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Al-B-Mg (Aluminum-Boron-Magnesium)

V. Raghavan

An isothermal section at 1000 °C for this ternary system was determined by [1971Vek] in the B-rich region. Recently, [2009Bod] reinvestigated this system in the temperature range of 900-1400 °C and presented an isothermal section at 1000 °C and a vertical section along the AlB_2-MgB_2 join.

Binary Systems

In the Al-B system [Massalski2], two borides are known: AlB_2 (*C*32, AlB_2-type hexagonal) and AlB_{12} (AlB_{12}-type tetragonal). The Al-Mg phase diagram has the following intermediate phases: Mg_2Al_3 (cubic, labeled β), R or ε (rhombohedral) and $Mg_{17}Al_{12}$ (*A*12, αMn-type cubic, denoted γ). The Mg-B phase diagram [Massalski2] depicts three intermediate compounds: MgB_2 (*C*32, AlB_2-type hexagonal), MgB_4 (orthorhombic, space group *Pnam*), and MgB_7 (orthorhombic, *Imam*).

Ternary Isothermal Sections

With starting metal powders of 99.9% Al, 99.5% B and 99.9% Mg, [2009Bod] compacted powder mixtures and reacted them in a hot-press between 1400 and 900 °C. Slow heating and cooling cycles and a holding time of 1 h at the annealing temperature were adopted. During the heat treatment, the oxide films on the powder samples reacted to produce the spinel $MgAl_2O_4$. The final composition of the metal matrix was recalculated taking into account the spinel formation. The phase equilibria were studied with x-ray powder diffraction.

A ternary compound $AlMgB_{14}$ (denoted τ here) is known in this system. It has orthorhombic symmetry (space group *Imma*, $a = 0.5848$ nm, $b = 1.0313$ nm and $c = 0.8115$ nm). The isostructural compounds AlB_2 and MgB_2 form a continuous *C*32 solid solution below the melting temperature of AlB_2 (~970 °C). The lattice parameters of this solid solution vary linearly with composition as: a (nm) = 0.30834 − 0.00008 × (mol% AlB_2) and c (nm) = 0.35213 − 0.0027 × (mol% AlB_2) [2009Bod]. The isothermal section determined by [2009Bod] at 1000 °C is shown in Fig. 1. The *C*32 solid solution stops short of reaching the Al-B side. At 1200 and 1400 °C, the phase relations are the same as in Fig. 1 [2009Bod]. The isothermal section at 900 °C is shown in Fig. 2. The *C*32 solid solution is continuous here.

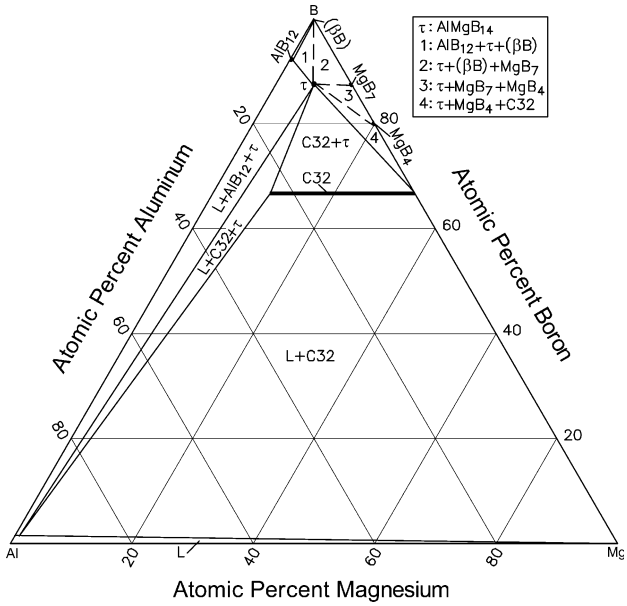

Fig. 1 Al-B-Mg isothermal section at 1000 °C [2009Bod]. Narrow two-phase regions are omitted

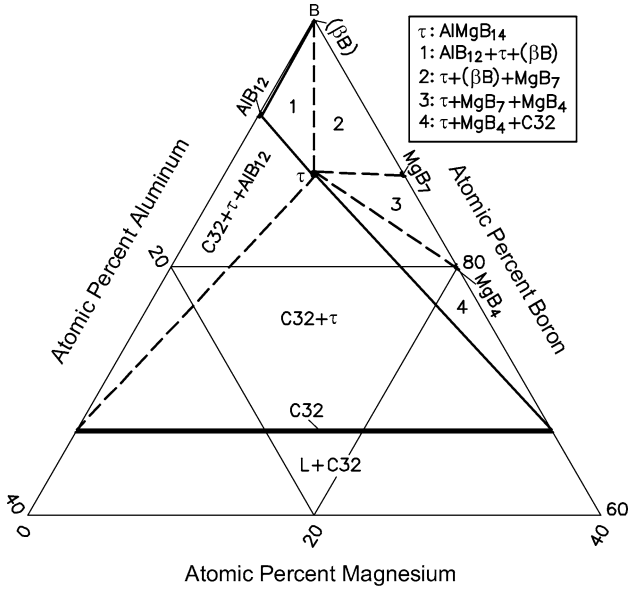

Fig. 2 Al-B-Mg isothermal section at 900 °C. Narrow two-phase regions are omitted

References

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2009Bod: R. Bodkin, M. Herrmann, N.J. Coville, and I. Sigalas, A Study of the Al-Mg-B Ternary Phase Diagram, *Int. J Mater. Res.*, 2009, **100**(5), p 663-666