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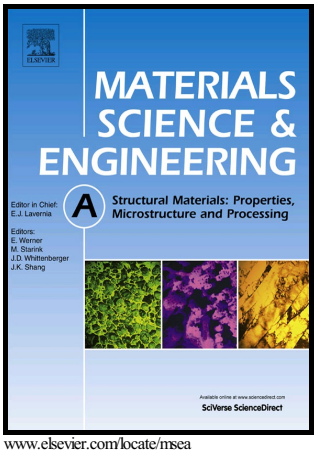

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The Effect of Strain Distribution on Microstructural Developments during Forging in a Newly Developed Nickel Base Superalloy

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Abstract

In the current study, the effect of strain distribution in a simple forging geometry on the propensity for recrystallisation, and its impact on mechanical properties has been investigated in a newly developed experimental nickel-based superalloy. The new alloy was produced via a Powder Metallurgy (PM) route and was subsequently Hot Isostatic Processed (HIP), isothermally forged, and heat treated to produce a coarse grain microstructure with average grain size of 23-32 μm. The alloy was examined by means of Electron Back-Scatter Diffraction (EBSD) to characterise the microstructural features such as grain orientation and morphology, grain boundary characteristics and the identification of potential Prior Particle Boundaries (PPBs) throughout each stage of the processing route. Results at the central region of the cross-section plane parallel to the loading direction showed significant microstructural differences across the forging depth. This microstructural variation was found to be highly dependent on the value of local strain imparted during forging such that areas of low effective strain showed partial recrystallisation and a necklace grain structure was observed following heat treatment. Meanwhile, a fully recrystallised microstructure with no PPBs was observed in the areas of high strain values, in the central region of the forging.