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Microstructural and Textural characterization of Zircaloy-4 processed by rolling at different temperatures

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Abstract

In the present work, the effect of rolling at room (298 K) and cryogenic temperatures (77 K) on the microstructural and textural evolution of the as-received Zircaloy-4 bar along the planes parallel to the extrusion direction (ND - ED) and in the transverse direction (ND - TD) has been investigated. The as-received Zircaloy-4 was subjected to various rolling reductions of 25%, 50%, 70% and 90% which is corresponding to true strains of 0.29, 0.69, 1.2, and 2.3, respectively. A detailed analysis of microstructures and textures of the deformed alloy has been carried out through the electron backscattered diffraction (EBSD) and the XRD texture. Microstructures and textures of the samples rolled along the extrusion direction (ND - ED) at lower strains showed a few extension twinning ($\{10\bar{1}2\}\langle\bar{1}011\rangle$) along with <a> prismatic slip at room temperature, and a combination of extension twinning, <a> prismatic, <c+a> pyramidal, and basal slips at cryogenic temperature. While along the transverse direction (ND - TD), at lower strains, extension twinning exhibited a dominant role at both the temperatures. This was eventually changed to slip dominant activity (<a> prismatic, <c+a> pyramidal and basal) from medium to high strains along both the directions (extrusion & transverse) at both the temperatures (RT & CT).