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Fe-Ni-Sb (Iron-Nickel-Antimony)

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The previous review of this system [1992Rag] presented the pseudobinary section along the Fe-NiSb join, depicting a eutectic between (Fe) and NiSb at 60 mol% NiSb and at 1000 °C. Recently, [1997Ric] determined a liquidus surface, an isothermal section at 600 °C, and several vertical sections of this system in the composition range of 42-100 at.% Sb; see the update by [2004Rag]. Recently, [2003Voi] investigated the solid-liquid equilibria at 1150 °C in alloys rich in Fe and Ni.

Binary Systems

The Fe-Ni phase diagram [1991Swa] is characterized by a very narrow solidification range with a peritectic reaction at 1514 °C, between body-centered cubic (bcc) δ and liquid that yields the Fe-based face-centered cubic (fcc) solid solution. A continuous solid solution denoted γ between fcc Fe and Ni is stable over a wide range of temperature. An ordered phase $FeNi_3$ forms congruently at 517 °C from γ. The Fe-Sb phase diagram [1993Oka] depicts two intermediate phases. The NiAs-type $B8_1$ phase Fe_3Sb_2 (ε) has a homogeneity range of 40-47 at.% Sb. The other intermediate phase $FeSb_2$ is stoichiometric and has orthorhombic symmetry. The Ni-Sb phase diagram [Massalski2] shows three intermediate phases. Ni_3Sb has the βCu_3Ti-type orthorhombic structure. The high-temperature form of Ni_5Sb_2 is monoclinic and the low-temperature form (denoted Ni_7Sb_3 by [Massalski2]) is tetragonal. NiSb has a composition range of 43-52 at.% Sb and has a NiAs-type $B8_1$ structure. $NiSb_2$ is orthorhombic with FeS_2 (marcasite) as the prototype.

Ternary Isothermal Section

Using starting metals of purity of 99.9+% purity, [2003Voi] annealed alloy samples in sealed tubes at 1150 °C for 12 h followed by water quenching. The phase equilibria were studied by optical microscopy and electron probe microanalyzer. The isothermal section constructed by [2003Voi] at 1150 °C is redrawn in Fig. 1 to agree with the accepted binary data. Near the Fe-Sb side, the bcc solid solution α is in equilibrium with the liquid. The presence of (α + L) field is schematically illustrated in Fig. 1. Antimony activities were also measured by [2003Voi], using an isothermal isopiestic method.

References

1991Swa: L.J. Swartzendruber, V.P. Itkin, and C.B. Alcock, The Fe-Ni (Iron-Nickel) System, *J. Phase Equilibria,* Vol 12 (No. 3), 1991, p 288-312

1992Rag: V. Raghavan, The Fe-Ni-Sb (Iron-Nickel-Antimony) System, *Phase Diagrams of Ternary Iron Alloys,* Indian Institute of Metals, Calcutta, 1992, p 1061-1062

1993Oka: H. Okamoto, Fe-Sb (Iron-Antimony), *Phase Diagrams of Binary Iron Alloys,* H. Okamoto, Ed., ASM International, 1993, p 366-370

1997Ric: K.W. Richter and H. Ipser, An Experimental Investigation of the Fe-Ni-Sb Ternary Phase Diagram, *J. Phase Equilibria,* Vol 18 (No. 3), 1997, p 235-244

2003Voi: L. Voisin, M. Hino, and K. Itagaki, Phase Relations and Activities in the Fe-Ni-As and Fe-Ni-Sb Systems at 1423 K, *Mater. Trans.,* Vol 44 (No. 12), 2003, p 2654-2658

2004Rag: V. Raghavan, Fe-Ni-Sb (Iron-Nickel-Antimony), *J. Phase Equilibria,* Vol 25 (No. 1), 2004, p 89-91

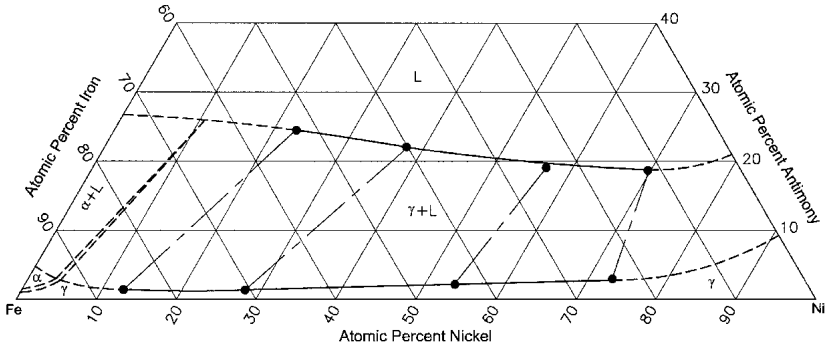

Fig. 1 Fe-Ni-Sb isothermal section at 1150 °C [2003Voi]