SPACE PROPULSION SYMPOSIUM (C4)
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DEVELOPMENT OF 2,500 N CLASS HYDROGEN PEROXIDE/POLYETHYLENE HYBRID ROCKET FOR LAB-SCALE SOUNDING ROCKET APPLICATION

Abstract

This paper reports the design procedure and scaling feasibility of the 2,500 N class hydrogen peroxide/polyethylene hybrid rockets applied to sounding rockets. Sounding rockets, carrying scientific equipment, have been used for atmospheric change measurements and sub-orbital exploration. It has been able to conduct re-entry trajectory, supersonic combustion, and aerodynamic tests. In particular, many countries have developed and carried out flight tests with sounding rockets utilizing hybrid rockets. A sounding rocket employing a hybrid propulsion system is desirable because hybrid rockets have higher specific impulse than solid rockets. Furthermore, hybrid rockets can control throttle and re-ignitable system, which is generally difficult to do in solid rockets. In addition, hybrid rockets are more cost-effective due to its simplicity, and is safer because of its separating liquid oxidizer and solid fuel. For these reasons, hybrid propulsion system is a promising technology for sounding rockets. The KAIST rocket laboratory, using the hydrogen peroxide/polyethylene hybrid rocket, has accumulated a large amount of experimental data especially through the use of catalytic ignition system. Catalytic ignition system has many advantages such as higher ignition reliability and re-ignitability. Furthermore, it does not require an additional ignition system. In this paper. It presents the scaling feasibility of a hybrid rocket. To design the 2,500 N class hybrid rocket, we first made the 250 N class hybrid rocket. Catalytic ignition of the 250 N class hydrogen peroxide/polyethylene hybrid rocket was successfully conducted. The important parameters of hybrid rocket such as regression rate, efficiency of characteristic velocity, specific impulse, and influence of the chamber pressure were evaluated. In addition, in order to scrutinize the effect on the increase in thrust force and decrease in combustion chamber length, several experiments using multi-port fuel were conducted. As a result, based on the data of previous experiments using the 250 N class hydrogen peroxide/polyethylene hybrid rocket, this paper suggests possible design and procedures of a rocket scaled 10 times larger, the 2,500 N class hydrogen peroxide/polyethylene hybrid rocket, to be applied to a sounding rocket. The 2500 N class hybrid rocket is approximately 10 kg and the oxidizer mass flow rate is 1.07 kg/s. Also, the oxidizer and fuel ratio is 7.5 and its chamber pressure was designed to be 20 bar to prevent ablation of the graphite nozzle. Manufactured 2500 N class hydrogen peroxide/polyethylene hybrid rocket is scheduled for performance verification in a vertical test stand and flight tests.