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Finite element simulation and experimental investigation on homogeneity of Mg-9.8Gd-2.7Y-0.4Zr magnesium alloy processed by repeated-upsetting

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Highlights

1. A novel SPD method for producing large size of plate shaped bulk material.
2. A systemic investigation of fields of effective strain, microstructure, and micro hardness to illustrate the homogeneity of RU processing.
3. Microstructure evolution and mechanical properties enhancement of a high performance Mg alloys during RU processing was investigated.

ABSTRACT

A novel severe plastic deformation (SPD) process called repeated-upsetting (RU), which produces homogenous samples of large size, is employed to process a high performance magnesium alloy Mg-9.8Gd-2.7Y-0.4Zr at 350 °C with 1-4 passes. Homogenous microstructure and mechanical properties can be achieved after 4 passes of RU. Experimental and finite-element modeling results show that effective strain accumulation with more passes can improve both grain refinement and micro-hardness of samples.

Keywords: *Severe plastic deformation (SPD); Repetitive upsetting (RU); Finite element modeling (FEM); Magnesium alloys; Homogeneity*

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1. Introduction

Severe plastic deformation (SPD) techniques have been successfully implemented to investigate a variety of materials with exceptional properties (Valiev et al., 2006). It is now well established that significant grain refinement and strengthen enhancement can be achieved in bulk polycrystalline metals through the application of SPD. For example, room temperature