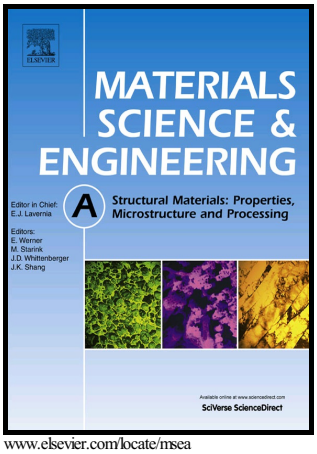

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Tensile properties and related microstructural aspects of hypereutectic Al-Si alloys directionally solidified under different melt superheats and transient heat flow conditions

Rodrigo V. Reyes[a], Thomas S. Bello[a], Rafael Kakitani[b], Thiago A. Costa[b], Amauri Garcia[b], Noé Cheung[b], José E. Spinelli[a,*]

[a]Department of Materials Engineering, Federal University of São Carlos – UFSCar, 13565-905, São Carlos, SP, Brazil

[b]Department of Manufacturing and Materials Engineering, University of Campinas, UNICAMP, 13083–860 Campinas, SP, Brazil

[*]Corresponding author - E-mail address: spinelli@ufscar.br

Abstract

The present investigation deals with directional solidification (DS) of Al-15wt.% and 18wt.% Si alloys under transient heat flow conditions and further characterization of the related microstructures. Emphasis is given on the eutectic growth being affected not only by solidification kinetics but also by melt superheat, which is varied in two degrees for each alloy, i.e., 6% and 23% above the liquidus temperature. The dependences of interphase spacing (λ) on both solidification kinetics (fast, intermediate and slow cooling conditions) and on melt superheat during solidification of hypereutectic alloys are reported for the first time. Furthermore, functional experimental interrelations of tensile mechanical properties and interphase spacing between eutectic Si particles of both alloys evaluated are proposed. It is shown by these correlations that the tensile properties increase with the decrease in these spacings. More significant variations in properties are associated with a certain range of spacings ($1.0\mu m < \lambda < 2.3\mu m$) in the case of the Al-15wt.%Si alloy. Tensile strength and elongation-to-fracture decrease with increasing alloy silicon content. The applicability of the eutectic growth expression $\lambda = f(V^{-1/2})$ has been verified for the present tested alloys and experimental conditions.

Keywords: *Al-Si alloys; solidification; microstructure; mechanical properties.*

1. Introduction

Aluminum alloys offer several advantages, such as good fluidity, low melting temperature, short foundry cycles, relatively low tendency to hot fracture, good superficial finishing after foundry process and good chemical stability. Among the foundry aluminum alloys, Al-Si alloys are the most widely used, particularly in the automotive industry. Si provides a good fluidity and wide variety of