§12. Development of Operational Method for Reducing Adsorbed Gases on the Surface of Carbon Sheet Pump

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For improvement of energy confinement, it is necessary to reduce hydrogen recycling. Plasma facing material is exposed to charge exchange fast neutrals, and desorbed hydrogen from the material induces hydrogen recycling. The purpose of our research is to control hydrogen recycling by applying carbon sheet pump (CSP)[1, 2] to actual plasma devices. Recently the pumping effect of CSP was confirmed by using hot-ion plasmas[3]. However experimental results suggest that a certain amount of hydrogen adsorbs on the CSP surface in actual plasma condition. Gases adsorbed on the CSP surface have possibilities of hydrogen recycling and impurity flux to main plasma. Therefore, an operational method which reduces adsorbed gas on the surface is required.

Fig. 1 shows the schematic view of CSP test module which is mounted on the central region of the GAMMA 10 tandem mirror. CSP, which is made of two-dimensional C/C sheet (CX-270, Toyo Tanso Co.), has a diameter of 170 mm and 1.5 mm in thickness. CSP is installed with heat insulator for the baking in the water-cooled test module. Total pressure in the test module is measured by fast ionization gauge during plasma discharge and in thermal desorption experiment. A gate valve (GV) which separated the vacuum circumstance in each chamber during shot to shot intervals of plasma discharges was installed between the test module and the GAMMA10 vacuum chamber in order to improve vacuum condition in the test module.

Hydrogen trapped in the carbon material is hardly desorbed by heating up to 200 °C. Irradiation was carried out with continuously heated CSP from room temperature to 250 °C to reduce adsorbed gases. Fig. 2 shows time evolution of total pressure in the thermal desorption experiments after exposure to fast neutrals. There is no significant difference between time evolution of total pressure using gate valve and that without GV. However, time evolution of total pressure in the case of 200 °C is much lower than that of 30 °C. These results clarify that adsorbed gases can be reduced by continuously heating CSP to 200 °C regardless of using GV or without it. Furthermore, there is no remarkable difference between the pumping effect of CSP with continuously heating of CSP and that without heating[4]. It is found that adsorbed gases can be reduced by continuously heating CSP with sufficient pumping effect sustained in the actual devices.

Conceptual and mechanical design of a surface station to investigate influence of actual plasmas on CSP has been started. The objectives of experiments by use of this apparatus are quantitative measurement of trapped particles and depth profiles of ones and estimation of contamination of the CSP surface. As shown in fig. 3, samples can be replaced without opening the main chamber to air. In this apparatus, the influence of actual plasma devices on not only CSP but also other candidates for plasma facing material such as isotropic graphite, C/C and tungsten can be investigated. Construction of the system has completed and irradiation experiments will be started in the next experimental series.

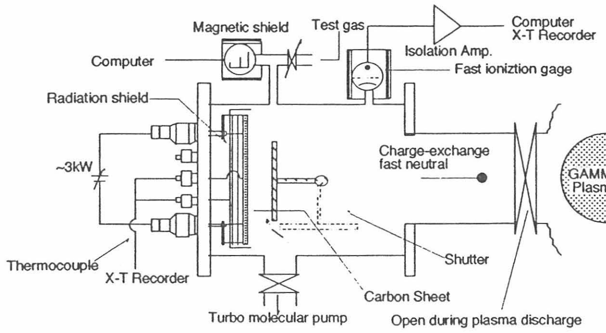

Fig. 1. Schematic view of the test module of CSP and the experimental setup.

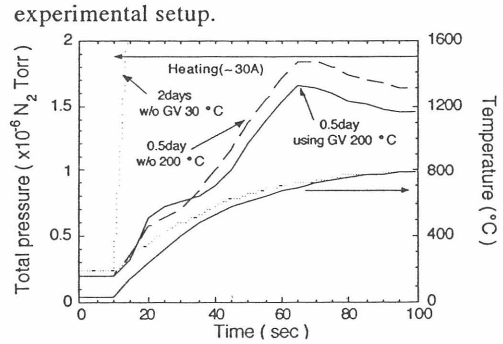

Fig. 2. Time evolution of total pressure in the case of 200 °C is much lower than that of 30 °C.

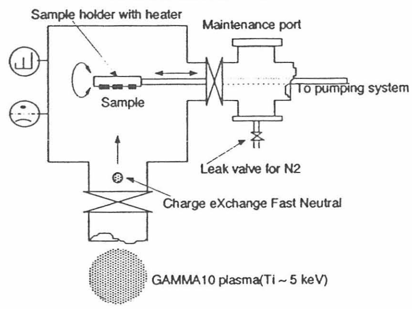

Fig. 3. Schematic illustration of the surface station.

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