§15. Characteristics of Particle Balance in the Carbon Sheet Pump

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Reduction of hydrogen recycling is one of the important subjects for improvement of the plasma performance. First wall of fusion device is exposed to charge- exchange fast neutrals and a large amount of hydrogen is desorbed from the wall. Carbon Sheet Pump (CSP) [1,2], which was developed for the reduction of hydrogen recycling in the Large Helical Device (LHD) was newly designed and investigated for the test on the actual plasma device. The subject of this collaboration is to understand the influence of charge-exchange fast neutral on hydrogen recycling quantitatively. Recently the pumping effect of CSP on the actual plasma device was confirmed by using hot-ion plasmas produced in the GAMMA 10 tandem mirror [3]. However, experimental results suggest that the carbon sheet adsorbs molecular hydrogens to a certain extent under the actual plasma circumstance. In order to investigate the above influence we installed a gate valve between the test module and GAMMA10 which opens during plasma discharge.

Fig.1 shows the schematic view of the CSP module. CSP is shaping in ϕ170mm disk made of two-dimensional C/C sheet of 1.5mm thickness. CSP is installed with radiation shield for the baking in the test module. Charge-exchange fast neutrals emitted from the GAMMA10 plasma are introduced via extension tube of 400mm in length. In front of the CSP, a rotational shutter which intercepts the incident charge-exchange fast neutrals is mounted and the pumping effect is examined by using the shutter (CSP-on and CSP-off) shot by shot. Impurity gases during plasma discharge is also measured by quadrupole mass spectrometer (QMS) installed in the test module.

Fig.2 shows the thermal desorption spectra of hydrogen (m/e=2) pressure before and after the installation of the gate valve. The amount of desorbed hydrogen is reduced to about 20% by improvement the vacuum condition. Since particle flux is almost constant through the each experiment, pressure difference is thought to be dominated by the adsorbed molecular hydrogen.

Fig.3 shows the correlation between the number of incident charge exchange neutral particles and that of the desorbed molecular hydrogen. Desorbed particles increase with incident charge-exchange fast neutrals. The ratio of desorbed particles to incident particles is estimated to be within the range of 1~0.3.

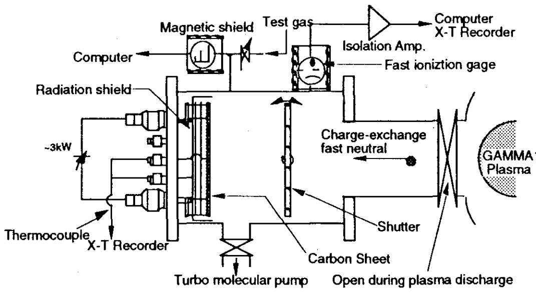

Fig.1 Schematic view of the test module of CSP and the experimental setup.

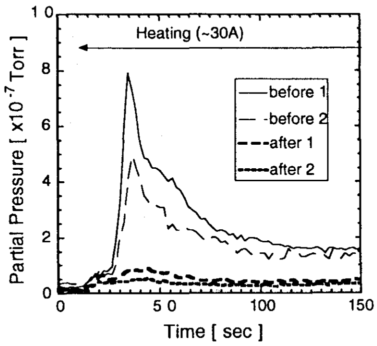

Fig.2 Thermal desorption spectra of hydrogen (m/e=2) pressure before and after improvement of the vacuum condition.

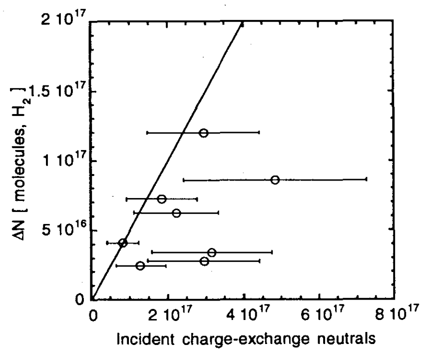

Fig.3 Correlation between the number of incident charge exchange neutral particles and that of desorbed molecular hydrogen. The solid line shows that incident particles are equal to desorbed particles.

References

1) Sagara, A. et al., J. Nucl. Mater. **220-222** (1995) 627.
2) Suzuki, H. et al., Trans. of Fusion Technol. **27** (1995) 523.
3) Nakashima, Y. et al., J. Nucl. Mater. **266-269** (1999) 901.