

Research Programs

SSM Processing of 390 Alloy

Research Team:

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Objectives:

- Development of a novel technique for the SSM processing of 390 Alloy
- Understand the growth mechanism of primary Si and study and identify the effect of novel grain refining techniques with respect to nucleation and growth

Hyper-eutectic Al-Si alloys have gained enormous significance in the recent past due to their superior properties (i.e., low coefficient of thermal expansion, high yield strength and high wear resistance). The processing of hyper-eutectic aluminum via SSM route has however been plagued by the growth of primary Si to an unacceptable range (> 100 microns). Various refining agents have been studied in the past to reduce the growth of primary Si, however, the cooling rate and the isothermal hold during SSM processing play a very important role in obtaining the desired optimal levels of primary Si. In this study, the nucleation of primary Si in hyper-eutectic alloys was achieved using the mixing of two different liquids. An alloy of 23 - 25 % Al - Si @ T₂ was mixed with 7 - 8 % Al - Si alloy (held in the SSM range) @ T₁ to study the nucleation of primary Si due to the rapid heat extraction due to the presence of the primary Al in the hypo-eutectic alloy; a schematic of the two compositions on the phase diagram is shown in Figure 1. The final composition of the final mixture was that of a 390 alloy. It was seen that the temperature dropped to T₃, which is below the temperature of nucleation of primary Si in a 390 alloy. The under cooling achieved provides the necessary driving force for the nucleation of fine primary Si. The heat released by the nucleation and growth of primary Si is absorbed by the dissolving primary Al from the hypo-eutectic SSM slurry. The mixed liquid is held for a period of time for thermal equilibrium and the resultant mixed

slurry is quenched to study the microstructure achieved. Figure 2 lists some the resultant microstructures obtained with the primary Si in the range of < 50 microns. We are currently working in other avenues for the rapid heat extraction from the liquid temperature to the SSM temperature range. It includes industrial trials and new innovative processing concepts.

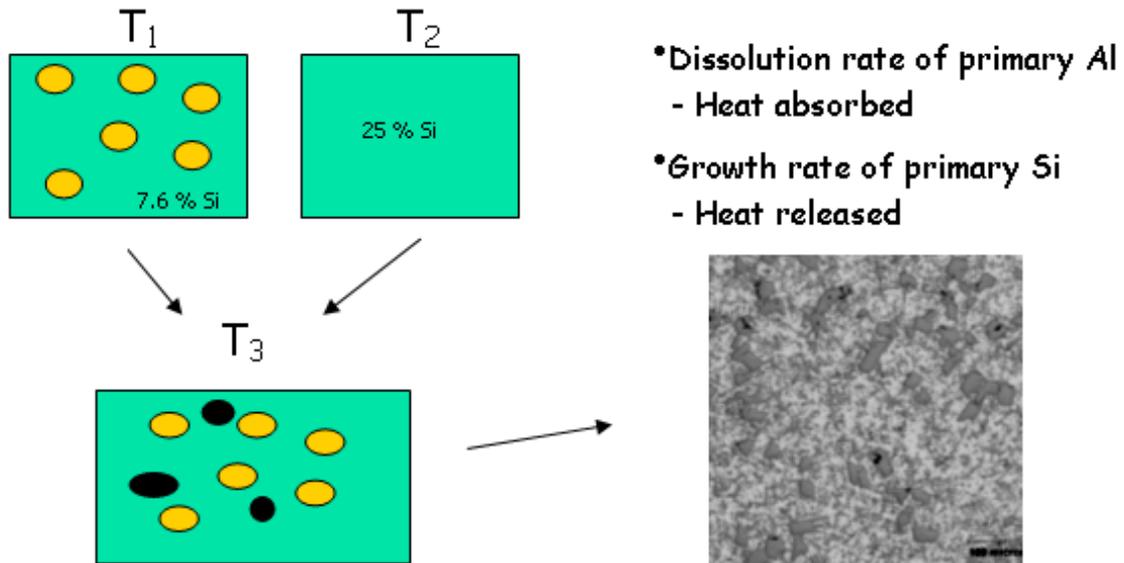


Figure 1: Concept behind the liquid mixing for the SSM processing of 390 Alloy