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Co-Fe-Gd (Cobalt-Iron-Gadolinium)

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The review of this ternary system by [1992Rag] presented an isothermal section at 1050 °C from the studies of [1990Ati]. An update by [2001Rag] reviewed the results of [1995Liu], [1995She], and [1998Su] and presented three isothermal sections at 1200, 900, and 427 °C from the computed equilibria of [1998Su]. Recently, [2009Hua] investigated the system and presented an isothermal section at 600 °C.

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 γ → α (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 *B*2 structure via a second-order transition. The Co-Gd phase diagram [1995Liu] depicts the following intermediate phases: $Co_{17}Gd_2$ ($Ni_{17}Th_2$-type hexagonal or Th_2Zn_{17}-type rhombohedral), Co_5Gd ($D2_d$, $CaCu_5$-type hexagonal), Co_7Gd_2 (Co_7Er_2-type rhombohedral), Co_3Gd (Be_3Nb-type rhombohedral), Co_2Gd ($C15$, $MgCu_2$-type cubic), Co_3Gd_4 (Co_3Ho_4-type hexagonal), Co_7Gd_{12} (Co_7Ho_{12}-type monoclinic), and $CoGd_3$ ($D0_{11}$, Fe_3C-type orthorhombic). The Fe-Gd phase diagram [Massalski2] depicts the following intermediate compounds: $\beta Fe_{17}Gd_2$ ($Ni_{17}Th_2$-type hexagonal), $\alpha Fe_{17}Gd_2$ (Th_2Zn_{17}-type rhombohedral), $Fe_{23}Gd_6$ ($D8_a$, $Mn_{23}Th_6$-type cubic), Fe_3Gd (Be_3Nb-type rhombohedral), and Fe_2Gd ($C15$, $MgCu_2$-type cubic).

Ternary Isothermal Section

With starting metals of at least 99.9% purity, [2009Hua] arc-melted about 25 alloys under Ar atm. The alloys were given a final anneal at 600 °C for 10 d and quenched in liquid nitrogen. The phase equilibria were studied with metallography, x-ray powder diffraction, electron probe microanalysis, and differential thermal analysis. The isothermal section at 600 °C constructed by [2009Hua] is

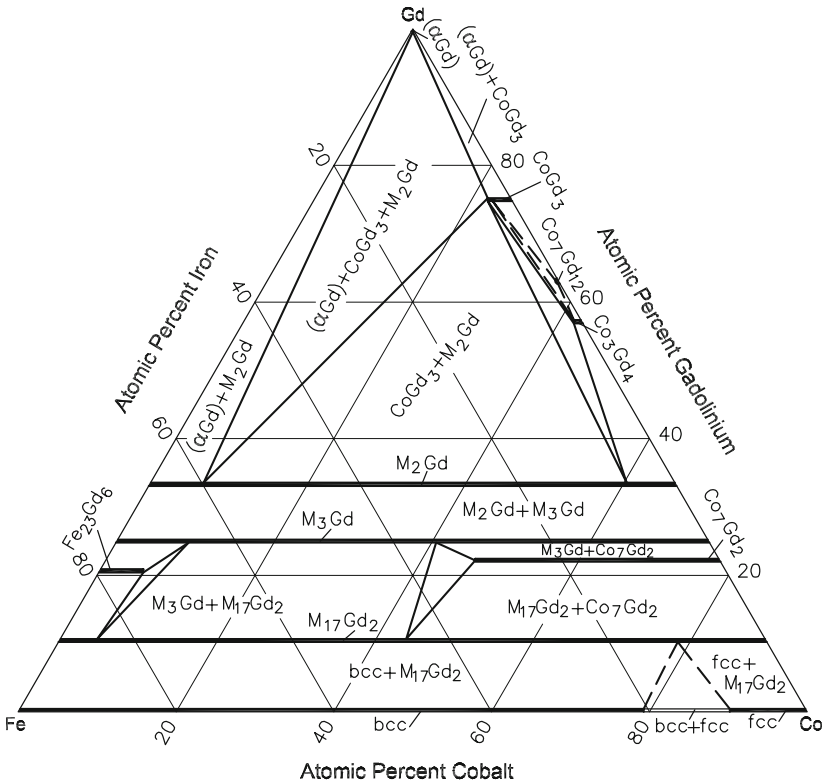

Fig. 1 Co-Fe-Gd isothermal section at 600 °C [2009Hua]

shown in Fig. 1. The binary compound Co_5Gd was not found at 600 °C. The isostructural pairs $Fe_{17}Gd_2$-$Co_{17}Gd_2$ (Th_2Zn_{17}-type), Fe_3Gd-Co_3Gd, and Fe_2Gd-Co_2Gd form continuous solid solutions. These solutions are denoted $M_{17}Gd_2$, M_3Gd and M_2Gd, respectively, in Fig. 1. The Co-Gd compounds Co_7Gd_2, Co_3Gd_4, and $CoGd_3$ dissolve up to 31, 1 and 3 at.% Fe, respectively. $Fe_{23}Gd_6$ dissolves up to 7 at.% Co. No ternary compounds were found.

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