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

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[1990Ati] determined an isothermal section for this system at 1050 °C (reviewed by [1992Rag]). Recently, [1998Su] employed the tie-line compositions determined by the diffusion-couple technique by [1995She] to optimize the thermodynamic interaction parametes. They computed six isothermal sections that agree reasonably well with the limited experimental results available.

Binary Systems

The Co-Fe phase diagram was reviewed by [1993Nis]. The fcc phase γ forms through a peritectic reaction at 1499 °C between bcc δ and liquid. The Co and Fe form a continuous fcc solid solution (γ) over a wide range of temperature, which transforms to bcc (α) below 985 °C. An order-disorder transformation occurs in the equiatomic α phase at 730 °C and the CsCl-type ordered phase exists over a wide composition range below this temperature. The Co-Gd phase diagram was calculated by [1995Liu]. There are seven intermetallic phases in this system: $Co_{17}Gd_2$, Co_5Gd, Co_7Gd_2, Co_3Gd, Co_2Gd, Co_3Gd_4, and $CoGd_3$. With the exception of $Co_{17}Gd_2$, they form through peritectic reactions. The final solidification is through a eutectic reaction at 645 °C and 63.2 at.% Gd. The Fe-Gd phase diagram was reassessed by [1998Zha]. There are four line compounds in this system: $Fe_{17}Gd_2$, $Fe_{23}Gd_6$, Fe_3Gd, and Fe_2Gd. All of them form through peritectic reactions. The final solidification is through a eutectic reaction at 832 °C and 73.6 at.% Gd.

Ternary Isothermal Sections

The isothermal section at 1050 °C determined by [1990Ati] (reviewed in [1992Rag]) shows that the pairs $Fe_{17}Gd_2$-$Co_{17}Gd_2$, Fe_3Gd-Co_3Gd, and Fe_2Gd-Co_2Gd form continuous solid solutions. These solutions are denoted here by $M_{17}Gd_2$, M_3Gd, and M_2Gd, respectively. [1995Liu] evaluated the thermodynamic properties of this ternary system, using the experimental results of [1990Ati].

[1995She] studied the phase equilibria in this system by the diffusion-couple technique and presented five isothermal sections at 1200, 1050, 1000, 950, and 900 °C. Tie-line compositions were determined for the pairs γ-$M_{17}Gd_2$, $M_{17}Gd_2$-M_3Gd, M_3Gd-M_2Gd, $M_{17}Gd_2$-Co_5Gd, Co_5Gd-Co_7Gd_2, and Co_7Gd_2-M_3Gd. Using the experimental data of both [1990Ati] and [1995She], [1998Su] optimized the thermodynamic properties of the ternary system and recalculated the ternary equilibria at 1200, 1050, 1000, 950, 900, and 427 °C. The calculated and experimental tie-line compositions agree reasonably well. The computed isothermal sections at 1200, 900, and 427 °C are redrawn in Fig. 1, 2, and 3. The liquid phase region shrinks from Fig. 1 to Fig. 2 and is not

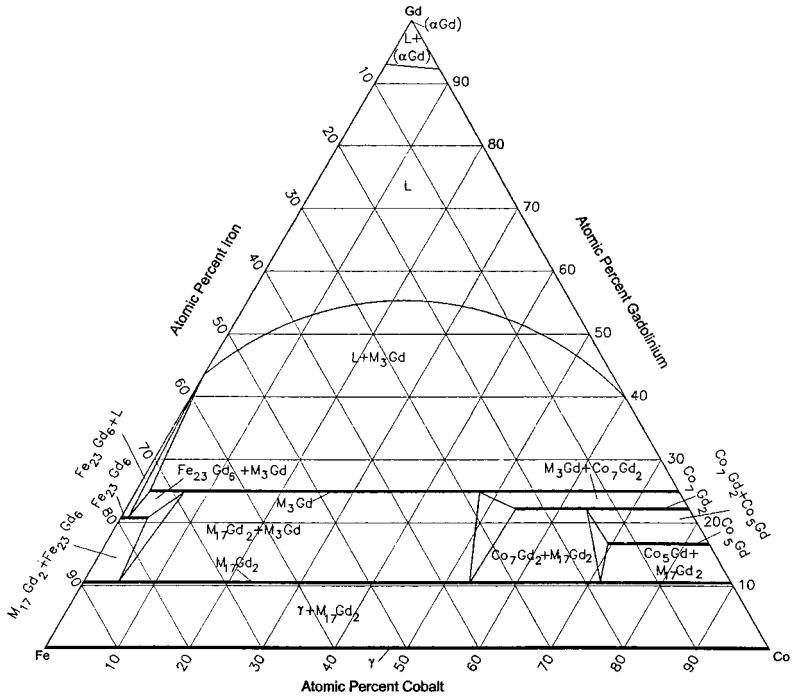

Fig. 1 Co-Fe-Gd computed isothermal section at 1200 °C [1998Su]

