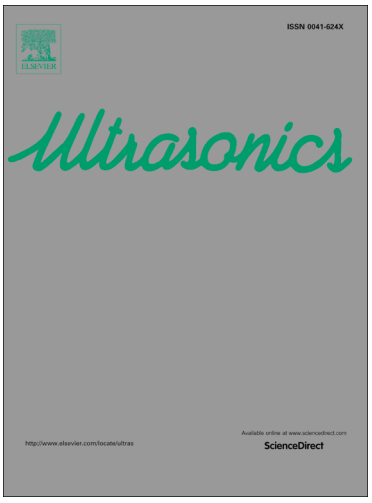

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Microstructure changes in ultrafine-grained nickel processed by high pressure torsion under ultrasonic treatment

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Abstract. Commercially pure nickel was processed by high pressure torsion (HPT) and subjected to ultrasonic treatment (UST) with different amplitudes of compression-tension stresses in the zone of stress antinode of a standing wave. It was found that microstructure parameters such as the dislocation density, low- and high-angle grain boundary fractions, microhardness, and the stored excess energy as well, non-monotonically depend on the ultrasound amplitude. A structure relaxation leading to a reduction of internal stresses and stored energy and increase of the fraction of high-angle boundaries was observed at some intermediate amplitudes of the oscillating stress. The maximum relaxation effect was observed in the samples after UST with the amplitude of 60 MPa. Possible mechanisms of the influence of ultrasound on the microstructure of deformed materials are discussed.

Key words: ultrafine-grained nickel; high pressure torsion; ultrasonic treatment; microstructure; structure relaxation

1. Introduction

The influence of ultrasonic treatment (UST) on the microstructure, mechanical and functional properties of different materials, on deformation processes and various industrial processes has been explored for a fairly long time. A large number of studies have shown that high intensity ultrasonic impact treatment can result in surface hardening of materials [1,2]. More recent experiments have demonstrated that under the surface UST an ultrafine-grained or even nanocrystalline structure is formed that can lead to significant improvements of fatigue behavior of materials [3-6]. On the other hand, application of oscillating stresses during plastic straining of metals results in a significant drop of the flow stress that is known as acoustoplastic effect

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