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MICROSATELLITES-FRIENDLY PROPULSION SYSTEM USING LOW-TOXIC PROPELLANT CULTIVATING THEIR ONCOMING APPLICATIONS

Abstract

This paper reports overview of our development of propulsion systems for under-100kg microsatellites and proposal of their in-future application of the propulsion systems.

Microsatellites are now challenging next step space missions including a major orbit transfer for magnetosphere observation or a constellation for continuous earth observation, which inevitably require propulsion system dedicated to microsatellite, so that we have been devoting ourselves to develop a propulsion system of monopropellant and bipropellant for microsatellite with three policies of Safety First, Border Free, and Effective COTS, to enable orbit transfer, phase shift, and attitude control of microsatellites. Microsatellite can be launched as secondary payload in other country's launch vehicle, thus, propulsion system for microsatellite must be kept in safety and propellant is favorable to be low toxic and commercially available at the launch site. In addition, Commercial-Off-The-Shelf (COTS) are aggressively employed to reduce cost of propulsion system. We selected 60 wt

We already accomplished some in-space demonstrations of our first models of monopropellant system launched in Japanese 50kg-class microsatellites, Hodoyoshi-1 and -3, and long-term storage of propellant in tanks is now going on in orbit. After on-orbit operations, these thrusters are desired to be used for not only orbit transfer or maintenance but also more precise satellite attitude control, then we are upgrading the system, especially a thruster, to realize very quick responsiveness of less than 1 second and long lifetime of thruster in parallel to improvement for the higher specific impulse to meet the demand from some space missions.

The bipropellant system includes a gas generator, in which propellant decomposition technique of the monopropellant thruster was applied. Oxygen gas generated in the gas generator is blended with ethanol and the mixture is ignited to raise thrust with the higher specific impulse of over 150 seconds. We already obtained controllable range of assured ignition and continuous combustion of a bipropellant thruster with various ratio of oxidizer to fuel, and over 1,200 degrees C in combustion chamber, and have been pursuing the longer operation.

Finally, based on the demand of microsatellite developer, we make a proposal of application of our propulsion system with disclosing its system specification.