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Al-Fe-Mg-Si (Aluminum-Iron-Magnesium-Silicon)

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[2005Du] developed a thermodynamic description of this quaternary system and compared two computed isopleths with the experimental data of [1946Phi]. Earlier, [1975Bar] reviewed the experimental data on the liquidus and the phase distribution in the solid state.

Ternary Systems

The Al-Fe-Mg and Fe-Mg-Si systems were reviewed by [1992Rag]. An update of the Al-Fe-Si system was given by [2002Rag]. An Al-Mg-Si update appears in this issue.

Quaternary Phase Equilibria

A quaternary phase $Fe_2Mg_7Si_{10}Al_{18}$ (denoted π) is stable in this system. It has hexagonal symmetry, with space group $P\bar{6}2m$ and lattice parameters $a = 0.6625$ nm and $c = 0.7910$ nm [1998Kre].

During the course of their investigation of the Al-Fe-Mg-Mn-Si quinary system, [1975Bar] reviewed the experimental data on the liquidus projection for this quaternary system, in which the Al apex of the tetrahedron is used to project on the basal plane the features nearest to the apex. The fields in Fig. 1 have in addition (Al) in equilibrium with the liquid [1975Bar]. Figure 2 shows the phase distribution in the solid state. The phase fields contain additionally (Al).

In their thermodynamic modeling, [2005Du] used the ternary assessments from [1999Liu] (Al-Fe-Si), COST 507

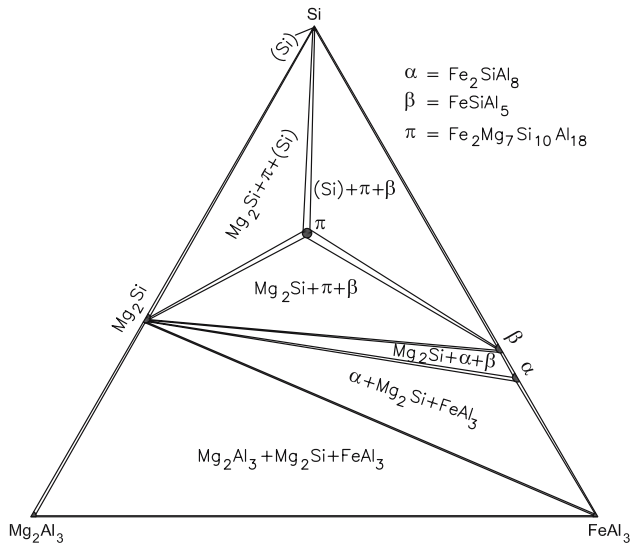

Fig. 2 Al-Fe-Mg-Si phase distribution in the solid state. All fields have (Al) as an additional phase [1975Bar]

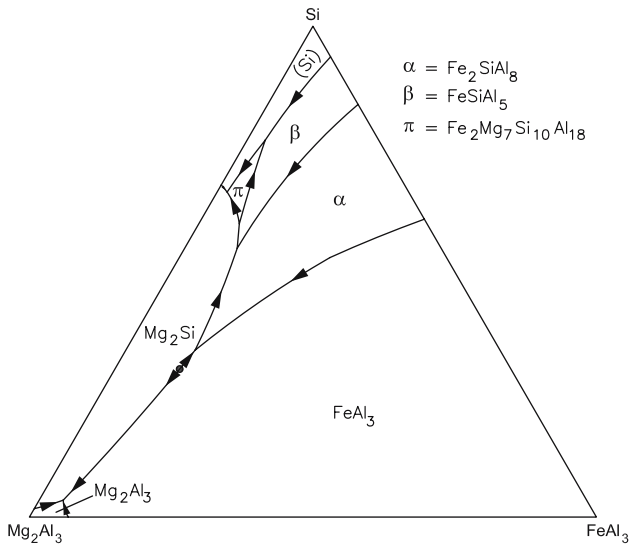

Fig. 1 Al-Fe-Mg-Si liquidus projected from the Al apex on to the basal plane showing the phases nearest to the apex. All fields have additionally (Al) [1975Bar]

