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NUMERICAL ANALYSIS OF ENGINE CYLINDER LINER WITH INNER FUNCTIONALLY GRADED THERMAL BARRIER COATING

Abstract

Functionally graded materials composed of ceramic and metal have good performance of high temperature resistance and oxidation resistance. So functionally graded thermal barrier coating has a wide range of application prospect in high temperature engineering fields. In this paper, an engine cylinder liner with inner functionally graded thermal barrier coating was analyzed and the finite element method was adopted to study the temperature and thermal stresses of the engine cylinder liners with inner functionally graded thermal barrier coating. Using empirical formula and existing experimental curves, the average heat transfer coefficients and the average gas temperature inside the cylinder liner were given and the heat transfer coefficient was determined between cylinder liner and frame. Material parameters of the functionally graded thermal barrier coating which is composed of ceramic ZrO2 and alloy steel were assumed to change as a power function along thickness direction of coating. The simulation models of engine cylinder liner were built in ABAQUS analysis software and its thermoelastic analysis was carried on by using the finite element method. The effects of distribution indexes of material parameters and the thickness of functionally graded coating on the temperature and the thermal stresses of liner were discussed. The reasonable distribution indexes of material parameters and the reasonable functionally graded coating thickness were determined. In order to obtain more practical analysis results, the thermoelastic analysis of cylinder liner with functionally graded coatings was also done in the condition of considering temperature dependence of material parameters by using the finite element method and more accurate analysis results were obtained.