Role of Grain Boundary Sliding in Texture Evolution for Nanoplasticity

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Grain boundary sliding (GBS) is an important deformation mechanism in superplastic forming, in powder processing, and also in nano-polycrystalline materials. A crystal plasticity model is proposed to account for the effect of GBS on texture evolution during plastic deformation of nanocrystalline materials. In the model, flat grain boundaries are assigned for each grain and their sliding rates are calculated using Newtonian viscoplasticity. The lattice rotation of the grain interior is computed by taking into account the deformation field modification produced by GBS.

The model was employed for predicting the texture evolution in a nanocrystalline Pd-10 at.% Au alloy subjected to High Pressure Torsion (HPT) and Shear Compression. It is revealed that, as GBS increases, the texture strength decreases while the signature of the texture type remains the same. GBS affects the texture components differently with respect to intensity and angular position. A comparison of the simulation and experiment on this alloy with a 15 nm grain size shows that, at room temperature, the predominant deformation mode is GBS contributing to strain by around 60%.