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Abstract

A microstructure-based model is presented to predict the fatigue life of polycrystalline metallic alloys which present a bilinear Coffin-Manson relationship. The model is based in the determination of the maximum value of a fatigue indicator parameter obtained from the plastic energy dissipated by cycle in the microstructure. The fatigue indicator parameter was obtained by means of the computational homogenization of a representative volume element of the microstructure using a crystal-plasticity finite element model. The microstructure-based model was applied to predict the low cyclic fatigue behavior of IN718 alloy at 400°C which exhibits a bilinear Coffin-Manson relationship under the assumption that this behavior is triggered by a transition from highly localized plasticity at low cyclic strain ranges to more homogeneous deformation at high cyclic strain ranges. The model predictions were in very good agreement with the experimental results for a wide range of cyclic strain ranges and two strain ratios ($R_\varepsilon = 0$ and -1) and corroborated the initial hypothesis. Moreover, they provided a micromechanical explanation for the influence of the strain ratio on the fatigue life at low cyclic strain

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