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Al-Mg-Mn (Aluminum-Magnesium-Manganese)

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The data on this ternary system given by [1995Vil] include a partial liquidus projection and partial isothermal sections at 750, 710, 670, 500, 450, 425, and 400 °C, for compositions near the Al-Mg side. Recently, [2005Ohn] developed a thermodynamic description of this system, with emphasis on Mg-rich alloys. Here, a liquidus projection and an isothermal section at 710 °C are given from the computed results of [2005Ohn].

Binary Systems

The Al-Mg phase diagram [1998Lia] has the following intermediate phases. Mg_2Al_3 (denoted β) is cubic, space group $Fd\bar{3}m$ with a = 2.8239 nm. The other phases are: R or ε (rhombohedral) and $Mg_{17}Al_{12}$ ($A12$, αMn -type cubic, denoted γ). The Al-Mn phase diagram [Massalski2, 1999Liu] has the following intermediate phases: ε (close packed hexagonal, 55-72 at.% Mn), γ (body centered cubic, ~34.5-52 at.% Mn), γ_1 (~30-38.7 at.% Mn, structure not known), γ_2 ($D8_{10}$, Cr_5Al_8-type rhombohedral, ~31.4-50 at.% Mn,) Mn_4Al_{11} (triclinic), μ (hexagonal, 19-20.8 at.% Mn), λ (hexagonal, 16.8-19 at.% Mn) and $MnAl_6$ ($D2_h$-type orthorhombic). There are no intermediate phases in the Mg-Mn system. See [2005Gro] for the phase diagram in the Mg-rich region.

Ternary Phase Equilibria

An Al-rich ternary phase $Mg_3Mn_2Al_{18}$ (cubic, space group $Fd\bar{3}m$, a = 1.4529 nm) is known in this system [Pearson3]. [1998Ans] assessed the thermodynamic properties of this compound.

In their thermodynamic description of this ternary system, [2005Ohn] used the binary descriptions of [1998Lia] (Al-Mg), [1999Liu] (Al-Mn), and [2005Gro] (Mg-Mn). The published experimental data were reviewed and the reliable results from amongst them were selected for use in the optimization. In the Al-Mn system, the parameters for Mn_5Al_8 (γ_2) and Mn_4Al_{11} were reoptimized and used in place of those given by [1999Liu]. The solution phases: bcc, fcc, cph, αMn, and βMn were treated as having a randomly occupied single lattice. Most of the binary phases and the ternary phase were treated as stoichiometric compounds.

The computed isothermal sections for Mg-rich alloys at 850, 750, 730, 710, 700, 670, 430, 400, 350, 250 and 200 °C were found to be in good agreement with the experimental data. Satisfactory agreement was also found between the computed liquidus projection at the Mg corner with experimental results from a number of sources. Similar comparisons were made with two computed vertical sections at 0.6 and 6.0 mass % Al. Here, a liquidus projection and an isothermal section at 710 °C computed by

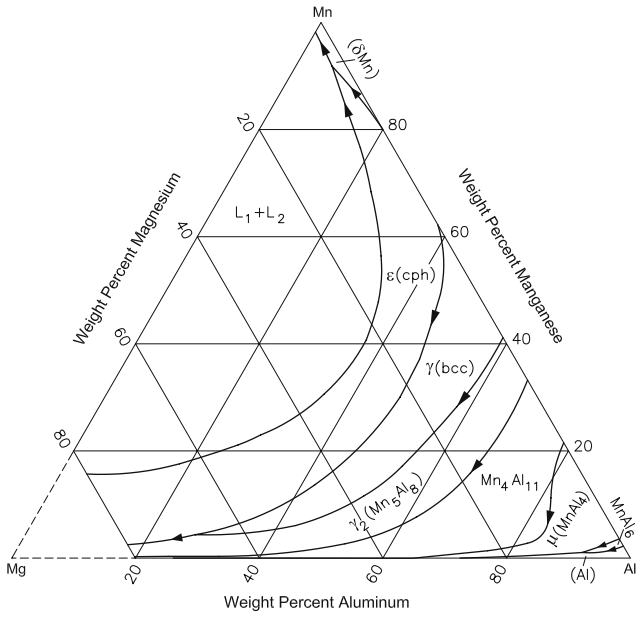

Fig. 1 Al-Mg-Mn computed liquidus projection [2005Ohn]

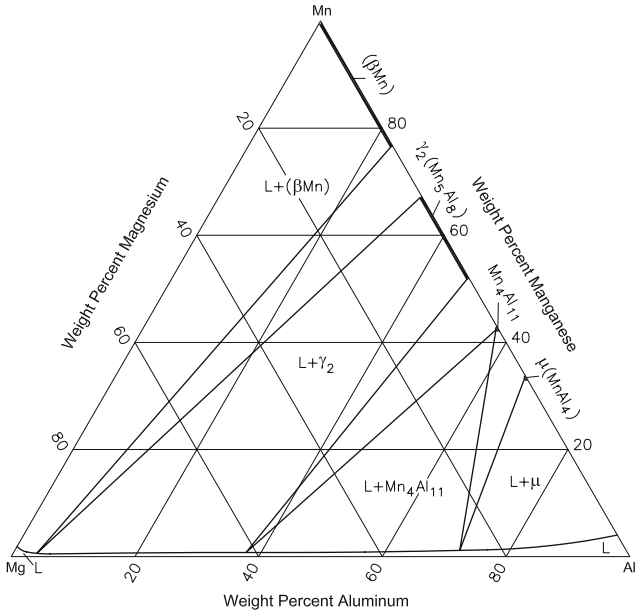

Fig. 2 Al-Mg-Mn computed isothermal section at 710 °C [2005Ohn]

[2005Ohn] are given in Fig. 1 and 2. The details of the liquidus near the Mg-corner are not shown in Fig. 1. Also, the invariant reactions near the Al-Mg side occur too close to the side to be shown in Fig. 1. The ternary phase does not take part in the computed liquid-solid equilibrium and does not appear in the section at 710 °C.

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