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# B-Fe-Ni (Boron-Iron-Nickel)

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## Introduction

The previous review of this system by [1992Rag] presented lattice parameter measurements along the $Fe_2B$-$Ni_2B$ and '$Fe_3B'$-$Ni_3B$ joins, a partial liquidus projection for the B-lean region, and isothermal sections at 925 °C from [1989Loo] and at 800 °C from [1968Kuz]. A thermodynamic description of this system was recently reported by [2005Tok].

## Binary Systems

The Fe-B phase diagram [1993Lia] depicts two intermediate phases: $Fe_2B$ ($C16$, $CuAl_2$-type tetragonal) and FeB ($B27$-type orthorhombic). $Fe_3B$ is a metastable phase with several crystal modifications. In the Ni-B system [Massalski2], there are five intermediate phases: $Ni_3B$ ($D0_{11}$, $Fe_3C$-type orthorhombic), $Ni_2B$ ($C16$, $CuAl_2$-type tetragonal), $Ni_4B_3$ with an orthorhombic and a monoclinic modification, and NiB ($B_f$, CrB-type orthorhombic). In the Fe-Ni system, the face-centered cubic (fcc) Fe and Ni form a continuous solid solution denoted γ.

## Computed Ternary Phase Equilibria

With starting materials of 99% B, 99.998% Fe and 99.9% Ni, [2005Tok] arc-melted five ternary compositions with a constant B content of ~26 at.%. Differential scanning calorimetry (DSC) was performed at a cooling/heating rate of 5 °C per min. The liquidus temperatures were derived from the DSC peaks in the heating experiments. Combining their results with the experimental data from [1968Kuz], [1969Sta], and [1989Loo] (these three references are reviewed in [1992Rag]), [2005Tok] optimized and listed the interaction parameters. The borides $(Fe,Ni)_2B$, FeB, $Ni_3B$ and NiB were described using a two-sublattice model, with Fe and Ni occupying the metal sublattice. The two modifications of $Ni_4B_3$, $Ni_4B_3$(o) and $Ni_4B_3$ (m), were

