Evaluation of Orientation Dependent Dislocation Density in Cold Rolled Pure Iron Using Neutron Diffraction and EBSD

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Abstract

This study presents evaluation methods of orientation dependent dislocation density of heavily cold-rolled pure iron by means of two approaches. In the first approach, the geometrically necessary dislocation (GND) density was evaluated by kernel average misorientation analysis of restricted orientation area using SEM-EBSD method modified from Kamaya's method (1). By combining with the orientation determination at each scanning point, the GND density distribution is shown in stereographic projection. In the second approach, the total dislocation density, i.e. the sum of GND and statistically stored dislocation densities, was evaluated by line profile analysis using TOF neutron diffraction at J-PARC MLF BL20 (iMATERIA). By controlling geometry between sample and measurement system, a wide range of diffraction vector is covered one by one which gives the dislocation density map by stereographic projection. These two evaluations indicate the dislocation density differed by more than one order of magnitude depending on crystal orientation. This newly established methods allow us to understand orientation dependency of dislocation density visually and quantitatively, and it is to be effective as a new tool for texture analysis.
(1) M. Kamaya, Ultramicroscopy 111 (2011) 1189-1199.
(2) T. Tanaka, et al. CAMP-ISIJ 35 (2022), 293, CD-ROM.

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