SPACE PROPULSION SYMPOSIUM (C4)
Propulsion System (2) (2)

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THROTTLING CAPABILITY AND LOX VAPORIZATION FOR HYBRID ROCKET ENGINE WITH MULTI-SECTION SWIRL INJECTION METHOD

Abstract

The authors have proposed a new combustion method which can increase fuel regression rate by 3 to 8 times compared with that of conventional method for hybrid rocket engine. The new method is named as Multi-Section Swirl Injection Method, which generates swirling flows throughout combustion chamber. In the present study, various improvements have been conducted in order to increase performance of the hybrid rocket engine. HDPE fuel and oxygen gas are selected as propellant. Oxygen gas will be replaced by liquid oxygen for real flight. To realize Multi-Section Swirl Injection Method for practical application, module-type engine structure, in which swirl oxygen injection is attached at upstream end of each module to introduce and keep swirl flow at each combustion module, has been proposed. In the combustion experiments the present authors tuned mass flow rates of oxygen injections of two module-type engines to keep each O/F value from 1.8 to 3.4. This range of O/F means 94Also to realize the throttling capability throttling experiment of the module-type engine has been conducted. The same engine is used. The duration of the combustion experiment is 11 seconds. During this duration supply pressure of oxygen gas has been changed three times. The first pressure level is at moderate pressure level of 0.64 MPa, second pressure level is increased at 2 times of initial supply pressure, then third pressure level is decreased at 0.38 times of initial pressure. The thrust of second supply pressure is 2.7 times of initial thrust and the thrust of third supply pressure is 0.15 times of initial thrust. This means that control the thrust of engine with swirl oxygen injector is realized. The detail investigation of non-proportional relationship between supply pressure and thrust should be conducted. Also LOX vaporization for hybrid rocket engine with Multi-Section Swirl Injection Method has been conducted. LOX is supplied to vaporization chamber through special shower head. In the vaporization chamber combustion gas, which is generated from pre-burner, is applied to LOX. Almost all of LOX has been vaporized because of special shower head. The technique is quite useful for LOX vaporization.