Mesoscale Simulation of Texture Evolution in Particle-Containing Aluminum Alloys[1]

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It is well known that under certain deformation conditions coarse particles cause the formation of local deformation zones that contain random crystallographic orientations that differ significantly from the specific deformation components that are produced in the absence of particles. Upon subsequent annealing, nuclei of random orientations form in the vicinity of the particles, and their subsequent growth during recrystallization introduces a random texture component that weakens the cube texture in commercial aluminum alloys. The extent of such weakening depends on the relative growth kinetics of the random component compared to the cube and other deformation components. The objective of this study is to understand through mesoscale modeling the formation of random texture components during deformation and recrystallization of polycrystalline aluminum containing coarse, non-deformable particles. The effect of microstructural location of the particle such as grain interior, grain boundary or triple line, and the effect of local grain orientation(s) on the formation and growth of texture components will be simulated using single crystals, bi-crystals or tri-crystals of specific orientations. The mesoscale modeling will be based on coupling a grain-level deformation simulation based on crystal plasticity approach with a Monte Carlo simulation of recrystallization. The simulation results will be used to develop nucleation criteria for random texture components. The nucleation criteria will then be used to simulate the texture evolution during deformation and recrystallization of a polycrystalline grain structure that contains a known volume fraction of hard particles distributed at various microstructural locations.

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