§43. Measurement of LHD Divertor Plasmas using Ion Sensitive Probe and Divertor Langmuir Probes

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Temperature measurement of divertor plasmas using divertor probes, such as Langmuir probes and Ion Sensitive Probes (ISP)[1] is one of the key issues for studying the divertor performance in the long pulse discharges with high power neutral beam and RF heating. Particle and energy transport between the ergodic region and divertor along the magnetic field line is another concern. So far Doppler broadening of impurity ion lines or asymmetric double probe[2] have been used to measure the ion temperature in the divertor plasmas. Here we employ ISP to measure the ion and electron temperature of the divertor plasmas. The ISP has a simple structure compared with the asymmetric double probe.

Before installing ISP to LHD, we have tested its performance characteristics for Ti measurement in a linear divertor simulator, NAGDIS-II. After applying some DC biasing voltage to the guard electrodes of ISP to reduce the noise current to the probe, we have obtained a clear I-V characteristic curve shown in Fig. 1. This curve gives Ti of about 2 eV, whose value agrees well with that measured with Doppler broadening of line radiation from HeII (468.6 nm), as shown in Fig. 2. Here, the ion temperature is changed by adding helium neutral gas into the plasma. A prototype of ISP for

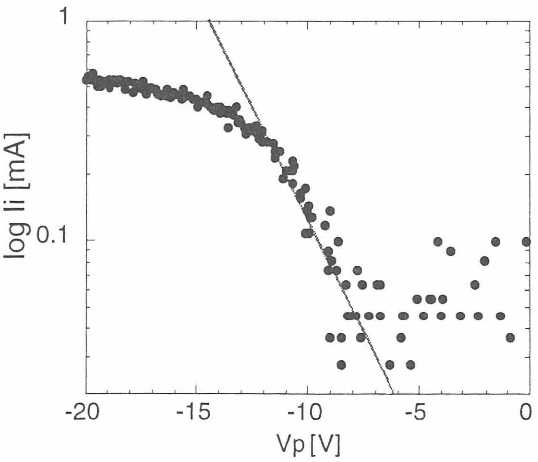

Fig. 1 Voltage-current characteristic curve of ISP obtained in NAGDIS-II helium plasma. The magnetic field is 0.2 T, the electron density and temperature are $5x10^{18}m^{-3}$.

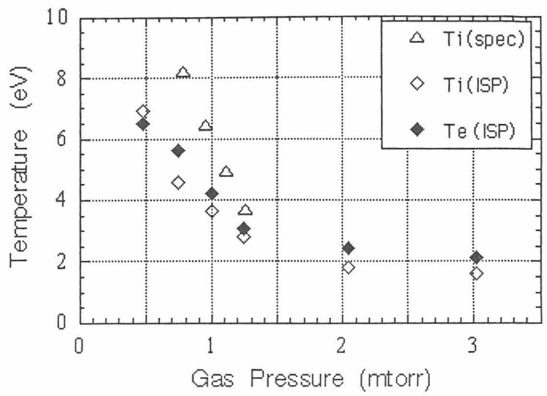

Fig. 2 Comparison between the ion temperature measured with ISP and that from Doppler broadening. The electron temperature measured with ISP is also shown in the figure.

LHD will be continuously developed, taking account of the structure of the magnetic filed in the divertor plasma.

Since density and electrostatic fluctuations in the divertor plasma must be strongly related to the plasmas in the edge and ergodic layer due to fast electron transport along the magnetic field line, high frequency component of the ion saturation current obtained at the divertor probe (6I#2) is analyzed preliminary. A contour plot of the fluctuation intensity of the ion saturation current in the frequency-time space is shown in Fig. 3. The fundamental frequency of the fluctuation is 2~2.5 kHz and gradually changes in time. And higher harmonic components are strongly observed as shown in the figure. The magnetic fluctuations observed by a magnetic pickup coil have the same frequency spectra. The correlation between the magnetic fluctuations and those of the density and electrostatic potential in the divertor plasmas will be studied to investigate the particle transport from the edge region to the divertor plasma.

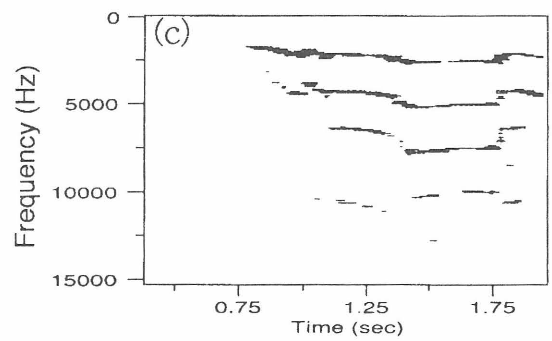

Fig. 3 Fluctuation spectra of the ion saturation current in the divertor probe.

References

1) Katsumata, I., Contrib. Plasma Physics, 36 (1996)73.
2) Uehara, K.; Kawakami, T.; Amemiya, H.; Hothker, K.; Cosler, A.; Bieger, W. Nuclear Fusion. 38 (1998)1665.