Contraction Twinning Dominated Tensile Deformation in a Magnesium Alloy at Ambient Temperature

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Motivation
Mg is the lightest engineering metal with high specific strength and stiffness values.

Challenge: Limited cold formability
This is partly due to the limited number of deformation systems. However, additional mechanisms might contribute to limited elongation-to-failure.

Technique: in-situ testing + EBSD analysis
Material studied: Extruded Mg-1Mn (wt%)

Tensile tests were performed at 50°C, 150°C, and 250°C. Slip/twin trace analysis was performed to characterize the deformation mechanisms.

Results: Deformation Behavior

The aim of the study is to investigate the mechanisms that contribute to limited elongation-to-failure.

- Slip mechanisms dominated the deformation at 150°C and 250°C
- Contraction twinning dominated the deformation at 50°C
- Improved elongation-to-failure was observed at elevated temperatures

At elevated temperature, the CRSS of pyramidal <c+a> slip becomes lower than that of contraction twinning. Thus, decreased twinning is expected to result in improved elongation-to-failure by limiting shear band formation.

The Evolution of Contraction Twins in to Shear Bands

At ambient temperature, contraction twinning followed by extension twinning results in {10\(\overline{1}\)1}-{10\(\overline{1}\)2} double twin. A shear band is formed in this region due to high Schmid factor for basal <a> slip. This was expected to lead to failure due to shear localization.