

# Co-Fe-Ho-Sm (Cobalt-Iron-Holmium-Samarium)

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Recently, [2004Liu] determined an isothermal section for this system at 800 °C and at a constant Ho/Sm atom ratio of 1.

Co-Fe-Sm system, the pairs  $\text{Co}_{17}\text{Sm}_2$ - $\text{Fe}_{17}\text{Sm}_2$ ,  $\text{Co}_3\text{Sm}$ - $\text{Fe}_3\text{Sm}$ , and  $\text{Co}_2\text{Sm}$ - $\text{Fe}_2\text{Sm}$  form continuous solid solutions.

## Binary Systems

In the Co-Fe system, the face-centered cubic (fcc) Fe forms a continuous solid solution  $\gamma$  with  $\alpha\text{Co}$  over a wide range of temperature. The  $\gamma$  phase transforms congruently to the body-centered cubic (bcc) solid solution  $\alpha$  at 985 °C and 45 at.% Co. The Co-Ho phase diagram up to 33.3 at.% Ho depicts the following compounds:  $\text{Co}_{17}\text{Ho}_2$  ( $\text{Th}_2\text{Zn}_{17}$ -type rhombohedral),  $\text{Co}_5\text{Ho}$  ( $\text{CaCu}_5$ -type hexagonal),  $\text{Co}_7\text{Ho}_2$  ( $\text{Co}_7\text{Er}_2$ -type rhombohedral),  $\text{Co}_3\text{Ho}$  ( $\text{Ni}_3\text{Pu}$ -type rhombohedral) and  $\text{Co}_2\text{Ho}$  ( $\text{MgCu}_2$ -type cubic). The Co-Sm diagram up to 33.3 at.% Sm depicts the following compounds:  $\text{Co}_{17}\text{Sm}_2$  ( $\text{Th}_2\text{Zn}_{17}$ -type rhombohedral),  $\text{Co}_5\text{Sm}$  ( $\text{CaCu}_5$ -type hexagonal),  $\text{Co}_{19}\text{Sm}_5$ ,  $\text{Co}_7\text{Sm}_2$  ( $\text{Co}_7\text{Er}_2$ -type rhombohedral),  $\text{Co}_3\text{Sm}$  ( $\text{Ni}_3\text{Pu}$ -type rhombohedral), and  $\text{Co}_2\text{Sm}$  ( $\text{MgCu}_2$ -type cubic). The Fe-Ho phase diagram depicts four intermediate compounds:  $\text{Fe}_{17}\text{Ho}_2$  ( $\text{Th}_2\text{Ni}_{17}$ -type hexagonal),  $\text{Fe}_{23}\text{Ho}_6$  ( $\text{Mn}_{23}\text{Th}_6$ -type cubic),  $\text{Fe}_3\text{Ho}$  ( $\text{Ni}_3\text{Pu}$ -type rhombohedral), and  $\text{Fe}_2\text{Ho}$  ( $\text{MgCu}_2$ -type cubic). The Fe-Sm phase diagram depicts the following phases:  $\text{Fe}_{17}\text{Sm}_2$  ( $\text{Th}_2\text{Zn}_{17}$ -type rhombohedral and  $\text{Th}_2\text{Ni}_{17}$ -type hexagonal),  $\text{Fe}_3\text{Sm}$  ( $\text{Ni}_3\text{Pu}$ -type rhombohedral) and  $\text{Fe}_2\text{Sm}$  ( $\text{MgCu}_2$ -type cubic).

## Ternary Systems

In the Co-Fe-Ho system,  $\text{Co}_2\text{Ho}$  and  $\text{Fe}_2\text{Ho}$  form a continuous  $\text{MgCu}_2$ -type cubic solid solution. In the

## Quaternary Isothermal Section

With starting metals of 99.99% Co, 99.8% Fe, 99.8% Ho, and 99.8% Sm, [2004Liu] prepared by arc-melting 5 g alloy samples, which were annealed at 800 °C. The phase equilibria were studied by x-ray powder diffraction. The isothermal section constructed by [2004Liu] at 800 °C and at a constant Ho/Sm atom ratio of 1 is redrawn in Fig. 1.  $R = (\text{Ho} + \text{Sm})$  in Fig. 1. According to the (Ho,Sm):(Fe,Co) ratio, the quaternary phases are denoted as 1:2 ( $\text{MgCu}_2$ -type), 1:3 ( $\text{Ni}_3\text{Pu}$ -type), 1:5 ( $\text{CaCu}_5$ -type), 2:17(r) ( $\text{Th}_2\text{Zn}_{17}$ -type), 2:17(h) ( $\text{Th}_2\text{Ni}_{17}$ -type), 2:7 ( $\text{Co}_7\text{Er}_2$ -type), and 6:23 ( $\text{Mn}_{23}\text{Th}_6$ -type). The 1:2 and 1:3 phases form continuous solid solutions.  $\text{Fe}_{23}\text{R}_6$  and  $\text{Fe}_{17}\text{R}_2$  dissolve Co to the extent of  $(\text{Fe}_{0.9}\text{Co}_{0.1})_{23}\text{R}_6$  and  $(\text{Fe}_{0.8}\text{Co}_{0.2})_{17}\text{R}_2$ , respectively.  $\text{Co}_7\text{R}_2$ ,  $\text{Co}_5\text{R}$  and  $\text{Co}_{17}\text{R}_2$  dissolve Fe up to  $(\text{Co}_{0.77}\text{Fe}_{0.23})_7\text{R}_2$ ,  $(\text{Co}_{0.95}\text{Fe}_{0.05})_5\text{R}$ , and  $(\text{Co}_{0.3}\text{Fe}_{0.7})_{17}\text{R}_2$  respectively. The phase corresponding to 5:19 was not found by [2004Liu].

## Reference

2004Liu: W. Liu, D. Sun, and G. Jin, A Study of the Isothermal Phase Change of (Fe-Co-(Sm<sub>0.5</sub>Ho<sub>0.5</sub>)) Series Alloys, *J. Shenyang Inst. Technol.*, 2004, **23**(1), p 60-62, in Chinese

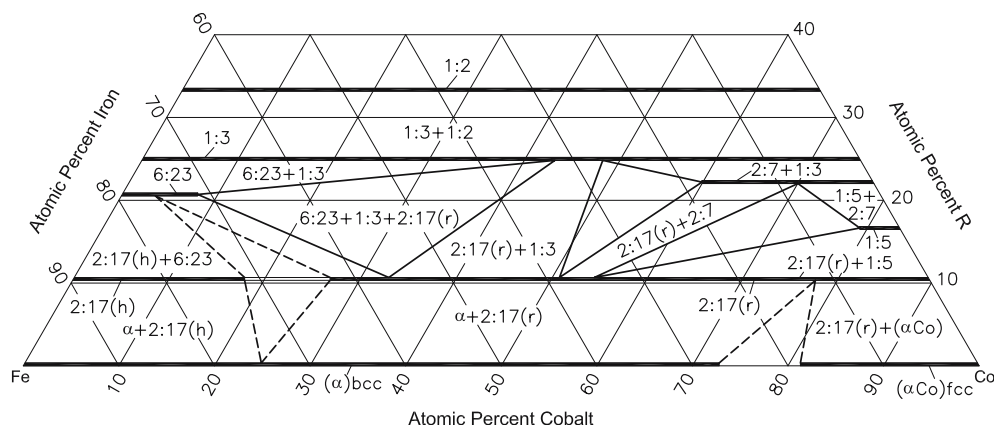


Fig. 1 Co-Fe-Ho-Sm isothermal section at 800 °C and at Ho/Sm = 1 [2004Liu]