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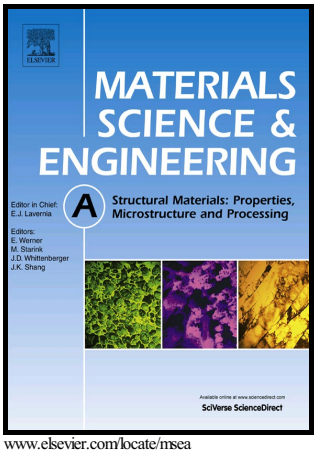

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Influence of microalloying with zirconium on the structure and properties of Cu-Cr alloy after high pressure torsion

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Abstract:

Alloying of binary Cu-Cr alloy with a small amount (0.08%) of zirconium decreases its average grain size from 209 nm to 141 nm after high pressure torsion (HPT). A combination of quenching, HPT and following aging of Cu-Cr-Zr alloy allowes obtaining an ultrafine grained (UFG) structure (grain size: 188 nm) having high strength and sufficient electrical conductivity.

Keywords: Copper alloy, severe plastic deformation, ultrafine grained structure, aging, electrical conductivity

1. Introduction

Low-alloyed copper-based alloys have excellent thermal and electrical conductivity in combination with moderate strength. Thus, they are widely used in the electrical industry. Ternary Cu-Cr-Zr alloys can be significantly hardened by precipitation of both Cr and Zr phases and plastic deformation. There are many reports on precipitation phases and properties of the Cu-Cr-Zr alloys [1-7]. The majority of the reports [5-7] indicate that age hardening of Cu-Cr-Zr alloy is coming from the Cr and Cu_5Zr precipitates. However, age hardening is limited by the solubility of Cr and Zr in the copper matrix [8]. Severe plastic deformation (SPD) can further enhance the strength of these alloys by forming an ultrafine-grained (UFG) structure. Many studies have been undertaken on the effect of equal-channel angular pressing (ECAP) [9-18] and high-pressure torsion (HPT) [19-21] on properties of copper alloys. Along with substantial improvement in strength values of the alloys, SPD improves some functional properties such as wear resistance [16,18], electrical conductivity [9,11,15-17,20] and fatigue life [9-11,12]. However, there are no data for Cu-Cr-Zr alloys after HPT though this method can produce a significantly smaller grain size than ECAP. Thus, HPT is applied to the Cu-Cr-Zr alloy for the first time in this paper. The main purpose of the present study is to investigate the effect of small addition of zirconium on the structure, mechanical properties and thermal stability of Cu-Cr alloy after high pressure torsion.