Foreign Object Damage characteristics and their effects on high cycle fatigue property of Ni-based superalloy GH4169

Xu Jia[1], Zi-wen Zhang[1], Chen Ling[1], Xu-ping Lu[2], Rong Jiang[1], and Yingdong Song[1]

[1]Nanjing University of Aeronautics and Astronautics
[2]China Gas Turbine Establishment

November 1, 2021

Abstract

In this study, high-speed ballistic impact tests were conducted on GH4169 alloy samples with the aeroengine compressor blade leading edge feature to simulate the notch-type foreign object damages (FOD). Macroscopic and microscopic characterization of FOD and high cycle fatigue tests were performed to investigate the effect of FOD depth on GH4169 alloy fatigue strength along with numerical analysis using Kitagawa-Takahashi diagram. Results show the incident side of notch-type FOD is relatively smooth, whereas the exit side is rugged. The FOD depth ranges from 0.18mm to 1.33mm, and the fatigue strength of damaged samples is 37.93%˜97.04% of the undamaged samples. As FOD depth increases, damage length, material losses and stress concentration coefficient of the FOD increase significantly along with the increasing adiabatic shear bands, micro voids and cracks, resulting in fatigue strength reduction. Numerical analysis indicates that the Kitagawa-Takahashi diagram can provide a basic model for the design of FOD tolerance.

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