(214) 541.123: 669.6: 669.775: 669.782: 669.3: 669.12-154.4

The Physicochemical Interactions among Sn, Si and S during the Vacuum Melting of Iron Alloys.

The University of Tokyo R. Morales
N. Sano

1. Introduction

The physicochemical interactions among Si, Sn and S during the vacuum melting of iron alloys have been studied and the principal results are reported here.

2. Experimental Method

The experimental method consisted in melting and alloying electrolytic iron with Sn, Cu and S using a 3 Kg (Fe) capacity vacuum induction furnace. Initially experiments were carried out with the binary systems Fe-S and Fe-Sn. Subsequently, the ternary system Fe-Sn-S and the quaternary system Fe-Sn-Si-S were also studied. The temperature was measured with a thermocouple immersed into the metallic bath and the sampling was carried out without breaking the vacuum, using a device installed in the vacuum induction facility.

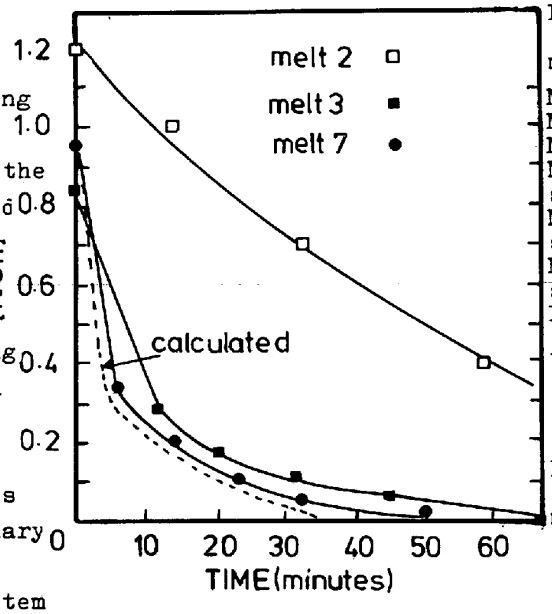
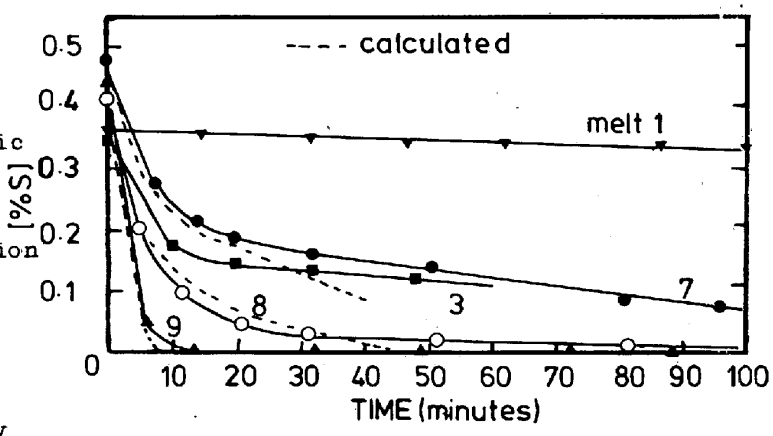


Fig. 1. Vaporization of Sn from Fe-Si-S-Sn molten alloys.

Melt1:Fe-S system
Melt2:Fe-Sn system
Melt3:Fe-S-Sn system
Melt7:Fe-1.30%Si-S-Sn system
Melt8:Fe-2.87%Si-S-Sn system
Melt9:Fe-6.10%Si-S-Sn system
Experimental temperature: 1630 °C
Vacuum: 1.5×10^{-4} - 7.0×10^{-4} mm of Hg.

Fig. 2. Vaporization of S from Fe-Si-S-Sn molten alloys.



3. Results and Discussion

Figures 1 and 2 show the behavior of tin and sulfur for the binary Fe-S, the ternary Fe-Sn-S and the quaternary Fe-Si-S-Sn systems. The evaporation of sulfur is considerably fast due to the formation of SiS(g) as reported by Fruehan and Turkdogan[1] and SnS(g) was identified in the present work by using the mass spectrometry technique. The vaporization rate of tin and sulfur was greatly enhanced by the presence of silicon. These results propose a process for the simultaneous elimination of tin and sulfur from molten iron alloys. The high vapor pressure of SnS(g) (see Fig. 1) is responsible for the observed high vaporization rate of tin. The vaporizations of tin and sulfur obeyed well a proposed kinetic model (Figs. 1 and 2) with the assumption that the reaction between silicon and sulfur is a first order one and the reaction between tin and sulfur a second order one. The vaporization of sulfur as SiS(g) and SnS(g) is likely to be rate-controlled by the slow chemical reactions among tin, silicon and sulfur on the surface of the molten metal. Silicon was found to enhance the reaction between sulfur and tin up to 3 w % Si, in agreement with the previous results using the levitation melting technique[2]. With Si more than 3%, SiS formed in preference to SnS.

References

(1) Fruehan and Turkdogan: Met. Trans., 1971, (2), 895.
(2) R. Morales, N. Sano and Y. Matsushita: 97th, ISIJ Conf., S. 151, Nagoya, Japan.