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Co-Fe-Sb (Cobalt-Iron-Antimony)

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The previous review of this system by [1992Rag] presented a liquidus projection from the studies of [1939Gel]. Recently, [2007Amo] determined three vertical sections along the $Fe_{0.56}Sb_{0.44}$-CoSb join and at 30 and 75 at.% Sb, respectively.

Binary Systems

In the Co-Fe system [2002Ohn, Massalski2], a continuous face-centered cubic (fcc) solid solution denoted γ forms between fcc Fe and fcc Co. The γ → α (bcc) transformation temperature in Fe is initially raised by the addition of Co, reaching a maximum of 985 °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. [2002Ohn] showed that the (α + γ) two-phase field extends below the temperature where the bcc/*B*2 boundary meets the α/(α + γ) boundary. The Co-Sb phase diagram [2005Oka, Massalski2] depicts three intermediate phases: CoSb (48-51 at.% Sb; $B8_1$, NiAs-type hexagonal), $CoSb_2$ (*C*18, marcasite-type orthorhombic structure transforming below 377 °C to monoclinic symmetry), and $CoSb_3$ ($D0_2$, $CoAs_3$-type cubic). The Fe-Sb phase diagram [1997Ric] has two intermediate phases: $FeSb_{1-x}$ (41-49 at.% Sb; $B8_1$, NiAs-type hexagonal) and $FeSb_2$ (*C*18, marcasite-type orthorhombic).

Vertical Sections

With starting metal powders of >99.99% purity, [2007Amo] melted alloy compositions by heating mixtures to 1100 °C in a sealed tube, followed by water quenching. Subsequently, the alloys were annealed at 900 °C (550 °C for samples containing 75 at.% Sb). The phase equilibria were studied with x-ray powder diffraction, scanning electron microscopy, and energy dispersive X-ray spectroscopy. Differential thermal analysis was performed at a heating rate of 5 °C per min. The vertical sections constructed by [2007Amo] are shown in Fig. 1-3. Along the CoSb-$Fe_{0.56}Sb_{0.44}$ join (Fig. 1), a continuous $B8_1$-type solid solution is seen between the isostructural end-members. The section at a constant 30 at.% Sb is shown in Fig. 2. A minimum in the liquidus occurs at 55 at.% Fe. The vertical section at 75 at.% Sb (Fig. 3) depicts an invariant horizontal at ~620 °C corresponding to the ternary eutectic reaction L ↔ *C*18 + $CoSb_3$ + (Sb).

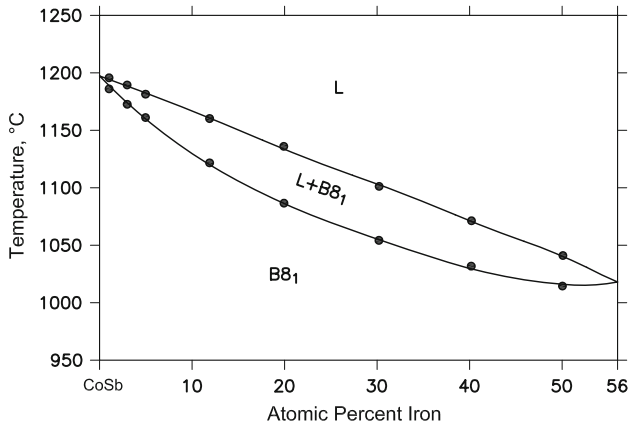

Fig. 1 Co-Fe-Sb vertical section along the CoSb-$Fe_{0.56}Sb_{0.44}$ join [2007Amo]

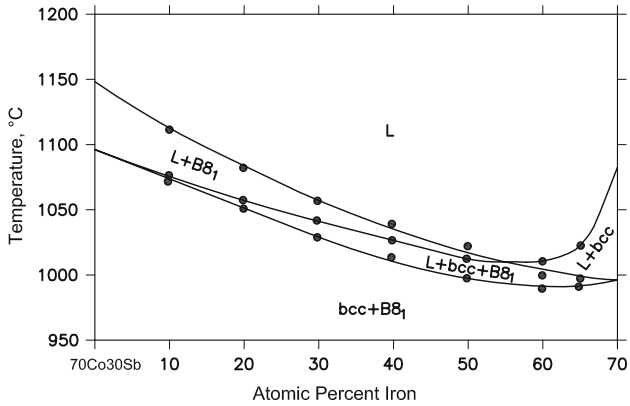

Fig. 2 Co-Fe-Sb vertical section at 30 at.% Sb [2007Amo]

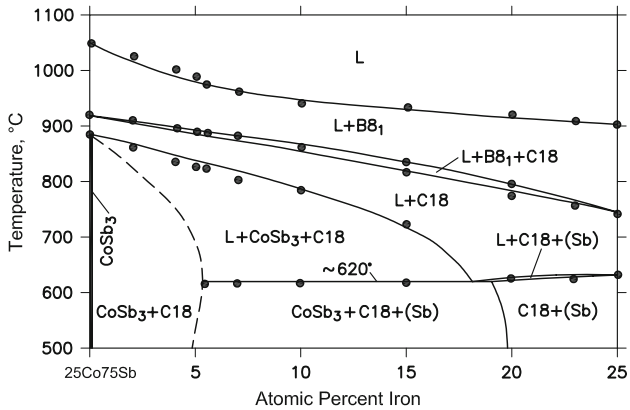

Fig. 3 Co-Fe-Sb vertical section at 75 at.% Sb [2007Amo]

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