Bi-Fe-Pr (Bismuth-Iron-Praseodymium)

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[2000Bod] determined an isothermal section at 400 °C for this system, which depicts a ternary compound of unknown structure.

Binary Systems

There is no mutual solubility between Bi and Fe and there are no intermediate compounds in the Bi-Fe system [1993Oka]. In the Bi-Pr system, there are five line compounds: Bi_2Pr , BiPr , Bi_3Pr_4 , Bi_3Pr_5 , and BiPr_2 . See [Massalski2] for the phase diagram. The Fe-Pr phase diagram was recently reassessed by [1999Zha]. Their assessed diagram depicts only one intermediate compound, $\text{Fe}_{17}\text{Pr}_2$. Both the crystalline forms of Fe_2Pr (C14 and C15) are considered metastable. See [Pearson3] for structural data on the binary compounds.

Ternary Compounds

A ternary compound $\sim\text{Pr}_3\text{FeBi}_2$ (τ_1) of unknown structure was found by [2000Bod] to be stable from the melting temperature down to at least 400 °C. An Fe-rich compound $\text{Pr}_6\text{Fe}_{13}\text{Bi}$ (τ_2) was found only in cast alloys and not after annealing at 400 °C. The τ_2 phase is of the $\text{Nd}_6\text{Fe}_{13}\text{Si}$ type (space group $I4/mcm$) with lattice parameters $a = 0.8117$ and $c = 2.3515$ nm.

Ternary Isothermal Section

With starting metals of purity 99.99% Bi, 99.99% Fe, and 99.98% Pr, [2000Bod] melted 42 alloy samples in an arc furnace under Ar atm. The alloys were annealed at 400 °C for 240 h and quenched in water. The phase equilibria were studied by x-ray powder diffraction and energy-dispersive x-ray analysis measurements. Their isothermal section at 400 °C is redrawn in Fig. 1 to agree with the accepted binary data. The metastable compound Fe₂Pr is omitted. None of the binary compounds show any solubility for the third component. The ternary compound ~Pr₅FeBi₂ (τ_1) is located about 2 at.% Pr higher than indicated by the exact stoichiometry [2000Bod]. (α Fe) forms tie-lines with four of the five Bi-Pr binary compounds.

References

- 1993Oka:** H. Okamoto: *Phase Diagrams of Binary Iron Alloys*, ASM International, Materials Park, OH, 1993, pp. 62-63.
1999Zha: W. Zhang, C. Li, and X. Su: *J. Phase Equilibria*, 1999, vol. 20 (2), pp. 158-62.
2000Bod: O. Bodak, J. Stepien-Damm, and E. Galdecka: *J. Alloys Compounds*, 2000, vol. 298, pp. 195-97.

Fig. 1 Bi-Fe-Pr isothermal section at 400 °C [2000Bod]. The thin two-phase fields around tie-triangles are omitted