§63. Plasma Wall Interactions and Wall Conditions During 3rd and 4th Experimental Campaigns in the Large Helical Device

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Five experiment campaigns were conducted in the Large Helical Device since Mar., 1998. He ECR discharge cleaning was employed in the first campaign, and glow discharge cleanings from the 2nd campaign[1,2]. From the 3rd campaign, graphite tiles were installed in the divertor wall region. From the 1st campaign, material probes such as SS and graphite were placed at several inner wall positions of #7 toroidal sector along the poloidal direction as shown in **Fig.1**. After each campaign, impurity deposition, change of surface morphology and retention properties of discharge gas and impurity gas were examined in order to clarify the plasma wall interactions and the wall conditions. This note describes the results obtained for the 3rd and 4th experimental campaigns.

From the 3rd campaign, the wall surface largely changed by the installation of graphite tiles at the divertor target region. The shot number was twice increased compared to that of 2nd campaign. At the entire wall region, the deposition of carbon was observed. At the first wall, the carbon concentration and the deposition thickness were 60 at.% and 20 nm, respectively. At the walls far from the plasma, outer divertor region and port, the carbon concentration and the deposition thickness were 80-90 at.% and 800-900 nm, respectively. Namely, the entire wall was significantly covered by the carbon. Fe concentration at top surface and deposition thickness were comparable to those of 2nd campaign. Since the discharge shot number was twice of the 2nd campaign, the deposition thickness per shot of 3rd campaign becomes a half of 2nd campaign. These results are consistent with the reduction of metal impurity level in the plasma. Gas retention at the wall increased approximately twice of that of the 2nd campaign. In particular, the increase was large at the wall far from the plasma where the carbon deposition was dominant. In the 4th campaign, the samples exposed to only main discharges and only glow discharges were prepared. **Figure 2** shows the depth profiles of atomic composition for the SS sample exposed to only main discharges and the graphite sample exposed to only glow discharges. On the SS sample, a thick carbon deposition was observed. On the graphite sample, Fe deposition was relatively large. These results indicate that the main discharge largely erodes the graphite tiles at the divertor and the glow discharge sputtered the first wall. The helium retention was also examined for these samples. At the toroidal position far from the anode, the retained amount of helium in the sample exposed to only main discharges was roughly the same as that in the sample exposed to only glow discharges. However, at the toroidal position close to the anode, the helium retention due to the glow discharge was very much larger that that due to the main discharge.

In order to improve the plasma confinement, the reduction of gas retention including helium retention is required. Possible methods are surface heating before main discharge shot and boronization, which are scheduled in the next experimental campaigns.

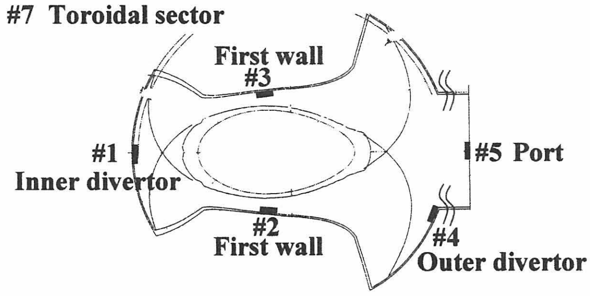
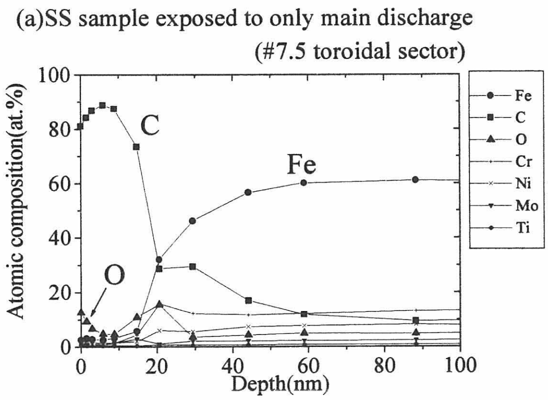


Fig.1 Location of material probes placed along poloidal direction at toroidal sector, #7.



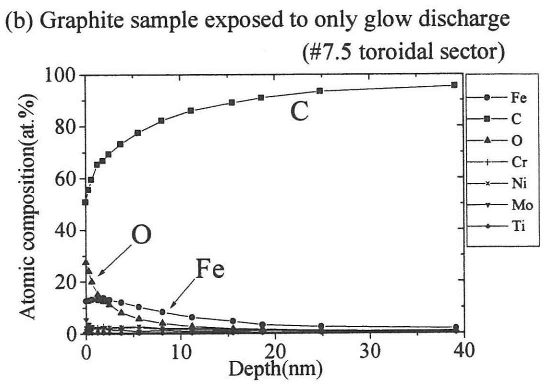


Fig.2 Depth profiles of atomic composition for SS sample exposed to only main discharges **(a)** and graphite sample exposed to only glow discharges **(b)**, during the 4th experimental campaign.

References
[1] T.Hino et al, J.Nucl.Mater., **290-293**(2001)1176.
[2] S.Masuzaki et al, J.Nucl.Mater., **290-293**(2001)12.