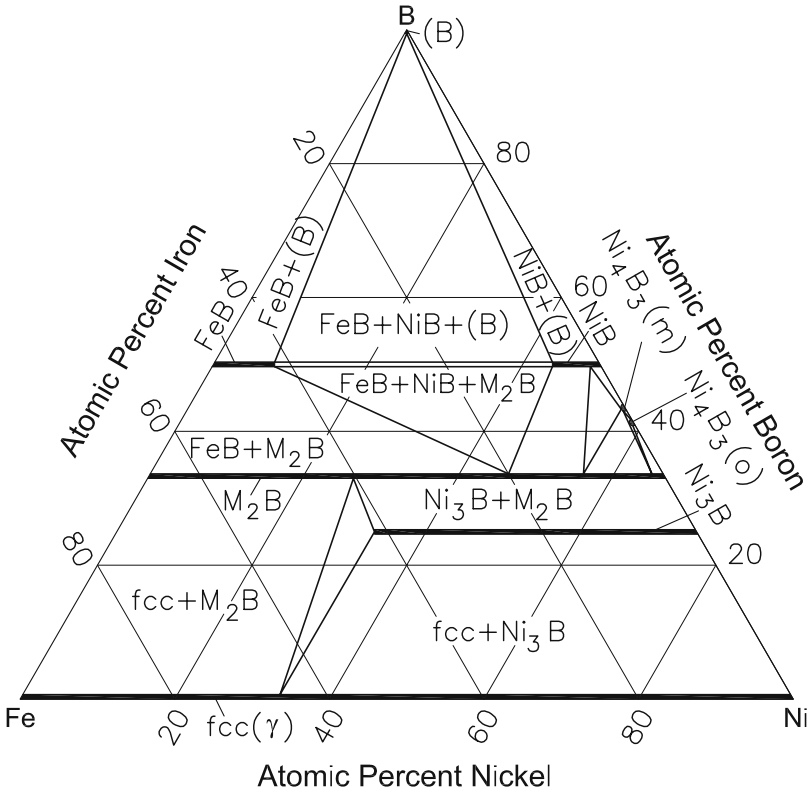


**Fig. 1** B-Fe-Ni computed isothermal section at 925 °C [2005Tok]

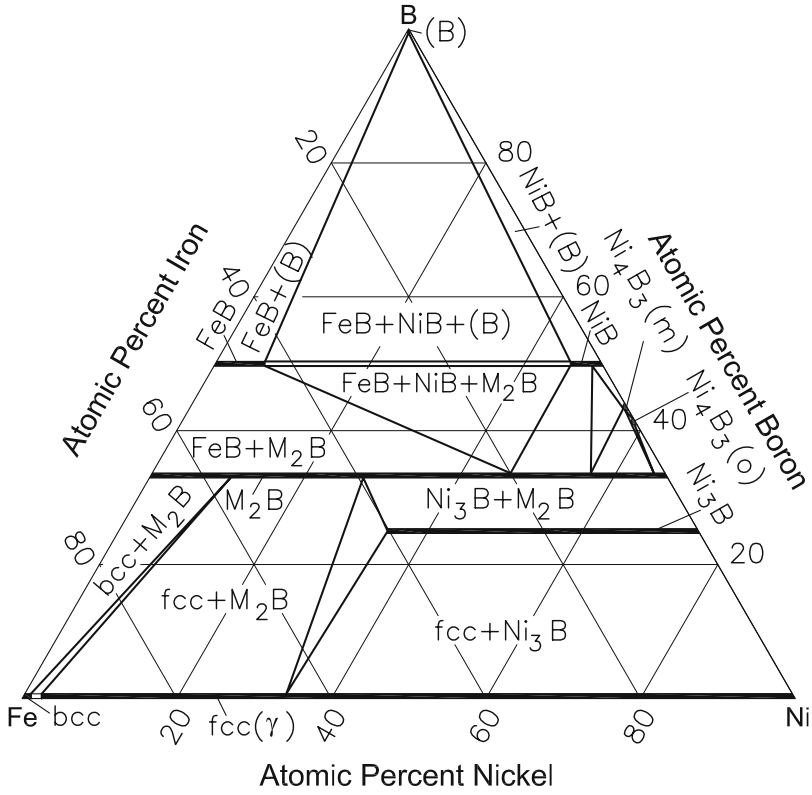


**Fig. 2** B-Fe-Ni computed isothermal section at 800 °C [2005Tok]

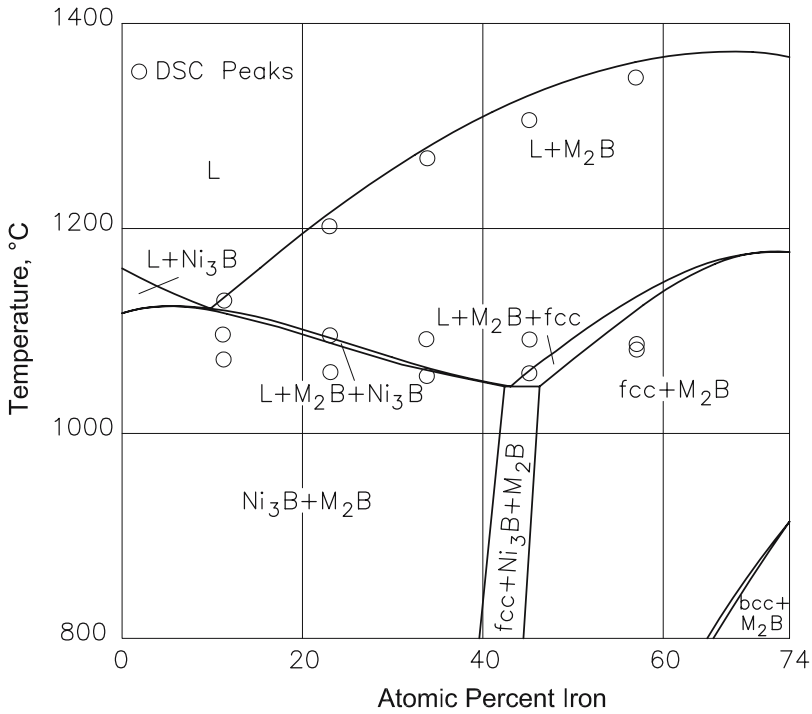


**Fig. 3** B-Fe-Ni computed vertical section at 26 at.% B [2005Tok]

treated as pure compounds without any ternary solubility. The cohesive energies of the stable NiB (CrB type) and metastable NiB (FeB type) were obtained from the Full Potential Linearized Augmented Plane Wave (FLAPW) method. The computed isothermal sections at 925 and 800 °C shown in Fig. 1 and 2 were found to be in satisfactory agreement with the experimental data. The intermediate phase $NiB_6$ shown by [1968Kuz] at 800 °C, known to be a metastable phase, was not included in the computation. The computed vertical section at 26 at.% B is compared with the DSC data in Fig. 3 [2005Tok]. The agreement between computed phase boundaries and the observed DSC peaks is satisfactory.

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