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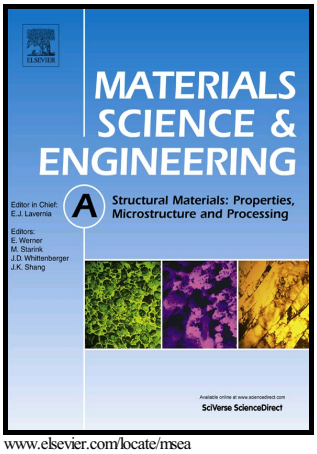

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Microstructure-based modeling of tensile deformation of a friction stir welded AZ31 Mg alloy

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Abstract

The deformation and fracture behaviors of friction stir welded (FSWed) Mg alloys are topics under investigation. The microstructure and texture of a FSWed Mg alloy were characterized by electron back scattered diffraction. Four characteristic sub-zones with different orientations in the FSWed Mg alloy joint were identified. The texture distribution across the stir zones and transition zone were obviously inhomogeneous. For comparison, four sub-regions in the base material were also characterized. Based on the experimental microstructure and texture, a crystal plasticity finite element model was developed to represent the friction stir welded Mg alloy. Simulations were carried out to study the effect of texture variation on the deformation behaviors during transverse tension. Compared with the base material case, strong macroscopic strain localization was observed for the FSWed joint case after transverse tension. Strain localization may have contributed to the decayed elongation of the FSWed joint in the transverse tension. Texture variation in the thermal-mechanical affected zone did not change the deformation mechanism in the stir zones, while it did decrease the strain localization, thus assuming to improve the elongation of the friction stir welded Mg alloy.

Keywords: Mg alloy; Friction stir welding; Crystal plasticity finite element method; Texture; Deformation mechanism

1. Introduction