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小ヘリコン装置(SHD)を用いたプラズマの広域分光法
Wide Area Plasma Spectroscopy Using Small Helicon Device (SHD)

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An electric propulsion is better for a long term space mission than a chemical one because of its higher specific impulse. However, an operation lifetime of a conventional electric propulsion system is limited by a damage of electrodes contacting directly with a plasma. To solve this problem, we have been studying an electrodeless plasma propulsion system [1], and as one of topics, we have developed Small Helicon Device (SHD) [2], as shown in Fig. 1, to decrease weight and space of thrusters. This small-diameter source will also contribute to industrial applications such as a coating of inner wall of a thin tube.

Plasma diagnostics is very important to characterize plasma performance. Although an electrostatic probe is a common method to measure plasma parameters such as an electron density n_e and its temperature T_e, it disturbs a plasma flow in SHD because an inner diameter of a discharge tube is less than 20 mm. Therefore, not to disturb the plasma performance, spectroscopic methods are important.

A Collisional Radiative (CR) model for He [3] determines the excited state populations of He atoms in plasma for a given set of parameters such as n_e and T_e. The elementary processes included in our code are the electron impact excitation and de-excitation, radiative decay, electron impact ionization, electron impact three-body recombination, radiative recombination, and photo-excitation from the ground state to 2^1P, 3^1P and 4^1P states.

Although our final goal is to obtain n_e and T_e in an Ar discharge by a CR model for Ar, development of a reliable code is under way. Here, we show our attempt to evaluate those parameters in He and Ar mixed discharges by a CR model for He, which can be used to correlate the obtained parameters with the observed Ar line intensity ratios. Figure 2 shows spectra of He and Ar mixed discharges by using a wide-range spectrometer (HR2000+, Ocean Optics, Inc., 360 – 792 nm), and we have chosen 12 He I lines. Here, we modified the code to fit our experiment conditions because 21 He I lines are necessary as input parameters in the original code.

We have carried out the initial spectroscopic experiment to derive n_e and T_e based on the CR model, and compared the results with those by the probe method. In this presentation, details of these results will be shown.

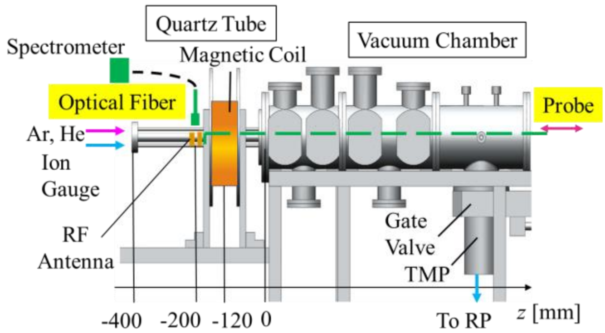

Fig. 1. Schematic of SHD.

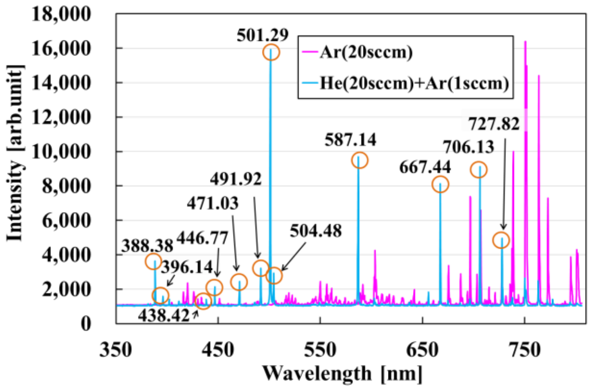

Fig. 2. Spectra of He and Ar discharges.

[1] S. Shinohara *et al.*: IEEE Trans. Plasma Sci. **42** (2014) 1245.
[2] D. Kuwahara, A. Mishio, T. Nakagawa and S. Shinohara: Rev. Sci. Instrum. **84** (2013) 103502.
[3] T. Fujimoto: J. Quant. Spectrosc. Radiat. Transfer. **21** (1979) 439.