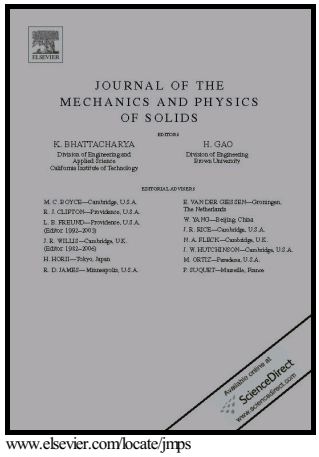

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Separating Plasticity-Induced Closure and Residual Stress Contributions to Fatigue Crack Retardation Following an Overload

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Abstract

The introduction of an overload or underload within a constant amplitude loading fatigue test leads to a retardation or acceleration of the Fatigue Crack Growth Rate (FCGR). The understanding of the causes of these effects is essential in the context of variable amplitude fatigue loading, since in principle any loading history can be represented as a sequence of overloads and underloads. In the case of overload, along with some other minor causes, the residual stress changes at the crack tip and crack closure behind the tip can be thought of as the main factors that affect the fatigue crack growth rate. Whilst this has been recognised and accepted for many decades, controversy persists regarding the relative significance and presence of these two effects, and consensus is yet to emerge. The effect of crack closure, when the baseline loading ratio is high enough, can be inhibited so that the main cause of retardation becomes doubtless the residual stress present ahead the crack tip.

In the present paper we report our attempt to deconvolve the contributions of crack closure and residual stress on crack retardation following an overload. To accomplish this task we analyse the results of fatigue tests run at two baseline load ratios, namely R=0.1 and R=0.7. At the load ratio of R=0.7 the crack closure effect is not operative, as confirmed by Digital Image Correlation analysis of