Co-Fe-Ho (Cobalt-Iron-Holmium)

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Recently, [2011He] determined an isothermal section for this ternary system at 500 °C, which depicts three continuous solid solutions between isostructural pairs of Fe-Ho and Co-Ho compounds.

Binary Systems

In the Co-Fe system [Massalski2], a continuous face-centered cubic (fcc) solid solution denoted γ forms between fcc Fe and fcc Co. The $\gamma \rightarrow \alpha$ (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 $B2$ structure via a second-order transition. The Co-Ho phase diagram [Massalski2] has eight intermetallic compounds: $\text{Co}_{17}\text{Ho}_2$ ($\text{Ni}_{17}\text{Th}_2$ -type hexagonal), Co_5Ho ($D2_d$, CaCu₅-type hexagonal), Co_7Ho_2 (Co_7Er_2 -type rhombohedral), Co_3Ho (Ni_3Pu -type rhombohedral), Co_2Ho ($C15$, MgCu₂-type cubic), Co_3Ho_4 (Co_3Ho_4 -type hexagonal), $\text{Co}_7\text{Ho}_{12}$ ($\text{Co}_7\text{Ho}_{12}$ -type monoclinic) and CoHo_3 ($D0_{11}$, Fe₃C-type orthorhombic). The Fe-Ho phase diagram [Massalski2] depicts four line compounds: $\text{Fe}_{17}\text{Ho}_2$ ($\text{Ni}_{17}\text{Th}_2$ -type hexagonal), $\text{Fe}_{23}\text{Ho}_6$ ($D8_a$, $\text{Mn}_{23}\text{Th}_6$ -type cubic), Fe_3Ho (Ni_3Pu -type rhombohedral) and Fe_2Ho ($C15$, MgCu₂-type cubic).

Ternary Isothermal Section

With starting metals of $\geq 99.9\%$ purity, [2011He] melted alloy samples in an arc furnace under Ar atm. After homogenization, the alloys were given a final anneal at 500 °C for 10 d and quenched in liquid nitrogen. The phase equilibria were studied with optical microscopy, scanning electron microscopy with energy dispersive analysis and x-ray powder diffraction.

Fig. 1 Co-Fe-Ho isothermal section at 500 °C [2011He]

The isothermal section at 500 °C constructed by [2011He] is shown in Fig. 1. The isostructural pairs Fe₁₇Ho₂-Co₁₇Ho₂, Fe₃Ho-Co₃Ho and Fe₂Ho-Co₂Ho form continuous solid solutions. The solubility of Co in Fe₂₃Ho₆ is 29 at.% at constant Ho content. The solubility of Fe in Co₇Ho₂, Co₇Ho₁₂ and CoHo₃ is 9, 2 and 5 at.% respectively, with Fe substituting for Co. No ternary phases were found.

Reference

2011He: W. He, Y. Zhao, Y. Zhang, M. Yu, and L. Zeng, Isothermal Section of the Ho-Co-Fe System at 773 K, *J. Alloys Compd.*, 2011, **509**, p 632-635