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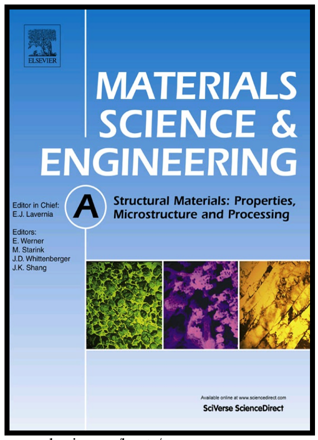

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Texture-dependent character of strain heterogeneity in a Magnesium AZ31 under reversed loading

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Abstract

Depending on operational micromechanisms and crystallographic texture, the innate strain localization at microstructural length scales of a polycrystal can spatially coordinate to induce macroscopic strain localization. A challenge for material performance and modeling, this behavior is observed in wrought Magnesium alloys when they deform with heavy tensile twinning. With in-situ, multi-surface image correlation, a compression-tension experiment is implemented on samples with extrusion and rolling texture that have a consistent 11 μm grain size. While samples of both textures exhibit a clear twin plateau with close stress levels (90/99 MPa for rolled/extruded samples), the strain localization patterns are vastly different, both in terms of geometric structure and intensity. Rolled sample exhibits sharp shear banding structures with a fixed plane of shear. Extruded sample exhibits strain localization that is not in macroscopic $\pm 45°$ shear form and much weaker in intensity (by about a factor of 2). Once the load is reversed and the tensile twin is deactivated, strain accommodation largely homogenizes for both textures during detwinning and subsequent high hardening stages.

Keywords: strain measurement, magnesium alloys, twinnning, strain heterogeneity, shear banding

1. Introduction

The mechanical behavior of textured Magnesium alloys exhibit a very high level of dependence on the loading path [1, 2, 3]. Consequently, highly-distorted stress strain loops result when extruded or rolled components are put under cyclic loading[4, 5, 6]. The primary factor underlying this behavior is the profuse activation of deformation twinning in these hexagonal-close-packed (HCP)

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