

Al – Mg (Aluminum – Magnesium)

Phase diagram

For a short discussion of phase equilibria and crystal structure of intermediate phases see [98 Oka]. Su et al. [97 Su] have reinvestigated the phase equilibria in the concentration range between 37 and 53 at% Mg. The resulting partial phase diagram is shown in Fig. 1.

Chartrand et al. [94 Cha] have critically evaluated all thermodynamic data and phase equilibria in the Al-Mg system. Of special interest is the middle of the concentration range. The results obtained in this area are shown in Fig. 2.

The whole phase diagram, as recommended by Okamoto [98 Oka], is given in Fig. 3.

By rapid solidification of liquid alloys Hehmann [90 Heh] has prepared metastable solid alloys (partially amorphous). Transformation of these metastable phases have been investigated thoroughly.

By ball-milling of mixtures of elemental Al and Mg powder alloys with extended solid solubility of Mg in Al could be observed [93 Cal]. Starting with a mixture of $\text{Al}_{70}\text{Mg}_{30}$ solid solution with 18 at% Mg and starting with the composition of $\text{Al}_{50}\text{Mg}_{50}$ metastable solid solution with 45 at% Mg could be obtained.

Zhang et al. [94 Zha] have prepared by mechanical alloying stable as well as metastable phases.

By twin roll technique [99 Cho] produced such flakes, in which the solubility of Al in Mg-solid solution increased from < 1 at-% Al (equilibration condition) to 10.6 at-% Al (metastable, remaining at RT).

Thermodynamics

Soares et al. [95 Soa], using an isopiestic method, have determined thermodynamic activities of Mg in liquid alloys at concentrations < 50 at% Mg and at temperatures $900 > T > 1150$ K. The results obtained are not realistic. The activity coefficient γ_{Mg} should be due to the overall tendency for compound formation $\gamma_{\text{Mg}} < 1$. But within the experimental scatter the authors found $\gamma_{\text{Mg}} > 1$.

Critical evaluation by [94 Cha] yields some reliable thermodynamic data. They are given in the next figures.

The thermodynamic activities of Mg in liquid Al-Mg alloys are shown in Fig. 4. Thermodynamic activities of Mg in solid Mg alloys are plotted in Fig. 5 (710 K).

By high-temperature calorimetry Agarwal et al. [91 Aga] have determined enthalpies of mixing of liquid alloys. The results are plotted in Fig. 6.

Belton et al. [69 Bel] have determined partial Gibbs free enthalpies of liquid alloys (Fig. 7). The results obtained are in good agreement with partial Gibbs free enthalpies obtained by evaluation of ΔH^{L} data given in Fig. 6 [91 Aga].

Figures

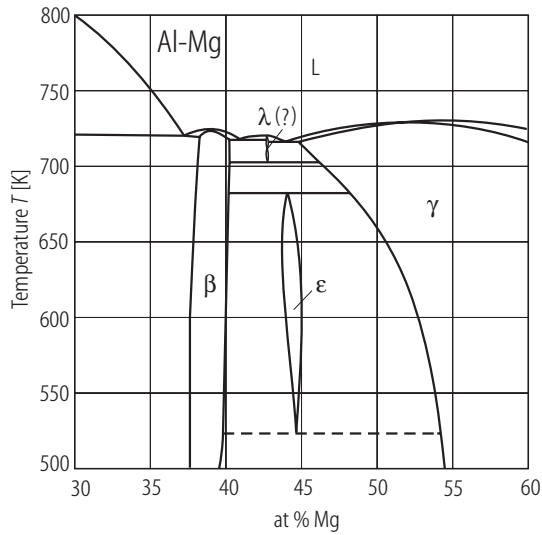


Fig. 1. Al-Mg. Partial phase diagram for 37 to 53 at% Mg [97 Su].

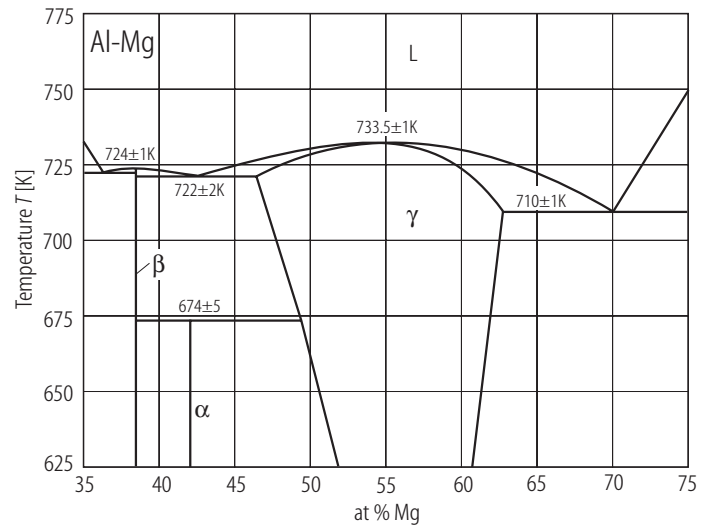


Fig. 2. Al-Mg. Partial phase diagram calculated by [94 Cha].

