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MODIFICATION OF THE EUTECTIC MG2SI-PHASE OF ALMGSI-CAST ALLOYS

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Abstract & Introduction

The present work shows a possible method for refining the microstructure of AlMgSi cast alloys in a similar fashion to the method which has been state of the art for many years in the case of hypoeutectic AlSi alloys.

The effects of different melt purification processes, purification agents and the incorporation of different alloy and microalloying elements to modify the eutectic Mg_2Si phase within near eutectic AlMgSi alloys are investigated. As a base material a near-eutectic alloy of type Al-Mg_2Si is investigated in the project as the base. Systematic studies lead to an optimum composition of the purging gases and the duration of the melt purification treatment. Also the negative effects of other purification agents and trace elements on the formation of the eutectic phase were documented.

Investigations and Results

Microstructure

The effect of the modification upon the microstructure has been elucidated, in the first instance, by the determination of the most significant structural parameters, such as the form factor (FF), laminar separation (LA) and morphological factor of the microstructure (GF), using quantitative image analysis (see Figure 1) and deep etching methods (see Figure 2).

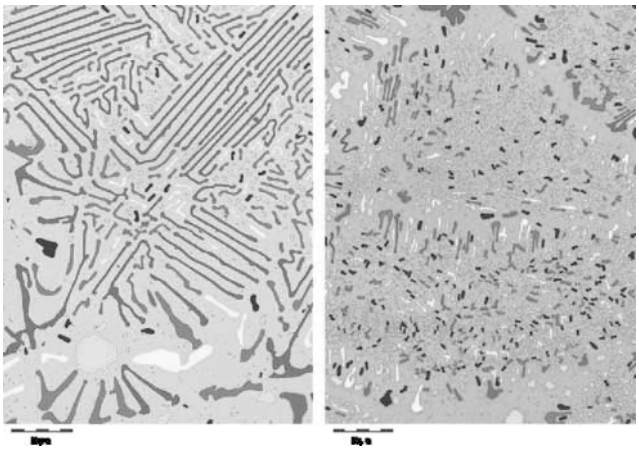

Figure 1. Microstructure of the non-modified Mg2Si-Phase (left) and modified Mg2Si-Phase (right)

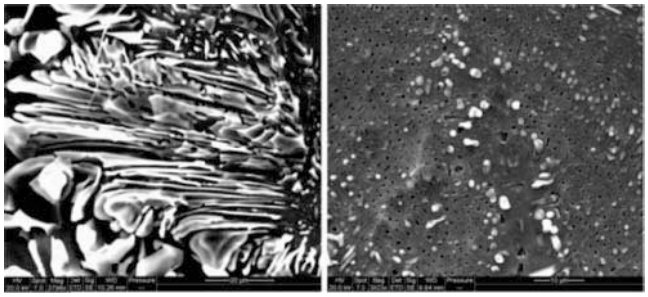

Figure 2. Deep etch of the non-modified Mg_2Si-Phase (left) and modified Mg_2Si-Phase (right)

Mechanical Testing

The results of the tensile test and the resistance to bending correlate well with the modification found in the alloy and the results obtained by image analysis (see Figure 3).

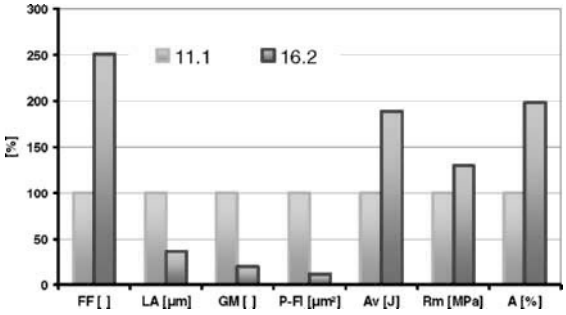

Figure 3. Results of microstructure parameters and tensile tests (orange none modified, blue modified)

Scanning electronic microscope

In complementary research using scanning electronic microscope (SEM, see Figure 4) and transmission electronic microscope (TEM, see Figure 5), the effects of different melt treatment variants on the morphology of the Mg_2Si microstructure were analyzed in detail.

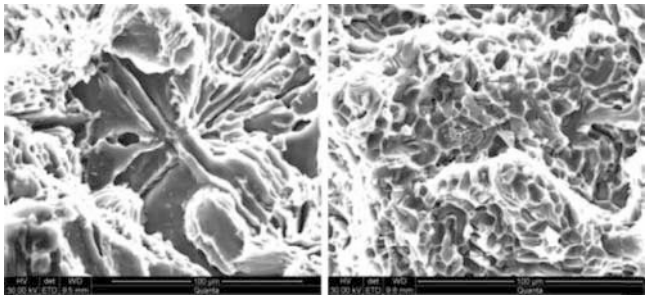

Figure 4. Fracture surface (SEM) of the non-modified Mg2Si-Phase (left) and modified Mg2Si-Phase (right)

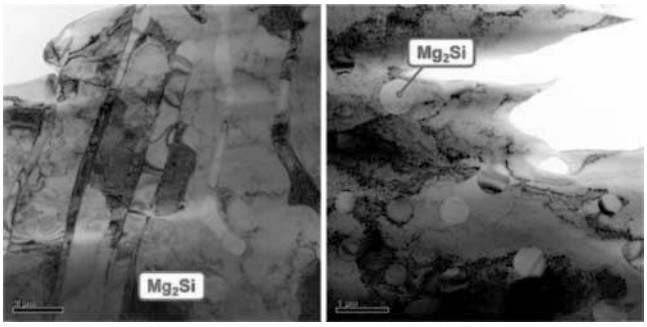

Figure 5. TEM investigations of the non-modified Mg2Si-Phase (left) and modified Mg2Si-Phase (right)

Summary

All investigations have shown that the microstructure of Mg_2Si changes its morphology with melting treatment, from a coarse laminar morphology to fine globular morphology. Owing to the spheroidization in the eutectic phase, ductility increases and offers new application fields and possible use for AlMgSi alloys in sand and permanent mould castings.