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Multiaxial fatigue investigation of titanium alloy annular discs by a vibration-based fatigue test

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Abstract

A novel vibration-based fatigue experimental system has been established to study the fatigue properties of titanium alloy annular discs in near resonance conditions. The excitation frequency-response curves are experimentally obtained in order to clarify the large amplitude nonlinear vibration characteristics of the discs. Then a vibration-based fatigue test of the discs and the corresponding 10° segment specimens are conducted respectively to obtain the $S-N$ curves and the fatigue limit stresses. A multiaxial fatigue criterion is subsequently proposed to predict the fatigue properties of the discs, which is compared with the present experimental results finally. It is demonstrated that the high-cycle fatigue properties of the discs can be obtained by the present vibration-based fatigue test, which is an in-phase biaxial fatigue test. The fatigue limit stress of the discs can be predicted well by the proposed elliptic multiaxial fatigue criterion together with the fatigue testing results of the corresponding segment specimens.

Keywords: Vibration-based fatigue test; Titanium alloy; Annular disc; Multiaxial fatigue; Nonlinear Vibration

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