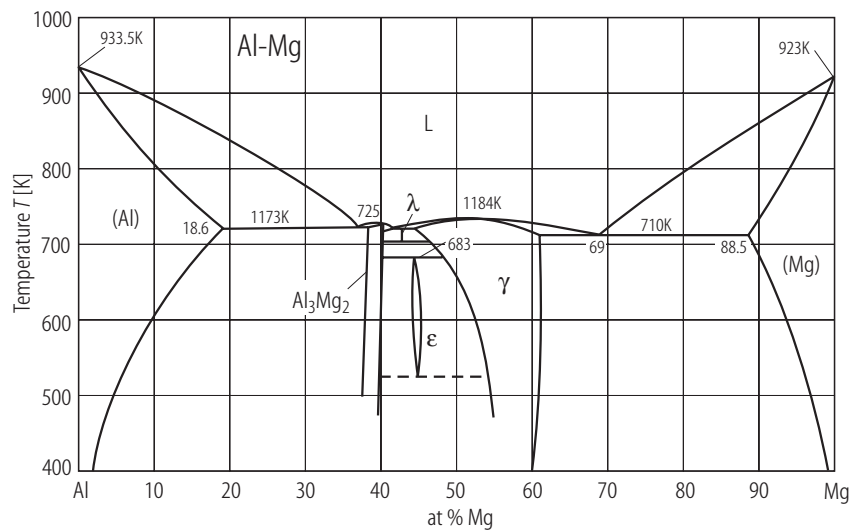


Fig. 3. Al-Mg. Phase diagram recommended by [98 Oka].

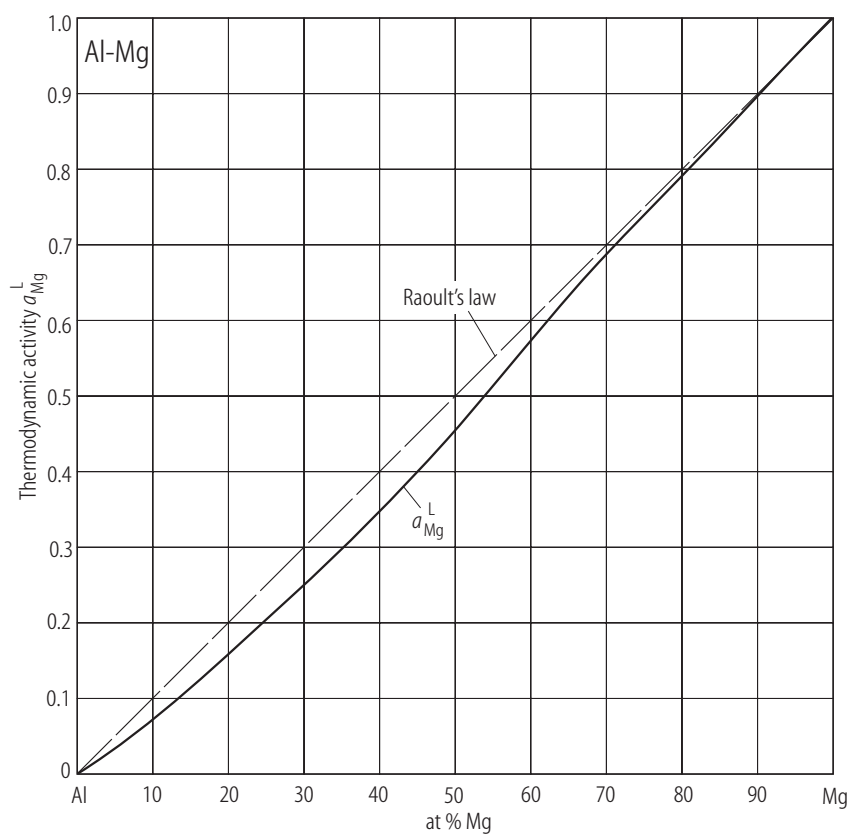


Fig. 4. Al-Mg. Thermodynamic activities of Mg in liquid Al-Mg alloys [94 Cha], [93 Zuo].

