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Fe-Sn-W (Iron-Tin-Tungsten)

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Recently, [2009Sko] reported a tentative isothermal section for this ternary system at 1200 °C.

Binary Systems

The Fe-Sn phase diagram [1993Oka] depicts a liquid miscibility gap that closes at 1495 °C, followed by a monotectic reaction at 1130 °C. The established 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-W system [Massalski2] has the following intermediate phases: Fe_2W ($C14$, $MgZn_2$-type hexagonal), Fe_7W_6 ($D8_5$-type rhombohedral) and FeW (MoNi-type orthorhombic). No phase diagram is known for the Sn-W system [Massalski2]. There are no intermediate phases and the mutual solubility between Sn and W is very small.

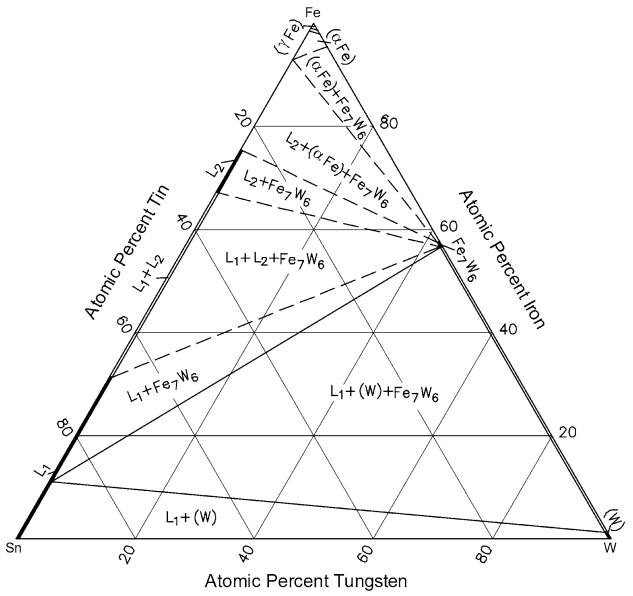

Fig. 1 Fe-Sn-W tentative isothermal section at 1200 °C [2009Sko]

Ternary Isothermal Section

With starting metals of 99.99% Fe, 99.999% Sn and 99.95% W, [2009Sko] inserted W rods in the Fe-Sn melts of pre-determined composition at 1200 °C, till W saturation in the melt occurred. The solubility of W was found to be a function of the Fe content in the melt. The atomic fraction of W (X_w) was expressed by the following equation: $\log X_w = -4.544 + 14.293\, X_{Fe} - 23.583\, X_{Fe}^2$. The Fe fraction X_{Fe} in the melt corresponding to the formation of Fe_7W_6 is equal to 0.111 and the corresponding W solubility X_w is 0.00056. This composition of the melt is in three-phase equilibrium with (W) and Fe_7W_6. A tentative isothermal section at 1200 °C constructed by [2009Sko] is shown in Fig. 1.

[2009Sko] also studied the growth kinetics of the Fe_7W_6 layer and carried out similar experiments with Cu-Fe melts.

References

1993Oka: H. Okamoto, Fe-Sn (Iron-Tin), *Phase Diagrams of Binary Iron Alloys*, H. Okamoto, Ed., ASM International, Materials Park, OH, p 385-392

2009Sko: V.V. Skorokhod, V.P. Titov, and M.M. Churakov, Interaction of Tungsten with Iron-Copper and Iron-Tin Melts, *Poroshk. Metall.*, 2009, **48**(1-2), p 3-11, in Russian; TR: *Powder Metall. Met. Ceram.*, 2009, **48**(1-2), p 1-7