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燃烧室结构对固液火箭发动机燃速和性能的影响

Effect of chamber structure on fuel regression rate and performance of hybrid rocket motor

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英文关键词:hybrid rocket motor chamber structure pre-chamber post-chamber draw ratio numerical calculation

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中文摘要:

对不同燃烧室结构固液火箭发动机进行了二维轴对称一体化数值计算,计算结果表明:燃速随前燃室的增长而增大,增幅越来越小,特征速度和真空比冲随前燃室的增长先增大后趋于平稳.后燃室的长度对燃速没有影响,特征速度和真空比冲随后燃室的增长而增大.相同氧化剂质量流率下,药柱长径比不影响燃速沿轴向分布,平均燃速随药柱长径比的增大而增大,增幅越来越小,最终趋于平稳,特征速度随药柱长径比的增大先增大再减小,在长径比为10.0附近达到最大值.相同理论氧燃比下,燃速随长径比的增大而增大,但不影响燃速的分布趋势;燃烧效率随着长径比的增大先减小再增大;实际氧燃比随长径比的增大而逐渐减小,且变化趋势逐渐缓慢.

英文摘要:

The flow-field and combustion processes of hybrid rocket with different chamber structures under 2-D and axisymmetric environment was numerically calculated. Analytical result indicates that the fuel regression rate increases with the increase of pre-chamber length, but the acceleration is smaller and smaller, and the tendency to characteristic velocity and vacuum specific impulse with increasing pre-chamber is bigger at first and then smaller and keeps steady in the end. The fuel regression rate does not change when the post-chamber extends, and the characteristic velocity and vacuum specific impulse become higher with longer post-chamber. The draw ratio of grain does not affect the fuel regression rate distribution along the axis under the condition of the same oxidizer mass flux. Both draw ratio and average fuel regression rate have the same changing trend, but speed of the increase of average fuel regression rate is smaller and smaller. The characteristic velocity increases with draw ratio firstly and then decreases, and the position of the maximum is around draw ratio of 10.0. Fuel regression rate increases with draw ratio with the same theoretical oxygen/fuel ratio, but this does not affect its distribution tendency; combustion efficiency reduces firstly and then increases gradually with of the increase of draw ratio; actual oxygen/fuel ratio decreases gradually when draw ratio becomes large and the change tendency is slower and slower.

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