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PRELIMINARY TEST OF HYDROGEN PEROXIDE THERMAL DECOMPOSITION MONOPROPELLANT THRUSTER

Abstract

In this research, realizability of hydrogen peroxide thermal decomposition monopropellant thruster which was substituted for conventional hydrogen peroxide catalytic decomposition monopropellant thruster was substantiated. Thrusters are necessary to control an attitude or transfer an orbit and a trajectory of a satellite and a launch vehicle. Among them, a monopropellant thruster which is one of the types of chemical thrusters has advantages such as moderate specific impulse, reusability, throttleability, simplicity, and reliability. Recently, the monopropellant thruster using hydrogen peroxide which is a green propellant has been actively investigated to replace that using hydrazine which has outstanding performance and high toxicity at the same time. Hydrogen peroxide monopropellant thruster which is usually composed of an injector, a catalyst bed, a combustion chamber, a nozzle, a distributor, and a gasket operates by catalytic decomposition of hydrogen peroxide with high concentration, so thermal decomposition of it is treated secondarily. However, two major problems can occur in catalytic decomposition of hydrogen peroxide. First, a catalyst to decompose hydrogen peroxide is required to have not only high decomposition performance but also high strength and high heat resistance. As the size of a pellet which is commonly used as the catalyst decreases to increase decomposition performance, strength and heat resistance decrease, so abrasion and dissipation may arise. Second, in order to inhibit decomposition of hydrogen peroxide during storage, a stabilizer is added. Some stabilizer may act as a catalyst poison. Therefore, studies to solve the aforementioned problems by changing an active material precursor, a support, and an additive of the catalyst has been conducted. Furthermore, in this research, hydrogen peroxide thermal decomposition monopropellant thruster that mainly utilized a heater instead of the catalyst is proposed. Hydrogen peroxide thermal decomposition monopropellant thruster with specifications of 90 weight percent as concentration of hydrogen peroxide, 10 N as thrust, 10 bar as combustion chamber pressure, a spray injector, and a heater bed was conservatively designed based on a design procedure of hydrogen peroxide catalytic decomposition monopropellant thruster. The catalyst bed was replaced by the heater bed. Heater capacity was defined as decomposable mass flow rate of a propellant per unit volume of the heater bed. Through preliminary tests including a cold flow test and a thermal decomposition test, feasibility before optimization of hydrogen peroxide thermal decomposition monopropellant thruster was confirmed.