Effects of withdrawal rate and starter block size on crystal orientation of a single crystal Ni-based superalloy

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Abstract

Fabrication of single crystal (SC) Ni-based gas turbine blades with a minimum crystal misorientation has always been a challenge in gas turbine industry, due to its significant influence on high temperature mechanical properties. This paper reports an experimental investigation and numerical simulation of the SC solidification process of a Ni-based superalloy to study effects of withdrawal rate and starter block size on crystal orientation. The results show that the crystal misorientation of the sample with 40 mm starter block height is decreased with increasing withdrawal rate up to about 9 mm/min, beyond which the amount of misorientation is increased. It was found that the withdrawal rate, height of the starter block and temperature gradient are completely inter-dependent and indeed achieving a SC specimen with a minimum misorientation needs careful optimization of these process parameters. The height of starter block was found to have higher impact on crystal orientation compared to the withdrawal rate. A suitable withdrawal rate regime along with a sufficient starter block height was proposed to produce SC parts with the lowest misorientation.

Keywords

Ni-based superalloy; Single crystal solidification; Withdrawal rate; Crystal orientation

1. Introduction

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