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Effect of Sc Additions on the Modification of Eutectic Si of As Cast Al-9wt%Si Alloy

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The demand for high–strength castings at competitive prices, for applications where the ratio strength/unit mass is a critical factor, such as automotive and aeronautics, has increased exponentially. Among the aluminum casting alloys stand out the Al-Si alloys (with or without Cu and/or Mg additions), which represent 80% of aluminum casting alloys. One of the microstructural parameters that most influence the properties of Al-Si alloys is the morphology (volume fraction, size, shape and distribution) of eutectic silicon. The modification of the eutectic can be obtained by chemical modification by the addition of several elements [1,2]. It was recently reported that some transition metals can promote the modification of the eutectic, among which stands out scandium (Sc) [3]. The addition of scandium to aluminum alloys has been the subject of several studies in recent years, since the addition of small amounts induces a significant increase in the mechanical properties of these alloys.

This work focuses on evaluating the effect of the addition of Sc on the grain refinement and the modification of eutectic silicon of an as-cast AlSi9 alloy.

The OM micrographs presented in Fig. 1 revealed that the addition of Sc obviously reduced the sizes of the α-Al primary phase and eutectic silicon particles as well as secondary dendrite arm spacing value.

According to the microstructures shown in Fig. 2, it is evident that the Sc has a high potential to change the morphology of eutectic silicon. In fact, the silicon lamellar/acicular morphology, characteristic of unmodified alloys (Fig. 2a), was transformed into a fibrous structure with rounded edges and compact shaped (Fig. 2b and c), characteristic of modified alloys.

The EDS analysis (Fig. 3) showed that Sc precipitates mainly in the interdendritics regions forming Fe and Si rich intermetallic phases, which reduces drastically the amount of Sc on α-Al and consequently the hardening effect of the Al-Si (Sc) alloys.

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