Investigation of the effect of initial stress on the following macro-micro plasticity behavior with finite element & self consistent coupled numerical simulation

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Summary

Large numbers of micro lattice plastic deformation of grains set up the macro plastic deformation of polycrystal metallic materials under different macro boundary condition. And the macro homogeneous deformation is in fact the statistical result of micro anisotropic lattice plastic flow. Both of the macro and micro deformation were influenced by intrinsic initial stress, which was intrinsic in the component from micro scale impurity to macro scale non-uniform deformation. In this paper, focused on the engineering application and further damage evaluation, effect of macro initial stress on the macro and micro plasticity deformation of sample under uniaxial tension was discussed with coupled FE(finite element) & SC(self consistent) model. To enhance the calculation efficient, classical Mises constitutive equation with isotropic hardening was used in macro plastic simulation and to investigate the micro anisotropic lattice strain distribution self-consistent model was used by taking the macro stress and strain from FE as the micro boundary condition to set up the multi-scale macro-micro plastic deformation relationship. Simulation results indicate that initial stress plays an important role in the following macro and micro plastic deformation and influence the damage behavior of the materials greatly.