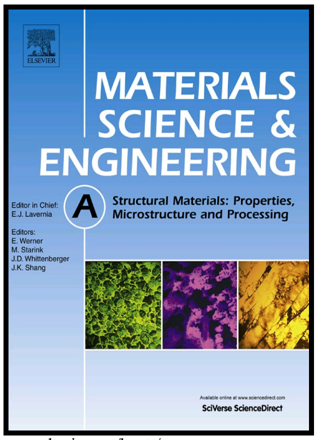
Author's Accepted Manuscript



www.elsevier.com/locate/msea

Plastic deformation behavior of Spray Formed Superalloy FGH100

Hai-Xin Wu, Chang-Chun Ge, Qing-Zhi Yan, Min Xia, Tian Tian, Zhi-Li Zhu, Qi-Peng Hu

PII: S0921-5093(17)30224-1
DOI: http://dx.doi.org/10.1016/j.msea.2017.02.063
Reference: MSA34739

To appear in: *Materials Science & Engineering A*

Received date: 11 November 2016
Revised date: 13 February 2017
Accepted date: 17 February 2017

Cite this article as: Hai-Xin Wu, Chang-Chun Ge, Qing-Zhi Yan, Min Xia, Tiar Tian, Zhi-Li Zhu and Qi-Peng Hu, Plastic deformation behavior of Spray Forme Superalloy FGH100, *Materials Science & Engineering A* http://dx.doi.org/10.1016/j.msea.2017.02.063

Plastic deformation behavior of Spray Formed Superalloy FGH100

Hai-Xin Wu, Chang-Chun Ge*, Qing-Zhi Yan, Min Xia, Tian Tian, Zhi-Li Zhu, Qi-Peng Hu

School of Materials Science and Engineering, University of Science and Technology Beijing, Beijing 100083, China

*Corresponding author: Chang-Chun Ge, E-mail: ccge@mater.ustb.edu.cn

Abstract

Hot compression tests of hot isostatic pressed (HIPped) spray formed (SF) nickel-base superalloy were carried out in the temperature range of 1050-1150℃ at strain rates of 0.001-1s^{-1}, between 10-70% of engineering strain, using a Gleeble-1500 thermal simulator. Thereafter, the flow curve was developed and the constitutive equation of flow stress during hot deformation was established. The results show that the flow stress decreases by increasing deformation temperature and decreasing strain rate. Processing maps were developed based on the data obtained using the principles of dynamic materials modeling. The microstructure of deformed samples was characterized using optical and electron microscopy. The processing maps exhibit the stability domain at the temperatures of 1140-1150℃ and strain rate of 0.01 s^{-1}, with a peak efficiency of approximately 50%. High deformation temperature and high strain rate are conducive to the occurrence of dynamic recrystallization. The activation energy of the new Ni-Cr-Co based SF superalloy FGH100 was found to be 866.7 kJ/mol. Besides, the experimental results verify the hyperbolic sine model including strain variable, reflecting the changing law of flow stress during the hot deformation process.

Keywords: Hot deformation, Spray Formed, Superalloy; Processing map; EBSD

1. Introduction

Spray forming (SF) is a novel rapid solidification technique which was developed in recent years at a fast pace. It is widely used for preparing and forming metallic materials with excellent properties, such as stainless steels, aluminum alloys, or titanium alloys[1]. However, there is porosity in the spray formed superalloy deposition billet, which is not good for the stability and reliability of the performance of superalloy[2,3]. In the hot working process of nickel-base superalloys, there are problems, such as narrow hot working window and high deformation resistance[4]. Similar to many other nickel-base superalloys, FGH100 contains large amounts of alloying elements, such as Co, Cr Ti, Al, which often make the microstructure control difficult in the hot working process[5]. The alloy is a newly designed powder superalloy, which has excellent fatigue, high strength and stiffness ratio at room temperature and 705° C. In addition, the mechanical properties of alloys depend on the microstructure which can be controlled by changing deformation temperature, strain and strain rate[6,7]. As a result, hot deformation tests of FGH100 are performed to optimize the hot working parameter and control the microstructure under various conditions. The processing map is used here to couple the deformation conditions with desired