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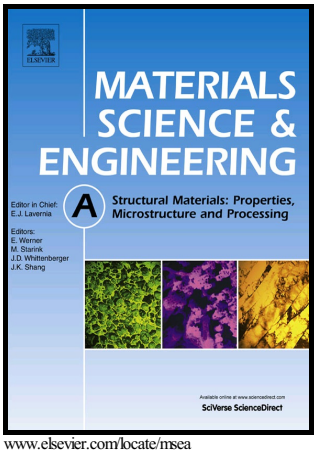

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Effect of strain rate on the recrystallization mechanism during isothermal compression in 7050 aluminum alloy

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Abstract

Isothermal compression tests were carried out on 7050 aluminum alloy at the temperature range of 300°C to 450°C and the strain rate range of $10^{-3}s^{-1}$ to $5\times10^{-6}s^{-1}$. The microstructure of samples was observed using electron backscatter diffraction (EBSD) and transmission electron microscopy (TEM) techniques. Results showed that the recrystallization mechanism changes from continuous dynamic recrystallization (CDRX) to discontinuous dynamic recrystallization mechanism (DDRX) as the Z (Zener-Hollomon parameter) value gradually decreases. For Z values larger than $2.76\times10^{10}s^{-1}$, the dominant mechanism is CDRX and the ratio of high angle grain boundaries (HAGB) is larger than 28%. The mechanisms of DDRX and CDRX are occurred at the same time while the Z value change from $2.76\times10^{8}s^{-1}$ to $4.10\times10^{9}s^{-1}$, and HAGB% is between 28% and 41%. For Z values less than $2.77\times10^{7}s^{-1}$, the mechanism is DDRX and HAGB% is larger than 41%. For isothermal compression at $5\times10^{-6}s^{-1}$ and a temperature of 350°C or 400°C, a large number of fine grains are formed for the growth of these recrystallized grains were hindered, because of the presence of Al3Zr particles, which precipitate during isothermal compression.

Keywords: recrystallization mechanism; Zener-Hollomon; dynamic recrystallization; Al-Zn-Mg-Cu; isothermal compression

1. Introduction

7050 aluminum alloy is a high stacking fault energy alloy, in which dynamic recovery and dynamic recrystallization occur during hot deformation. Many studies have studied dynamic recrystallization in hot deformation, such as hot rolling [1-5], hot extrusion [6-9] and hot forging [10-12]. The grain structure differs greatly among different processing methods and parameters, which contributes to different recrystallization mechanisms. After hot rolling, most of the grain