Paper ID: 71981
oral
student

IAF SPACE PROPULSION SYMPOSIUM (C4)
Electric Propulsion (1) (5)

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WATER ION THRUSTER FOR CUBESAT: LABORATORY MODEL SYSTEM EVALUATION

Abstract

This study evaluates the performance of a laboratory model of a water ion thruster for CubeSat propulsion.

CubeSats have the advantages of a low cost and a short development period compared to conventional satellites due to its small size. As a result, the number of CubeSat launches has been increasing in recent years, but there are not so many examples of CubeSats equipped with propulsion systems. The development of propulsion systems that can be mounted on CubeSats is underway for advanced missions.

Since CubeSats are small, the amount of propellant is limited. Electric propulsion is suitable as a propulsion system for CubeSat because electric propulsion can achieve high V with less propellant. Pulsed plasma thrusters have been developed and operated in space as electric propulsion for CubeSat. In addition, ion thrusters for CubeSats are being developed for missions requiring higher specific impulse, such as deep space exploration. Xenon is conventionally used for ion thrusters, but the weight increase due to the high-pressure gas system is a problem for CubeSats. An RF ion thruster using iodine has been developed at ThrustMe and BUSEK. Iodine can be stored in solid form. On the other hand, it is difficult to handle iodine because it is harmful to the human body.

In the above view, we proposed an ion thruster that uses water as a propellant. Water can be stored as a liquid at room temperature and is easy to handle. It can also be obtained in large quantities at low cost and is suitable as a propellant for CubeSats. On the other hand, the oxidizing property of water is a problem. In our proposed water ion thruster, the hollow cathode, which is vulnerable to oxidation, is excluded by using a microwave discharge plasma source as a neutralizer, enabling operation with water.

We have previously modified the ion thruster and neutralizer to improve their performances. However, we have not operated the ion thruster and neutralizer simultaneously after the modifications. The coupling operation is necessary for the feasibility of the propulsion system. Therefore, the laboratory model system is created, and the ion thruster and neutralizer are tested simultaneously. The power and the thrust of the entire system are measured experimentally to evaluate the performance. The advantages of the water ion thruster are derived from these results, and we will discuss the feasibility of the water ion thruster for CubeSats.