JPEDAV (2006) 27:508-509
DOI: 10.1361/154770306X136449
1547-7037/$19.00 ©ASM International

Al-Cr-Ni-Re (Aluminum-Chromium-Nickel-Rhenium)

V. Raghavan

A thermodynamic description of this quaternary system was developed by [1999Hua] and compared with the limited experimental data available.

Binary Systems

For brief descriptions of the Al-Cr, Al-Ni, and Cr-Ni binaries, see the Al-Cr-Ni update by [2006Rag]. Descriptions of the Al-Re and Ni-Re systems appear in the Al-Ni-Re update in this issue. The Cr-Re phase diagram [Massalski2] depicts one intermediate phase σ ($D8_b$-type tetragonal) stable between 58 and 66 at.% Re. [1999Hua] presented computed phase diagrams of these binary systems (except Cr-Ni).

Ternary Systems

For an update of the Al-Cr-Ni system, see [2006Rag]. An update of the Al-Ni-Re system appears in this issue, which is based mainly on the computed results of [1999Hua]. No experimental data seem to be available for the Al-Cr-Re system. [1999Hua] presented a computed liquidus projection for this system. For the Cr-Ni-Re system, [1999Hua] computed an isothermal section at 1152 °C (Fig. 1) and compared the same with the experimental results of [1998Sly].

Quaternary Phase Equilibria

Very limited experimental data are available on this quaternary system. With starting metals of 99.99% Al, 99.89% Cr, 99.9% Ni, and 99.96% Re, [1994Miy] prepared five quaternary alloys with a constant Re content of 1.5 at.% and Cr in the range of 2 to 10 at.%. The (Ni − Al) content was kept at a constant value of 62.5 at.%. The alloys were annealed at 1040 °C, and the composition of the coexisting phases (γ and γ′) was measured by electron probe microanalysis. The experimental results of [1994Miy] are compared with the computed data of [1999Hua] in Fig. 2. Considering that [1999Hua] used only the descriptions of the ternary subsystems without introducing any quaternary interaction parameters, the agreement is good. Figure 3 shows

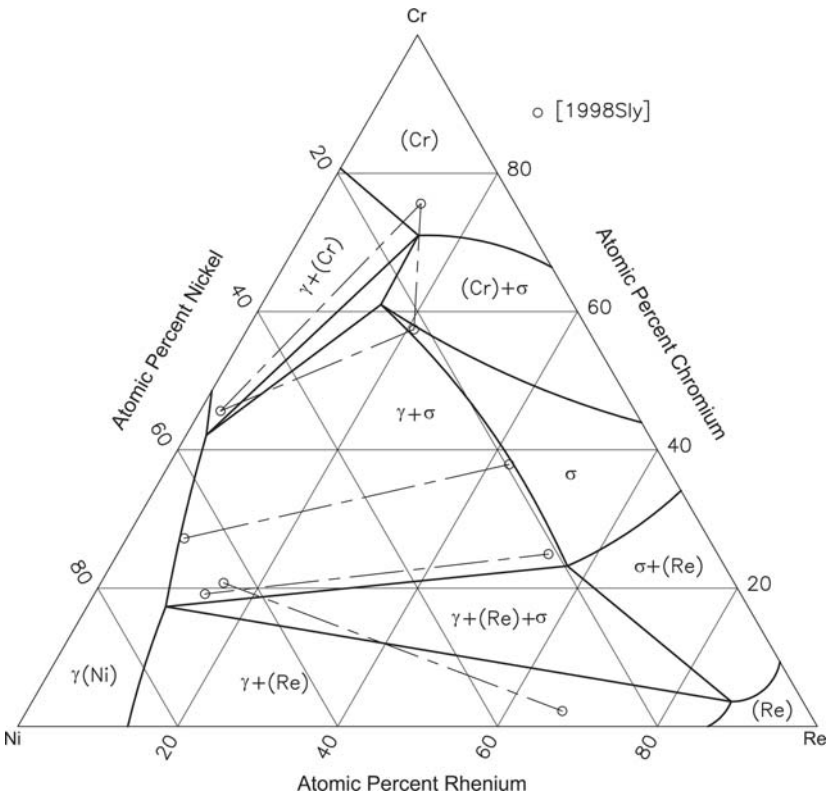

Fig. 1 Cr-Ni-Re computed isothermal section at 1152 °C [1999Hua]

