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Influence of microstructure variability on short crack growth behavior

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ABSTRACT

Fatigue life in metals is predicted utilizing regression analysis of large sets of experimental data. Furthermore, a high variability in the short crack growth (SCG) rate has been observed in polycrystalline materials, in which the evolution and distribution of local plasticity is strongly influenced by the microstructure features. We aim to identify relationships between the crack driving force and the materials microstructure; specifically addressing variability of microstructure features and slip activity near a crack-tip as a means to account for the variability in the SCG behavior. To investigate the effects of microstructure variability on the SCG rate, sets of different microstructure realizations are constructed, in which cracks of different length are introduced to mimic quasi-static SCG. Through fatigue indicator parameters within crystal plasticity models, scatter within the SCG rates is related to variability in the microstructural features as a means to quantify uncertainty in fatigue behavior.