Accepted Manuscript

Effect of stored strain energy heterogeneity on microstructure evolution of 90% cold rolled AISI 304L stainless steel during interrupted annealing treatment

Sailaja Sharma, B. Ravi Kumar, B.P. Kashyap, N. Prabhu

PII: S1044-5803(17)33454-X
DOI: doi:10.1016/j.matchar.2018.03.036
Reference: MTL 9125

To appear in: *Materials Characterization*

Received date: 9 December 2017
Revised date: 1 March 2018
Accepted date: 25 March 2018

Please cite this article as: Sailaja Sharma, B. Ravi Kumar, B.P. Kashyap, N. Prabhu , Effect of stored strain energy heterogeneity on microstructure evolution of 90% cold rolled AISI 304L stainless steel during interrupted annealing treatment. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Mtl(2017), doi:10.1016/j.matchar.2018.03.036

Effect of stored strain energy heterogeneity on microstructure evolution of 90% cold rolled AISI 304L Stainless Steel during interrupted annealing treatment

Sailaja Sharma[a],B. Ravi Kumar[b], B. P. Kashyap[c] and N. Prabhu[a]

[a]Department of Metallurgical Engineering and Materials Science, Indian Institute of Technology Bombay, Mumbai 400076, India

[b]MST Division, CSIR-National Metallurgical Laboratory, Jamshedpur, 831007, India

[c]Department of Metallurgical and Materials Engineering, Indian Institute of Technology Jodhpur, Karwar,342037, India

Email: sailajasharma98@gmail.com

ABSTRACT

This research work is an attempt to understand the effect of stored strain energy heterogeneity over macro-scale, induced during interrupted annealing treatment, on the micro structural evolution in a heavily cold rolled AISI 304L austenitic stainless steel. The cold rolled AISI 304L stainless steel (SS) samples were subjected to different annealing treatments. The microstructures obtained after each annealing treatment were characterized using optical and electron microscopy techniques. Further, an attempt was made to estimate the stored strain energy by a novel approach of micro hardness measurement both over small scale (area 3600 μm^2) and large scale (area ~0.25 mm^2). The stored strain energy was determined using hardness values. Using these data, spatial stored strain energy distribution contour maps were created. They were, in turn, used to characterize the local softening behavior both at micro and macro-scale levels after each interrupted annealing treatment. The results showed that, interrupted annealing treatment induces increased stored strain energy heterogeneity after each annealing interruptions. Also, it was possible to determine recrystallization kinetics of the material using stored strain energy map, which helps in designing annealing cycles for achieving ultrafine grained microstructure.

Keywords- strain heterogeneity, recrystallization kinetics, grain refinement, stored energy, ultrafine grain

1. Introduction

The grain refinement is a method used to simultaneously improve both strength and plasticity of metals, without altering their chemical composition [1]. In recent years, various methods have been employed for the production of ultrafine grain (ufg) materials. These methods are divided