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ECR プラズマパラメーターに対する磁場強度の影響

Effect of magnetic field strength on ECR plasma parameters

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1. Introduction

ECR plasma is getting wider attractions due to its areal flexibility. At the ECR plasma, a magnetic field strength is the most important parameter for its plasma performance. Here we analyze relationship between the magnetic field strength and the ECR plasma parameters using a Langmuir probe. Langmuir probe is a simple way to diagnose plasma and obtain plasma parameters such as electron temperature T_e, electron density N_e, electron energy distribution function(EEDF) etc. [1] Langmuir probes can obtain different forms of I-V characteristic curves and plasma parameters under different operating conditions, so the probe experiments are still of considerable interest. [2]

In this study, the I-V characteristic curve and changes of 2.45 GHz ECR plasma parameters are analyzed under different magnetic field strength.

2. Experimental Setup

For the ECR plasma, we set the coil current($I_{coil} \propto B$) from 80 to 110 A, the gas pressure at 0.93 Pa, and the microwave input power as 1 kW. The discharge gas is helium, and the probe is made of tungsten with a diameter of 0.5 mm and a length of 18 mm.

3. Result

Calculated plasma parameters for different coil currents are shown in Fig. 1, while the unit of T_e is eV, the unit of N_e is $\times 10^{16}\mathrm{m}^3$, and the unit of I_{coil} is Amps.

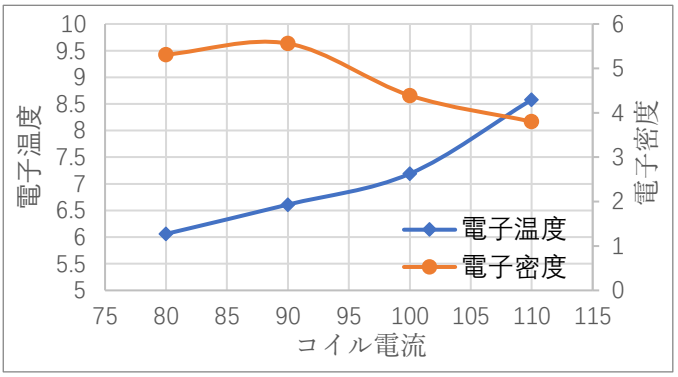

Fig. 1 Electron temperature and electron density while coil currents is 80 to 110 A

At coil currents of 80 to 110 A, the magnetic field strength B did not exceed 875 Gs, and under this condition there was a tendency for the electron temperature to increase with the coil current, while in contrast the electron density did not show a high positive correlation with the coil current.

Reference

[1]: Chen Francis F. Phys Plasma,2001,8(6):3023~3036

[2]: M. Mozjetchkov, T. Takanashi, Y. Oka, K. Tsumori, M. Osakabe, O. Kaneko, Y. Takeiri, and T. Kuroda, Review of Scientific Instruments. 69, 971 (1998).