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Bi-Fe-Sb (Bismuth-Iron-Antimony)

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Recently, [2008Boa] determined an isothermal section at 250 °C and two vertical sections at 80 at.% Bi and 30 at.% Sb, respectively, for this ternary system. They also developed a thermodynamic description of the system.

Binary Phases

The Bi-Fe phase diagram depicts no intermediate phases. The mutual solubility between Bi and Fe is very limited. A continuous solid solution forms between the isostructural elements Bi and Sb. In the solid state, a miscibility gap occurs with the critical point at 225 °C and 63.7 at.% Sb [1992Feu]. In the Fe-Sb system, two intermediate phases are known: $FeSb_{1-x}$ ($B8_1$, NiAs-type hexagonal; also denoted FeSb or ε) and $FeSb_2$ (orthorhombic). Using their own experimental results as additional input, [2008Boa] optimized the binary parameters for the Bi-Fe and Fe-Sb systems. The parameters for the Bi-Sb system were adopted from [1992Feu]. Computed phase diagrams for all the three binaries were presented by [2008Boa].

Ternary Phase Equilibria

With starting metals of 99.999% Bi, 99.99% Fe, and 99.999% Sb, [2008Boa] melted in evacuated silica tubes 18 ternary compositions along the isoconcentrate lines of 80 at.% Bi and 30 at.% Sb. The final anneal for the isothermal study was at 250 °C for 6-9 months. To determine the thermal arrests, differential scanning calorimetry or differential thermal analysis was conducted at heating/cooling rate of 0.5-2 °C/min. The composition of the co-existing phases was determined by electron probe microanalysis.

Combining their new experimental results and those of [2006Boa] on the thermodynamic properties with the literature data, [2008Boa] optimized and listed the interaction parameters for this ternary system. Two isothermal sections at 792 and 250 °C and two vertical sections along 80 at.% Bi and 30 at.% Sb were computed. The isothermal section at 792 °C (Fig. 1) shows one three-phase field of (αFe) + $FeSb_{1-x}$ + L. $FeSb_2$ is not stable at this temperature. The section at 250 °C (Fig. 2) is compared with the experimental data obtained by the authors [2008Boa]. Figures 3 and 4 show the details of the vertical sections at 80 at.% Bi and 30 at.% Sb between 267 and 327 °C. Two invariant horizontals corresponding to the transition reactions U_1: L + $FeSb_2$ ↔ (Bi,Sb) + $FeSb_{1-x}$ and U_2: L + $FeSb_{1-x}$ ↔ (Bi,Sb) + (αFe) are seen in Fig. 3 and 4. The experimental points [2008Boa] are shown. In addition, a ternary monotectic reaction M: L_1 ↔ L_2 + (Fe) + $FeSb_{1-x}$ was computed by [2008Boa] at 991 °C.

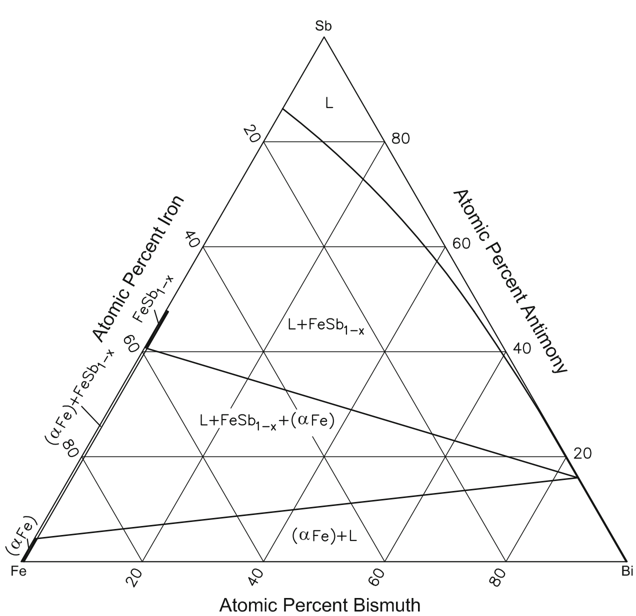

Fig. 1 Bi-Fe-Sb computed isothermal section at 792 °C [2008Boa]

