Dislocation Densities and Slip-Mode Distributions in Different Texture Components of Plastically Deformed hcp Materials

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Abstract

Structural materials with *hcp* crystal structure have wide applications in the nuclear, automotive or aviation industry. Materials with *hcp* structure are usually textured. Due to the limited operative slip-systems the dislocation structure can be different in the different texture components. In the present work we show that the convolutional multiple whole profile (CMWP) line profile analysis (LPA) method, in combination with the MTEX texture procedure can be used to determine the dislocation structure in texture components in *hcp* materials. Measured diffraction peaks may consist of contributions from grains belonging to different texture components, and only specific peaks consist of diffraction from grains belonging to one specific texture component. Reflections of this type are selected from diffraction patterns and are collected from diffraction patterns obtained from various sample orientations. We varied both the incident angle of the X-ray beam on the sample surface and the azimuthal orientation of the sample around the plane of incidence of the x-ray beam. The peaks corresponding to one specific texture component, with a percentage threshold selected slightly below unity, were collected from the patterns measured at different sample and beam orientations and merged into a single pseudo-pattern. The results of two Zr specimens, one tensile deformed in the rolling and the other in the transverse direction from a cold-rolled plate, will be presented. The pseudo-patterns related to specific texture components are evaluated for dislocation densities and prevailing slip systems. We found that in both specimens the $< a>$ -type dislocation density decreases and the $< c+a>$ -type dislocation density increases with strain. The $< c>$ -type dislocation density is found to be almost zero in both samples, in good correlation with other experiments (1). 1. Z. Fan, B. Jóni, L. Xie, G. Ribárik, T. Ungár, *J. Nucl. Mater.* 502 (2018) 301-310.

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