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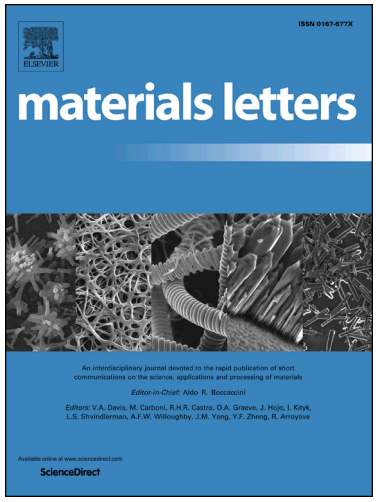

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Prediction of freckle formation in directionally solidified CMSX-4 superalloy

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ABSTRACT

Freckle defects appearing on the industrial gas turbine blade reduce the high temperature mechanical properties. It is necessary to predict the freckle formation on the castings before the directional solidification. In this paper, the relationship of fluid flow and crystal growth during the vertical directional solidification was analysed. Based on the analysis, a simple method considering the solidification conditions and concaved solidification interface was proposed to predict the freckle formation. The method was verified with specimens and dummy blade under the experimental environments. The validation results show that the method can predict where the freckle may appear on a casting with a large size and complex shape for directionally solidified CMSX-4 superalloy.

Keywords: Solidification; Defects; Metals and alloys; Freckle.

1. Introduction

Power generation mode based on the industry gas turbine for its high efficiency and less pollution to the environments is favored. However, the wide application is limited by the production of single crystal or directionally solidified blades for the increasing freckling tendency. Freckle defects is caused by the thermal solute convection in the mushy zone [1-5], and reduces the high temperature mechanical properties. Thus, before the production of castings, it is necessary to find a way to predict freckle

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