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Fe-Gd-Sn (Iron-Gadolinium-Tin)

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Recently, [2004Mud] determined a composite isothermal section for this system at 597 °C for <55 at.% Sn and at 397 °C for >55 at.% Sn.

Binary Systems

The Fe-Gd phase diagram [1998Zha] depicts the following line compounds, $\beta Fe_{17}Gd_2$ ($Ni_{17}Th_2$-type hexagonal), $\alpha Fe_{17}Gd_2$ ($Zn_{17}Th_2$-type rhombohedral), $Fe_{23}Gd_6$ ($D8_a$, $Mn_{23}Th_6$-type cubic), Fe_3Gd (Ni_3Pu-type rhombohedral) and Fe_2Gd ($C15$, $MgCu_2$-type cubic). In the Fe-Sn system, the intermediate phases are: Fe_5Sn_3 ($B8_2$, Ni_2In-type hexagonal), Fe_3Sn_2 (rhombohedral), FeSn ($B35$, CoSn-type hexagonal) and $FeSn_2$ ($C16$, $CuAl_2$-type tetragonal). The Gd-Sn system [1995Oka] has a number of intermediate compounds of fixed stoichiometry: Gd_3Sn, Gd_5Sn_3, Gd_5Sn_4, Gd_8Sn_7, $Gd_{11}Sn_{10}$, Gd_3Sn_4, $GdSn_2$, Gd_3Sn_7 and $GdSn_3$. See [1995Oka] for a listing of the known structural details.

Ternary Phases

Two ternary phases are known in this system. $GdFe_xSn_2$ ($x \sim 0.14-0.17$) is $ZrSi_2$-type orthorhombic phase based on the binary compound $GdSn_2$. The increase in the cell volume with increase in the Fe content indicates that $GdFe_xSn_2$ is an insertion-type solid solution. The lattice parameters of $GdFe_{0.14}Sn_2$ are: $a = 0.44444$ nm, $b = 1.6445$ nm and $c = 0.43672$ nm [2004Mud]. The other ternary phase $GdFe_6Sn_6$ is a true ternary compound. It has hexagonal lattice parameters $a = 0.5369$ nm and $c = 0.4463$ nm with YCo_6Ge_6 as the prototype. In the $TbFe_6Sn_6$-type orthorhombic setting, it has parameters $a = 0.8927$ nm, $b = 1.870$ nm and $c = 0.5357$ nm [2004Mud].

Isothermal Section

With starting metals of 99.9 wt.% Fe, 99.8 wt.% Gd, and 99.99 wt.% Sn, [2004Mud] arc-melted alloy samples under

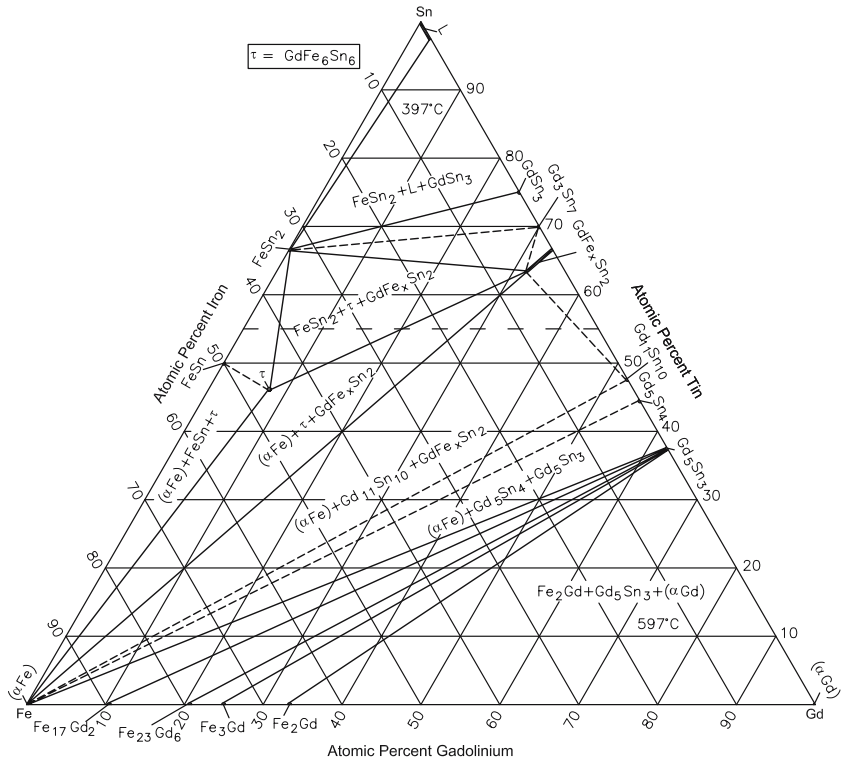

Fig. 1 Fe-Gd-Sn composite isothermal section at 597 and 397 °C [2004Mud]

Ar atm. The samples were annealed for 1 month at 597 °C for Sn <55 at.% and at 397 °C for Sn >55 at.%. The phase equilibria were studied mainly with x-ray diffraction. The composite isothermal section constructed by [2004Mud] is shown in Fig. 1. The binary Gd-Sn compounds Gd_3Sn, Gd_8Sn_7 and Gd_3Sn_4 were not found by [2004Mud].

References

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