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Abstract

Aeroengine titanium alloys such as Ti-6Al-4V experience creep-fatigue loading conditions during the critical fighter aircraft operations. To ensure and enhance the reliable application of such alloys, mechanical behaviour across multiple length scales need renewed attention. Hence, in the present investigation, an attempt has been made to study creep-fatigue damage across multiple length scales (microstructure to component level) using damage mechanics methodology for Ti-6Al-4V alloy. This involves ambient creep, fatigue and creep-fatigue experimentation; identification of various parameters for creep and fatigue models; developing a creep-fatigue model and finally application of this model for damage simulation at specimen, component and microstructure levels. At specimen level, creep-fatigue damage has been obtained from simulations and compared with experimental values. A very good comparison has been observed for the applied maximum peak stress range of 925-975 MPa. The creep-fatigue model has also been successful in mapping damage and identifying critical damage locations in component as well as in the microstructure.

Keywords: Creep-fatigue; damage mechanics; multiple length scales