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Al-B-Ni (Aluminum-Boron-Nickel)

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The previous review of this system by [1989Sch] presented isothermal sections at 1000 and 800 °C mainly from the experimental studies of [1962Sta] and [1973Cha]. More recently, [1999Cam] made a thermodynamic analysis of this system and compared the computed isothermal sections with the experimental data.

Binary Systems

The Al-B phase diagram depicts at least two intermediate phases: AlB_2 (*C*32-type hexagonal) and AlB_{12} (the high-temperature orthorhombic β form and the low-temperature tetragonal α form). [1999Cam] reassessed the system using new experimental data on the melting of AlB_{12} and presented a calculated diagram. The Al-Ni phase diagram [1993Oka] shows five intermediate phases: $NiAl_3$ ($D0_{11}$, Fe_3C-type orthorhombic), Ni_2Al_3 ($D5_{13}$-type hexagonal), NiAl (*B*2, CsCl-type cubic, also denoted β), Ni_5Al_3 (Ga_3Pt_5-type orthorhombic), and Ni_3Al ($L1_2$, $AuCu_3$-type cubic, denoted γ′). The B-Ni phase diagram recomputed by [1999Cam] shows five intermediate phases: Ni_3B ($D0_{11}$, Fe_3C-type orthorhombic), Ni_2B (*C*16, $CuAl_2$-type tetragonal), Ni_4B_3 (orthorhombic), Ni_4B_3 (monoclinic), and NiB (B_f, CrB-type orthorhombic).

Ternary Phases

Three ternary phases are known in this system: $Ni_{20}Al_3B_{6-12}$ ($D8_4$, $Cr_{23}C_6$-type cubic; denoted τ), Ni_8AlB_{11} (denoted here as τ′; monoclinic above 800 °C and unknown structure below 800 °C), and Ni_5AlB_4 (unknown structure; denoted here as τ″).

Isothermal Sections

[1999Cam] described the liquid phase using a regular solution model. The face-centered cubic (fcc) phases based on Ni and Al were described by a two-sublattice model, one for the metal atoms and the other for the interstitial B atoms in the octahedral voids. The Ni_3Al (γ′) was modeled by adding an ordering energy term to the disordered fcc description. The homogeneity range, if any, of the Al-B and Ni-B binary compounds and the third element solubility in them were ignored. Provision was made for the B variation in the ternary compound τ by adding vacancy to one of the sublattices containing B. The compounds τ′ and τ″ were treated as stoichiometric.

The isothermal sections computed by [1999Cam] at 1000 and 800 °C are redrawn in Fig. 1 and 2. At 1000 °C (Fig. 1),

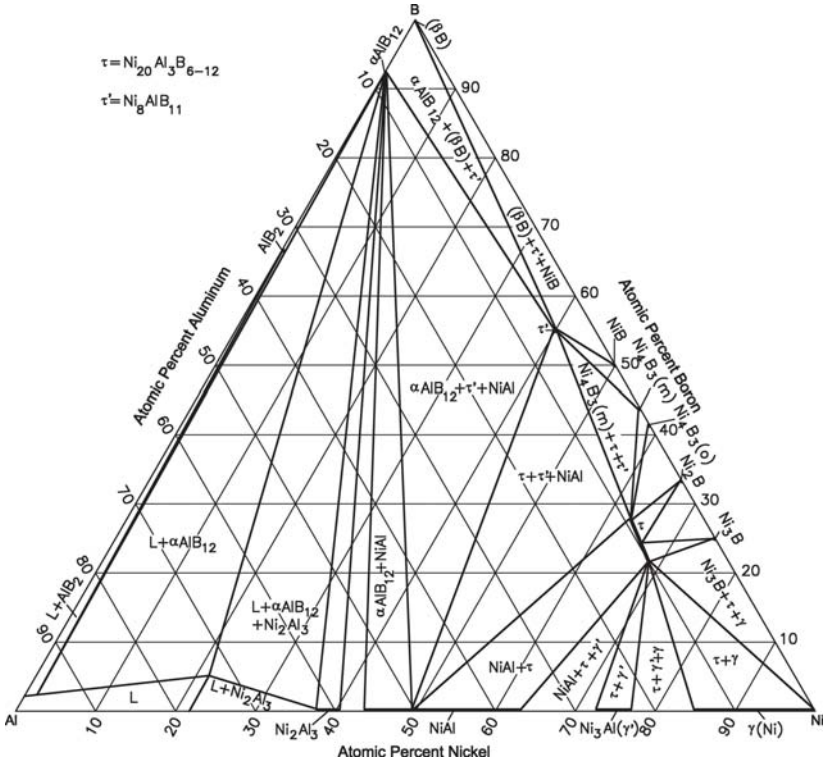

Fig. 1 Al-B-Ni computed isothermal section at 1000 °C [1999Cam]. Narrow two-phase regions are omitted.

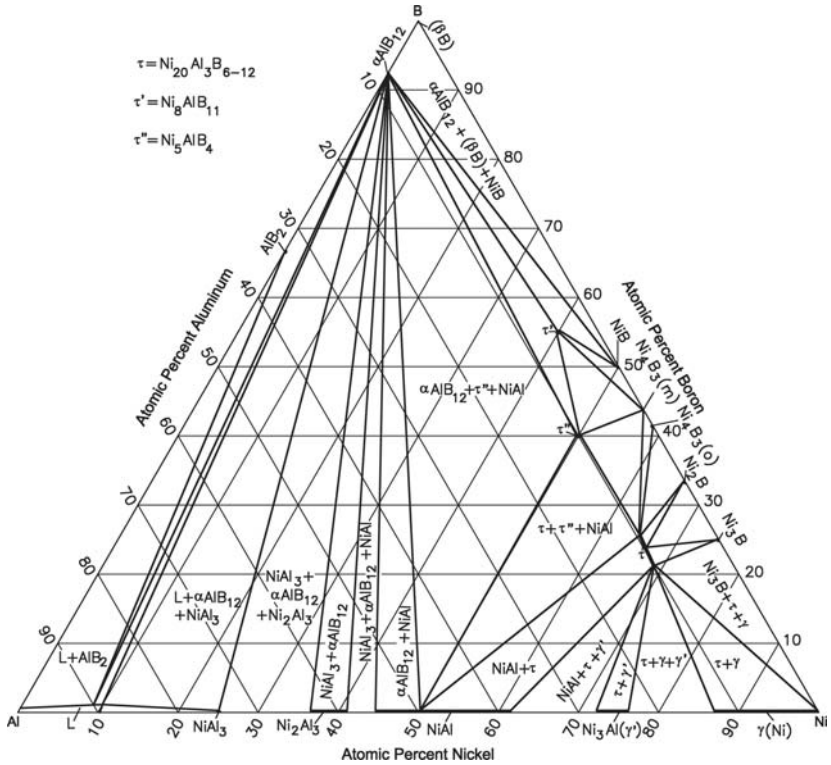

Fig. 2 Al-B-Ni computed isothermal section at 800 °C [1999Cam]. Narrow two-phase regions are omitted.

the three-phase regions of NiB + Ni_4B_3 (m) + τ′ and Ni_4B_3 (m) + τ + τ′ are present, in place of NiB + τ + τ′ and Ni_4B_3 (m) + τ + NiB in the experimental section [1989Sch]. This difference was not reconciled, pending the availability of more detailed experimental information. At 800 °C (Fig. 2), the triangulations in the computed and experimental sections are identical in this region.

References

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