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

*V. Raghavan*

The recent update of this ternary system by [2006Rag] presented five partial isothermal sections in the Al-rich region from the studies of [2003Mi], depicting several ternary phases including a quasicrystalline decagonal phase. More recently, [2006Try] determined isothermal sections at 1100 and 1000 °C in the Ni-NiAl-RuAl-Ru region.

## Binary Systems

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 ($B2$, CsCl-type cubic, also denoted β), $Ni_5Al_3$ ($Ga_3Pt_5$-type orthorhombic), and $Ni_3Al$ ($L1_2$, $AuCu_3$-type cubic; denoted γ′). The Al-Ru phase diagram [2006Rag] depicts six intermediate phases: $RuAl_6$ (orthorhombic, space group *Cmcm)*, $Ru_4Al_{13}$ (monoclinic, space group $C2/m$), $Ru_2Al_5$ (orthorhombic, space group *Cmcm*), $RuAl_2$ ($C54$, $TiSi_2$-type orthorhombic), $Ru_2Al_3$ ($Os_2Al_3$-type tetragonal), and RuAl ($B2$, CsCl-type cubic). The Ni-Ru phase diagram computed by [2004Hal] is a simple peritectic system with maximum solubility of 34.1 at.% Ru in Ni and 47.4 at.% Ni in Ru at the peritectic temperature of 1564 °C.

## Ternary Isothermal Sections

With starting metals of 99.999% Al, 99.999% Ni, and 99.98% Ru, [2006Try] melted single phase samples of the binary compounds NiAl, $Ni_3Al$, and RuAl and employed pressure welding at 1000 °C to prepare diffusion couples of NiAl-RuAl, NiAl-Ru, Ni-RuAl, $Ni_3Al$-Ru, and $Ni_3Al$-RuAl. The diffusion anneal was at 1100 or 1000 °C for 336 h. The samples were cooled slowly from the annealing temperature to minimize the effects of thermal expansion mismatches.

The heat treated samples were studied with scanning electron microscopy and electron probe microanalysis (EPMA). The backscattered electron images and the EPMA composition profiles obtained from the NiAl-RuAl couple confirmed the existence of a continuous $B2$ solid solution between NiAl and RuAl. The earlier controversy regarding the existence or otherwise of a miscibility gap between NiAl and RuAl appears to be settled with the results of [2006Try]. [2006Rag] reviewed these earlier results and, based on the work of [1998Hor], came to the tentative conclusion that a continuous $B2$ solid solution exists between NiAl and RuAl.

[2006Try] discussed the images and the composition profiles obtained from the other diffusion couples and presented the conclusions deduced from the results. Two isothermal sections at 1100 and 1000 °C constructed by [2006Try] for the Ni-NiAl-RuAl-Ru region are shown

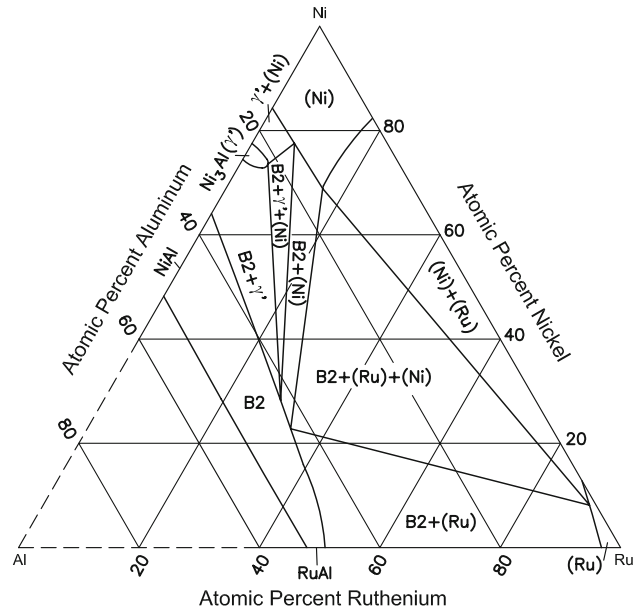


**Fig. 1** Al-Ni-Ru isothermal section in the Al-lean region at 1100 °C [2006Try]

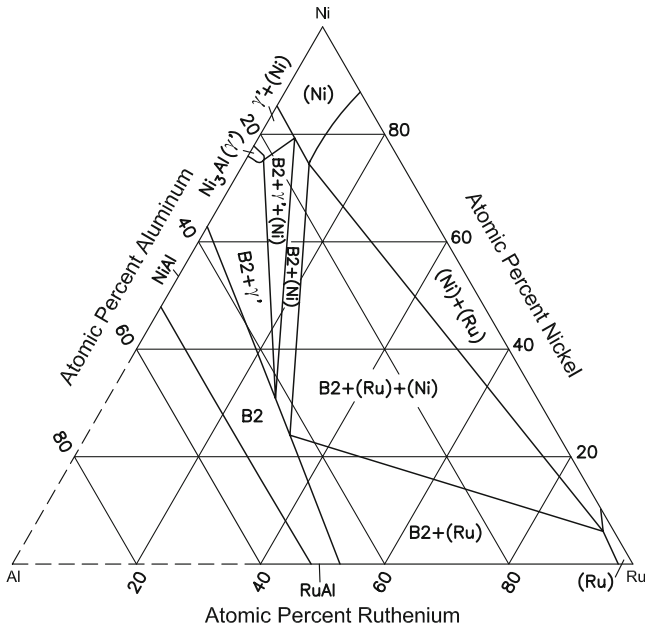


**Fig. 2** Al-Ni-Ru isothermal section in the Al-lean region at 1000 °C [2006Try]

Fig. 1 and 2. The phase distribution is very similar in the two sections.

## References

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