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高密度ヘリコンプラズマによる完全無電極電気推進の研究(VI)：スラストスタンドによる推力計測

Study on Completely Electrodeless Electric Propulsion System Using High-Density Helicon Plasma (VI): Development of Thrust Stand Measurement

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An electric thruster is indispensable for a long-time mission such as a deep space exploration due to a high specific impulse. However, most electric thrusters have a problem of electrode erosion due to direct contact with plasmas. Therefore, to extend the lifetime of a thruster, it is essential to eliminate electrodes contacting directly with plasmas. To solve this problem, we have been studying a helicon plasma thruster under the HEAT (Helicon Electrodeless Advanced Thruster)[1] project.

The outline of the helicon plasma thruster proposed is as follows: First, to generate a dense source plasma using a helicon wave with an radio-frequency applied from outside of a discharge cylinder. Second, in order to yield a higher thrust, the dense plasma is accelerated by Lorentz force F_z with the product of the induced azimuthal current j_θ and the static radial magnetic field B_r. There are several methods proposed in our HEAT project of inducing j_θ in the plasma, and our laboratory is promoting schemes by the use of two types of coils: Rotating Magnetic Field coils and an *m* (azimuthal mode number) = 0 coil.

In order to check above-mentioned methods, it is important to measure the thrust produced by exhaust plasma precisely. In our laboratory, a pendulum-type thrust stand with a cylindrical target has been developed. Figure 1 shows a schematic diagram of Large Mirror Device. Plasma is generated in a tapered quartz tube section, and it flows in a vacuum chamber along divergent magnetic field lines. The cylindrical target is installed in front of quartz tube. The thrust stand was designed to be capable of measuring impulse bits ranging from 1-100 mN.

Figure 2 shows a schematic diagram of the cylindrical target and support structures. A basic design is as follows: a large open mouth to collect whole plasma plume, almost no dumping of the target during the measurement time and to withstand ablation by the high-density plasma. An impulse bit from the exhaust plasma is measured by a displacement of the target structure using a displacement sensor.

In the presentation, more detail of the thrust stand and preliminary experimental results will be presented.

[1] S. Shinohara *et al*., Trans. Fusion Sci. Technol. **63** (2013) 164.
[2] M. Coletti *et al*., *Proc. 30th Int. Electric Propul. Conf*. (2007) IEPC-2007-158.

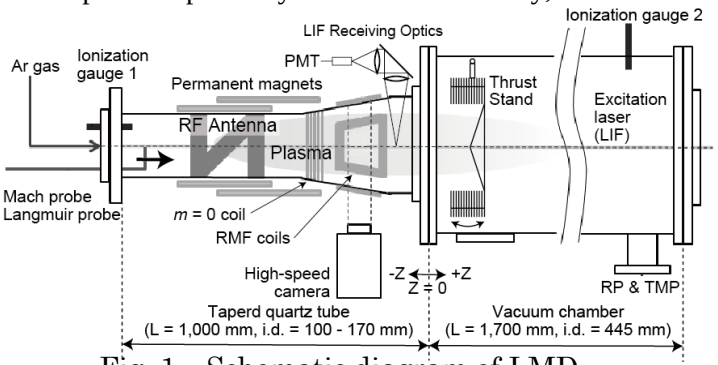

Fig. 1 Schematic diagram of LMD.

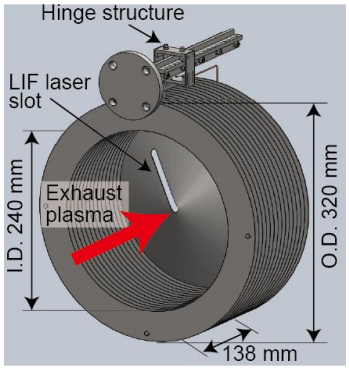

Fig. 2 Cylindrical target.