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Al-B-Er (Aluminum-Boron-Erbium)

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Recently, [2002Cha] determined an isothermal section for this system at 800 °C, which depicts two ternary compounds. Earlier, a partial isothermal section at 1600 ° C was determined by [1994Yu] for B-rich alloys.

Binary Systems

There are two intermediate phases in the Al-B system: AlB_2 (*C*32, AlB_2-type hexagonal) and AlB_{12} (AlB_{12}-type tetragonal). The Al-Er phase diagram [Massalski2, 2002Cha] depicts the following intermediate phases: $ErAl_3$ (*L*1_2, $AuCu_3$-type cubic), $ErAl_2$ (*C*15, $MgCu_2$-type cubic), ErAl (ErAl-type orthorhombic), Er_3Al_2 (Zr_3Al_2-type tetragonal), and Er_2Al (*C*23, Co_2Si-type orthorhombic). The B-Er diagram has the following intermediate phases: ErB_2 (AlB_2-type hexagonal), ErB_4 ($D1_e$, ThB_4-type tetragonal), ErB_{12} ($D2_f$, UB_{12}-type cubic), and ErB_{66} (cubic).

Ternary Phases

Two ternary compounds are known in this system: $ErAlB_4$ [1994Mik, 2002Cha] ($YCrB_4$-type orthorhombic, space group *Pbam*, a = 0.5926 nm, b = 1.1515 nm, and c = 0.3534 nm, denoted τ_1 here) and $ErAlB_{14}$ (τ_2) ($MgAlB_{14}$-type orthorhombic, space group *Imma,* a = 0.5819 nm, b = 1.0401 nm, and c = 0.8189 nm) [2002Cha]. τ_2 is a metal-deficient compound, more accurately represented by the formula $Er_{1-x}Al_{1-y}B_{14}$, with a narrow homogeneity range around $Er_{0.57}Al_{0.62}B_{14}$ [1994Yu].

Ternary Isothermal Section

With starting metals of 99.99% Al, 99.40% B, and 99.84% Er, [2002Cha] arc-melted 46 alloys and annealed them

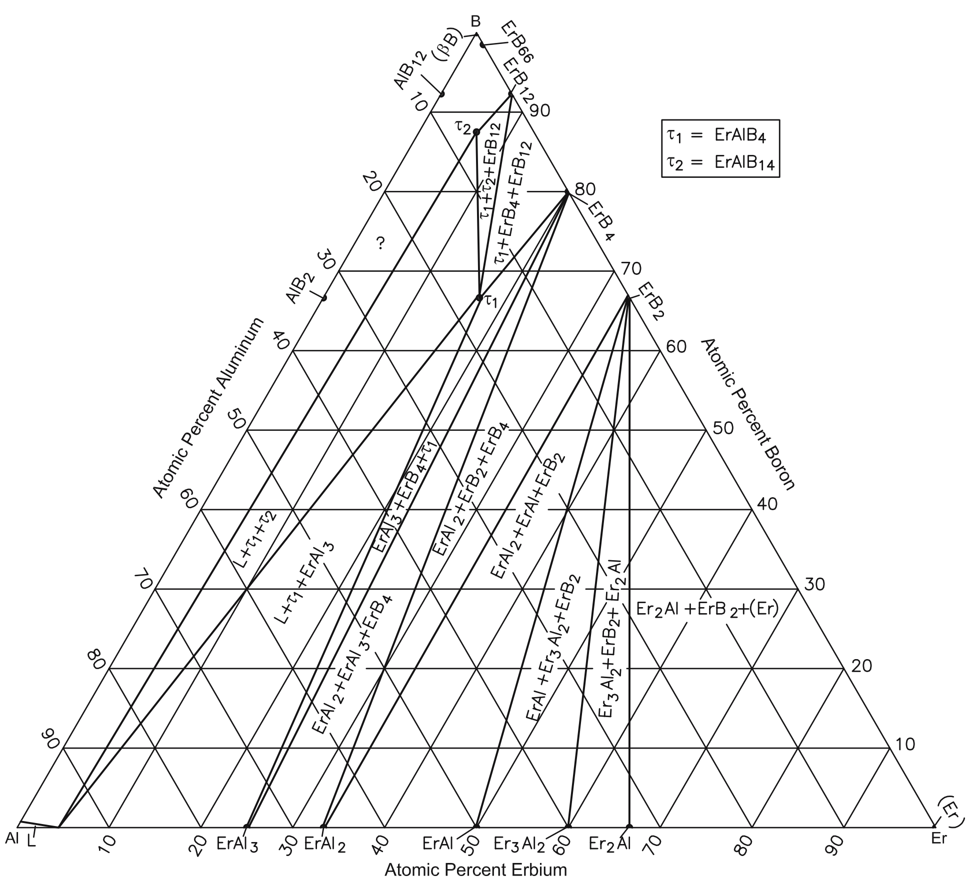

Fig. 1 Al-B-Er isothermal section at 800 °C [2002Cha]. Thin two-phase regions are omitted

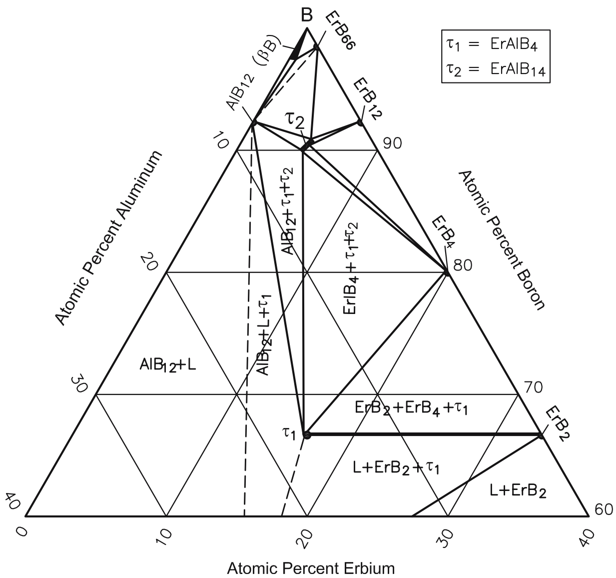

Fig. 2 Al-B-Er partial isothermal section at 1600 °C [1994Yu]. Thin two-phase regions are omitted

for ⩾720 h at 800 °C. The phase equilibria were studied with x-ray powder diffraction. The isothermal section at 800 °C constructed by [2002Cha] is shown in Fig. 1. [2002Cha] found that the ternary compound $ErAlB_{14}$ (τ_2) is slightly B-rich than indicated by the nominal formula. The composition region near ErB_{66} was not investigated by [2002Cha].

The B-rich region of this system was investigated by [1994Yu] at 1600 °C. With starting metals of purity > 99%, [1994Yu] used Ar atm to arc-melt 14 B-rich alloys, which were annealed at 1600 °C for 72-172 h. The phase equilibria were studied by x-ray powder diffraction and electron probe microanalysis. The isothermal section constructed by [1994Yu] for B-rich alloys is redrawn in Fig. 2. $Er_{1-x}Al_{1-y}B_{14}$ (τ_2) has a composition range of $Er_{0.55}Al_{0.64}B_{14}$-$Er_{0.58}Al_{0.58}B_{14}$. It forms tie-lines with AlB_{12}, ErB_4, ErB_{12}, ErB_{66}, and $ErAlB_4$(τ_1).

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