JPEDAV (2009) 30:104
DOI: 10.1007/s11669-008-9455-0
1547-7037 ©ASM International

Fe-Ni-Zr (Iron-Nickel-Zirconium)

V. Raghavan

The previous review of this system by [1992Rag] presented three tentative partial isothermal sections at 900, 820 and 700 °C. A continuous solid solution exists between $FeZr_2$ and $NiZr_2$ down to the temperature limit of stability of $FeZr_2$ (780 °C). Recently, [2007Zho] determined an isothermal section at 925 °C for the entire composition range.

Binary Systems

In the Fe-Ni phase diagram, a continuous face-centered cubic solid solution (denoted γ) forms between γFe and Ni and is stable over a wide range of temperature. At 517 °C, an ordered phase $FeNi_3$ ($L1_2$, $AuCu_3$-type cubic) forms congruently from γ. According to the Fe-Zr phase diagram proposed by [2002Ste], the intermediate phases in the system are: hexagonal Fe_2Zr (26.5-27.0 at.% Zr; *C*36, $MgNi_2$-type hexagonal, stable between 1345 and 1240 °C), cubic Fe_2Zr (27.5-34.4 at.% Zr; *C*15, $MgCu_2$-type cubic, stable from 1673 °C to room temperature), $FeZr_2$ (*C*16, $CuAl_2$-type tetragonal, stable between 951 and 780 °C), and $FeZr_3$ ($E1_a$-type orthorhombic, stable below 851 °C). The authors concluded that $Fe_{23}Zr_6$ (or Fe_3Zr) is not an equilibrium phase. The Ni-Zr phase diagram [Massalski2] depicts the following intermediate phases: Ni_5Zr ($C15_b$, $AuBe_5$-type cubic), Ni_7Zr_2 (monoclinic, space group *C*2/*m*), Ni_3Zr ($D0_{19}$, Ni_3Sn-type hexagonal), $Ni_{21}Zr_8$ (triclinic), $Ni_{10}Zr_7$ (orthorhombic), $Ni_{11}Zr_9$ (tetragonal), NiZr (B_f, CrB-type orthorhombic) and $NiZr_2$ (*C*16, $CuAl_2$-type tetragonal).

Ternary Isothermal Section

With starting metals of 99.99% Fe, 99.95% Ni and 99.9% Zr, [2007Zho] prepared diffusion triples, which were annealed at 925 °C for 1440 h and quenched in water. The phase equilibria were studied with electron probe microanalysis and the measured compositions of the coexisting phases were listed. No structural analysis was done. The tentative isothermal section at 925 °C constructed by [2007Zho] is redrawn in Fig. 1 to agree with the accepted binary data. Ni_3Zr and $Ni_{11}Zr_9$ are not stable at this temperature. [2007Zho] did not find $Ni_{21}Zr_8$ in their experiments. No ternary phases were found. The solubility of Fe in Ni_5Zr, Ni_7Zr_2, $Ni_{10}Zr_7$ and NiZr is about 5.7, 6.0, 3.2 and 1.4 at.% respectively. The solubility of Ni in Fe_2Zr (cubic) is 5.6 at.%.

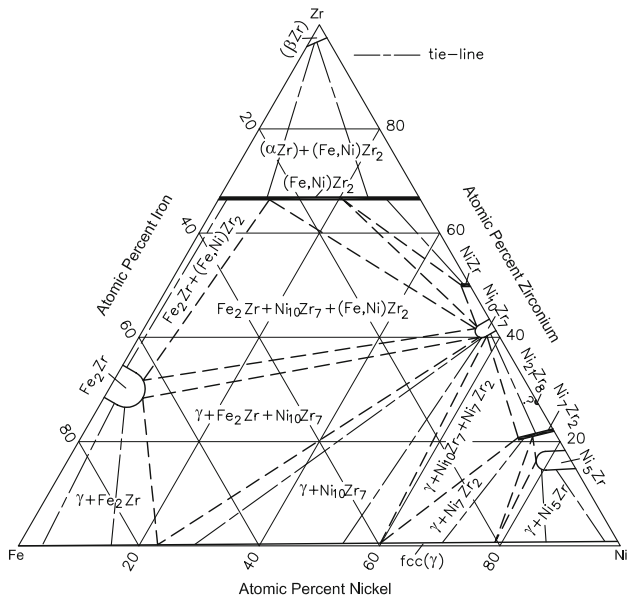

Fig. 1 Fe-Ni-Zr tentative isothermal section at 925 °C [2007Zho]

References

1992Rag: V. Raghavan, The Fe-Ni-Zr (Iron-Nickel-Zirconium) System, *Phase Diagrams of Ternary Iron Alloys, Part 6B*, Indian Institute of Metals, Calcutta, 1992, p 1094-1098

2002Ste: F. Stein, G. Sauthoff, and M. Palm, Experimental Determination of Intermetallic Phases, Phase Equilibria, and Invariant Reaction Temperatures in the Fe-Zr System, *J. Phase Equilb.*, 2002, **23**(6), p 480-494

2007Zho: G.J. Zhou, S. Jin, L.B. Liu, H.S. Liu, and Z.P. Jin, Determination of Isothermal Section of Fe-Ni-Zr Ternary System at 1198 K, *Acta Metall. Sinica (Eng. Lett.)*, 2007, **20**(6), p 398-402