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In Situ Analysis of the Effect of Twinning on Deformation and Cracking of Magnesium Alloy

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Abstract : Twinning is an important deformation mechanism of magnesium alloys, but there is no consensus on the relationship between twinning and ductility. To comprehensively understand the effect of twinning on plastic deformation and cracking, the in situ tensile tests of a magnesium alloy sample along its extrusion direction were conducted, accompanied by the observations using scanning electron microscopy (SEM) and electron backscattered diffraction (EBSD). The misorientation angles around specific axes and trace analysis of grains were used to identify the active twinning systems. The results show that the area fraction of tension twins increases with the increasing strain, resulting in the c-axes of most grains rotating from the normal direction to the transverse direction, and the intensity of (0002) pole is weakened. Based on the analysis of kernel average misorientation (KAM) and SEM maps, it is found that the appearance of tension twins accommodates plastic deformation. However, the stress concentration caused by the intersection of tension twinning with the second phase can lead to crack initiation, and the crack propagates along the direction perpendicular to the tension twinning. For contraction twinning, it plays a role in plastic relaxation and improving strain compatibility during deformation, and is not a necessary potential mechanism of crack nucleation.

Keywords : magnesium alloy, cracking, in-situ EBSD, twinning
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