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DISCUSSION QUASI-STEADY STATE OF OPERATING MPD THRUSTER WITH SPECIALIZED PULSED POWER SUPPLY

Abstract

An MPD (Magneto-Plasma-Dynamic) thruster requires the input of a large amount of power, 100 kW to 1 MW, and it is difficult to operate in a steady state. Therefore, MPD thrusters are operated in quasi-steady state with a pulse generated by a PFN (Pulse Forming Network). However, there are two ambiguities regarding the steady state of the discharge. First, the discharge time of a PFN, typically 0.5 to 1.0 ms, is insufficient to quantitatively verify discharge steady state. Second, the unsteady region at the end of a discharge can lead to error in the evaluation of the steady state of the entire discharge.

In this presentation, we propose a pulsed power supply which generates more rectangular pulses that are several longer and fewer unsteady regions than those of a PFN to evaluate the quasi-steady state of an MPD thruster. In an operation test with a 1.0 ms discharge, the unsteady regions was reduced from 0.532 to 0.085 ms, and the flat-top region which should be evaluated was increased from 0.393 to 0.880 ms. Therefore, the ratio of the evaluation time to the discharge time was improved from 42 to 91%.

Using the power supply, we operated an MPD thruster and obtained the discharge time characteristics of the discharge waveform and the thrust performance by sweeping the discharge time from 1.0 to 5.0 ms. As a result, the discharge current was maintained at 900 $\pm$ 100 A for each discharge time and the thrust was in the range of 0.3 $\pm$ 0.02 N, which is interpreted as being constant. These results confirm the quasi-steady state of the MPD thruster operation from 1.0 to 5.0 ms. In addition, we also investigated the influence of residual gas in a vacuum chamber on the quasi-steady state by sweeping gas supply timing.