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DESIGN AND PERFORMANCE EVALUATION OF HYDROGEN PEROXIDE OXIDIZER HYBRID THRUSTER FOR SOUNDING ROCKET SYSTEM

Abstract

Experimental research on hybrid rocket system using catalytically decomposed hydrogen peroxide oxidizer is conducted. Hybrid rocket has simple structure and high specific impulse compared to conventional chemical rockets. Due to these advantages, hybrid rocket system can be adapted in suborbital flight vehicle and sounding rocket system. Lab-scale hybrid thruster for compact sounding rocket system using hydrogen peroxide oxidizer was designed and evaluated. MnO2/Al2O3 catalyst was used for hydrogen peroxide decomposition. 80 N scale hybrid rocket was designed for preliminary research. Pressure drop inside thruster was calculated by water flow test and monopropellant test. 10 seconds combustion test was conducted with paraffin and polyethylene grain. Average thrust of 76.0 N and 85.8 N was observed after ignition in paraffin and polyethylene fuel grain. Considering the mass flow rate, pressure drop and thrust, polyethylene is considered as better fuel grain in hybrid rocket using catalytically decomposed hybrid thruster. Regression rate of polyethyelene was improved by 12.8% compared to previous study. Damage of nozzle in 80 N scale hybrid thruster was observed due to the high thermal stress. Based on the result of 80 N scale hybrid thruster, 250 N scale up thruster was designed. Three types of nozzles were designed considering the thermal stress on nozzle; Ablative nozzle, water cooling nozzle and inconel nozzle. Water cooling tests were conducted prior to 10 seconds combustion test with each nozzles. Carbon phenolic ablative material was used for ablative nozzle. Ablative nozzles were destroyed during both combustion experiments. Abrupt decrease in pressure and thrust was observed. Water cooling nozzle used tab water as a coolant. Stable combustion with average thrust 222.5 N was observed. In control group experiment with heat-resistant inconel nozzle, average thrust of 226.7 N was measured during 10 seconds combustion test. Combustion characteristics of test cases using water cooling nozzle and inconel nozzle were similar. Long duration combustion test for 30 seconds were conducted with 250 N scale thruster in order to evaluate the feasibility of hybrid thruster as a sounding rocket engine. Durable water cooling nozzle was applied. Stable combustion flame was observed during 30 seconds combustion test. Pressure and thrust dropped for 14.50% and 21.32% at the end of the combustion. Stable long-time combustion of 250 N scale hybrid thruster shows the applicability for sounding rocket system.