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Al-Ti-V-Zr (Aluminum-Titanium-Vanadium-Zirconium)

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The information on this system is limited to the pseudoternary sections at 1100, 1000, and 900 °C on the Al_3Ti-Al_3V-Al_3Zr plane of the composition tetrahedron [1996Par].

Binary Systems

For brief descriptions of the Al-Ti, Al-V, and Ti-V phase diagrams, see [2005Rag]. The Al-Zr phase diagram depicts ten intermediate phases [Massalski2]. For the limited purpose of this review, we need only to note that Al_3Zr has the $D0_{23}$-type tetragonal structure. There are no intermediate phases in the Ti-Zr system. βTi and βZr form a continuous body-centered cubic (bcc) solid solution. αTi and αZr form a continuous hcp solid solution. The V-Zr phase diagram [1989Smi] shows one intermediate phase: V_2Zr, which has the $C15$, $MgCu_2$-type cubic structure.

Ternary Systems

For an update of the Al-Ti-V system, see [2005Rag]. In the Al-Ti-Zr system, the Al_3Ti-Al_3Zr pseudobinary section determined by [1996Par] is shown in Fig. 1. The Al_3Ti-based $D0_{22}$ structure dissolves a few mol% Al_3Zr, whereas the Al_3Zr-based $D0_{23}$ structure dissolves more 80 mol% of Al_3Ti. The effect of Zr addition on the (αTi)-(βTi)-γ (TiAl) phase equilibria at 1300, 1200, and 1000 °C was reported by [2000Kai]. In the Al-V-Zr system, the Al_3V-Al_3Zr pseudobinary section was determined by [1996Par] (Fig. 2). Al_3V dissolves between 10 and 20 mol% Al_3Zr, whereas the solubility of Al_3V in Al_3Zr is less than 5 mol%. [1992Eno] reviewed the Ti-V-Zr system, presenting a liquidus surface, a reaction scheme, and an isothermal section at 750 °C.

Quaternary Phase Equilibria

With starting metals of 99.99% Al, 99.9% Ti, 99.8% V, and 99.8% Zr, [1996Par] arc-melted in vacuum four quaternary alloys with a fixed Al content of 75 at.%. The alloys were annealed at 1300-1100 °C for 24-72 h and quenched in water. The phase equilibria were studied with scanning electron microscopy, x-ray diffraction, and energy dispersive x-ray spectroscopy. The experimental data were used to derive the interaction parameters for the $D0_{22}$ and $D0_{23}$ solid solutions and to calculate the pseudoternary sections at 1300, 1200, and 1100 °C on the Al_3Ti-Al_3V-Al_3Zr plane of the composition tetrahedron. A composite computed diagram in Fig. 3 depicts the phase boundaries on this section at the above three temperatures. As the temperature decreases, the ($D0_{22}$ + $D0_{23}$) two-phase field expands, with the $D0_{23}$ phase field remaining almost unchanged.

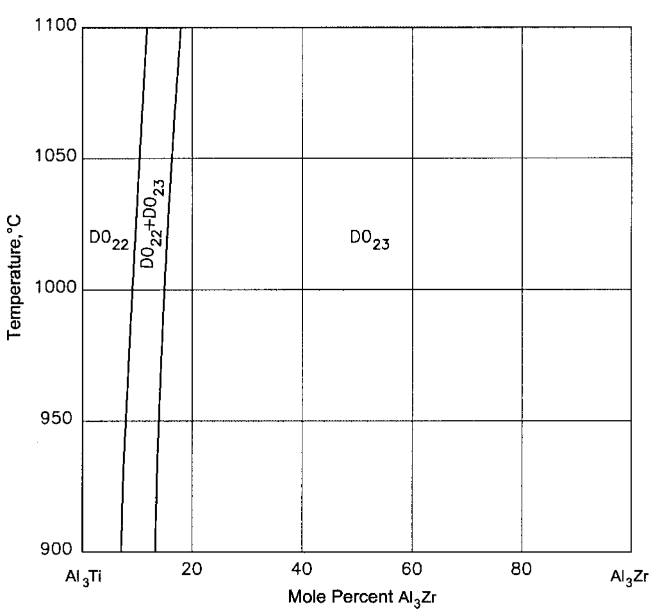

Fig. 1 Al-Ti-Zr pseudobinary section along the Al_3Ti-Al_3Zr join [1996Par]

