Effect of Texture on Evolution of Lattice Stress in Polycrystalline Solids under Elastoplastic Deformation

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In polycrystalline solids, lattice stress direction has strong dependence on the crystal orientation. In particular, during plastic flow, to satisfy the compatibility of complex deformation of neighboring crystals, lattice stress directions tend to move toward the vertices of single crystal yield surface. Preferred orientation (texture) in polycrystalline solids is also closely linked to anisotropic material properties. In this research, the effect of texture on the behavior of lattice stress during plastic flow is investigated using finite element analysis incorporating crystallographic slip. Three sets of materials are examined, specimens with a) random texture, b) deformation texture, c) deformation texture combined with recrystallization texture. The lattice stress evolutions among the three cases are compared, and the effect of texture on the elastoplastic behavior of aluminum polycrystalline solids is examined. The comparison of simulation results with experimental results from X-ray synchrotron is planned as a future work.

Keywords: Texture, Elasticity, Plasticity, Lattice stress, Finite element analysis