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### MTPS蜂窝夹芯结构传热性能及热应力分析

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### Analysis of Thermal and Mechanical Properties of Honeycomb Structure of MTPS

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摘要

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**摘要** 对于金属隔热结构的蜂窝夹芯结构的稳态情况, 基于材料的全灰体假设, 同时考虑热传导和热辐射两种传热形式对温度场的耦合作用, 利用热流量守恒建立了蜂窝芯层温度场的非线性积分方程。离散化后利用数值方法得到方程组的数值解。对于美国兰利研究中心的实验结果, 与本文方法的对比计算结果基本吻合。进一步, 利用计算结果讨论了给定面板温度边界情况下, 下面板、柱体层的灰度、蜂窝结构长径比对夹芯温度场的影响。并根据温度场和近似的应力分析模型, 用半解析结果讨论了稳态情况下蜂窝芯层上的热应力。

**关键词:** MTPS蜂窝夹芯结构 全灰体 温度场 灰度 热应力

**Abstract:** In this article, the steady state thermal field and heat stress in metal honeycomb core structures in metal thermal protection structures (MTPS) is analyzed. The coupled influence of two heat transfer forms of thermal conduction and radiation is taken into consideration, and a model of the honeycomb core structure is set up according to the assumption of the whole grey property of all the faces of the structure. By applying the principle of steady-state thermal flux conservation, a non-linear integral equation of the temperature filed in the honeycomb core is derived, whose solution is obtained by numerical method. The calculated data agree well with those obtained by NASA's Langley Research Center in its honeycomb structure experiment. Then the article discusses the impact of the emissivity of the slenderness ratio of honeycomb and the lower face of the sandwich plate on the thermal field of the structure under the boundary condition of given plate temperatures. Finally, by using the temperature field, the thermal stress of the honeycomb core in the steady state is analyzed by an approximate model.

**Keywords:** honeycomb core structure of MTPS whole grey body temperature field emissivity thermal stress

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