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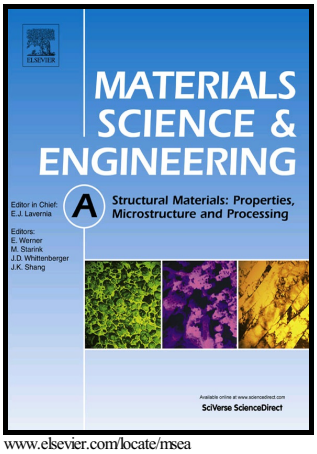

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Effect of temperature rise on microstructural evolution during high-pressure torsion

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Dynamic recrystallization occurs at room temperature during high-pressure torsion (HPT) leading to the formation of ultrafine grains with high angles of misorientation. There are questions concerning whether dynamic recrystallization occurs due to the temperature rise during severe plastic deformation or due to the effect of lattice defects. In this study, the real temperature rise was measured by directly placing a thermocouple separately on disc samples of tin, aluminum, silver, copper and titanium. The measurements, which are consistent with finite element simulations, show that the temperature rise is of minor significance in initiating dynamic recrystallization. A relationship is developed to predict the temperature rise in HPT.

Keywords: dynamic recrystallization (DRX); high-pressure torsion (HPT); severe plastic deformation (SPD); temperature rise; ultrafine-grained (UFG) materials.

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1. Introduction

Severe plastic deformation (SPD) techniques [1,2] are widely used to produce ultrafine-grained (UFG) microstructures in metallic [3,4] and non-metallic [5,6] materials. Although the microstructure is refined significantly in the early stages of SPD, the grain size finally saturates to a steady-state condition at large strains [1-6]. The mechanism for the occurrence of a steady state has been discussed from the early discoveries of Bridgman using the high-pressure torsion (HPT) method [7,8] to recent reviews using different SPD