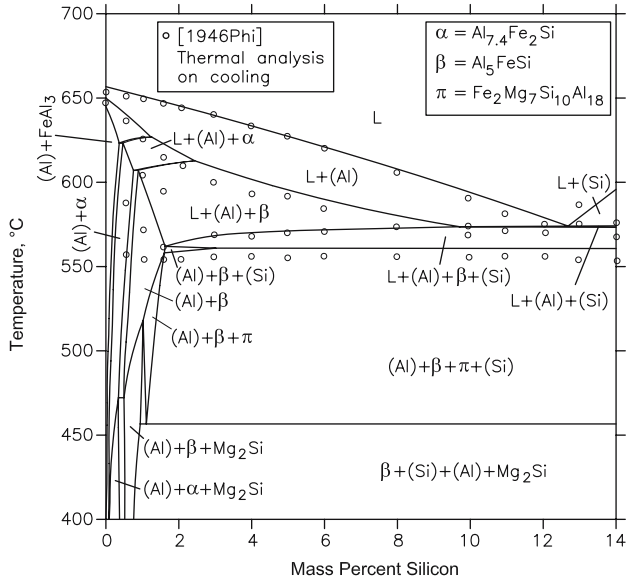

Fig. 3 Al-Fe-Mg-Si computed isopleth at 0.5Fe-0.5Mg (in mass%) [2005Du]

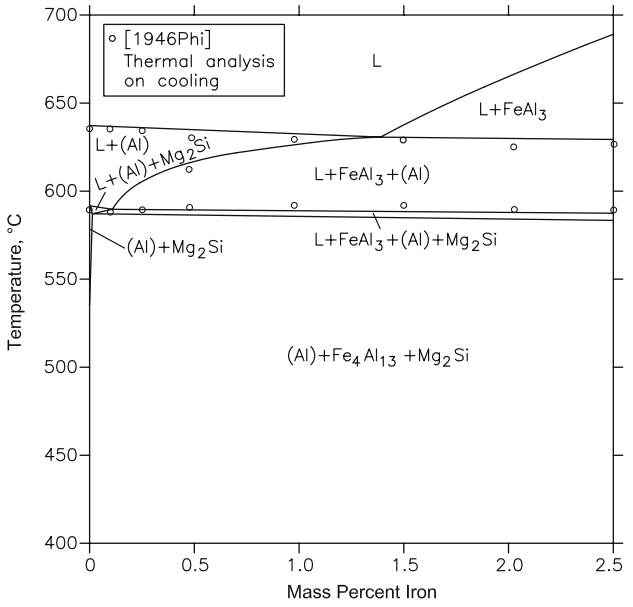

Fig. 4 Al-Fe-Mg-Si computed isopleth at 4Mg-0.5Si (in mass%) [2005Du]

(Al-Mg-Si), and [2001Dan] (Fe-Mg-Si). The interaction parameters for the Al-Fe-Mg liquid phase were optimized from the data of [1995Vil]. Using the invariant equilibria determined by [1946Phi] and [1958Gul], [2005Du] computed the phase equilibria and listed the invariant temperatures and composition for the reactions occurring at the Al corner. The calculated temperatures of [2005Du] and [2001Dan] agree well with the experimental values. The liquid compositions participating in the invariant reactions calculated by [2005Du] agree well with the experiments, whereas those of [2001Dan] show discrepancies up to 10 at.%. Two isopleths computed by [2005Du] at 0.5Fe-0.5Mg and 4Mg-0.5Si (in mass%) are shown in Figs. 3 and 4.

Among the other reports on this quaternary system, the effect of Mg on the primary Al morphology was studied by [2002Mer]. Recently, [2005Bel] outlined an approximate method of calculating the quaternary phase equilibria, starting from the experimental data on ternary systems and presented several approximate isothermal and vertical sections.

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