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

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Using the data on the Fe-Ni-Zn and Fe-Ti-Zn ternary systems and a limited number of new experiments on the composition of the dross phase Γ_1, [1997Reu] constructed a perspective view of this quaternary system near the Zn apex at 450 °C.

Binary Systems

The Fe-Zn binary system is briefly reviewed under the Fe-Zn on page 544. For the Fe-Ni and Ni-Zn systems, see the update on the Fe-Ni-Zn system in this issue. In the Fe-Ti system, the two intermediate phases Fe_2Ti and FeTi have limited homogeneity ranges at 450 °C. The partially known Ti-Zn system [Massalski2] has seven intermediate phases: $TiZn_{15}$, $TiZn_{10}$, $TiZn_5$, $TiZn_3$, $TiZn_2$, TiZn, and Ti_2Zn. In the Ni-Ti system [Massalski2], the intermediate phases are Ti_2Ni, TiNi, and $TiNi_3$.

Ternary Systems

An update on the Fe-Ni-Zn system appears in this issue. The isothermal section at 450 °C of the Fe-Ti-Zn system [1997Glo, 2002Rag] shows the presence of a large domain of the Γ_1 phase (denoted Γ_2 by [1997Glo] and [2002Rag]). This is also the case in the Fe-Ni-Zn system (see the update in this issue). The Γ_1 phase forms tie-lines with the Zn rich liquid and all the binary compounds. The review of the Fe-Ni-Ti system by [1990Gup] presented a liquidus projection; a full isothermal section at 900 °C; partial isothermal sections at 1100, 1027, and 700 °C; three vertical sections; and a reaction scheme. No ternary compounds form. The phase relationships in the Ni-Ti-Zn system do not appear to have been investigated.

The Quaternary Phase Equilibria

For times up to a few hours, [1997Reu] galvanized Fe-Ni, Fe-Ti, and Ni-Ti alloys of varying composition in a Zn bath containing 0.1 wt.% each of Ni and Ti. The layers of the coating were studied by x-ray diffraction and microprobe analysis. The Γ_1 dross phase (denoted Γ_2 by [1997Reu]) contained about 4.5 at.% Ti and 8 at.% of (Fe + Ni). The Γ_1 phase originating from the Fe-Zn binary side exists as a continuous solid solution in the quaternary region. It enters into equilibrium with the neighboring binary compounds. A schematic perspective view near the Zn apex of the composition tetrahedron at 450 °C is shown in Fig. 1 [1997Reu]. The compositions of the Zn rich liquid at the marked points are listed in the figure.

References

1990Gup: K.P. Gupta: "The Fe-Ni-Ti (Iron-Nickel-Titanium) System" in *Phase Diagrams of Ternary Nickel Alloys, Part 1,* Ind. Inst. Metals, Calcutta, 1990, pp. 321-43.

1997Glo: T. Gloriant, G. Reumont, and P. Perrot: "The Fe-Zn-Ti System at 450 °C," *Z. Metallkd.,* 1997, *88*(7), pp. 539-44 (in German).

1997Reu: G. Reumont, T. Gloriant, and P. Perrot: "The Zinc Rich Corner of the Fe-Zn-Ni-Ti Quaternary System at 450 °C," *J. Mater. Sci. Lett.,* 1997, *16*, pp. 62-65.

2002Rag: V. Raghavan: "Fe-Ti-Zn (Iron-Titanium-Zinc)," *J. Phase Equilibria,* 2002, *23*(2), pp. 182-83.

Composition, wt. %

	Fe	Ni	Ti
1	0.030	0	0
2	0.030	0.054	0
3	0.030	0	0.025
4	0	0	0.367
5	0.004	0	0.249
6	<0.002	0.54	0
7	0	0.54	0
8	—	not known	—
9	—	not known	—

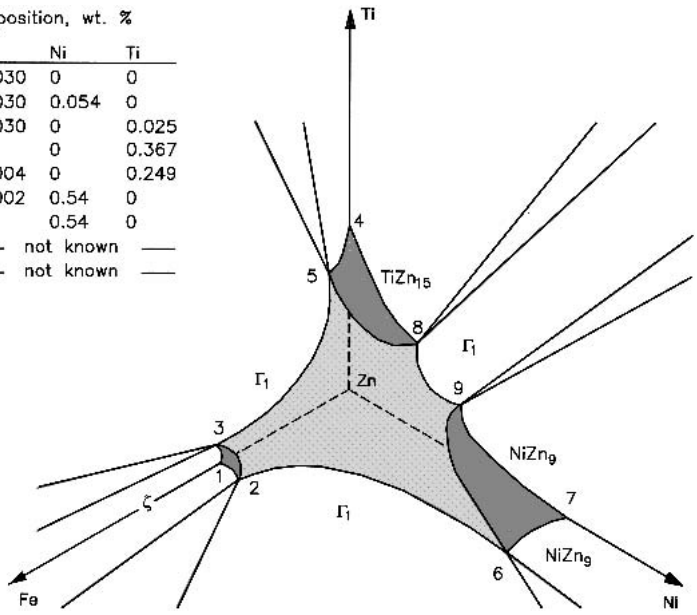

Fig. 1 Fe-Ni-Ti-Zn schematic perspective view of the liquid domain near the Zn apex at 450 °C [1997Reu]