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EXPERIMENTAL INVESTIGATION OF A FLOW-ORIENTED THROTTLEABLE INJECTOR DESIGNED FOR THROTTLEABLE HYBRID ROCKET MOTOR

Abstract

The thrust throttling is a significant advantage of hybrid rocket motor, it is necessary to control the injection conditions while controlling the mass flow rate to achieve stable and high-efficiency combustion during the thrust throttling. The flow-oriented throttleable injector has the advantages of simple structure and strong adaptability, which can control the injection pressure drop and ensure the combustion performance during the thrust throttling. Aiming at the characteristics of the throttleable hybrid rocket motor, a flow-oriented throttleable injector was designed. In order to verify the feasibility of the throttleable injector and obtain the pressure drop characteristics and atomization characteristics of the throttleable injector, a large number of cold flow tests were performed, including the injector casing pressure drop tests, the injector static state pressure drop tests with/without back pressure and the injector dynamic pressure drop tests with/without back pressure. Furthermore, the steady state tests and thrust throttling tests of the throttleable hybrid rocket motor were conducted, in which the 98% H2O2/PE were adopted as propellants and the variable area cavitating venturi was used to control oxidizer mass flow rate. And the thrust throttling ratio were 5:1 and 8:1 in the thrust throttling tests, respectively. During the thrust throttling, the motor worked stably, and the combustion chamber pressure, thrust, and injector pressure drop increased linearly with the increase of the oxidizer mas flow rate (the injection pressure drop of a conventional liquid injector is proportional to the square of the oxidizer mas flow rate). The combustion efficiency was about 90-100% during the thrust throttling, and the specific impulse efficiency was about 86.1-90.5%.