MD-Vol. 94, Proceedings of the ASME Materials Division — 2000
Book of Abstracts
ASME 2000

Abstract

Probabilistic Micromechanical Fatigue Model for High Temperature Materials

Robert G. Tryon

The paper discusses an enhanced analytical modeling approach to characterize and understand fatigue crack initiation and growth in gas turbine engine intermetallics. It is recognized that the design of components subjected to fatigue cannot be based on average material behavior but that designs must consider -3σ or some other appropriate extreme value material properties. Thus, a life prediction capability useful in a design application must address the scatter inherent in material response to fatigue. The paper addresses the scatter in fatigue life of gamma titanium aluminide by investigating the microstructural variables responsible for the scatter and developing analytical and semi-analytical models to quantitatively relate the variables to the response. The model is general and considers the entire range of damage accumulation sequences; from crack nucleation of the initially unflawed structure to final fast fracture. However, the model also allows failure to be defined as any subset of damage accumulation i.e., crack initiation life to a particular crack size or the number of cycles to grow a crack from a particular size to final fracture. The models allows the structural engineer to systematically and quantitatively assess the influence of the material uncertainties on the overall reliability of the structure.