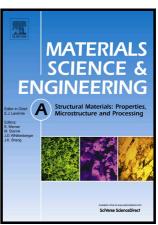
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Phase transformation and grain growth behavior of a nanocrystalline 18/8 stainless steel

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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

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