Fe-Ho-Ni (Iron-Holmium-Nickel)

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[1993Fan] determined an isothermal section at ~25 °C for this system for Ho contents up to 33.3 at.%.

Binary Systems

The Fe-Ho phase diagram reviewed by [1982Kub] depicts four line compounds: $Fe_{17}Ho_2$, $Fe_{23}Ho_6$, Fe_3Ho, and Fe_2Ho. See [Massalski2] for the Fe-Ni phase diagram. Iron and nickel form a complete solid solution (fcc, γ) at high temperatures, which decomposes eutectoidally at 347 °C to (αFe) and an ordered phase $FeNi_3$. The Ho-Ni phase diagram was determined by [1991Zho]. There are eight compounds in this system: Ho_3Ni, Ho_3Ni_2, HoNi, $HoNi_2$, $HoNi_3$, Ho_2Ni_7, $HoNi_5$, and Ho_2Ni_{17}. See [Pearson3] for structural data on the binary compounds.

Ternary Isothermal Section

With starting metals of purity of 99.95% Fe, 99.95% Ho, and 99.99% Ni, [1993Fan] prepared 123 alloy samples by induction melting in an Ar atm. The alloys were annealed at 500 °C for 5 days and cooled slowly at the rate of 10 °C h^{-1} to room temperature (~25 °C). It is presumed that the phase equilibria correspond to ~25 °C. The phase identification was carried out by x-ray powder diffraction and electron probe microanalysis techniques. Their isothermal section at ~25 °C is redrawn in Fig. 1 to agree with the accepted binary data. [1993Fan] did not report the existence of the $FeNi_3$ phase. The homogeneity ranges of (αFe), $FeNi_3$, and γ shown in Fig. 1 are approximate. The $PuNi_3$-type isostructural compounds Fe_3Ho and $HoNi_3$ form a complete series of solid solutions $Ho(Fe,Ni)_3$, denoted 1:3 in Fig. 1. $Fe_{17}Ho_2$ and $Fe_{23}Ho_6$ dissolve about 10 and 7 at.% Ni, respectively, at constant Ho content. $HoNi_5$ and $HoNi_2$ dissolve about 24 and 23 at.% Fe at constant Ho content. The lattice parameter of the cubic Laves phase $HoNi_2$ varies linearly from 0.7160 nm at 0% Fe to 0.7244 nm at 23 at.% Fe. The Fe-Ni phases dissolve about 2 at.% Ho. The 1:3 phase comes into equilibrium with a phase χ of high Ho content. The χ phase showed some weak diffraction lines similar to those of Ho_3Ni_2 [1993Fan]. More experiments are needed to determine its composition and structure.

References

1982Kub: O. Kubaschewski: *Iron-Binary Phase Diagrams*, Springer-Verlag, Berlin, 1982, pp. 111-12.

1991Zho: H. Zhou, Y. Ou, and X. Zhong: *J. Alloys Compounds*, 1991, vol. 177, pp. 101-06.

1993Fan: X. Fang, H. Zhou, X. Ou, and Y. Zhuang: *J. Alloys Compounds*, 1993, vol. 196, pp. L15-L17.

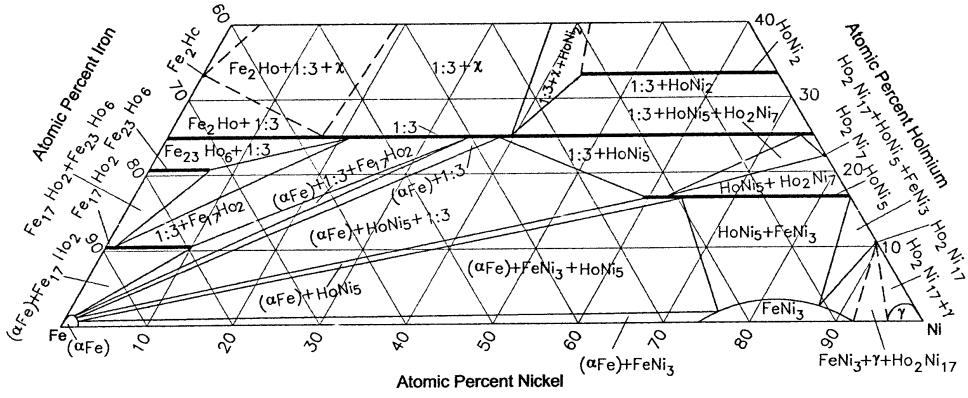

Fig. 1 Fe-Ho-Ni partial isothermal section at ~ 25 °C [1993Fan]