

# As-Fe-Ni (Arsenic-Iron-Nickel)

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A critical evaluation of this system by [1992Rag] presented a liquidus projection, four isothermal sections at 900, 851, 790, and 25 °C and a reaction scheme from the solidification range to room temperature. Recently, [2003Voi] investigated the solid-liquid equilibria at 1150 °C in alloys rich in Fe and Ni.

## Binary Systems

The As-Fe phase diagram [Massalski2] depicts three intermediate compounds.  $\text{Fe}_2\text{As}$  has the  $\text{Cu}_2\text{Sb}$ -type tetragonal structure.  $\text{FeAs}$  has the  $\text{MnP}$ -type orthorhombic structure.  $\text{FeAs}_2$  has the  $\text{FeS}_2$  (marcasite) type orthorhombic structure. The Fe-based face-centered-cubic (fcc) solution  $\gamma$  is enclosed by a loop. The solubility of As in body-centered-cubic (bcc) Fe ( $\alpha$ ) is up to 9 at.%. The As-Ni phase diagram [Massalski2] depicts three intermediate phases:  $\text{Ni}_5\text{As}_2$  (hexagonal),  $\text{Ni}_{11}\text{As}_8$  (tetragonal),  $\text{NiAs}$  ( $B8_1$ , hexagonal), and  $\text{NiAs}_2$  (orthorhombic). The Fe-Ni phase diagram [1991Swa] is characterized by a very narrow solidification range with a peritectic reaction at 1514 °C, between bcc  $\delta$  and liquid that yields the Fe-based fcc solid solution. A continuous solid solution denoted  $\gamma$  between fcc Fe and Ni is stable over a wide range of temperature. At 517 °C, an ordered phase  $\text{FeNi}_3$  forms congruently from  $\gamma$ .

## Ternary Isothermal Section

Using starting metals of purity of 99.9+% purity, [2003Voi] annealed alloy samples in sealed tubes at 1150 °C for 12 h followed by water quenching. The phase equilibria were studied by optical microscopy and electron probe microanalyzer. The isothermal section constructed by [2003Voi] at 1150 °C is redrawn in Fig. 1 to agree with the accepted binary data. Near the Fe-As side, the bcc solid solution  $\alpha$  is in equilibrium with the liquid. The presence of ( $\alpha + \text{L}$ ) field is schematically indicated in Fig. 1. Arsenic activities were also measured by [2003Voi], using an isothermal isopiestic method.

## References

- 1991Swa:** L.J. Swartzendruber, V.P. Itkin, and C.B. Alcock, The Fe-Ni (Iron-Nickel) System, *J. Phase Equilibria*, Vol 12 (No. 3), 1991, p 288-312
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- 2003Voi:** L. Voisin, M. Hino, and K. Itagaki, Phase Relations and Activities in the Fe-Ni-As and Fe-Ni-Sb Systems at 1423 K, *Mater. Trans.*, Vol 44 (No. 12), 2003, p 2654-2658

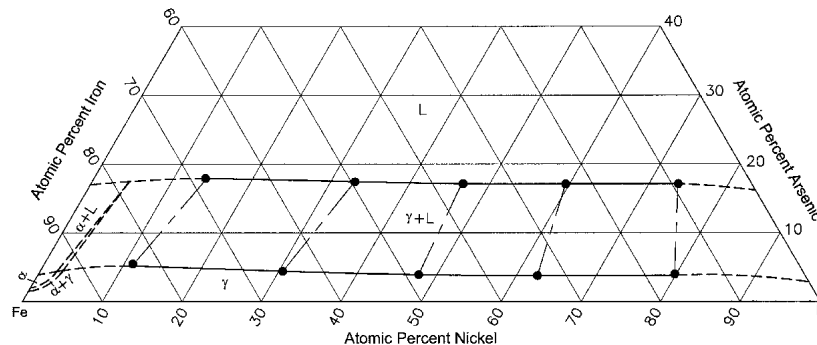


Fig. 1 As-Fe-Ni isothermal section at 1150 °C [2003Voi]