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Dislocation structure in textured Zirconium tensile-deformed along rolling and transverse directions determined by X-ray diffraction line profile analysis

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Abstract

Specimens of cold-rolled Zirconium were tensile-deformed along the rolling (RD) and the transverse (TD) directions. The stress-strain curves revealed a strong texture dependence. High resolution X-ray line profile analysis was used to determine the prevailing active slip-systems in the specimens with different textures. The reflections in the X-ray diffraction patterns were separated into two groups. One group corresponds to the major and the other group to the random texture component, respectively. The dislocation densities, the subgrain size and the prevailing active slip-systems were evaluated by using the convolutional multiple whole profile (CMWP) procedure. These microstructure parameters were evaluated separately in the two groups of reflections corresponding to the two different texture components. Significant differences were found in both, the evolution of dislocation densities and the development of the fractions of <*a*> and <*c*+*a*> type slip systems in the RD and TD specimens during tensile deformation. The differences between the RD and TD stress-strain curves are discussed in terms of the differences of the microstructure evolution.

Keywords: tensile deformed Zr, texture, dislocation densities, X-ray line profile analysis

Highlights: