§11. Radial Electric Field Control by Electrode Biasing in LHD

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The purpose of this study is to clarify the role of a poloidal viscosity against to the transition of a confinement mode by using a biasing between the vacuum vessel and the electrode made of Carbon (a cylindrical disk: 100 mm of diameter and 40 mm of length) in the Large Helical Device (LHD). To obtain the dependency of the transition condition on the ripple structure, we tried the biasing experiment in the configuration (R_{ax} = 3.53 m).

The target plasma for the biasing in LHD was produced by ECH (f = 77 GHz, t = 3.32 - 4.82 s, P_{ECH} ~280 kW, Helium). Figure shows the typical time evolutions of (a) the electrode voltage V_E, (b) the electrode current I_E, (c) the electron density n_e along the chord passing through the magnetic axis, (d) the stored energy W_p, (e) the stored energy W_p (expanded range), (f) the turburent flucuation ($20 < f < 200$ kHz) measured by a PCI, (g) the time evolution of electron density fluctuation spectra measured by a MIR and (h) the relation between the electrode voltage and the electrode current (#102719). The electrode was inserted to ρ ~ 0.85 ($Z_{4.5L}$ =3600 mm) and was positively (650 V) biased through the power supply (P_{out} ~ 3 kW) by the triangle input waveform for the power supply (t = 4.51 s to t = 4.81 s). Figure (a) and (b) show the plasma had the *negative resistance* (4.65 s < t < 4.71 s). In this region the stored energy W_p increased slightly, though the significant changes in the averaged electron density n_e was not clearly seen in Fig. (c). Figure (f) and (g) show the increase in the fluctuation before the transition and then reveal the suppression of the fluctuation in a wide frequency range corresponding to the transition in the region 4.65 s < t < 4.71 s. Moreover Fig. (h) shows that the electrode characteristics had a *hysteresis* under the ramp-up and ramp-down conditions in the electrode voltage.

These results are expected to develop the understanding the dependency of a poloidal viscosity on the ripple structure by the biasing experiment in various configurations in LHD and the comparison between the experimental results in TU-Heliac, CHS and Heliotron-J.