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简报

金属蜂窝夹芯板瞬态热性能的计算与试验分析

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Computation and Analysis of Transient Thermal Performance of Metal Honeycomb Sandwich Panels

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摘要 掌握热防护系统(TPS)中热结构超合金蜂窝面板在热环境下的传热隔热特性，是飞行器防热结构设计的先决条件。从镍基高温变形合金蜂窝板隔热试验出发，结合蜂窝板的试验和实际使用环境下的对流换热理论分析，建立了考虑夹芯的辐射、传导和对流传热形式的蜂窝面板的瞬态传热数值计算模型，得出镍基合金蜂窝板在高温下的防热特性。通过与试验结果进行对比，分析了试验误差和不同环境间的修正。讨论了部分蜂窝板设计参数对隔热效果的影响，得到了不同材料常数和蜂窝芯壁厚对隔热效果的影响规律。

关键词： 蜂窝板 热效应 瞬态 有限元方法 金属热防护结构

Abstract： Knowledge of the thermal performance of Ni-based honeycomb sandwich panels in a thermal protection structure (TPS) is a prerequisite for the design of metal thermal protection structures(MTPS). In this article, transient heat analysis of honeycomb sandwich panels is conducted starting from a simulation aerodynamic heating experiment on Ni-based superalloy sandwich panels of GH3039. Based on the theoretical analysis of convection heat transfer of the boundary conditions to the plate faces, simulation of the panel transient heat transfer is obtained. Impacts of the thermal field on metal honeycomb sandwich panels for different environments of underside faces are calculated. Then errors and corrections between the results of the panel in experiment and the panel in a multilayer structure are analyzed. Finally the effect of parameters in the sandwich panel design on the transient thermal performance of the panel is discussed and the influences of material properties and thickness of core wall on transient thermal performance are demonstrated.

Keywords： honeycomb sandwich panels heat performance transient finite element method metal thermal protection structure(MTPS)

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