Modelling the effects of texture beta annealing of an alpha-beta Ti alloy

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Abstract

We investigate here, the texture reversion in hot rolled Ti-6V-4Al characteristic for γ-fibre grains, whereby the large highly misorientated grains initially grow discontinuously, but are then consumed by the subgrain matrix. Recent work by Plowman uses a phase-field approach to investigate the fate of these γ-fibre grains, simulating a rogue grain model in a rotated cube subgrain matrix. The rogue grain and subgrains are assigned different GB energy and mobility values to simulate texture effects. Conditions associated with the discontinuous grain growth are analysed in terms of ratios of grain boundary energy, mobility, and the size of the rogue grain relative to that of the subgrain matrix based on Humphreys' mean field model. With a grain-boundary energy ratio set to twice those within the sub-grain matrix, the 2D model was found to be able to replicate the texture reversal, while varying the mobility ratios can significantly affect the lifetime of the γ-fibre. Notably, a broad range of lifetimes for the anomalous grains was also observed in microstructural realisations produced under the same parameters. Recently, we have found through further analysis, no link between the nucleus lifetime and the initial immediate environment (i.e., the density of grain boundaries in the vicinity of the rogue grain). However, the nucleus lifetimes were found to increase significantly with weaker sub-grain matrix textures, in some cases, completely avoiding the growth reversal. When employed on a 3D model, we found a much smaller radius was needed to obtain an overall size advantage necessary for discontinuous growth in comparison to the 2D model used previously. Subsequent work shall see the model being developed further to elucidate factors controlling abnormal grain growth.

Keywords: phase, field simulation, discontinuous grain growth, Ti, 6, 4, texture, gamma fibre

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