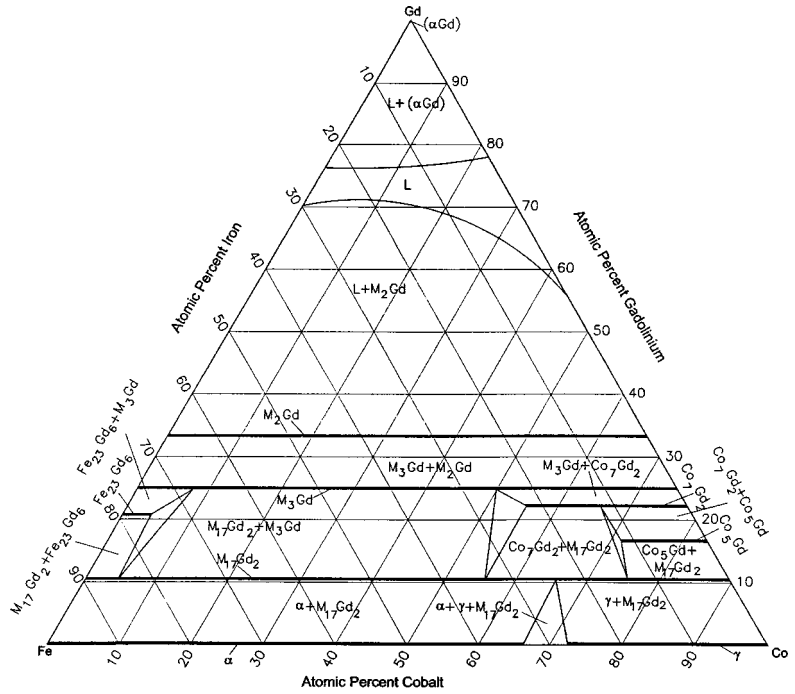

Fig. 2 Co-Fe-Gd computed isothermal section at 900 °C [1998Su]

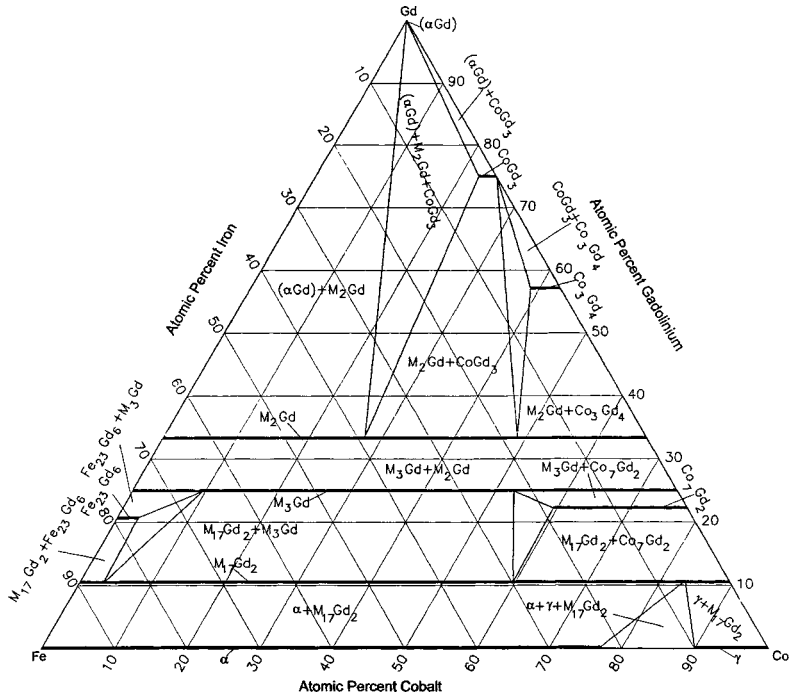

Fig. 3 Co-Fe-Gd computed isothermal section at 427 °C [1998Su]

present at 427 °C. Both Co_5Gd and Co_7Gd_2 are stable at 1200 and 900 °C. The α phase is present at 900 °C. At 427 °C (Fig. 3), Co_5Gd is not stable; at high Gd contents, Co_3Gd_4 and $CoGd_3$ are present. The ordering reaction in the α phase is neglected in Fig. 3.

A schematic liquidus surface deduced from the isothermal sections and the binary invariant reactions is shown in Fig. 4. The phases of primary crystallization are marked in the appropriate regions.

References

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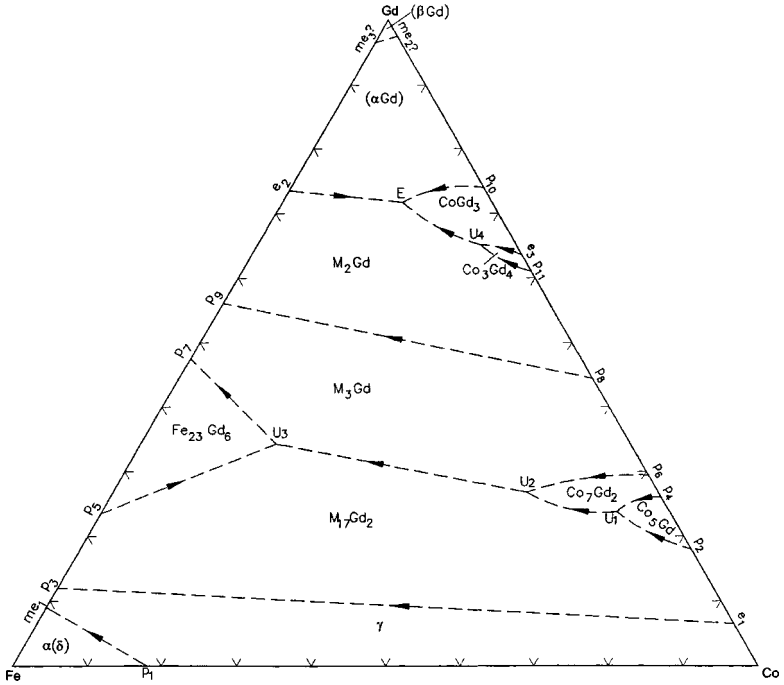

Fig. 4 Co-Fe-Gd schematic liquidus projection

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