§62. First Application of Carbon Sheet Pump to Plasma Devices

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Reduction of hydrogen recycling is an important subject to improve the plasma performance of magnetic confinement fusion devices. High-energy charge-exchange neutrals emitted from the plasma bombarded first-wall surface of the fusion device and cause a large amount of hydrogen desorption from the wall. An application experiment of Carbon Sheet Pump (CSP)[1], which has been developed for reduction of hydrogen recycling in National Institute for Fusion Science, recently started under the collaboration with Plasma Research Center, University of Tsukuba, etc..

In this study, a small scale of pump module has been designed and manufactured in order to evaluate the pumping characteristics of CSP actually applied to plasma devices. The module is applied for pumping the charge-exchange neutrals emitted from ICRF-heated plasmas produced in the GAMMA 10 tandem mirror device[2]. In the GAMMA 10 plasmas, relatively high ion temperatures (more than ~ 5 keV) have been achieved in the central cell, which enables easily to evaluate the pumping effect of high-energy neutrals.

Figure 1 shows the schematic view of the test module of CSP and the experimental setup. The CSP is shaping in ϕ170mm disk made of C/C sheet of 1.5 mm in thickness. The CSP is installed with a radiation shield for baking in a water-cooled vacuum chamber. The baking is carried out up to 800°C for outgassing the absorbed hydrogen. The test module has been mounted on the central cell vacuum chamber of GAMMA 10. Charge-exchange neutrals emitted from the GAMMA 10 plasma are introduced into the test module via extension tube of 400mm in length. In front of the CSP, a rotational plate is mounted and the pumping effect is examined by turning the plate shot by shot.

Figure 2 shows the temporal change of the pressure measured with a nude gauge installed in the test chamber during the plasma discharge. Solid line represents the pressure in the case with CSP and dashed one corresponds to the case without CSP. In this experiment, a fairly large amount of gas is flowed into the test module during the plasma shot. Hence, the resultant difference between the case with CSP and that without CSP is observed to be small. However, a simple numerical calculation of gas transport between the test chamber and the GAMMA 10 vacuum chamber proved that the pumping efficiency of the CSP was more than ~ 50% .

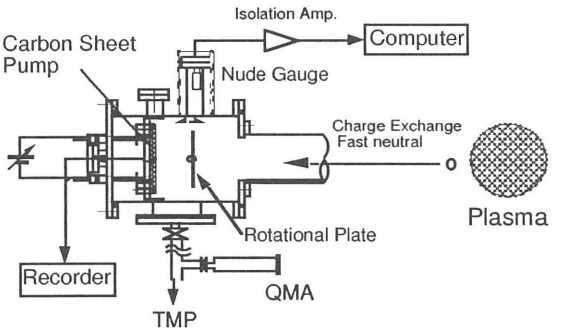

Fig. 1 Schematic view of the test module of CSP and the experimental setup.

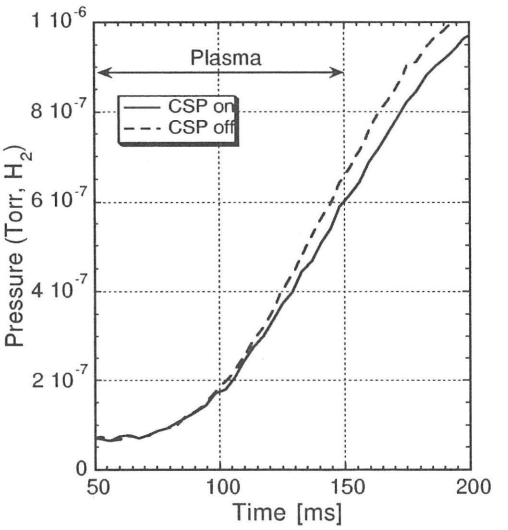

Fig. 2 Time behavior of pressure during he plasma discharges.

References
1) Sagara, A. et al., J. Nucl. Mater. 220-222 (1995) 627.
2) Tamano, T. et al., Proc. 15th Int. Conf. on Plasma Phys. and Controlled Nucl. Fusion Research, Seville, 1994, Vol. 2 (IAEA, Vienna, 1995) p.399.