JPEDAV (2006) 27:414-415
DOI: 10.1361/154770306X116379
1547-7037/$19.00 ©ASM International

Al-Cr-Ni-W (Aluminum-Chromium-Nickel-Tungsten)

V. Raghavan

Recently, [2003Bur] determined isothermal sections of this quaternary system at 71 and 76 at.% Ni and at 1000 and 900 °C. The previous work on this system by [1961Ali] presented three isothermal sections at 1100 °C and at constant weight ratios of W:Al = 3:1, 1:1, and 1:3 respectively. Also, [1989Cha] gave partial isothermal sections at 1250 and 1000 °C at a constant Ni content of 75 at.%.

Binary Systems

For the Al-Cr, Al-W, Cr-Ni, Cr-W, and Ni-W, binary systems, [Massalski2] can be used as a starting source. A partial list of updates on these systems is [2000Mah] (Al-Cr) and [1997Oka] (Cr-Ni). For a brief update of the Al-Ni system, see the Al-Nb-Ni update in this issue.

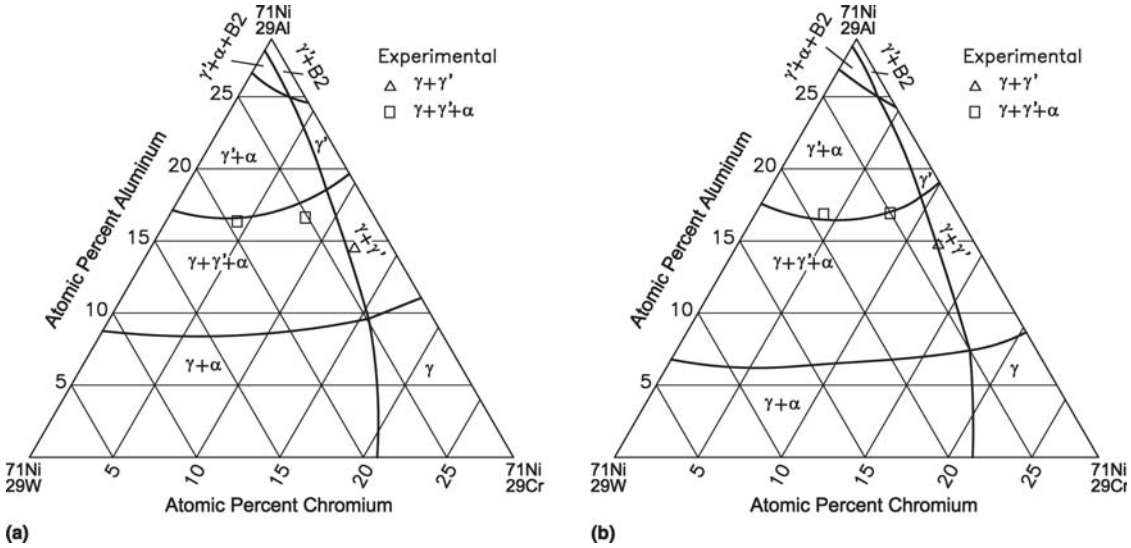

Fig. 1 Al-Cr-Ni-W computed isothermal sections at 71 at.% Ni (a) 1000 °C and (b) 900 °C [2003Bur]

