§59. Characterization of the LHD Edge & Divertor Plasma by Ion Sensitive Probe Measurement (II)

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Ion temperature (T_i) is one of the key parameters for characterizing edge and divertor 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. In this study, we 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. 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 Ion Sensitive Probe (ISP) [1] is a candidate for such diagnostics because the 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.

T_i measurement using an ISP in the divertor leg in LHD had been done 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. 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 in the edge and divertor region of LHD.

In order to measure the hotter T_i region, it is necessary to improve the structure of ISP. During this experimental cycle, we designed a new ISP head as shown in Fig. 1. The outer electrode is placed in slightly inside of BN shield in order to avoid high heat load when positive bias voltage is applied. Coaxial cables are used for wiring the ISP electrodes and the length of both electrodes is to be as short as possible in order to reduce electrical noise, which caused serious problem for analyzing measured data. Moreover, we also reassemble the wiring in the fast scanning probe system. Recent results of the linear plasma generator PSI-2 showed the difficulty of T_i measurement under the condition of the existence of electric field along the axis of the ISP electrodes [3]. Maybe we must consider the influence of the electric field around the ISP when the probe head moves into the edge plasma region. In the next experimental cycle, the probe head connector of the fast scanning probe system will be modified. We plan to redesign the ISP head along the modification of the probe connector.

References

1) Katsumata, I., Contrib. Plasma Phys. **36**, (1996) S, 73.
2) Ezumi. N. et al., J. Nucl. Mater. **313-316**, (2003) 696.
3) Ezumi. N. et al., J. Nucl. Mater. **337-339**, (2005) 1106.

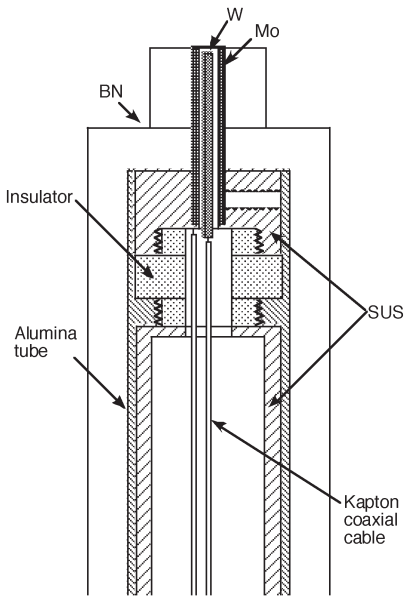

Fig. 1. Schema of redesigned ISP head for measuring the edge and divertor plasma in LHD.