§66. Evaluation Experiments of Carbon Sheet Pump in the GAMMA 10 Tandem Mirror

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Carbon Sheet Pump (CSP)[1], which has been developed for reduction of hydrogen recycling in National Institute for Fusion Science, has been applied to a plasma device to evaluate the pumping characteristics. A small scale of pump module was made and installed in the central cell of the GAMMA 10 tandem mirror device[2]. The module is exposed to charge-exchange neutrals emitted from ICRF-heated plasmas produced in the central region. 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. Charge-exchange neutrals from the plasma (~10^{18}H/m^{2}sec) 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 (CSP-on and CSP-off) shot by shot.

Figure 2 shows the time behavior of the pressure measured with a nude gauge during the plasma discharge. In this experiment, plasmas heated with four different ICRF powers (45 - 120 kW) are used and the resultant pressure change is measured in each ICRF power. The pressure difference between CSP-on and CSP-off increases with the ICRF power, which indicates that the pumping effect increases with the increase of high-energy charge-exchange netrals. Although, in the present experimental configuration, a fairly large amount of gas is flowed into the test module during the plasma shot, the pressure difference is confirmed under a good reproducibility.

In order to evaluate the pumping efficiency of CSP, a pressure-balance calculation is carried out. The calculation results are compared with the experimental data in Fig.3. It is found that the pumping efficiency η_{pump} is estimated to be more than 50% and that the above efficiency is sustained during more than 300 plasma shots.

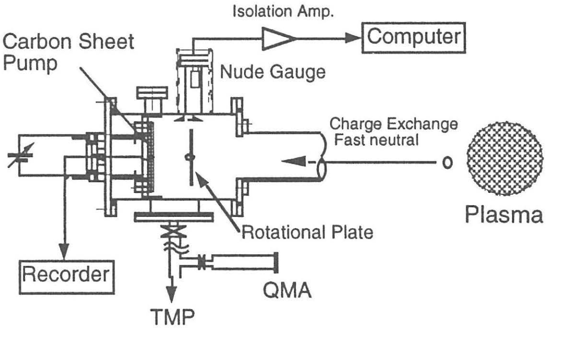

Fig. 1 Schematic view of the test module of CSP and the experimental setup.

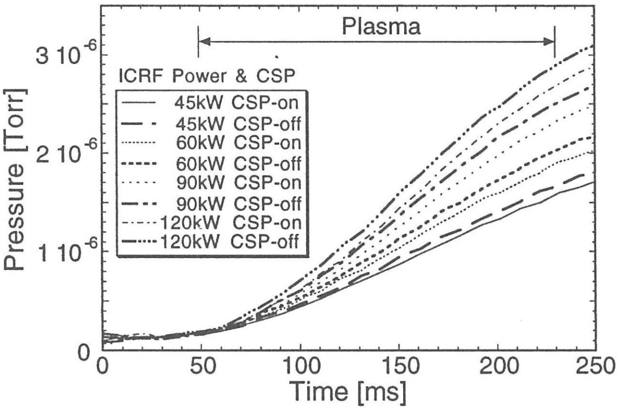

Fig. 2 Time behavior of pressure during the plasma discharges.

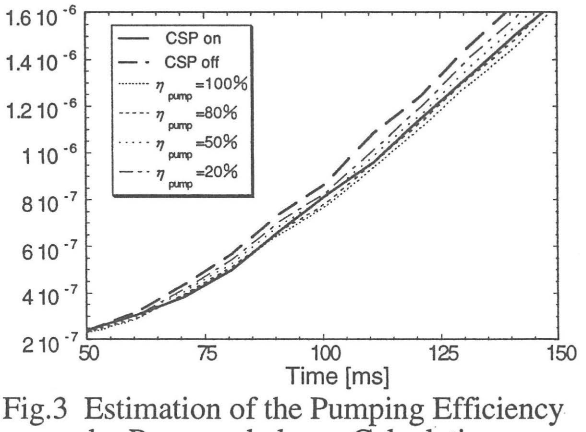

Fig.3 Estimation of the Pumping Efficiency by Pressure-balance Calculation

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.