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Al-Co-Fe (Aluminum-Cobalt-Iron)

V. Raghavan

The phase relationships in this system were reviewed by [1988Ray], who presented two partial liquidus surfaces, an isothermal section at 800 °C for Co-rich alloys and isothermal sections at 640 and 600 °C for alloys near the Al corner. A full isothermal section at 650 °C from [1999Koz] and a partial section at 1127 °C were reviewed by [2002Rag]. [2004Kam] determined the phase relationships in Co-rich alloys between 1200 and 900 °C in the region of magnetic and order-disorder transitions, briefly reviewed by [2005Rag]. Recently, [2004Koz] and [2006Koz] used the liquid-quenching and composition-gradient methods to determine the metastable *B*2/(*B*2 + *A*2) phase boundary at 650 °C in Co-rich alloys.

Binary Systems

In the Al-Co phase diagram [Massalski2], four intermediate phases, Al_9Co_2, $Al_{13}Co_4$,Al_3Co, and Al_5Co_2, occur in the Al-rich region. With increasing Co, AlCo (*B*2, CsCl-type cubic) occurs over a wide temperature and composition range (48-78 at.% Co). In the Fe-Al phase diagram [Massalski2], the solid solution based on the face-centered cubic (fcc) Fe is restricted by a γ loop. The solution based on the body-centered cubic (bcc) Fe exists in the disordered (*A*2) and the ordered (*B*2 and $D0_3$) forms. With increasing Al, four intermediate phases occur: ε, $FeAl_2$, Fe_2Al_5 and $FeAl_3$. In the Co-Fe system [Massalski2], a continuous fcc slid solution γ between fcc Fe and Co is stable over a wide temperature range. The fcc → bcc transformation temperature in Fe is initially raised by the addition of Co, reaching a maximum at 980 °C at 45 at.% Co. At 730 °C, the bcc phase of equiatomic composition orders to a *B*2 structure via a second-order transition.

Ternary Isothermal Section

With starting metals of 99.99% Al, 99.9% Co, and 99.98% Fe, [2006Koz] arc-melted under Ar atm five Co-rich ternary alloys containing 9.58-37 at.% Al and 6.11-7.26 at.% Fe. Liquid-quenching was one of the methods adopted to obtain the metastable condition. The alloys were remelted in a quartz tube and the melt was poured through a nozzle on to a steel roller rotating at high speed to produce ribbons. In the second method, a composition gradient was obtained in a sample through an appropriate heat treatment procedure. The phase equilibria were studied with x-ray powder diffraction and transmission electron microscopy. The compositions were measured with energy dispersive spectroscopy. The metastable isothermal section near the Co corner at 650 °C constructed by [2006Koz] is shown in Fig. 1. The thin lines correspond to stable equilibrium [1999Koz] and the thick line represents the metastable *B*2/(*B*2 + *A*2) phase boundary. The extent of the *B*2 field is increased under metastable conditions.

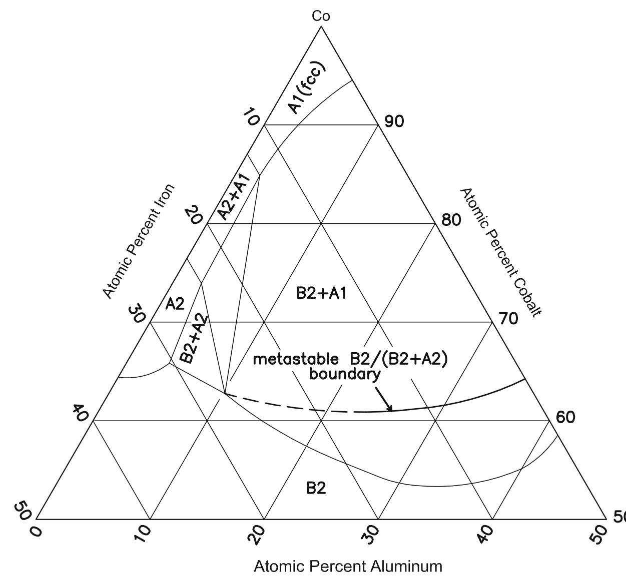

Fig. 1 Al-Co-Fe metastable *B*2/(*B*2 + *A*2) phase boundary in the Co-rich region at 650 °C [2006Koz]

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