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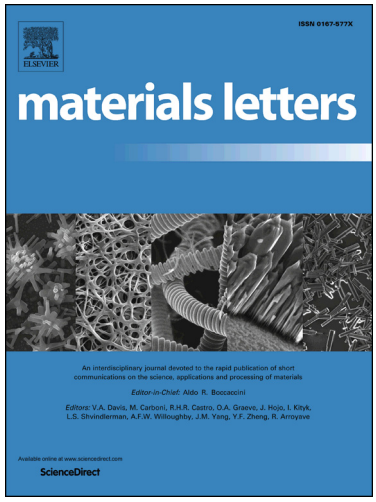

Significant impact of yttrium microaddition on high temperature tensile properties of Inconel 713C superalloy

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Significant impact of yttrium microaddition on high temperature tensile properties of Inconel 713C superalloy

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Keywords; Superalloy, Mechanical properties, Cast, Solidification, Microstructure

Abstract

High temperature tensile properties of Inconel 713C without and with Yttrium microaddition have been investigated. Yttrium addition affected the solidification structure with promotion of equiaxed grain formation in the center of mold. Ultimate tensile strength increased from approximately 892 to 1006 MPa while the elongation increased from approximately 13% to 21% by 0.05 mass% Yttrium addition. 0.05 mass% Yttrium addition in Inconel 713C alloy showed optimum high temperature tensile property.

Introduction

Ni based superalloys which are mainly used for high temperature turbine materials [1], have been investigated to improve their high temperature properties because of increased operating temperature by recently strengthened emission gas regulation [2]. As one of conventional polycrystalline casting alloy among Ni based superalloys, Inconel 713C (IN-713C) alloy is being applied for the material of high temperature turbine wheel in automotive turbocharger part. Nowadays, the application range of turbine wheel is being broadened with an increase of the operating temperature up to around 1050 $^{\circ}$C for gasoline engine due to strengthened gas emission regulation [3]. Therefore, it is necessary to progressive study about enhancement of the high temperature properties for conventional IN-713C alloy.

Yttrium element is well known for its improvement of the high temperature mechanical properties and oxidation resistances in various types of heat resistant alloys [4-13]. The studies conducted by Zhou's group have examined and discussed the effect of extremely small amount of Yttrium addition on high temperature rupture life as well as high temperature tensile strength in polycystalline casting Ni based superalloys [14-16]. Yttrium has considerably improved the high temperature rupture lives by morphological changes of MC carbides along grain boundary where M is metal, and C is carbon. However, excess Yttrium addition will give rise to large segregation to form detrimental phases such as intermetallic compounds along grain boundary, thus drop the rupture lives. However, until present, the effect of Yttrium addition for high temperature tensile strength and elongation, even though stress component was same as uniaxial tensile, has not been studied. For