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A Dislocation-based Crystal Plasticity FE Analysis on Mechanisms of Kink Band Formation in Mg-based LPSO Phase

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Mg alloys with long-period stacking ordered (LPSO) phases show excellent mechanical properties such as high specific strength. It is considered that these superior properties are attributed to formation of kink bands in LPSO phases during material processing and these kink bands may be formed by basal dislocation glides. Therefore, it is expected to reveal the formation mechanism in the view of numerical analysis based on crystal plasticity theory considering crystal defects. In this study, we develop a dislocation-based crystal plasticity model suitable for LPSO phase taking account of characteristics of LPSO phase such as strong anisotropy and plate-like shape. Using this model, we demonstrate FE analyses for a Mg-based LPSO phase to reproduce computationally deformation kink and investigate accumulations of geometrically necessary (GN) dislocation and incompatibility. In addition some numerical simulations for polycrystalline LPSO are carried out and we attempt to clarify the mechanism of strengthening of LPSO phase.

Keywords: Deformation kink, LPSO phase, Magnesium alloy, Crystal plasticity, FEM