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

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The measurements of plasma parameters in the divertor leg in LHD using the Ion Sensitive Probe (ISP) [1] were performed in hydrogen plasma in the operational configuration with the magenetic axis position (R_{ax}) of 3.60 m, a toroidal magnetic field strength of 2.887 T. It should be noted that in the discharges mentioned here, the toroidal field direction was reversed from the standard direction. Figure 1 shows typical current-voltage (*I-V*) characteristics of the inner (Ion Collector) and the outer (electron guard) electrodes of the ISP inserted in the divertor plasma in LHD obtained during the discharge of #31256. As shown in Fig. 1 (a), clearly different characteristics are obtained from both electrodes. The *I-V* curve of outer electrode shows the same characteristic as a conventional single Langmuir probe. On the other hand, the *I-V* characteristic of the inner electrode shows no negative current at even positive probe voltage. It is reasonable to suppose that electrons are prevented from coming into the inner electrode. T_i is estimated by the exponential fitting as shown in Fig. 1 (b). In this case, the estimated T_i is about 32 eV. On the other hand, T_e is estimated to 8 eV.

Figure 2 shows the profile of T_i, T_e and connection length of magnetic field lines (L_c) in the divertor leg along the movement path of the ISP. In the hatched region, *I-V* characteristics of the inner electrode are similar to that shown in Fig. 1. Namely, the estimation of T_i is possible with high reliability, and shows the higher value compared with T_e in this case. Unfortunately, these successful *I-V* characteristics of the inner electrode are obtained only in the hatched region, though the T_e estimation is succeeded in the whole position in the divertor leg. At the center region of the divertor leg, the ion current was not reached to zero. It is possible to estimate the T_i from these data as shown in Fig. 2 with some assumptions. The left side of the peaks of T_e , corresponds to the private region. In this region, the measured ion currents on the inner electrode are too noisy to evaluate T_i, in spite of the T_e and n_e are similar to those of the hatched region. In order to discuss the profile of T_i, the large error must be taken into account except for the results in hatched region. 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 [2]. A further direction of this study will be to realize the relationships of T_i between the divertor region and the edge or the core plasmas. In order to obtain the full profile of T_i in the divertor plasma, some improvements of the electrode's structure and the electric circuit are needed.

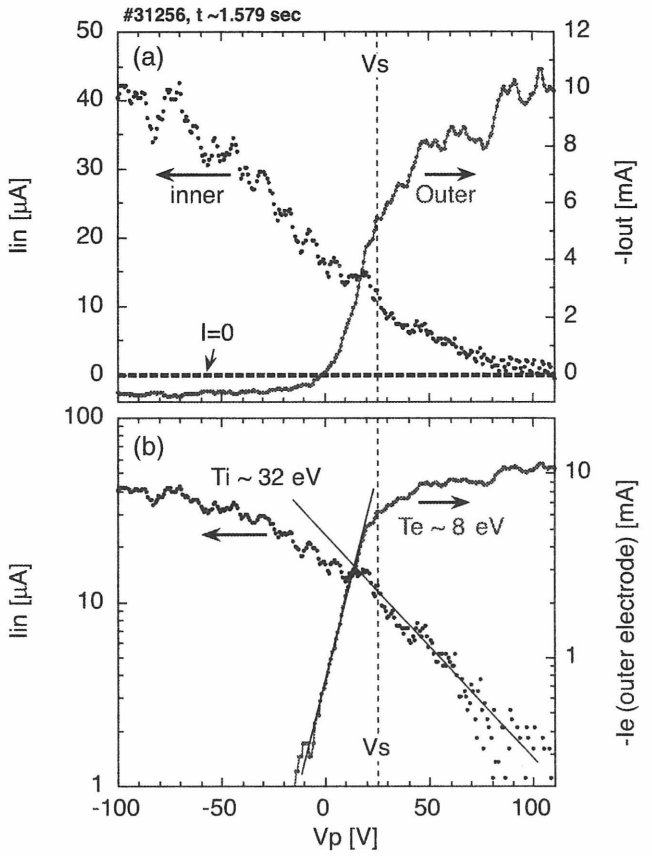

Fig. 1. Comparison between *I-V* Characteristics of the inner and the outer electrodes of the ISP; (a) In the linear scale, the current of the inner electrode (I_{in}) is almost zero at even positive biased voltage (V_p) in comparison with V_s, (b) results of the estimation of T_i and T_e in the logarithm scale.

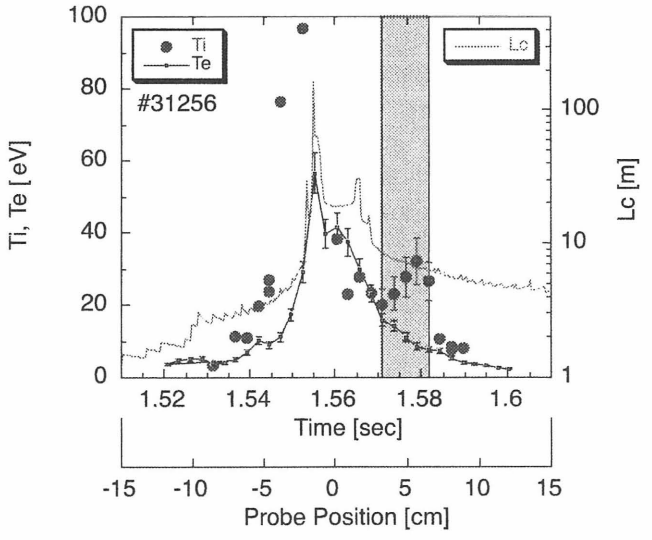

Fig. 2. Profiles of the T_i, T_e and L_c in the divertor leg along the path of the ISP probe. The time axis indicates the passing time of the ISP. The L_c structure is independent of the time evolution. The precious results of T_i estimation were obtained in the hatched region.

Reference
1) Katsumata, I. : Contrib. Plasma Phys. **36** (1996) S, 73.
2) Matsumoto, Y. et al. : NIFS-713.