Differences in fatigue crack growth between L-T and S-T orientations in an aluminium 7050-T7451 plate

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Abstract

This study is focused on the anisotropic fatigue crack growth (FCG) behaviour of an aluminium AA7050-T7451 plate. L-T and S-T orientations were studied in M(T) samples with W=50 mm, in mode I loading, with R-ratio of +0.05. A numerical approach was used, assuming that crack tip plastic strain is the crack driving force. A purely kinematic elastic-plastic model was calibrated using experimental data from low cycle fatigue tests of smooth specimens in L and S orientations. The predicted FCG rates agree well with experimental trends in the Paris' regime, suggesting that cyclic plastic deformation is the main damage mechanism. The numerical model was used to estimate the stress ratio effect for both orientations, which was found to be linked with crack closure variations. However, the closure free predicted trends for both microstructural orientations at R=0.05 are not overlapped, suggesting an effect of microstructure not linked to crack closure.

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