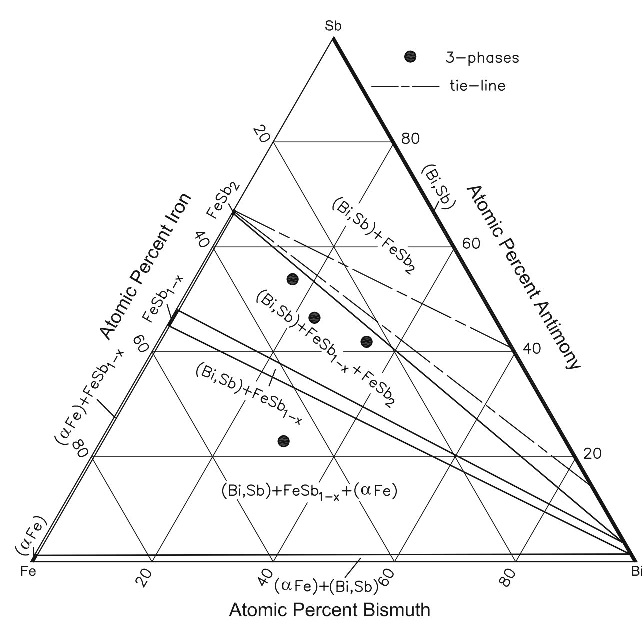

Fig. 2 Bi-Fe-Sb computed isothermal section at 250 °C [2008Boa]

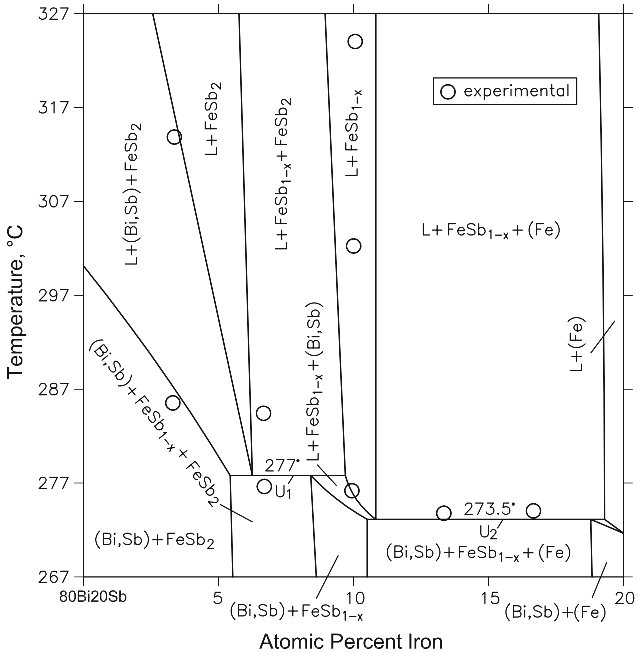

Fig. 3 Bi-Fe-Sb computed vertical section at 80 at.% Bi [2008Boa]

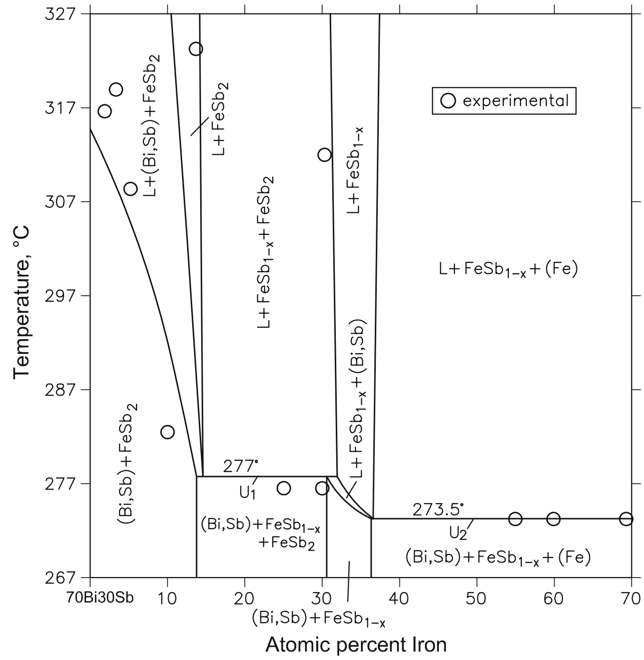

Fig. 4 Bi-Fe-Sb computed vertical section at 30 at.% Sb [2008Boa]

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