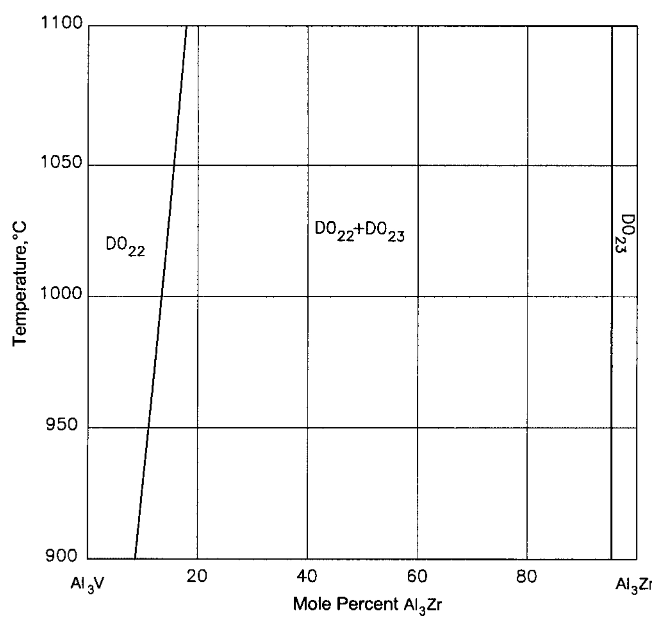

Fig. 2 Al-V-Zr pseudobinary section along the Al_3V-Al_3Zr join [1996Par]

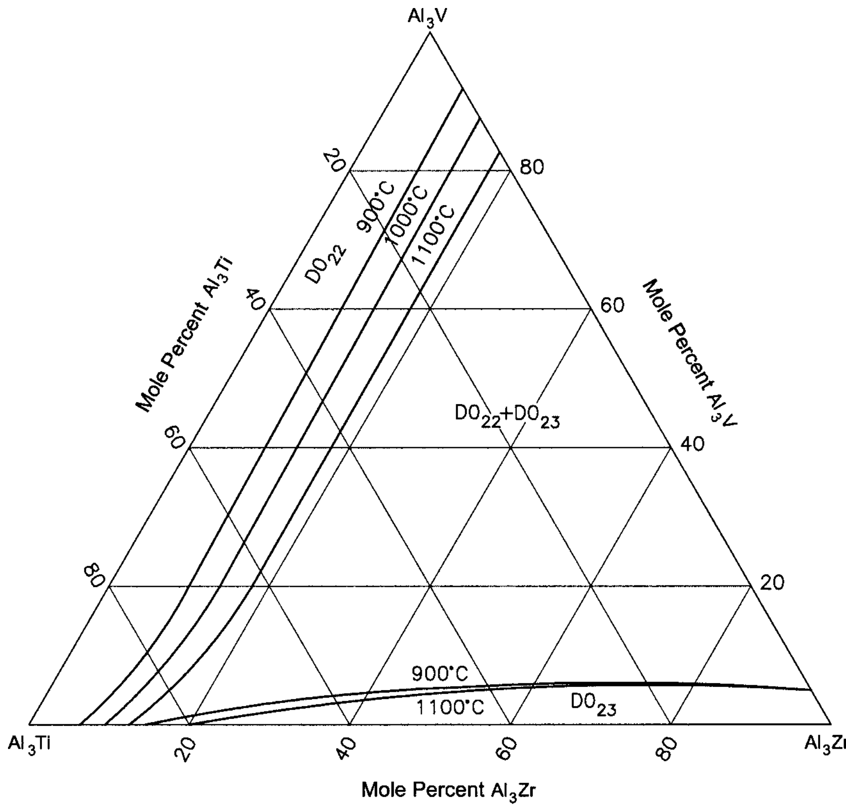

Fig. 3 Al-Ti-V-Zr pseudoternary sections at 1100, 1000, and 900 °C on the Al_3Ti-Al_3V-Al_3Zr plane [1996Par]

References

1989Smi: J.F. Smith, The V-Zr System, *Phase Diagrams of Binary Vanadium Alloys,* ASM International, 1989, p 326-329

1992Eno: M. Enomoto, The Ti-V-Zr (Titanium-Vanadium-Zirconium) System, *J. Phase Equilibria,* Vol 13, 1992, p 206-210

1996Par: S.I. Park, S.Z. Han, S.K. Choi, and H.M. Lee, Phase Equilibria of Al_3(Ti,V,Zr) Intermetallic System, *Scripta Materialia,* Vol 34, 1996, p 1697-1704

2000Kai: R. Kainuma, Y. Fujita, H. Mitsui, I. Ohnuma, and K. Ishida, Phase Equilibria among α (hcp), β (bcc) and γ ($L1_0$) Phases in Ti-Al Base Ternary Alloys, *Intermetallics,* Vol 8, 2000, p 855-867

2005Rag: V. Raghavan, Al-Ti-V (Aluminum-Titanium-Vanadium), *J. Phase Equilibria Diffusion,* 2005, Vol 26 (No. 3), p 276-279