JPEDAV (2004) 25:163
DOI: 10.1361/15477030418622
1547-7037/$19.00 ©ASM International

Al-Er-Fe (Aluminum-Erbium-Iron)

V. Raghavan

Recently, Yanson et al. [2001Yan] studied the phase relationships in this system at 500 °C in a narrow region around 10.5 at.% Er. Here, the structurally related phases of the types Th_2Ni_{17}, Th_2Zn_{17}, and $TbCu_7$ occur close to one another.

Binary Systems

The Al-Fe phase diagram [1993Kat] shows that the face-centered cubic (fcc) solid solution based on Fe is restricted by a γ loop. The body-centered-cubic (bcc) solid solution α exists in the disordered *A*2 form, as well as the ordered *B*2 and $D0_3$ forms and extends up to 50 at.% Al at the temperature of interest here (500 °C). In the Er-Fe system [1993Oka], there are four intermediate phases: Th_2Ni_{17}-type hexagonal phase Er_2Fe_{17} (denoted here 2:17H), Th_6Mn_{23}-type cubic phase Er_6Fe_{23}, $PuNi_3$-type rhombohedral phase $ErFe_3$, and $MgCu_2$-type cubic phase $ErFe_2$.

Ternary Isothermal Section

With starting metals of purity of not less than 99.9%, [2001Yan] melted about 65 alloy compositions in an arc furnace under Ar atm. Three series of compositions were prepared at 9.5, 10.5, and 11.5 at.% Er and at 2.5 at.% Al intervals up to 50 at.% Al. Some samples were also prepared at 5 and 15 at.% Er. The samples were given a final anneal at 500 °C for 720 h and quenched in water. The phase equilibria were studied by x-ray powder diffraction.

At 9.5 at.% Er, the 2:17H phase, the $TbCu_7$ type hexagonal phase 1:7, and the $ThZn_{17}$ type rhombohedral phase 2:17R are stable in the range of 0-27, 30-32, and 35-40 at.% Al respectively. At 10.5 at.% Er, they cover the concentration ranges of 0-25, 27, and 30-37 at.% Al, respectively. At 11.5 at.% Er, only 2:17R is stable in the range 22-35 at.% Al. The influence of the geometrical factors on the structural stability of these phases is discussed by [2001Yan].

Due to the narrow range of the Er content and the extensive line overlap in the x-ray patterns of the closely-related structures, the identification of the two-phase fields or of the presence of other closely-related structure variants such as the rhombohedral $PrFe_7$ type could not be done. A single plot of the subcell parameters of all the three structures indicated a general increase in the *a* and *c* parameters with increasing Al content, except for a decrease in the *c* parameter for the 2:17R phase [2001Yan].

The partial isothermal section at 500 °C constructed by [2001Yan] is redrawn in Fig. 1. The ordered forms of Fe-Al bcc phase α are not shown separately from α. The three phases 2:17H, 1:7, and 2:17R are "in equilibrium with the neighboring solid solutions α, $Er_6(Fe,Al)_{23}$ and $Er(Al,Fe)_2$ and a ternary compound with the $ThMn_{12}$ type structure," [2001Yan]. As seen in Fig. 1, these equilibria are sketched schematically by [2001Yan] without labeling the phase fields. The details are not known.

References

1993Kat: U.R. Kattner and B.P. Burton: "Al-Fe (Aluminum-Iron)" in *Phase Diagrams of Binary Iron Alloys,* H. Okamoto, ed., ASM International, Materials Park, OH, 1993, pp.12-28.

1993Oka: H. Okamoto: "Er-Fe (Erbium-Iron)" in *Phase Diagrams of Binary Iron Alloys,* H. Okamoto, ed., ASM International, Materials Park, OH, 1993, pp. 142-45.

2001Yan: T. Yanson, M. Manyako, O. Bodak, R. Cerny, and K. Yvon: "Effect of Aluminum Substitution and Rare-Earth Content on the Structure of $R_2(Fe_{1-x}Al_x)_{17}$ (R = Tb, Dy, Ho, Er) Phases," *J. Alloys Compd.,* 2001, *320,* pp. 108-13.

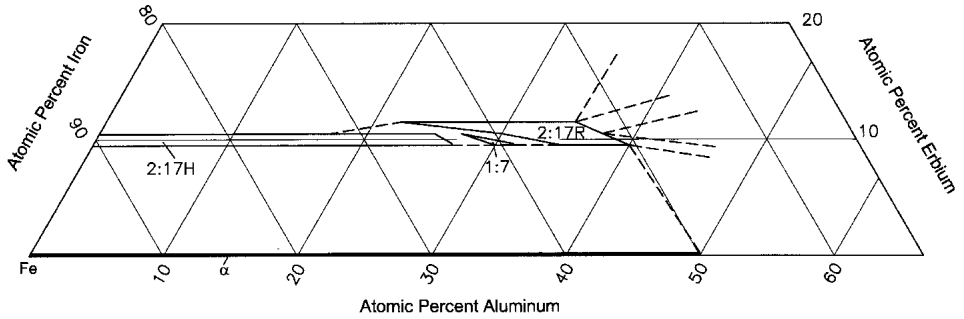

Fig. 1 Al-Er-Fe partial isothermal section at 500 °C [2001Yan]