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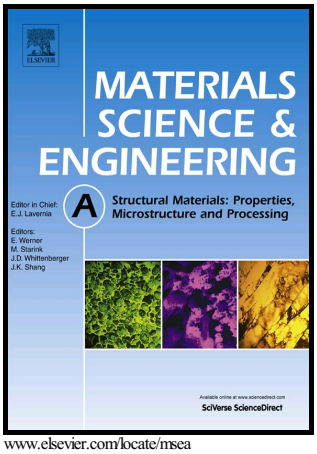

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Micro-mechanical and tribological properties of aluminum-magnesium nanocomposites processed by high-pressure torsion

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Abstract

High-pressure torsion (HPT) is one of the major severe plastic deformation (SPD) procedures where bulk metals, in the shape of a disk, achieve exceptional grain refinement at ambient temperatures. HPT has been applied for the consolidation of metallic powders and the bonding of machining chips whereas there are very limited reports examining the application of HPT for the production of new metal systems and the formation of nanocomposites. Accordingly, this investigation was initiated to evaluate the potential for the formation of a metal matrix nanocomposite (MMNC) by processing two commercial metal disks of an Al-1050 alloy and a ZK60 magnesium alloy through HPT under 6.0 GPa for 20 turns at room temperature. Evolutions in microstructure, mechanical properties including hardness and plasticity and the tribological properties were examined in the MMNC region of the processed Al-Mg system. The significance of post-deformation annealing (PDA) at 573 K for 1 hour was investigated by the change in microstructure and the enhancement in mechanical properties and wear resistance of the HPT-processed MMNC. This study demonstrates the promising feasibility of using HPT to fabricate a wide range of hybrid MMNCs from simple metals and for applying PDA for further improvement of the essential mechanical and tribological properties in the synthesized alloy systems.

Keywords: high-pressure torsion; metal matrix nanocomposite; nanoindentation; post-deformation annealing; tribology

1. Introduction

The synthesis of new materials is now driven by technological issues combined with the restrictions imposed by ecological considerations in a variety of industrial applications [1].