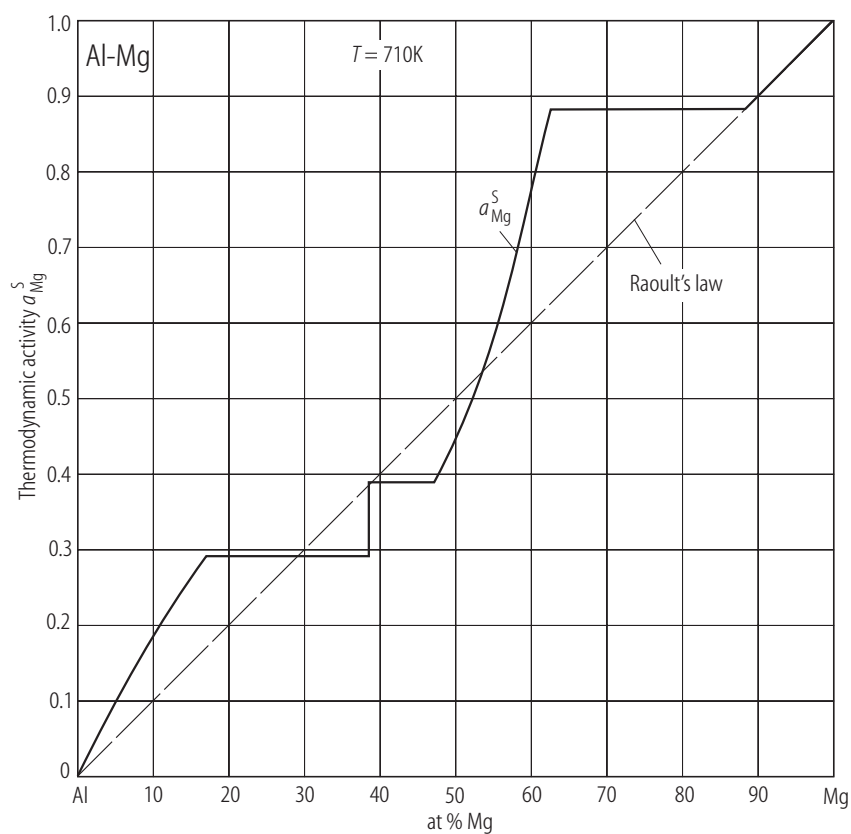


Fig. 5. Al-Mg. Thermodynamic activities of Mg in solid alloys at 710 K [94 Cha].

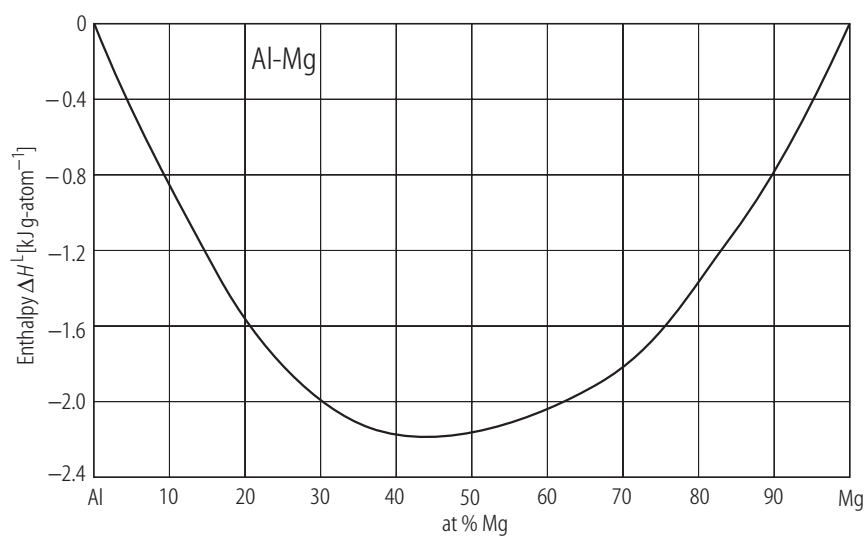


Fig. 6. Al-Mg. Calorimetrically determined enthalpies of mixing of liquid alloys [91 Aga].

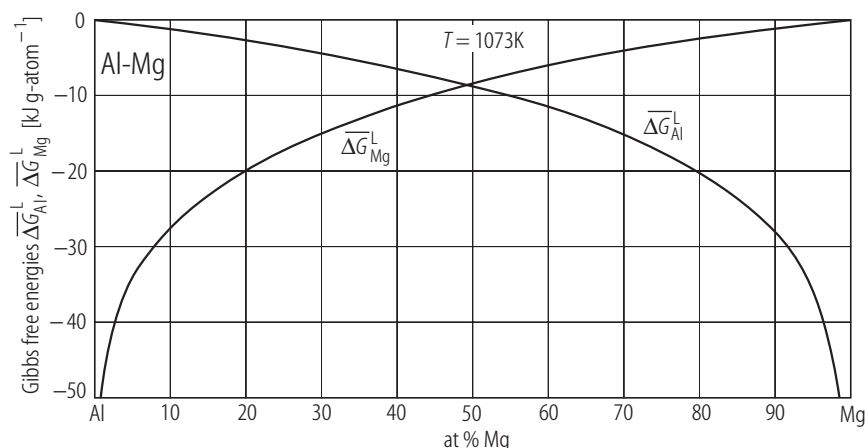


Fig. 7. Al-Mg. Partial Gibbs free enthalpies of mixing of liquid alloys [91 Aga].

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