# 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, $Fe_{17}Pr_2$. Both the crystalline forms of $Fe_2Pr$ (*C*14 and *C*15) are considered metastable. See [Pearson3] for structural data on the binary compounds.

## Ternary Compounds

A ternary compound $\sim Pr_5FeBi_2$ ($\tau_1$) of unknown structure was found by [2000Bod] to be stable from the melting temperature down to at least 400 °C. An Fe-rich compound $Pr_6Fe_{13}Bi$ ($\tau_2$) was found only in cast alloys and not after annealing at 400 °C. The $\tau_2$ phase is of the $Nd_6Fe_{13}Si$ type (space group *I*4/*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 $Fe_2Pr$ is omitted. None of the binary compounds show any solubility for the third component. The ternary compound $\sim Pr_5FeBi_2$ ($\tau_1$) is located about 2 at.% Pr higher than indicated by the exact stoichiometry [2000Bod]. ($\alpha$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.

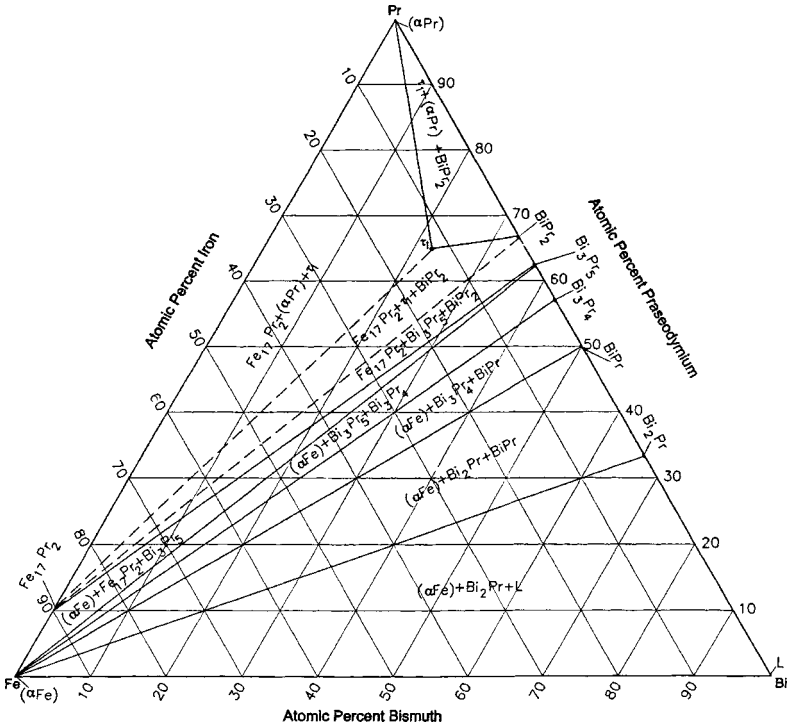


**Fig. 1** Bi-Fe-Pr isothermal section at 400 °C [2000Bod]. The thin two-phase fields around tie-triangles are omitted