Paper ID: 7856
student

SPACE PROPULSION SYMPOSIUM (C4)
Propulsion Technology (3)

Author: Mr. Yuta Matsuura
Tokyo Metropolitan University, Japan, y-matsuura@astak3.tmit.ac.jp

Mr. Toru Tajika
Tokyo Metropolitan University, Japan, t-tajika@astak3.tmit.ac.jp
Dr. Junichiro Aoyagi
Tokyo Metropolitan University, Japan, j-aoyagi@astak3.sd.tmu.ac.jp
Prof. HARUKI TAKEGAHARA
Tokyo Metropolitan University, Japan, hal@astak3.tmit.ac.jp

STUDY ON DECOMPOSITION OF GREEN PROPELLANT WITH ATMOSPHERIC PLASMA FOR PLASMA CHEMICAL THRUSTER

Abstract

The monopropellant thruster obtains thrust by the catalytic decomposition of hydrazine. Because hydrazine is toxic, a careful/cautious handling is indispensable to deal with it. And there is the extra cost problem for environmental protection and human health. Moreover, a solid catalyst will be broken and into the small peaces by the exposure to the thermal distortion in the repetitive operation on orbit. Particulates of the catalyst will flow out from the catalyst bed, and it will affect several critical problems such as deterioration of the thrust performance or choke of the injector, the capillary tube or the valve. Therefore we suggest Plasma Chemical Thruster (PCT) in order to improve these serious problems. Instead of catalyst and hydrazine, the PCT employs the electric discharge and green propellant. The electric discharge is expected to provide its chemical activity for the propellant decomposition, not to provide the thermal or electromagnetic energy for the plume acceleration. The green propellant, which we employed for PCT, is HAN-based propellant. The propellant was needed to confirm to react on discharge. And so this was studied by the experiment in our laboratory. The propellant mass decrement was confirmed while it reacted on discharge whose electric power are several watts. Besides the pressure in reaction chamber will be expected over 1 MPa, because the normal monopropellant thruster is in operation. And the electric power must be restrained under 100 W because it should be as same as the heater power for the conventional catalyst bed. Therefore, it is clear that technique for producing and sustaining plasma in high pressure (0.1 1.0 MPa) will be required for the PCT. So we focused on low frequency (50 Hz 10 kHz) plasma that is one of the atmospheric glow plasma and that can be made less than 100 W and in high-pressure environment. As a result, luminescence and jet of plasma were observed at the approximately several watts of the electrical discharge energy in Ar and He flow field. Furthermore, the evaluation of the reaction among this atmospheric plasma and the atomized HAN-based propellant will be reported.