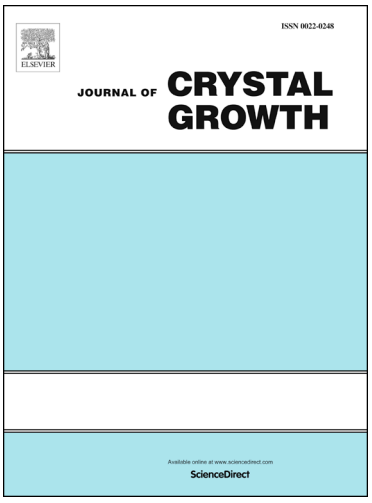

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The effect of ultrasonic treatment on the mechanisms of grain formation of as-cast high purity zinc

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Abstract

The potential for producing a large refined equiaxed zone by ultrasonic treatment (UST) of high purity zinc was investigated in order to improve the mechanical and formability performance. The macrostructure of cast ingots changed from large columnar grains without UST to three zones of fine columnar grains adjacent to the mould walls of the ingot, a refined equiaxed zone and a zone of a mixture of coarse equiaxed and columnar grains. A small zone of equiaxed grains was obtained when UST was applied during cooling from 440˚C to 419˚C for 2 minutes. The size of the equiaxed zone increased from about 20% of the casting's cross section to 50% when UST was applied for 3 or 4 minutes. In contrast, the application of UST for a longer time from a higher temperature (450˚C to 419˚C for 4 min) resulted in a smaller equiaxed zone of 18% indicating that a specific combination of UST time and temperature is required for the formation of a large equiaxed zone. The factors affecting the formation of the equiaxed zone throughout the solidification cycle are described.

Keywords: A1. Grain refinement, A2. ultrasonic treatment, B1. pure zinc, A1. solidification, A1. equiaxed and dendritic grains

1. Introduction

Zinc (Zn) and its alloys are primarily used to galvanize steel, a processing step that protects the steel against corrosion. Zinc alloys are also cast into gravity and pressure die cast parts,