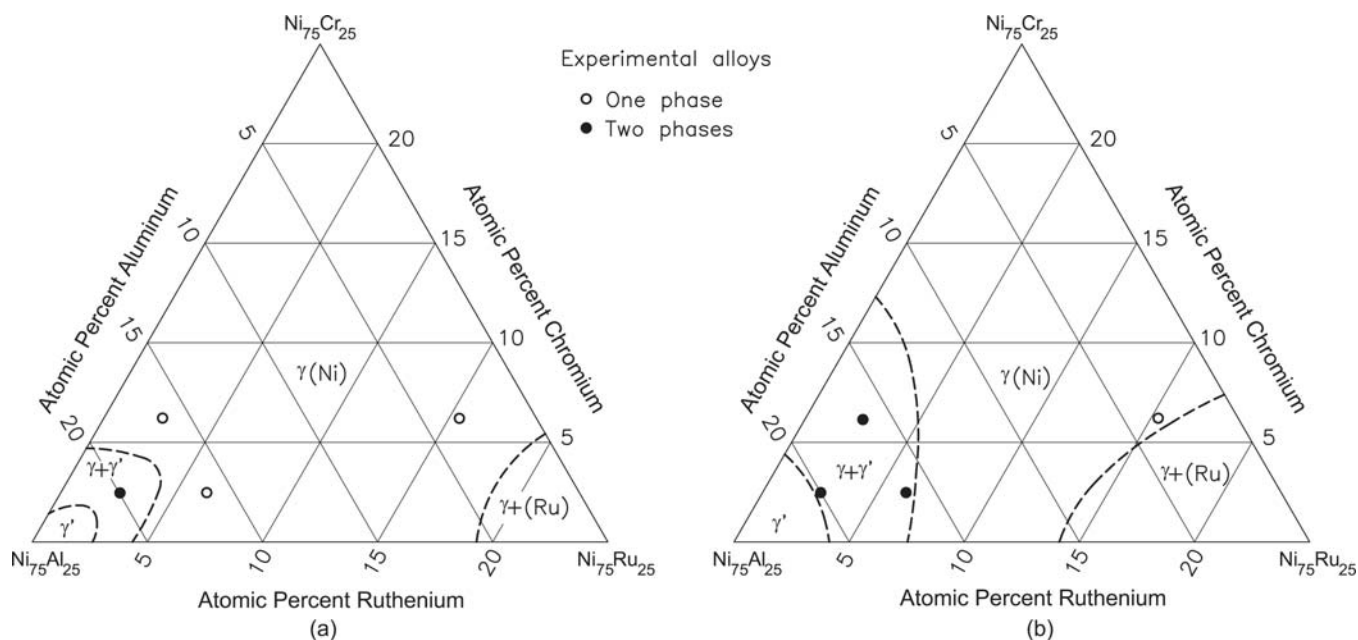


Fig. 1 Al-Cr-Ni-Ru partial isothermal sections at 75 at.% Ni and at (a) 1250 and (b) 1000 °C [1985Cha]