JPEDAV (2007) 28:394
DOI: 10.1007/s11669-007-9107-9
1547-7037 ©ASM International

Fe-Ni-Zn (Iron-Nickel-Zinc)

V. Raghavan

The review of this system by [2003Rag] presented two versions of the isothermal section at 450 °C for Zn-rich alloys from the studies of [1994Per] and [2001Tan], respectively. As compared to [1994Per], [2001Tan] used a long annealing time to achieve near-equilibrium conditions. Recently, [2005Pen] determined an isothermal section at 560 °C for this system.

Binary Systems

In Fe-Ni system [1991Swa], a continuous solid solution denoted γ between face-centered cubic (fcc) Fe and Ni 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. The Fe-Zn phase diagram exhibits a γ loop, extensive solubility of Zn in the body-centered cubic (bcc) Fe (denoted α), and four intermediate phases: Fe_3Zn_{10} (denoted Γ; 68.5-82.5 at.% Zn, Cu_5Zn_8-type cubic), $Fe_{11}Zn_{40}$ (denoted Γ_1; 75-81 at.% Zn, cubic), $FeZn_{10}$ (denoted δ; 86.5-91.8 at.% Zn, hexagonal), and $FeZn_{13}$ (denoted ζ; 92.8-94 at.% Zn, $CoZn_{13}$-type monoclinic). In the Zn-rich region, the Ni-Zn phase diagram depicts $NiZn_9$ with a structure related to $FeZn_{13}$, and Γ which is isostructural with Γ of the Fe-Zn system.

Ternary Isothermal Section

With starting metals of > 99.99% purity, [2005Pen] melted 13 Zn-rich ternary alloys in evacuated quartz tubes. The encapsulated samples were given a final anneal at 560 °C for 21 days, followed by water quenching. The phase equilibria were studied by optical and scanning electron microscopy and x-ray powder diffraction. The composition of the phases was measured by energy dispersive x-ray spectroscopy. The isothermal section constructed by [2005Pen] at 560 °C for Zn-rich alloys is shown in Fig. 1, with an enlarged view of the Zn corner. The isostrutural phases Γ in the Fe-Zn and Ni-Zn systems form a continuous solid solution. The ternary phase is labeled Γ_1' following [2003Rag] (denoted as T by [2005Pen]). There appears to be no fresh evidence to show conclusively that Γ_1' is structurally different from Γ_1. In ternary phase equilibria, it is not uncommon for a binary-based phase to be stable in the ternary region at a temperature where the binary phase itself is not stable.

References

1991Swa: L.J. Swartzendruber, V.P. Itkin, and C.B. Alcock, The Fe-Ni (Iron-Nickel) System, *J. Phase Equilib.*, 1991, **12**(3), p 288-312

1994Per: P. Perrot and G. Reumont, Thermodynamic Description of Dross Formation When Galvanizing Silicon Steels in Zinc-Nickel Baths, *J. Phase Equilib.*, 1994, **15**(5), p 479-482

2001Tan: N.Y. Tang, X.P. Su, and J.M. Toguri, Thermodynamic Description of Dross Formation When Galvanizing Silicon Steels in Zinc-Nickel Baths, *CALPHAD*, 2001, **25**(2), p 267-277

2003Rag: V. Raghavan, Fe-Ni-Zn (Iron-Nickel-Zinc), *J. Phase Equilib.*, 2003, **24**(6), p 558-560

2005Pen: F. Peng, F. Yin, X. Su, L. Zhi, and M. Zhao, 560 °C Isothermal Section of Zn-Fe-Ni System at the Zn-Rich Corner, *J. Alloys Compd.*, 2005, **402**, p 124-129

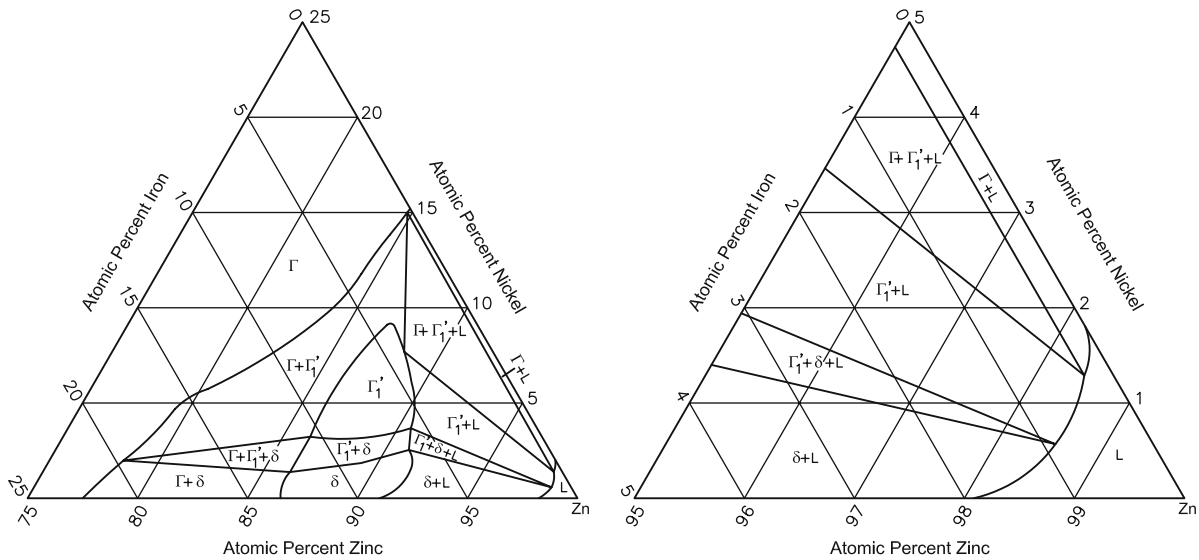

Fig. 1 Fe-Ni-Zn isothermal section at 560 °C with an enlarged view of the Zn corner [2005Pen]