

§41. Characterization of the LHD Edge & Divertor Plasma by Ion Sensitive Probe Measurement

Ezumi, N. (Nagano National College of Tech.)
Ohno, N. (Ecotopia Sci. Inst. Nagoya Univ.)
Uesugi, Y. (Dept. Elec. Eng. Kanazawa Univ.)
Takamura, S. (Dept. Energy Eng. & Sci. Nagoya Univ.)
Masuzaki, S.

The aim of this study is to investigate the ion's behavior in the LHD edge and divertor region since it is important to reveal the property of edge and divertor plasma for improving the LHD plasma performance. Ion temperature (T_i) is one of the key parameters for characterizing these plasmas. A lot of studies have been made on electron temperature (T_e) and electron density (n_e) measurements for the divertor region of the LHD. However, an ion temperature (T_i) profile in this region is not well known. There are some methods for measuring T_i at the boundary plasmas. Conventional optical methods for measuring the T_i , especially a doppler broadening measurement, have a difficulty to obtain the local values and the profile of T_i , because the evaluated values are integrated (averaged over) along the line of sights. In the case of LHD divertor measurement, there are many restrictions for the arrangement of optical devices, because the vacuum chamber of the LHD has the complicated geometric structure. Therefore, in order to measure the profile of T_i in this region, it is necessary to prepare a high spatial resolution diagnostic system. An T_i measurement using an Ion Sensitive Probe (ISP)[1] in the divertor leg in LHD had been done during 4th, 5th and 6th experimental cycles. An ISP is electrical probes used for measuring the spatial profile of T_i in the magnetized plasmas and has high spatial resolution. Moreover, T_e and plasma space potential (V_s) can be measured, simultaneously.

During 4th, 5th and 6th experimental cycles, the prototype-ISP for LHD was installed to the fast scanning probe system and the measurement system was established. During the cycles, several measurements of plasma parameters in the divertor leg using the probe were performed in hydrogen plasma in the operational configuration with the magnetic axis position of 3.60 m, a toroidal magnetic field strength of -2.887 T (the field direction was reversed from the standard direction). We obtained current-voltage (I - V) characteristics of the inner (Ion Collector; P) and the outer (electron guard; G)

electrodes of the ISP obtained during the several discharge shots. In #31256, typical ISP's I - V characteristics were obtained from both electrodes [2]. The estimated T_i and T_e using the I - V characteristics were about 20-35 eV and 5-15 eV at the outside region of the divertor leg, respectively. The spatial distribution of the evaluated T_i is qualitatively consistent with the results of calculations of particle's orbits around the edge and divertor region in LHD.

However, a lot of obtained data included strong electrical noise. Because of the noise, it was difficult to evaluate reliable T_i using the data. In order to improve the signal to noise ratio and to obtain the full profile of T_i in the divertor plasma, an improved ISP head and measurement system have been designed during 7th experimental cycle. One of the modified points is that coaxial cables are used for wiring the ISP electrodes in the ISP head. Furthermore, the method of the connection of the ISP head to the fast scanning probe system has been also improved. In the next experimental cycle, the new modified ISP head will be installed to the scanning probe system as shown in Fig. 1. We plan to measure not only the divertor leg but also the edge region, in order to investigate a spatial distribution of ion density and temperature in the broad region.

References

- 1) Katsumata, I., Contrib. Plasma Phys. **36**, (1996) S, 73.
- 2) Ezumi, N. et al., J. Nucl. Mater. **313-316**, (2003) 696.

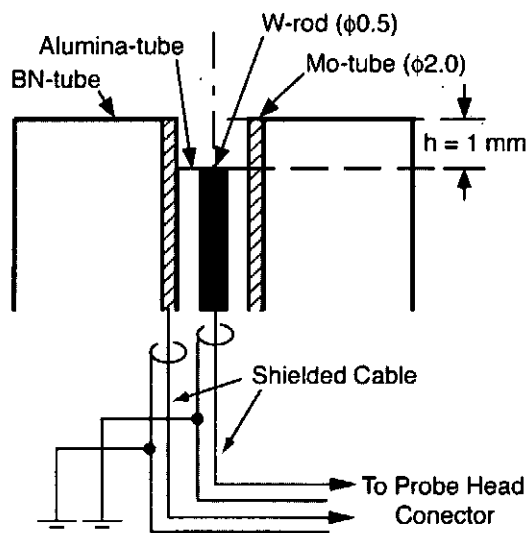


Fig. 1. Schema of modified ISP head designed for the measurement of the edge and divertor plasma in LHD. Shielded coaxial cables are used for wiring electrodes to the probe head connector.