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Al-Fe-V (Aluminum-Iron-Vanadium)

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The previous review of this system by [1992Rag] presented an isothermal section at 500 °C, which did not clarify the phase relationships between the disordered and the ordered forms of the body-centered cubic (bcc) phase in Fe-rich alloys. The update by [2002Rag] presented an isothermal section at 500 °C for the Fe-rich region, depicting the equilibrium between *A*2, *B*2, and $D0_3$ phases. Recently, [2004Mae] measured the compositions of coexisting phases and obtained tie-lines in the *A*2 + $D0_3$ ($L2_1$) two-phase region between 750 and 650 °C.

Binary Systems

The Al-Fe phase diagram [1993Kat] depicts four intermediate phases: the high temperature phase ε, $FeAl_2$ (triclinic), Fe_2Al_5 (orthorhombic), and $FeAl_3$ (monoclinic). The Fe-based face-centered cubic (fcc) phase is enclosed by a γ loop. The bcc solid solution α dissolves more than 50 at.% Al and exists in the disordered form *A*2 and the ordered forms of the CsCl-type (*B*2) and BiF_3-type ($D0_3$). The Al-V diagram [2000Ric] depicts five intermetallic compounds: V_5Al_8 ($D8_2$, Cu_5Zn_8-type cubic), VAl_3 ($D0_{22}$, $TiAl_3$-type tetragonal), V_4Al_{23} (hexagonal), V_7Al_{45} (monoclinic), and V_2Al_{21} (cubic). The γ loop and the intermediate phase σ with a significant range of homogeneity are the characteristic features of the Fe-V system [1993Smi].

Ternary Isothermal Sections

With starting metals of 99.99% Al, 99.9% Fe, and 99.5% V, [2004Mae] arc-melted under Ar atmosphere or induction-melted under vacuum 30 ternary alloys with Al range of 5-24 at.% and V range of 5-22 at.%. The alloys were given a final anneal at 750, 700, and 650 °C for times ranging from 28 to 960 h and quenched in iced brine. The phase equilibria were studied by transmission electron microscopy and energy dispersive x-ray spectroscopy. The partial isothermal sections constructed by [2004Mae] at 750, 700, and 650 °C are redrawn in Fig. 1. The tie-lines in the *A*2 + $L2_1$ ($D0_3$) field are approximately parallel to the direction joining the Fe corner to Fe_2AlV (stoichiometric Heusler composition of $L2_1$). The width of the two-phase field increases with decreasing temperature. The addition of V to Fe-Al alloys raises the $D0_3$ ($L2_1$) → *B*2 transition temperature and expands the *A*2 + $D0_3$ ($L2_1$) two-phase region.

References

1992Rag: V. Raghavan, The Al-Fe-V (Aluminum-Iron-Vanadium) System, *Phase Diagrams of Ternary Iron Alloys. Part 6,* Indian Institute of Metals, Calcutta, India, 1992, p 204-207

1993Kat: U.R. Kattner and B.P. Burton, Al-Fe (Aluminum-Iron), *Phase Diagrams of Binary Iron Alloys,* H. Okamoto, Ed., ASM International, 1993, p 12-28

1993Smi: J.F. Smith, Fe-V (Iron-Vanadium), *Phase Diagrams of Binary Iron Alloys,* H. Okamoto, Ed., ASM International, 1993, p 433-443

2000Ric: K.W. Richter and H. Ipser, The Al-V Phase Diagram between 0 and 50 Atomic Percent Vanadium, *Z. Metallkd.,* 2000, **91**(5), p 383-388

2002Rag: V. Raghavan, Al-Fe-V (Aluminum-Iron-Vanadium), *J. Phase Equilibria,* 2002, **23**(5), p 439-440

2004Mae: T. Maebashi, T. Kozakai, and M. Doi, Phase Equilibria in Iron-Rich Fe-Al-V Ternary Alloy System, *Z. Metallkd.,* 2004, **95**(11), p 1005-1010

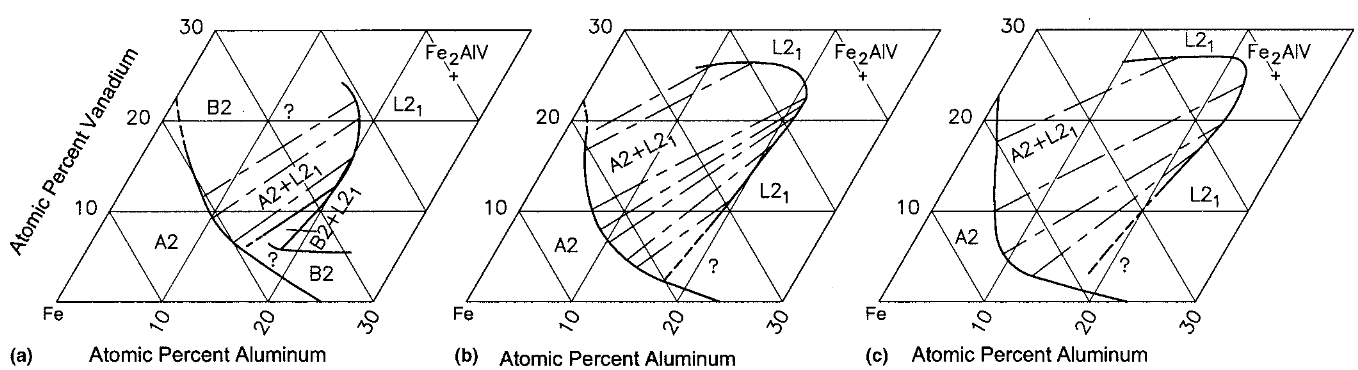

Fig. 1 Al-Fe-V isothermal section at (a) 750 °C, (b) 700 °C, and (c) 650 °C [2004Mae]