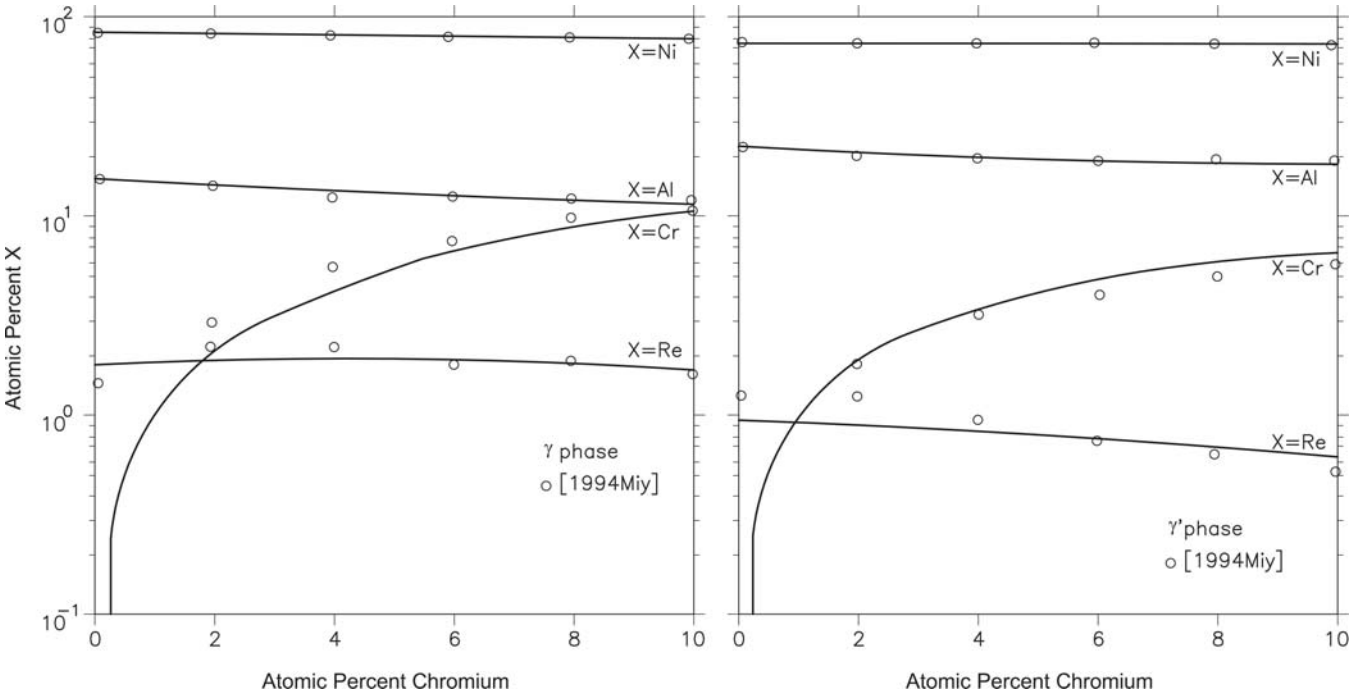

Fig. 2 Al-Cr-Ni-Re computed partitioning of Al, Cr, Ni, and Re between γ and γ′ at 1040 °C with Re = 1.5 at.% and (Ni – Al) = 62.5 at.% [1999Hua]

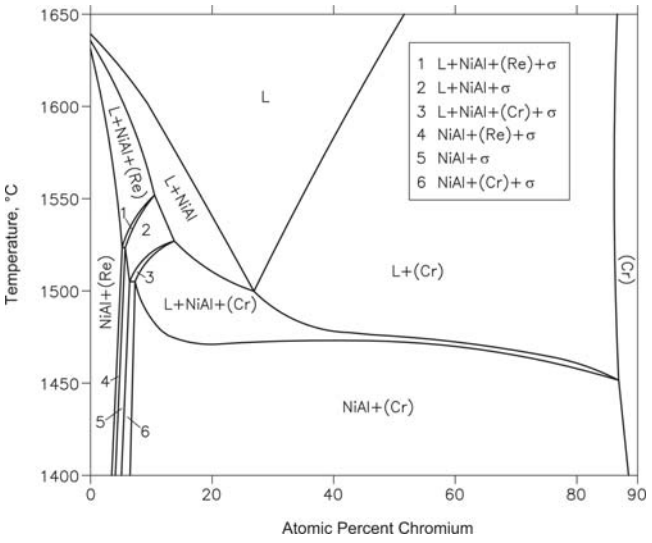

Fig. 3 Al-Cr-Ni-Re computed vertical section at 1.5 at.% Re and at constant Ni/Al ratio of 1 [1999Hua]

a vertical section computed by [1999Hua] at 1.5 at.% Re and at a constant Ni/Al atom ratio of 1.

References

1994Miy: S. Miyazaki, Y. Murata, and M. Morinaga, Evaluation of Partitioning Ratios of Re Atoms in Ni-Al-Re-X (X: Cr, Mo, W, Ti, Ta, Nb, Co) Quaternary Alloys, *Tetsu-to-Hagane,* 1994, **80**(2), p 166-171, in Japanese

1998Sly: E.M. Slyusarenko, A.V. Peristyi, E. Yu. Kerimov, M.V. Sofin, and D. Yu. Skorbov, Ternary Systems of Nickel and Rhenium with Transition Metals, *J. Alloys Compd.,* 1998, **264,** p 180-189

1999Hua: W. Huang and Y.A. Chang, A Thermodynamic Description of the Ni-Al-Cr-Re System, *Mater. Sci. Eng. A,* 1999, **A259,** p 110-119

2006Rag: V. Raghavan, Al-Cr-Ni (Aluminum-Chromium-Nickel), *J. Phase Equilib. Diffus.,* 2006, **27**(4), p 381-388