Grain-size effect in 3D polycrystalline microstructure including texture evolution

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A finite element analysis of the large deformation of 3D polycrystals is presented adopting continuum slip theory and strain gradient plasticity. Based on a rate-independent constitutive model, the mechanical properties and the texture evolution of polycrystals are investigated. The orientation distribution function is evaluated based on a discrete algorithm in the Rodrigues space. The grain size effect, due to geometrically necessary dislocations, on the hardening with multilength parameters is analyzed. A domain decomposition approach is adopted for parallel computation to allow efficient large scale simulations of realistic microstructures. Numerical examples are presented and verified. This work is incorporated in a multiscale simulation framework through a homogenization hypothesis.