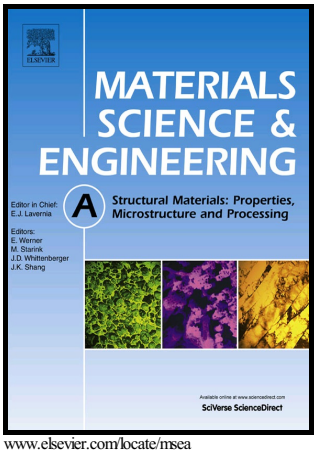
Phase transformation and grain growth behavior of a nanocrystalline 18/8 stainless steel

Hasan Kotan, Kris A. Darling



www.elsevier.com/locate/msea

PII: S0921-5093(17)30039-4
DOI: http://dx.doi.org/10.1016/j.msea.2017.01.031
Reference: MSA34593

To appear in: *Materials Science & Engineering A*

Received date: 13 December 2016
Accepted date: 9 January 2017

Cite this article as: Hasan Kotan and Kris A. Darling, Phase transformation and grain growth behavior of a nanocrystalline 18/8 stainless steel, *Materials Science & Engineering A,* http://dx.doi.org/10.1016/j.msea.2017.01.031

Phase transformation and grain growth behavior of a nanocrystalline 18/8 stainless steel

Hasan Kotan[1*], Kris A. Darling[2]

[1]Konya Necmettin Erbakan University, Department of Metallurgical & Materials Engineering, Konya, 42090, Turkey

[2]U.S. Army Research Laboratory, Weapons and Materials Research Directorate, RDRL-WMM-F, Aberdeen Proving Ground, MD 21005-5069, USA

[*]Corresponding Author: Phone number: + 90 332 336 2144 – 4021, e-mail: hasankotan@gmail.com

Abstract

Fe-18Cr-8Ni and Fe-18Cr-8Ni-1Y (at%) stainless steel powders were nanostructured by mechanical alloying from elemental powders and subjected to 90 min. annealing treatments at various temperatures. The microstructural evolutions as a function of alloy compositions and temperatures were investigated by in-situ and ex-situ x-ray diffraction experiments, transmission electron microscopy and focused ion beam microscopy. The dependence of hardness on the microstructure was utilized to study the mechanical changes. It was found that the resulting microstructures by mechanical alloying were bcc solid solution, the so-called α'-martensite structure. The high temperature in-situ x-ray diffraction experiments showed that the martensite-to-austenite reverse phase transformation was completed above 800 and 900 °C for Fe-18Cr-8Ni and Fe-18Cr-8Ni-1Y steels, respectively. A partial or complete retransformation to martensite was observed upon cooling to room temperature. Annealing of nanocrystalline Fe-18Cr-8Ni steel yielded grain growth reaching to micron sizes at 1100 °C while addition of 1 at% yttrium stabilized the microstructure around 160 nm grain size and 6 GPa hardness after 90 min. annealing at 1200 °C.

Keywords: stainless steels; martensitic transformation; grain growth; phase transformation; high temperature x-ray diffraction; metastable austenite