§59. Characterization of the LHD Divertor Plasma by Ion Sensitive Probe Measurement

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The purpose of this study is to investigate the ion's behavior in the LHD divertor by using ion sensitive probes (ISP) . It is important to reveal the property of edge and divertor plasma for improving the LHD plasma performance. Although studies have been made on electron temperature (T_e) and electron density (n_e) measurement for the divertor region of the LHD, an ion temperature (T_i) profile in this region is unknown. Conventional optical methods for measuring the T_i have some difficulty for obtaining the profile of T_i. In particularly, there are many restrictions for the arrangement of optical devices, because the vacuum chamber of the LHD has the complicated geometric structure.

An ISP is electrical probes used for measuring T_i in the magnetized plasmas. Simultaneously, T_e and plasma space potential (V_s) can be measured. In this study, we are planning to install an ISP in the fast scanning probe system located in the LHD divertor region. Figure 1 shows a schematic of the ISP head designed for the LHD divertor plasma measurement. The ISP consists of two electrodes that an ion collector (P) and an electron guard electrode (G) .The P electrode collects ions when the bias voltage of the both electrodes are even close to the V_s .The G electrode functions as a fence to prevent electrons flowing into the ion collector. These behaviors are based on the difference of the Larmor radius between the ions and the electrons in a magnetic field. The distance between the top surface of the ion collector and the upper end of G electrode is defined as h. Namely, h = 0 means that edges of P and G electrodes are same height. The value of h for the experimental conditions of the LHD divertor plasma was estimated to be 0.5 ~ 1 mm according to a numerical simulation and Katsumata theory [1], where n_e, T_e and the magnetic field (B) were assumed to be 5 x 10^{18} m^{-3}, 20 eV and 1 T, respectively. Figure 2 shows the global structure of an ISP for the first scanning probe system in the LHD. The material of the outside tube is chosen to be BN for withstanding a high heat load from the diverotr plasma.

In the 5th cycle experiment of the LHD, we are planning to install the ISP head constructed during the 4th cycle experiment to the fast scanning probe system and to measure the T_i profile of the LHD divertor plasma.

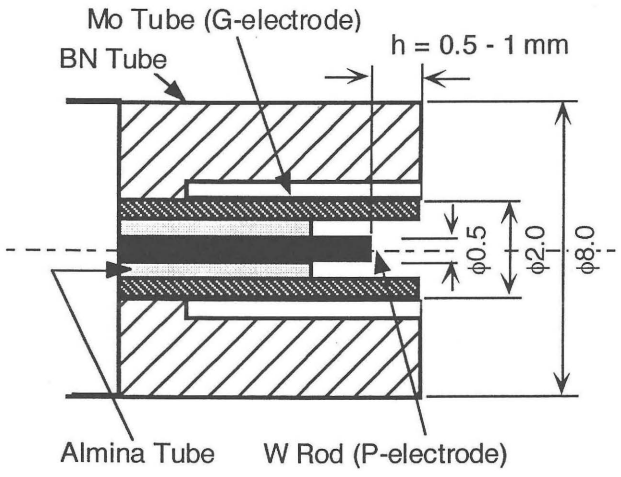

Fig. 1. Detailed schema of ISP head for the LHD divertor plasma measurement.

Reference

1) I. Katsumata, Contrib. Plasma Phys. 36 (1996) S, 73-80.

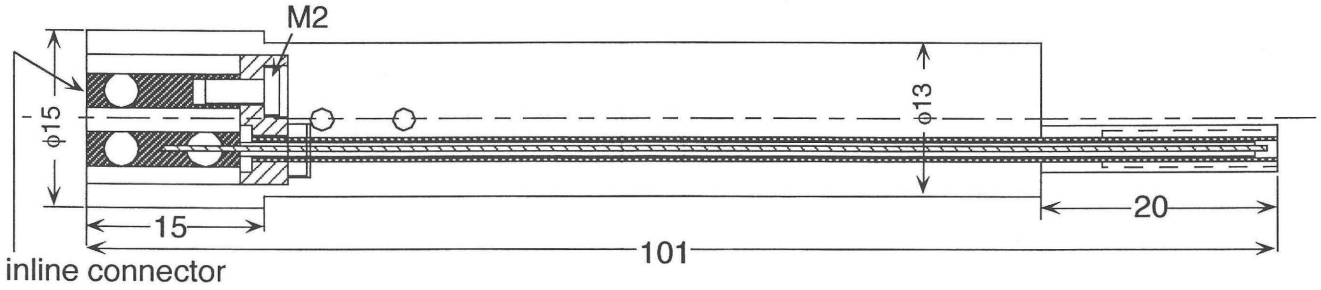

Fig. 2. Schematic view of ISP for fast scanning probe system in the LHD.