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Steady thermal stresses in ceramic-fgm-metal three-layered composite plate under ecbf mechanical boundary

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Abstract

The steady thermal stress in the composite plate made of metal-ceramic with an interlayer of FGM was analyzed by the finite element method and the Sinpson method. The validity of this method was examined. The steady stress distributions during heating process (T_a=850K,T_b=1750K) were obtained. The results are as follows. The influence of increase of FGM layer thickness on the steady thermal stress in the composite ECBF plate is not obvious. When M = 1, thermal stress curve is gentle and smooth, when M = 0.1and 10, the thermal stress curves appear distinct turning point and undulations. With the increase of FGM layer porosity P, the change of thermal stress in the transition region from the pure metal or ceramic to the graded material increases, the thermal stress curves appear sharp angle and reach to peak values, the maximum tensile stress on the surface of ceramic increases three times. The thermal stress in graded plate has no sharp changes and very gentle as compared with that of nongraded plate. The results provide the foundations of theoretical calculation for the design and application of the composite plate.

Key words: *FGM composite plate,steady thermal stress, Finite element method,metal-ceramic,ECBF mechanical boundary*

1. Introduction

Functionally graded material (FGM) is a new type of nonhomogeneous composite material with special properties that is far more advantageous than homogeneous material, therefore, the research of FGM has been one of hot topics in current material science and related field (Tanigerwa, 1995). Because it is used widely in high temperature working environment such as aviation and nuclear reactor, and so on, it is important to analyze the thermal stress filed of body made of the material. Obata (Obata and Noda, 1993) has researched thermal stresses of pure FGM plate by perturbation method. Huang (Huang and Lu, 2003)has finished the thermoelasticity limit analysis of the four-layered composite EFBF plate with an interlayer of FGM by analytical method. Xu (Xu *et al.*, 2005) has solved the calculating problems of the transient

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