§9. ECH Plasma Experiments of an Internal Ring Device with HTS Coil

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The internal coil device Mini-RT, in which the high temperature superconductor coil is levitated, has been constructed, and the levitation experiments have been carried out[1-3]. Here we have focused on studying to clarify the effect of the removal of the supporting structure by the levitation of the internal coil. So experiments with the supported and levitated internal coil have been carried out in order to investigate the difference in plasma properties.

Figure 1 shows the dependence of electron density measured by the electrostatic probe as a function of the neutral gas pressure. When the internal coil is levitated, plasma production at the neutral gas pressure of 10^{-3} Pa was successfully carried out. In addition, it can be seen that the electron density increases as the increase of gap length between the internal coil and the supporting structure.

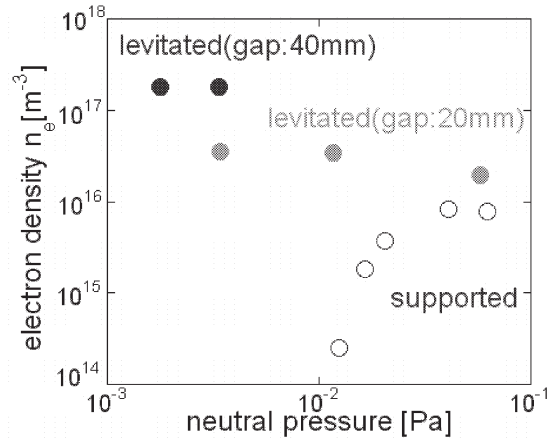

Fig. 1 Plasma density for cases of supported and levitated internal coil.

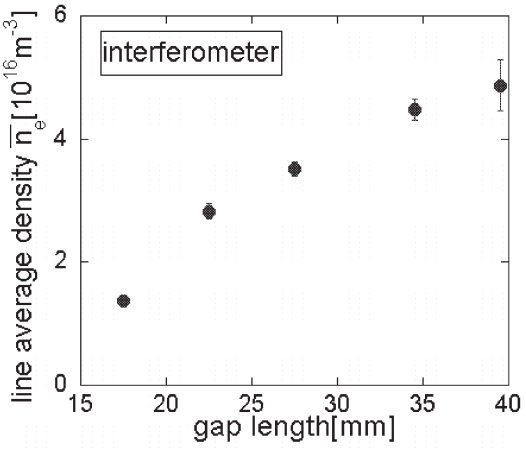

Fig. 2 Line-averaged density as a function of the gap length between the floating coil and the supporting structure.

The relation between the gap length and electron density at the constant neutral gas pressure was also measured. Figure 2 shows the results measured by the 4mm interferometer system. The neutral gas pressure was 3×10^{-3} Pa. It is apparent that the line-averaged density increases as the increase of the gap length.

Figure 3 shows the density profiles measured by electrostatic probe, when the internal coil is levitated. In this measurement, the neutral gas pressure was 1.5×10^{-3} Pa, and the injected ECH power was around 2.5 kW. The result obtained by the experiment with supported internal coil is also plotted for comparison, where the neutral gas pressure is in the range of 10^{-2} Pa. Notice that the neutral gas pressure is different in both cases. It is apparent that the plasma region becomes to be localized around the internal coil, when the internal coil is levitated. So the density gradient becomes much steeper, compared with the supported case. This is because that a separatrix is produced, when the current is applied in the levitation coil. The calculated position of the magnetic surface which passes the separatrix on the equatorial plane is around R = 0.28 m, which is in good agreement with the position of the density drop.

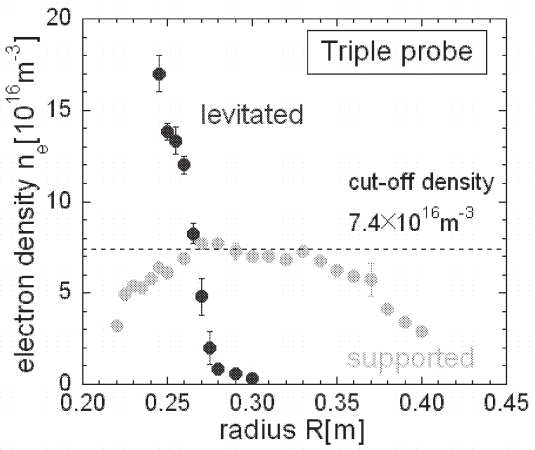

Fig. 3 Density profiles of supported and levitated coil cases.

More important difference lies in the absolute value of the density. Although the peak value is unknown in the levitated case, the maximum measured electron density (1.6×10^{17} m^{-3}) is much higher than the supported case, which is about twice of the cutoff density of the 2.45GHz microwave (7.4×10^{16} m^{-3}), resulting in the increase of the ionization degree to 50%. The electron temperature also increases in most region, and the value is about twice of the one obtained in the supported case.

References
1) Ogawa, Y., J. Cryog. Soc. Japan, **39** (2004), 175.
2) Mito, T., J. of Cryog. Of Japan, **39,** (2004) 182.
3) Yanagi, N., J. of Cryog. Soc. Japan, **39** (2004) 201.