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Fe-Sn-Y (Iron-Tin-Yttrium)

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Recently, [2004Mud] determined a composite isothermal section for this system at 597 °C for Sn < 30 at.%, at 497 °C for Sn = 30-50 at.%, and at 397 °C for Sn > 50 at.%.

Binary Systems

In 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 Fe-Y phase diagram [1993Zha] depicts the following intermediate phases: $\beta Fe_{17}Y_2$ ($Zn_{17}Th_2$-type rhombohedral), $\alpha Fe_{17}Y_2$ ($Ni_{17}Th_2$-type hexagonal), $Fe_{23}Y_6$ ($D8_a$, $Mn_{23}Th_6$-type cubic), Fe_3Y(Ni_3Pu-type rhombohedral), and Fe_2Y ($C15$, $MgCu_2$-type cubic). The Sn-Y phase diagram [1995Oka] has a number of intermediate phases: Sn_3Y ($L1_2$, $AuCu_3$-type cubic), Sn_5Y_2 (orthorhombic), Sn_2Y ($C49$, $ZrSi_2$-type orthorhombic), $Sn_{10}Y_{11}$ (tetragonal), Sn_4Y_5 (orthorhombic), and Sn_3Y_5 ($D8_8$, Mn_5Si_3-type hexagonal).

Ternary Compounds

Two ternary phases are known in this system. YFe_xSn_2 ($x \sim 0.22$) is $ZrSi_2$-type orthorhombic phase based on the binary compound Sn_2Y. The increase in the cell volume with increase in the Fe content indicates that YFe_xSn_2 is an insertion-type solid solution. The lattice parameters of $YFe_{0.22}Sn_2$ are: a = 0.44158 nm, b = 1.63533 nm and c = 0.43377 nm [2004Mud]. The other ternary phase YFe_6Sn_6 is a true ternary compound. It has hexagonal lattice parameters a = 0.5385 nm and c = 0.4452 nm with YCo_6Ge_6 as the prototype. In the orthorhombic setting, it has the parameters a = 0.8904 nm, b = 7.438 nm and c = 0.5403 nm [2004Mud].

Isothermal Section

With starting metals of 99.9 wt.% Fe, 99.99 wt.% Sn and 99.8% Y, [2004Mud] arc-melted alloy samples under an Ar atmosphere. The samples were annealed for 1 month at

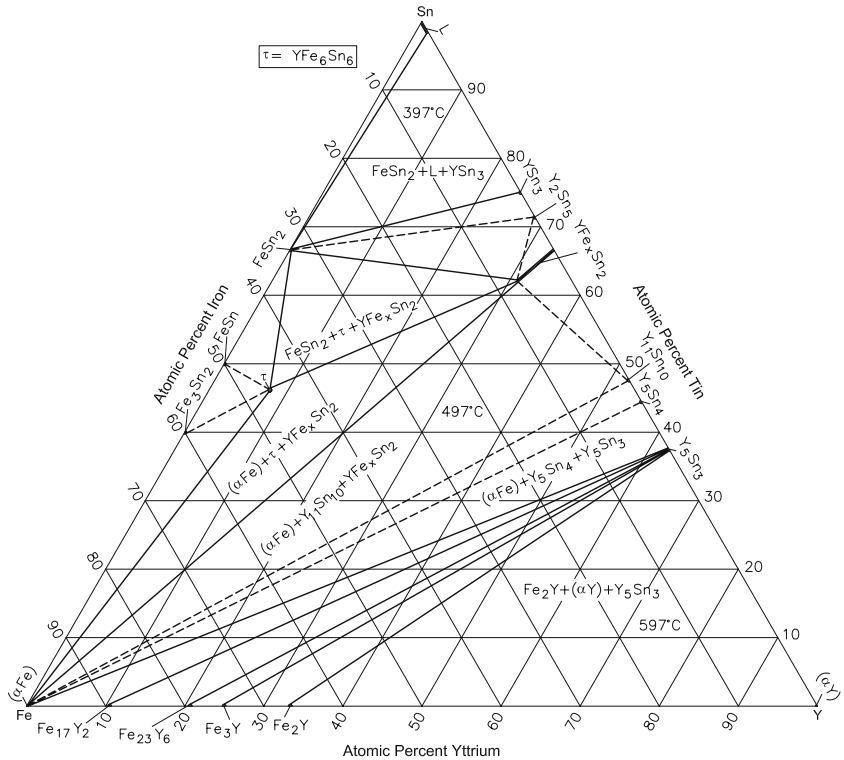

Fig. 1 Fe-Sn-Y composite isothermal section at 597, 497, and 397 °C [2004Mud]

597 °C for Sn < 30 at.%, at 497 °C for Sn = 30-50 at.%, and at 397 °C for Sn > 50 at.%. Due to the low melting point of Sn, the alloys with a higher Sn content were annealed at lower temperatures. The phase equilibria were studied mainly with x-ray diffraction. The composite isothermal section constructed by [2004Mud] is shown in Fig. 1.

References

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