JPEDAV (2010) 31:466–467
DOI: 10.1007/s11669-010-9749-x
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Fe-Nb-V (Iron-Niobium-Vanadium)

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Recently, [2009Liu] determined four isothermal sections for this ternary system in the temperature range of 1300 to 1000 °C.

Binary Systems

The Fe-Nb phase diagram [2000Tof] has the following intermediate phases: Fe_2Nb ($C14$, $MgZn_2$-type hexagonal) and Fe_7Nb_6 (denoted μ; $D8_5$, Fe_7W_6-type rhombohedral). The Fe-V phase diagram [1984Smi] depicts one intermediate phase σ (31-66 at.% V; $D8_b$, σCrFe-type tetragonal). Recent unconfirmed results indicating the decomposition of the σ phase below 700 °C were reviewed by [2006Oka]. In the Nb-V system [Massalski2], Nb and V form a continuous bcc solid solution.

Ternary Isothermal Sections

With starting metals of 99.9% Fe, 99.7% Nb and 99.7% V, [2009Liu] arc-melted a number of ternary alloys under Ar atm. The alloys were annealed between 1300 and 1000 °C for 228-1272 h and quenched in ice-water mixture. The phase equilibria were studied with optical and electron metallography, x-ray powder diffraction and electron probe microanalysis. The measured compositions of the co-existing phases were listed. The isothermal sections constructed by [2009Liu] at 1300, 1200, 1100 and 1000 °C are shown in Fig. 1-4. The solubility of V in Fe_7Nb_6 and Fe_2Nb at 1000 °C is about 17.6 and 43.5 at.% respectively.

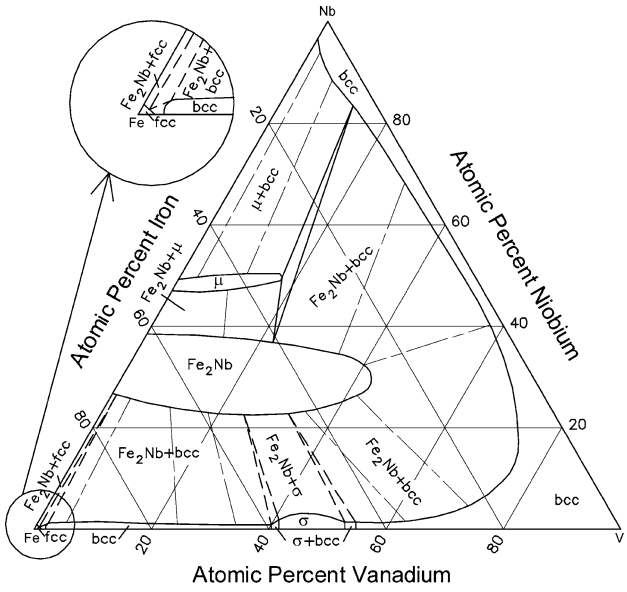

Fig. 2 Fe-Nb-V isothermal section at 1200 °C [2009Liu]

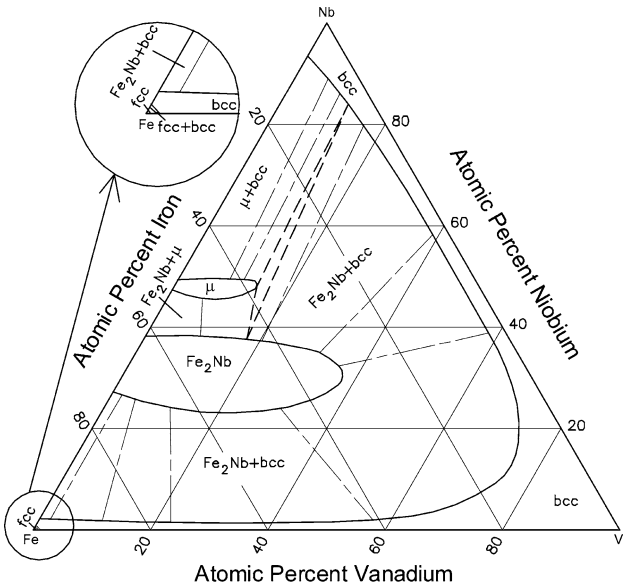

Fig. 1 Fe-Nb-V isothermal section at 1300 °C [2009Liu]

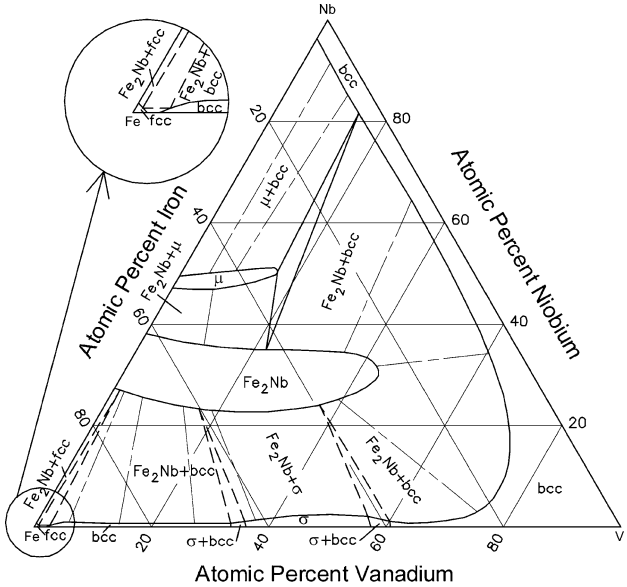

Fig. 3 Fe-Nb-V isothermal section at 1100 °C [2009Liu]

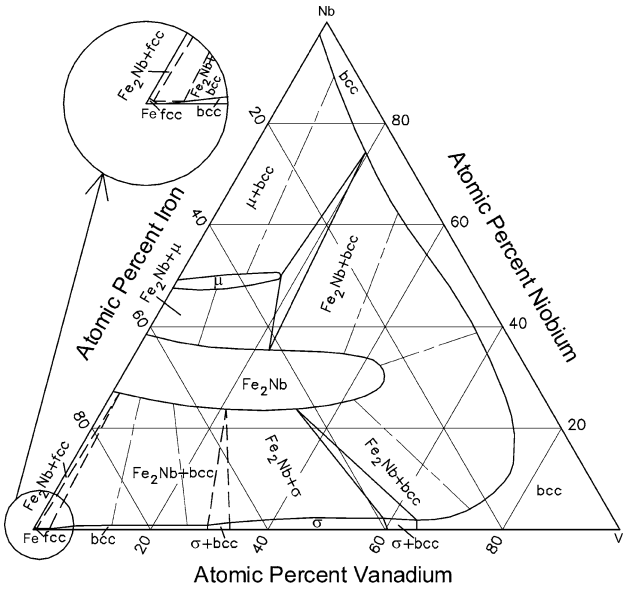

Fig. 4 Fe-Nb-V isothermal section at 1000 °C [2009Liu]

The solubility decreases slightly with increasing temperature. No ternary phases were found. The solubility of Nb in FeV-σ phase is much more limited. The phase distribution at 1200, 1100 and 1000 °C (Fig. 2-4) are similar, with the presence of the same 4 three-phase fields: Fe_2Nb + μ + Nb-rich bcc, Fe_2Nb + σ + Fe-rich bcc, Fe_2Nb + σ + V-rich bcc, and fcc + Fe-rich bcc + Fe_2Nb. At 1300 °C (Fig. 1), only the (Fe_2Nb + μ + Nb-rich bcc) field is present [2009Liu].

References

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