

# Al-Ir-Nb (Aluminum-Iridium-Niobium)

V. Raghavan

The previous work on this system by [1976Hor] reported several ternary compounds in the isothermal section at 1100 °C of the Nb-rich region. Recently, [2005Miu] determined a partial liquidus projection and an isothermal section at 1650 °C for Ir-rich alloys of this system.

## Binary Systems

The Al-Ir phase diagram in the Ir-rich region determined by [2005Miu] depicts a eutectic reaction between (Ir) and IrAl (*B2*, CsCl-type cubic) at 30.5 at.% Al and ~2020 °C. The other Al-Ir phases are: Ir<sub>2</sub>Al<sub>5</sub> (cubic, space group *Pm* $\bar{3}$ *n*), IrAl<sub>3</sub> (*D*<sub>018</sub>, Na<sub>3</sub>As-type hexagonal), Ir<sub>4</sub>Al<sub>13</sub> (monoclinic) and Ir<sub>2</sub>Al<sub>9</sub> (*D*<sub>8d</sub>, Co<sub>2</sub>Al<sub>9</sub>-type monoclinic). The Ir-Nb phase diagram [Massalski2] has the following intermediate phases: Ir<sub>3</sub>Nb (*L*<sub>12</sub>, AuCu<sub>3</sub>-type cubic),  $\alpha_2$  (39-45.5 at.% Nb; orthorhombic),  $\alpha_1$  (47-48 at.% Nb; *L*<sub>10</sub>, AuCu-type tetragonal),  $\sigma$  (58.5-67 at.% Nb; *D*<sub>8b</sub>,  $\sigma$ CrFe-type tetragonal), and IrNb<sub>3</sub> (*A*<sub>15</sub>, Cr<sub>3</sub>Si-type cubic).

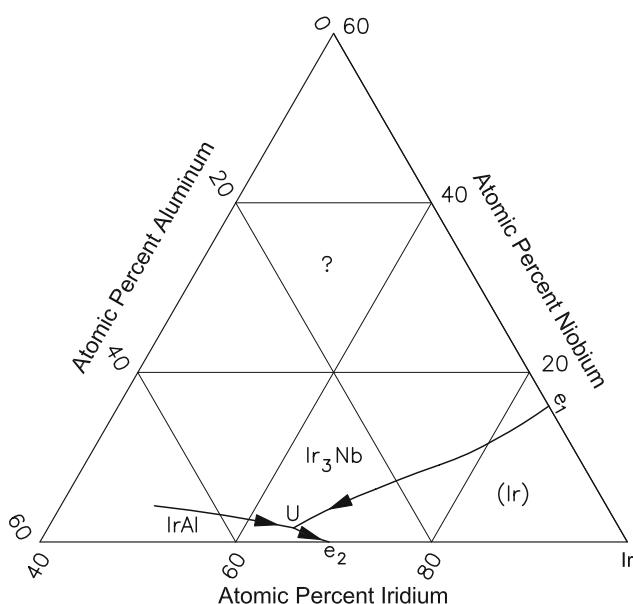
## Ternary Phase Equilibria

With starting metals of 99.99% Al, 99.9% Ir, and 99.9% Nb, [2005Miu] arc-melted under Ar atm an Ir-rich ternary

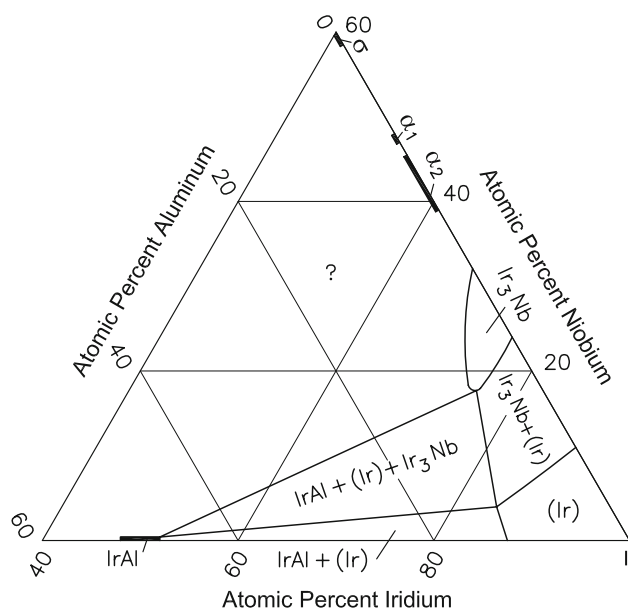
alloy: 70Ir-20Al-10Nb (atomic percent). The sample was annealed at 1650 °C for 24 h. The phase equilibria were studied with scanning electron metallography, wavelength dispersive x-ray spectroscopy and differential thermal analysis. The partial liquidus projection constructed by [2005Miu] is shown in Fig. 1. In the Ir-rich region, a U-type transition reaction  $L + \text{Ir}_3\text{Nb} \leftrightarrow (\text{Ir}) + \text{IrAl}$  is postulated by [2005Miu]. Figure 2 shows the partial isothermal section at 1650 °C. In the solid solution based on Ir<sub>3</sub>Nb, Al substitutes for Nb up to the solubility limit of 7.3 at.%. No ternary phases were found in this region. Figures 1 and 2 may be considered tentative, in view of the very limited experimental results.

## References

- 1976Hor:** R. Horyn, The Niobium-Aluminum-Iridium Ternary System. Part II. X-ray Study of the Intermediate Phases and Phase Equilibria at 1100 °C, *J. Less-Common Met.*, 1976, **45**, p 315-321
- 2005Miu:** S. Miura, K. Ohkubo, Y. Terada, Y. Kimura, Y. Mishima, Y. Yamabe-Mitarai, H. Harada, and T. Mohri, Phase Equilibria in the Ir-Rich Portion of the Ir-Al-X (X: V, Nb and Ta) Ternary Systems, *J. Alloys Compd.*, 2005, **395**, p 263-271



**Fig. 1** Al-Ir-Nb partial liquidus projection for Ir-rich alloys [2005Miu]



**Fig. 2** Al-Ir-Nb partial isothermal section at 1650 °C for Ir-rich alloys [2005Miu]