§9. Modification of the Edge Plasma with Polarized Bias Electrode

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The importance of the edge plasma is now recognized generally. The central plasma condition such as impurities and confinement can be governed by edge conditions. For example, it is well known that the improvement of the confinement of the H-mode is achieved in the very edge region and that the performance depends on the neutral density of the edge plasma. In this fiscal year, we try to control edge plasma with polarized bias electrode.

The schematic drawing of the bias electrode system is shown in Fig.1. A Linear motion feed-through sends a probe head deeply into the plasma from a top port of JIPP-TIIU. The probe head is made of carbon-carbon composite with 20% boron. The advantage of this material is robustness for the heat load and that it can act as getter; pumping both oxygen and hydrogen. So when head is located at in the plasma; e.g., r/a=0.85, it does not make the plasma performance worse significantly. The head and the holding rod are insulated from vacuum vessel. With the use of the power supply system, we can apply positive/negative voltage with respect to the vacuum vessel. Since the currents from the capacitor banks (-500V) are controlled by power transistor array in the power supply system, we can apply arbitrary wave form of voltage to the electrode. We can check the effect of the biased electrode system efficiently.

After the several trials, we have not controlled the edge plasma effectively yet. On positive biasing case, the edge density increases slightly and the intensity of the H_α/D_α light changes a bit. However the main plasma does not seem to be affected. As for negative biasing case, because of the voltage drop due to the internal resistance of the power supply, applied voltage is only several tens of voltage. We observe very litter change. In contrast to the effect for the main plasma, the bias experiment affects the edge fluctuation drastically. Time evolution of the plasma parameters in the positive biasing experiment is shown in Fig.2. The head of the biased electrode lies at z=20 cm where several centimeters inner from the LCFS. The fluctuation of the SOL plasma is monitored by 5-pin Langmuir probe located at the next section of the JIPP-TIIU. Measured fluctuation exhibits a clear reduction when biasing voltage are applied though the shear of the radial electric shear does not established at that area. The fluctuation level of the density and the electron temperature changes from 21% to 13%, 28% to 13%, respectively. The suppression effect is more efficient in the NBI-heated plasma. We continue to study fluctuation induced transports using 5-pin Langmuir probe array and the magnetic fluctuation using magnetic pick-up coils set in the electrode itself. A electrode inserted from outward port will be also tried to see the difference.

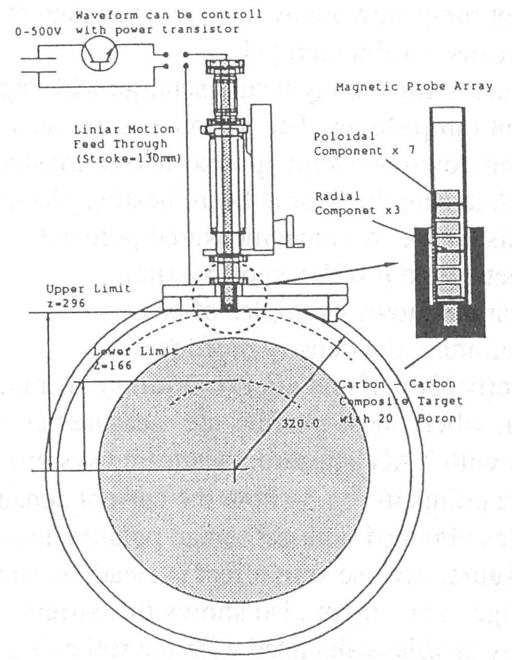

Fig.1:Schematic drawing of the biassed electrode.

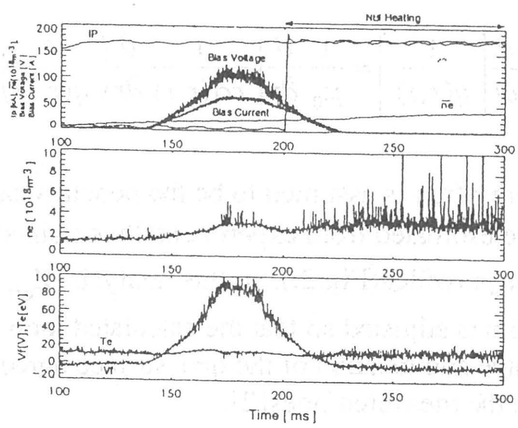

Fig.2:Time evolution of the plasma current, I_p, line averaged electron density $\overline{n_e}$, the bias voltage v, the bias current I, the edge density n_e, edge floating potential V_f and edge electron temperature T_e monitored by triple Langmuir probe.