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二氧化碳探测仪的热控系统

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Thermal control system of carbon dioxide detection instrument

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摘要 根据二氧化碳探测仪所处的空间环境、结构特点和工作模式, 采用被动热控和主动热控相结合的方法设计了它的热控系统。首先, 介绍了探测仪结构及内热源, 同时分析了探测仪的外热流, 从而得到了热控任务难点。然后, 对探测仪的各个部分进行了热设计, 采用被动热控与主动热控相结合的方式进行了热隔离、热疏导和热补偿;根据探测仪所处的空间环境和采取的热控措施利用TMG软件进行了热分析。仿真分析结果表明, 光学系统主体框架的温度为13.3~21.7 ℃, 满足了设计要求。最后, 通过真空条件下的热平衡试验对热设计进行了试验验证, 试验结果显示光学系统主体框架的温度为13.0~20.3 ℃, 试验值与计算值基本一致, 满足热控指标要求。得到的数据表明提出的热设计方案合理可行。

关键词 : 二氧化碳探测仪, 热控系统, 热设计, 热分析, 热试验

Abstract : According to the structure characteristics and working modes of a dioxide detection instrument and considering its space environments, a thermal control system for the detection instrument was designed by combination of passive thermal control and active thermal control. Firstly, the structure and the internal heat source were introduced, the heat flux of the instrument was analyzed, and the difficulties of thermal control were obtained. Then, the thermal design of the instrument was carried out and the combination method of passive thermal control and active thermal control was used for the thermal isolation, thermal transmission and the thermal compensation. According to the space environment and thermal control measures, a thermal analysis model was constructed and the thermal transfer was solved with a TMG code. The simulation results show that the temperature of the main frame in the optical system is 13.3 ℃-21.7 ℃, which meets the design requirements. Finally, the thermal design was verified with a vacuum thermal balance test and the test results indicate that the temperature of the main frame in the optical system is 13.0 ℃-20.3 ℃. The tested value is in agreement with the calculated ones, which meets the thermal design targets and verifies that the thermal design is reasonable.

Key words : carbon dioxide detection instrument thermal control system thermal design thermal analysis thermal test

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