

Accepted Manuscript

Hot deformation characterization of nickel-based superalloy UNS10276 through processing map and microstructural studies

Enxiang Pu, Wenjie Zheng, Zhigang Song, Han Feng, Han Dong



PII: S0925-8388(16)33137-1

DOI: [10.1016/j.jallcom.2016.10.029](https://doi.org/10.1016/j.jallcom.2016.10.029)

Reference: JALCOM 39196

To appear in: *Journal of Alloys and Compounds*

Received Date: 16 July 2016

Revised Date: 11 September 2016

Accepted Date: 4 October 2016

Please cite this article as: E. Pu, W. Zheng, Z. Song, H. Feng, H. Dong, Hot deformation characterization of nickel-based superalloy UNS10276 through processing map and microstructural studies, *Journal of Alloys and Compounds* (2016), doi: 10.1016/j.jallcom.2016.10.029.

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Hot deformation characterization of nickel-based superalloy UNS10276 through processing map and microstructural studies

Enxiang Pu^{a, b, *}, Wenjie Zheng^b, Zhigang Song^b, Han Feng^b, Han Dong^b

^a School of Materials Science and Engineering, Tsinghua University, Beijing 100084, China

^b Special Steel Institute, Central Iron and Steel Research Institute, Beijing 100081, China

Abstract: The deformation characteristics of nickel-based superalloy UNS10276 at elevated temperature were investigated by employing hot compression tests at temperatures of 950 °C to 1250 °C and strain rates between 0.01 s⁻¹ and 10 s⁻¹. The microstructures of all samples deformed were characterized by electron backscatter diffraction (EBSD) to evaluate the softening mechanisms of alloy UNS10276. Both peak flow stress and peak strain were found to increase with increasing Zener-Hollomon parameter. The average activation energy was determined as 480 kJ/mol. Processing maps at true strains of 0.1 to 0.9 were developed using the experimental flow stress data. To maintain relatively lesser extent of instability, the amount of strain for hot working of alloy UNS10276 should be controlled in the range of 0.2 to 0.5. Based on processing map and microstructural observation, the optimum hot working window, in which the alloy UNS10276 exhibited a significant dynamic recrystallization (DRX), was identified as 1000-1220 °C and 0.07-2.2 s⁻¹. Two instability domains were delineated in the processing map. The first one occurred at temperatures lower than 1180 °C and strain rates higher than 5 s⁻¹ and was manifested in the form of microbands, deformation twins and lower degree of DRX. The second one occurred at temperatures ranging from 1035 °C to 1250 °C and strain rates below 0.06 s⁻¹, for which the occurrence of dynamic strain aging (DSA) and secondary work hardening were responsible.

Keywords: Hot deformation; Superalloy UNS10276; Processing map; Microstructure; Dynamic recrystallization

1. Introduction

Nickel-based superalloy UNS10276, a solid solution strengthening alloy with face-centered-cubic structure, is known for its exceptional combination of corrosion resistance and high temperature strength, and has been used as the rotor and stator shielding in the nuclear reactor coolant pump of AP1000 advanced passive plant [1]. It has been, moreover, considered as a candidate material for fuel cladding in future Generation-IV Supercritical Water-Cooled Reactors. It also finds wide applications in chemical processing, pollution control and aerospace industries [2]. For the successful application of the alloy UNS10276 in nuclear industries, hot deformation such as forging and rolling plays a significant role in manufacturing critical component with high quality. However, because of containing a significant number of refractory elements, such as Mo and W, along with other alloying elements, such as Cr, Fe and Co, both hot strength and critical temperature for recrystallization of the alloy UNS10276 are higher than ordinary nickel-based alloy [3-5] and typical austenitic stainless steels [6-8]. The hot working temperature range for this alloy tend to be narrow, which inevitably increases difficulty in deformation at elevated temperature, and hence great care must be exercised during hot working to achieve satisfactory results.

Hot workability is commonly defined as the ease with which metals and alloys plastically deform at high temperatures without being subject to the risk of flow localization or fracture [9].

* Corresponding author. Tel.: +86 10 6218 2934.

E-mail address: pexsinghua@163.com (E. Pu).

Download English Version:

<https://daneshyari.com/en/article/5460950>

Download Persian Version:

<https://daneshyari.com/article/5460950>

[Daneshyari.com](https://daneshyari.com)