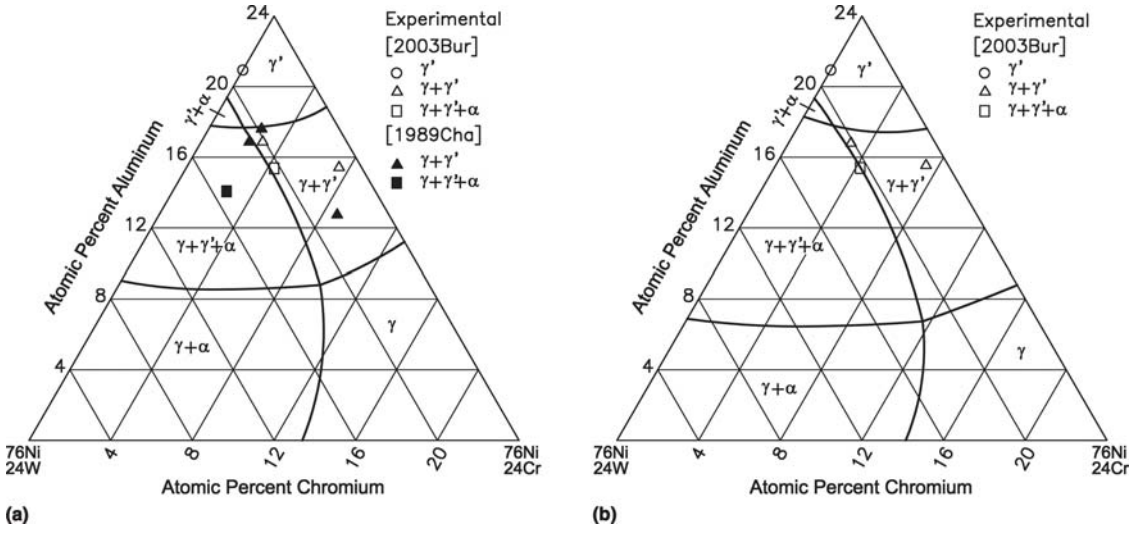

Fig. 2 Al-Cr-Ni-W computed isothermal sections at 76 at.% Ni (a) 1000 °C and (b) 900 °C [2003Bur]

Ternary Systems

Compilations of data on the Al-Cr-Ni, Al-Ni-W, and Cr-Ni-W systems can be found in [1995Vil1], [1995Vil2], and [1995Vil3], respectively. No phase diagram data appear to be available on the Al-Cr-W system. In the Ni-rich alloys reviewed here, the Al-Cr-W system is not relevant.

Quaternary Phase Equilibria

With starting metals of purity of 99.9 to 99.99%, [2003Bur] induction-melted seven Ni-rich alloys with compositions in the range of 14.5 to 21.0 wt.% Al, 0 to 12.5 wt.% Cr, and 0.8 to 7.6 wt.% W. The samples were annealed at 1000 °C for 176 h or at 900 °C for 672 h, followed by water quenching. The phase equilibria were studied by metallography and selected area electron diffraction in a transmission electron microscope. Compositions of the coexisting phases were measured by energy-dispersive x-ray spectroscopy and listed. The phase equilibria were computed using the CALPHAD approach. To obtain a better fit with the experimental data, the interaction parameters for the γ (fcc) and γ' ($L1_2$) phases of the Al-Ni-W system were reoptimized and used in conjunction with the literature values of the other parameters in the calculations. The computed isothermal sections at 1000 and 900 °C at 71 and 76 at.% Ni are compared in Fig. 1 and 2 with the limited experimental data. In addition to γ and γ' phases, the W-based bcc solid solution denoted α is present.

References

1961Ali: S.P. Alisova, P.B. Budberg, and K.I. Shakhova, Equilibrium Diagram of the Aluminum-Chromium-Nickel-Tungsten Quaternary System at 1100°, *Zh. Neorg. Khim.,* 1961, **6**(11), p 2607-2611, in Russian; TR: *Russ. J. Inorg. Chem.,* 1961, **6**(11), p 1318-1320

1989Cha: S. Chakravorty, S. Sadiq, and D.R.F. West, Constitution of the Ni_3Cr-Ni_3Al-Ni_3W System, *J. Mater. Sci.,* 1989, **24,** p 577-583

1995Vil1: P. Villars, A. Prince, and H. Okamoto, Al-Cr-Ni, *Handbook of Ternary Alloy Phase Diagrams,* Vol 3, ASM International, 1995, p 3149-3163

1995Vil2: P. Villars, A. Prince, and H. Okamoto, Al-Ni-W, *Handbook of Ternary Alloy Phase Diagrams,* Vol 4, ASM International, 1995, p 4228-4236

1995Vil3: P. Villars, A. Prince, and H. Okamoto, Cr-Ni-W, *Handbook of Ternary Alloy Phase Diagrams,* Vol 7, ASM International, 1995, p 9169-9199

1997Oka: H. Okamoto, Cr-Ni (Chromium-Nickel), *J. Phase Equilibria,* 1997, **18**(2), p 221

2000Mah: K. Mahdouk and J.C. Gachon, Thermodynamic Investigation of the Aluminum-Chromium System, *J. Phase Equilibria,* 2000, **21**(2), p 157-166

2003Bur: J. Bursik, P. Broz, and R. Picha, Microstructural and Phase Equilibria Study in the Ni-Al-Cr-W System at 1173 and 1273 K, *Intermetallics,* 2003, **11,** p 483-490