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A NEW APPROACH BASED ON METALLOGRAPHIC ANALYSIS AND MICRO HARDNESS TEST ON EVALUATING THE TEMPERATURE OF REUSABLE RAMJET ENGINE

Abstract

Ramjet may be used as the main propulsion unit for the next generation cruise vehicle performed by reusability, which makes the thermal low cycle fatigue and creep fatigue of the thermal protection structure(TPS) of ramjet combustion chamber as one of the most important critical design factors. The reliable evaluation of the thermal fatigue and creep fatigue is based on the precise temperature field distribution and the accurate thermal structure analysis of corresponding stress and strain. However, it is difficult to measure the temperature distribution of the complex TPS in the engine firing test, and unpractical to numerically calculate the temperature under the test conditions. Therefore, the determination of TPS temperature is the key for the fatigue estimation. A new approach, consisting of Metallographic analysis and micro hardness test, is conducted to determinate the temperature of TPS, which has been subjected to several hot tests. The baseline of the approach is to get the relation curves of hardness value and heat treatment under different temperature, and to obtain the database of the metallographic examination of the original material under different ranges of temperature. Comparing the hardness and metallographic analysis of the real TPS to the above curves and database, the results indicate that the TPS suffers from extremely high temperature over 1300K. The approach can efficiently identify the used temperature conditions of TPS, and shows it's feasibility for high temperature fatigue estimation.