庞丽娜,徐惊雷,葛建辉.超燃冲压发动机喷管下唇板可调方案[J].航空动力学报,2015,30(7):1685~1690

超燃冲压发动机喷管下唇板可调方案

Scramjet nozzle with adjustable cowl scheme

投稿时间：2014-02-26

DOI：10.13224/j.cnki.jasp.2015.07.021

中文关键词: 超燃冲压发动机 单膨胀斜面喷管 几何调节 俯仰力矩差 风洞试验

英文关键词:scramjet single expansion ramp nozzle geometry adjustment difference of pitch moment wind tunnel experiment

基金项目:国家自然科学基金(90916023)

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中文摘要:

高超声速飞行器在飞行接力点和巡航结束点受喷管冷、热态膨胀状态不同的影响,会产生较大的冷、热态俯仰力矩差,从而对飞行器姿态控制带来较大困难.针对该问题,研究了下唇板可调方案对降低冷、热态俯仰力矩差的有效性,对不同下唇板角度进行数值模拟,得到了喷管性能参数.结果表明:下唇板旋转6°时,设计马赫数*Ma*=4.5下冷、热态俯仰力矩差下降29.57%,推力系数减小0.42%.并且进行了下唇板角度可调方案的风洞试验和对应的数值模拟,对比发现数值模拟结果与试验结果吻合较好,验证了所提出的可调方案及数值模拟结果的正确性.

英文摘要:

The difference of cold/hot pitch moment will result in difficulty of vehicle attitude control when the hypersonic vehicle works at the relay point and cruising end point under the influence of cold and hot expansion conditions. To solve this problem, an adjustable cowl scheme was adopted and investigated, and also proven in effectively decreasing the difference of cold/hot pitch moment. The flow-field with different cowl angles was numerically simulated to obtain the performance parameters of nozzle. The results showed that, when the cowl angle was adjusted to 6°, the difference of cold/hot pitch moment was reduced by 29.57% and the thrust coefficient decreased only 0.42% in design Mach number 4.5. Finally, a wind tunnel experiment was carried out, and numerical simulation was performed based on the conditions of the wind tunnel experiment. The results of the simulation were in good agreement with experiment data, validating the effectiveness and correctness of the adjustment scheme and the results of numerical simulation.

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