Paper ID: 87444
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IAF SPACE PROPULSION SYMPOSIUM (C4)
Interactive Presentations - IAF SPACE PROPULSION SYMPOSIUM (IP)

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FLUIDIC THROAT TECHNOLOGY FOR HYBRID ROCKET MOTOR BASED ON LIQUID OXIDIZER COOLING

Abstract

Hybrid rocket motor have great application prospects in the field of cruise aircraft due to its relatively simple structure, easy thrust adjustment, and relatively high specific impulse performance. However, during deep thrust adjustment, there is a significant loss of specific impulse at low thrust conditions. Therefore, this paper proposes a fluid throat design for hybrid rocket motor based on liquid oxidizer cooling. A small amount of secondary oxidizer flow is diverted from the tank, flows through the cooling channels in the converge section of the nozzle, cools the nozzle wall, and then forms a catalyzed high-temperature secondary jet at the throat position through injection holes with catalytic bed structure, achieving throat choking and improving the overall specific impulse of the motor. This paper conducts numerical simulations of the heat transfer of liquid oxidizer cooling and the flow process in the motor combustion chamber. The results show that under the condition of equal total mass flow rate, the addition of secondary flow increases the overall specific impulse of the motor. With the increase of the ratio of secondary flow to main flow rate, the overall specific impulse of the motor increases first and then decreases. The overall specific impulse is also affected by the angle of the jet, which reaches its maximum value at around 30 degrees. In addition, as the secondary flow rate increases, the wall temperature of the converging section of the motor decreases, and the wall temperature of the expansion section also decreases due to the isolation effect of the secondary flow squeeze layer on the main flow gas.