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Al-Ga-Ti (Aluminum-Gallium-Titanium)

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[1992Per] reviewed the limited data on the phase relationships in Ti-rich alloys of this system. More recently, [1998Ant] determined a vertical section along the TiAl-TiGa join.

Binary Systems

The Al-Ga phase diagram [Massalski2] contains no intermediate phases. Up to 9 at.% Ga dissolves in solid Al. Ga, on the other hand, shows no significant solubility of Al. An update of the Al-Ti system appears in this issue. The Ga-Ti phase diagram [Massalski2] is not firmly established. A number of intermediate phases have been reported: $TiGa_3$ ($TiAl_3$-type tetragonal), $TiGa_2$ ($HfGa_2$-type tetragonal), Ti_3Ga_5 (Ti_3Al_5-type tetragonal), Ti_2Ga_3 (tetragonal), TiGa (AuCu-type tetragonal), Ti_5Ga_4 (hexagonal), Ti_5Ga_3 (W_5Si_3-type tetragonal), Ti_2Ga ($B8_2$-type hexagonal), and Ti_3Ga (Ni_3Sn-type hexagonal). Not all are established equilibrium phases.

Vertical Section Along the TiAl-TiGa Join

With starting metals of 99.995% Al, 99.99% Ga, and 99.98% Ti, [1998Ant] melted eight alloy compositions in an arc furnace under Ar atm. The alloys were homogenized at 1300-1200 °C. The phase equilibria were studied by metallography, x-ray diffraction, electron probe microanalysis, and differential thermal analysis at a heating rate of 40 °C per min. The vertical section along the TiAl-TiGa join constructed by [1998Ant] is redrawn in Fig. 1. At the TiAl end, the phase of primary crytallization is (αTi). With increasing TiGa, a large area of primary separation of Ti(Al,Ga) (γ) is present. Near the TiGa end, the first phase to crystallize is Ti_5Ga_4 (denoted ρ by [1998Ant]). Up to 70 mol% TiGa dissolves in TiAl in the subsolidus range. The lattice parameters of the Ti(Al,Ga) solid solution were determined by [1998Ant] over the entire composition range, presumably by using samples obtained through rapid cooling near the TiGa end. The *a* parameter decreases linearly from 0.4003 nm at TiAl to 0.3969 nm at TiGa. The *c* parameter decreases linearly from 0.4076 nm at TiAl to 0.3978 nm at TiGa.

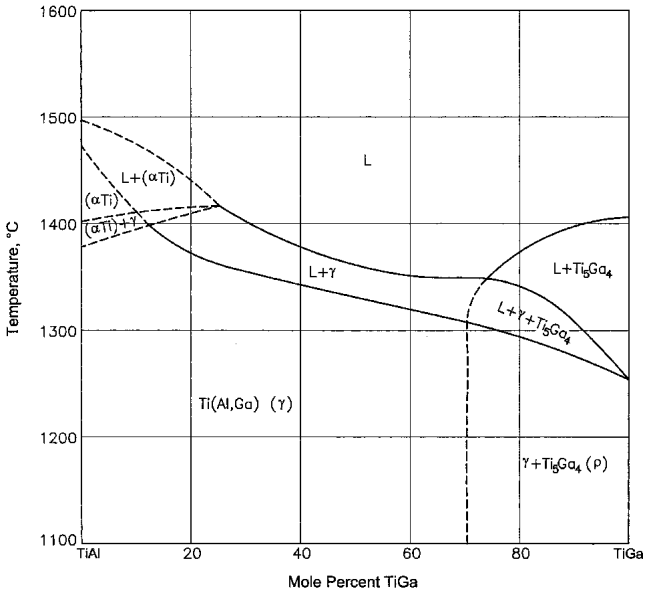

Fig. 1 Al-Ga-Ti vertical section along the TiAl-TiGa join [1998Ant]

[1995Qin] studied the shift of the phase boundaries in the (αTi)-TiAl(γ) with the addition of Ga. With the addition of 3 at.% Ga, the (αTi)/(αTi) + γ and (αTi) + γ/γ boundaries shift on an average of 1.1 and 1.7 at.%, respectively, to the Al-poor side in the temperature range of 1300-1150 °C. Ga resides preferentially in γ, with the distribution coefficient $K^{(\alpha Ti)/\gamma} \approx 0.8$ to 0.9.

References

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