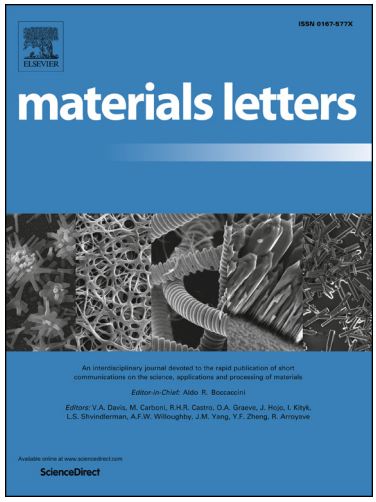

Study of the Austenitic Stainless Steel with Gradient Structured Surface Fabricated via Shot Peening

Yinsheng He, Keun-Bong Yoo, Houyu Ma, Keesam Shin

PII: S0167-577X(17)31779-2
DOI: https://doi.org/10.1016/j.matlet.2017.12.021
Reference: MLBLUE 23519

To appear in: *Materials Letters*

Received Date: 16 October 2017
Revised Date: 3 December 2017
Accepted Date: 5 December 2017

Please cite this article as: Y. He, K-B. Yoo, H. Ma, K. Shin, Study of the Austenitic Stainless Steel with Gradient Structured Surface Fabricated via Shot Peening, *Materials Letters* (2017), doi: https://doi.org/10.1016/j.matlet.2017.12.021

Study of the Austenitic Stainless Steel with Gradient Structured Surface Fabricated via Shot Peening

Yinsheng He[1], Keun-Bong Yoo[1], Houyu Ma[2] and Keesam Shin[2,*]

[1]Clean Power Generation Lab., KEPCO Research Institute, Daejeon 34056, Korea

[2]School of Nano & Advanced Materials Engineering, Changwon National University, Changwon 51140, Korea

*Corresponding to: keesamgg@gmail.com

Abstract

A gradient-structured layer with initially nanoscale grain size increased gradually to original coarse microscale (~50 μm) was fabricated on the surface of austenitic (γ) stainless steel SS304 via ultrasonic nanocrytallization surface modification (UNSM) peening. Modified cross-sectional and depth-specific plan-view (DSPV) sample preparation methods were explored with the analysis scales from macro to atom by synchrotron radiation XRD, EBSD, and TEM to determine the depth (strain) dependent deformation microstructures and grain refinement mechanism. The depth-dependent deformation microstructures were ascribed to strain-induced martensitic-transformed (SIMT) α′- and ε-martensite, deformation nanotwins (NT), and dislocation grids. The grain nanocrystallization mechanism was suggested as the formation of α′ and ε grain boundaries that divided the original coarse grains (CG) to the nanoscale. The strains also appeared to play a key role in the crystallographic orientation relationship (OR) of the γ/α′: Kurdjumov-Sachs (K-S) and Pitsch in low strain region and Nishiyama-Wassermann (N-W) in the high strain region.

Key words: Austenitic steels; Plastic deformation; Shot peening; Gradient microstructure; TEM

1. Introduction

Gradient-structured materials attracted more and more interesting due to their ability to make steels both stronger and more ductile [1], which are traditionally fabricated by surface plastic deformation techniques of milling, grinding and various shot peening methods. The strain-induced formation of gradient structure from the initial bulk material has the grain size from nanoscale increased gradually to microscale from the surface of the material along its depth [1,2]. Shot peening, an UNSM technology, has been proven an effective approach to