A sectional critical plane model for multiaxial high-cycle fatigue life prediction

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Abstract

A stress-based sectional critical plane model for multiaxial fatigue life prediction is proposed. The proposed model considers the effects of material properties and loading paths on the crack initiation and propagation behaviors. By introducing the ratio of maximum shear stress amplitude to maximum normal stress amplitude, it is divided into three sections in which the maximum normal stress plane, maximum damage plane and maximum shear stress amplitude plane are considered as the critical planes, respectively. To verify the accuracy and applicability of the proposed model, experimental data of 30CrMnSiA steel conducted by the authors and other test data of different materials from the existing literatures are utilized. For 30CrMnSiA steel, the prediction results of the proposed model demonstrate that 79.3% and 93.7% of the prediction results are within the ±2 times and ±3 times scatter band of fatigue life. For the experimental data from the existing literatures, more than 85% and 70% of the results predicted by the proposed model are within ±3 times scatter band of fatigue life for steel and aluminum alloy materials, respectively.

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