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Numerical Analysis of Large Strain Simple Shear and Fixed-End Torsion of HCP Polycrystals

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Summary

Large strain homogeneous simple shear of Hexagonal Close Packed (HCP) polycrystals is first studied numerically. The analyses are based on the classical Taylor model and the Visco-Plastic Self-Consistent (VPSC) model with various Self-Consistent Schemes (SCSs). In these polycrystal plasticity models, both slip and twinning contribute to plastic deformations. The simple shear results are then extended to the case of solid circular bars under large strain fixed-end torsion, where it is assumed that the solid bar has the same mechanical properties as the element analyzed for large strain simple shear. It is shown that the predicted second-order axial force is very sensitive to the initial texture, texture evolution and the constitutive models employed. Numerical results suggest that the torsion test can provide an effective means for assessing the adequacy of polycrystal plasticity models for HCP polycrystalline materials.