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Modeling of the Damage Evolution at the Granular Scale in Polycrystals under Complex Cyclic Loadings

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A multi-scale model of damaged elasto-inelastic behavior is proposed to predict the plastic fatigue life for FCC metallic polycrystals under multiaxial loading paths. This model is expressed in the time dependent plasticity for a small strain theory. It is assumed that the damage variables initiate and then evolve at the grain level in the polycrystal where the phenomenon of the localized plastic deformation occurs. The totally damaged polycrystal is defined by a probabilistic approach. In this work, the model is tested under different multiaxial cyclic loading situations (tension-compression and tension-torsion with different out-of-phase angles) to show the effect of the loading paths on the fatigue life of polycrystals. As a conclusion, the model can appropriately describe the overall and local damaged behavior of polycrystals.

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