Hot deformation characteristics and microstructure evolution of Hastelloy C-276

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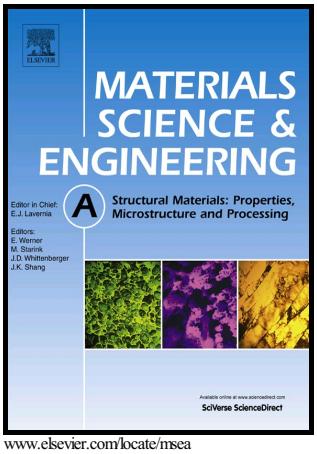

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Abstract

High temperature deformation characteristics of Hastelloy C-276 was investigated using compression tests at elevated temperature ranging from 900 °C to 1200 °C and strain rates covering quasi-static to quasi-dynamic regions (0.001 s^{-1}-10 s^{-1}) to a final true strain 0.69 (50% Engineering strain). The flow curves at all strain rates and high temperatures (1100 °C, 1200 °C) exhibit a peak stress, confirming the dynamic recrystallization (DRX) phenomena. To predict and establish the safe hot workability window, processing maps were evaluated based on the dynamic material model and plotted for strain of 0.65. Based on the detailed microstructure analysis and the identification of the active softening mechanisms, the optimal hot workability window was found to be 1200 °C and 0.001 s^{-1}. Bulk texture analysis revealed presence of fiber textures <011>and <001>parallel to deformation axis (ND), which were prevalent at high temperature and low strain rate conditions. Using Arrhenius model, the apparent hot working activation energy (Q_{HW}) was determined as 474 kJ/mol. Zener-Holloman parameter was calculated to gauge the deformation resistance and found to have a linear relationship with peak flow stress at given deformation conditions.

Keywords: Hastelloy C-276, Dynamic recrystallization, Hot deformation textures, Processing maps, Arrhenius model

1. Introduction

Hastelloy C-276 is a Nickel-based superalloy originally produced by Haynes International Company™. The alloy has high fraction of Chromium and Molybdenum (combined around 30%wt) making it highly corrosion resistant. This solid solution strengthened(from other alloying elements such as tungsten, cobalt, Iron) single-phase alloy exhibits high mechanical properties that are also retained at higher temperature [1, 2]. It is this superior combination of corrosion and mechanical properties at high temperatures along with good weldability that makes this alloy an important material system in chemical and power industries. It is also being actively considered as one of

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