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A STUDY ON LATTICE ROTATION OF POLYCRYSTALLINE FCC METALS USING HOMOGENIZATION-BASED APPROACH

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In this study, a crystal plasticity analysis of FCC polycrystal using the homogenization-based finite element method is conducted. An important advantage of the crystal plasticity approach is that the rotation of a crystal lattice, i.e., texture development, can be directly calculated.

The polycrystalline FCC metal with a randomly distributed texture is subjected to the uniaxial tension. As for polycrystalline mode, both the Taylor model and homogenization-based FEM are adopted for comparison. Histograms of the lattice rotations at a macroscopic true strain of 100% are shown in Fig. 1. The histograms clearly show that the Taylor model underestimates the lattice rotations at a 100% true strain. The trajectory of each crystal orientation is pursued during deformation, and those after plane stress tension of 20% true strain with random texture are plotted on <111> pole figure in Fig. 2. Black circles denote initial orientations. Blue and red lines represent trajectories of <111> plane obtained by the Taylor model and the homogenization-based finite element method, respectively.

Textures developed by the Taylor model appear to be sharper than those predicted with the homogenization-based finite element method. This does not mean that the lattice rotations are larger in the Taylor model analysis than in the homogenization-based finite element analysis. Crystal grains tend to rotate towards specific orientations rather quickly in the Taylor model

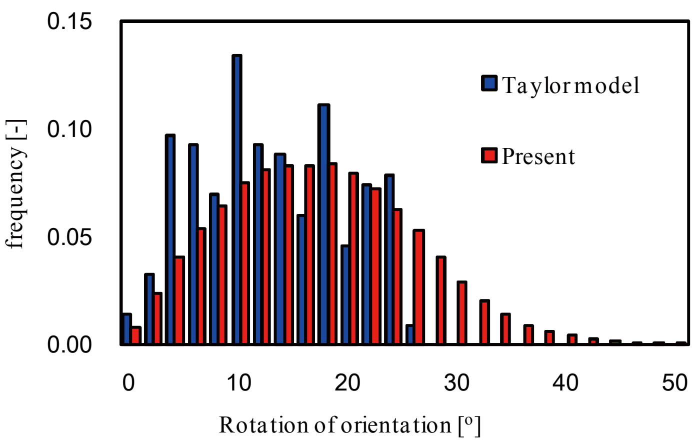

Fig. 1 Histogram of rotation of crystal orientation at 100% true strain with random texture under the plane stress condition.

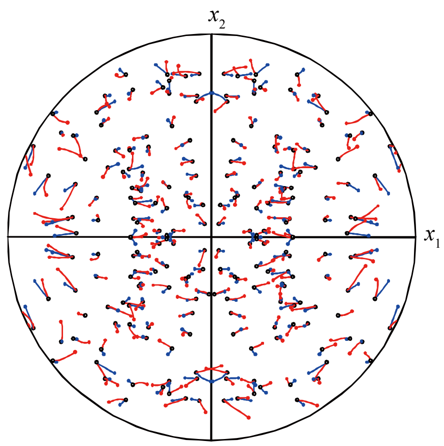

Fig. 2 Trajectories of each crystal orientation on {111} pole figure after plane stress tension of 20% true strain with random texture.

analysis. Consequently, the amounts of lattice rotations are smaller, but the predicted textures become sharper. The homogenization-based finite element method gives generally greater lattice rotations. Some grains rotate farther than their preferred orientation, and thus the consequent textures after deformation appear to be more scattered than those predicted by the Taylor model

REFERENCES

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