Influence of gradient microstructures on the texture and mechanical response in pure cobalt

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Abstract

Nickel-based superalloys are widely utilized in extreme environments owing to their excellent mechanical properties at elevated temperatures. Although cobalt-based superalloys exhibit superior hot corrosion resistance and enhanced repairability compared to their nickel counterparts, their application is restricted to low-stress environments such as non-rotating vanes and nozzles due to inherent limitations in mechanical properties. Enhancing the mechanical properties of cobalt alloys enables their substitution for nickel-based superalloys in higher-stress applications. The implementation of gradient microstructures, incorporating both fine and coarse grains, along with controlled texture, offers a superior balance between strength and ductility compared to a single-component microstructural system, thus presenting an avenue for tailoring microstructures to further enhance mechanical properties. This research presents a comparison of various severe plastic deformation techniques aimed at inducing gradient microstructures in pure cobalt. The observed allotropic FCC to HCP phase transformation found in cobalt is identified as a significant influence on texture gradients and deformation mechanics within these structures. The employed processing pathways generate gradients in grain size, and the observed texture is systematically quantified in relation to the resulting mechanical response.

Keywords: Microstructure, Gradient, Texture, Deformation, Cobalt, EBSD

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