
Analysis of texture and dislocation evolution of pure copper by in situ neutron diffraction and crystal plasticity modeling

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Abstract

Copper and copper alloys have excellent electrical and thermal conductivity despite their relatively low mechanical strength. By controlling the microstructure, the strength of copper and copper alloys can be increased without compromising their electrical and thermal properties. Therefore, analysis and modeling of the microstructure or texture during the manufacturing process is important to predict the properties. In this study, evolution in texture and dislocations in pure copper during tensile deformation have been investigated using the neutron diffraction method. The diffraction experiments were performed at the iMATERIA beamline at J-PARC (Japan Proton Accelerator Research Complex). The Rietveld-Texture Analysis (RTA) method (r1) was used to evaluate the microstructural changes. The dislocation characteristics were analyzed using the convolution multiple profile fitting (CMWP) method for dislocation density, dislocation arrangement parameters, and q parameters related to components of edge and screw dislocations (r2). Furthermore, we utilized the finite element method based on crystal plasticity model to understand the results obtained by in situ diffraction measurements. These results showed the characteristics of the texture and dislocation evolution are reasonably explained by modifying the crystal plasticity model for pure polycrystalline copper.

(r1) Y. Onuki, et al., J. Appl. Crystallogr., (2016).

(r2) G.Ribárik, J.Gubicza and T.Ungár: Mater. Sci. Eng. A, 387-389(2004), 343.

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