Fe-Nb-Ni (Iron-Niobium-Nickel)

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Introduction

The partial isothermal section for this ternary system at 1200 °C determined by [2001Tak] was reviewed by [2004Rag]. [2005Tak] carried out additional experiments at 1200 °C to construct a full isothermal section.

Binary Systems

The Fe-Nb phase diagram [1993Bej] has two intermediate phases: Fe_2Nb ($C14$, $MgZn_2$-type hexagonal) and Fe_7Nb_6(μ; $D8_5$, Fe_7W_6-type rhombohedral). The Fe-Ni phase diagram [1991Swa] is characterized by a very narrow solidification range. A continuous solid solution denoted γ between face-centered cubic (fcc) Fe and Ni is stable over a wide range of temperature. At 517 °C, an ordered phase $FeNi_3$ ($L1_2$, $AuCu_3$-type cubic) forms congruently from γ. The Nb-Ni phase diagram [1998Oka] has two intermediate

phases: Ni_3Nb (δ; $D0_a$-type orthorhombic) and Ni_6Nb_7 (μ; $D8_5$, Fe_7W_6-type rhombohedral).

Ternary Isothermal Section

Using high purity metals, [2005Tak] arc-melted under an Ar atmosphere four binary and three ternary alloys with Nb and Ni in the range of 15-38 at.% and 20-60 at.%, respectively. The alloys were annealed at 1200 °C for 72-240 h. The phase equilibria were studied by scanning and transmission electron microscopy and x-ray powder diffraction. The compositions of the coexisting phases were measured by electron probe microanalysis. The isothermal section at 1200 °C constructed by [2005Tak] is redrawn in Fig. 1 to agree with the accepted binary data (except that the homogeneity range of Fe_2Nb is as determined by [2005Tak]). The ternary phase τ [2001Tak, 2004Rag] and a small liquid field are seen. The Laves phase Fe_2Nb dissolves Ni up to 44 at.%. The variation of the lattice
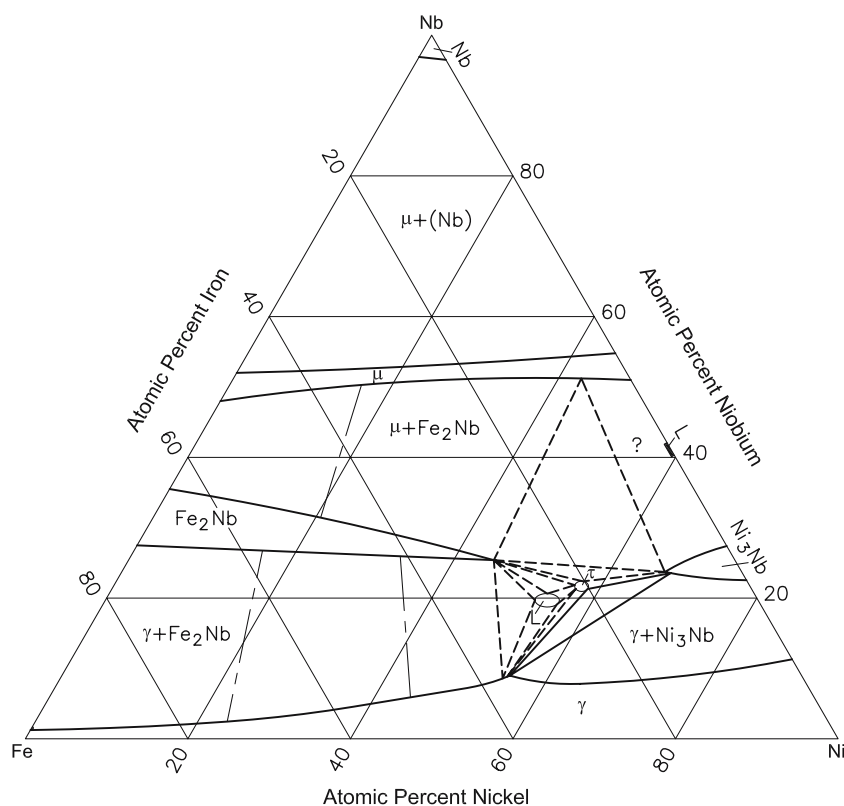

Fig. 1 Fe-Nb-Ni isothermal section at 1200 °C [2005Tak]

parameters of Fe_2Nb as a function of Fe and Ni contents (as well as with Cr as a quaternary addition) was reported by [2005Tak].

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