§14. Adsorption and Desorption Behavior of Tritium in the Plasma-Facing Materials

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A given amount of tritium depending on the experimental conditions necessarily produces in the vacuum chamber of the Large Helical Device (LHD), when the D-D experiments are conducted in LHD. A part of tritium produced was retained in the plasma-facing materials (PFMs), and the remainder was exhausted from the vacuum chamber by a pumping system. Tritium impinged in the PFMs diffuses into both directions of bulk and surface. The latter diffusion ultimately causes the release of tritium from the materials.

Continuous tritium release from the surface layers of PFMs is of a serious problem to avoid the tritium exposure of workers during maintenance of LHD. From this viewpoint, it is required to examine the detritiation methods corresponding to the release rate and the chemical form of tritium species. Therefore, the absorption and desorption behavior of tritium was focused on the samples of stainless steel type 316L (described as SS316L), which was widely used as a structural material in the vacuum chamber of LHD.

Aim of the present study is to establish a kinetic database being able to estimate the dynamic behavior of tritium release by measuring the chemical form of tritium and its release rate under various conditions.

To conduct the experiments mentioned above, a special device for tritium exposure and discharge cleaning of the samples was designed and constructed. A schematic diagram of the device is shown in Fig. 1. Main feature of the device is to be constructed by two vacuum chambers equipped with glow discharge electrodes. One is used for the tritium exposure of samples and the residual tritium can be exhausted by an ion pump after the exposure. The other is utilized to the measurements of tritium release behavior under the atmosphere and the vacuum.

Most important specification required is that the present device is able to confine perfectly molecular tritium at least. Namely, the leak rate of each vacuum

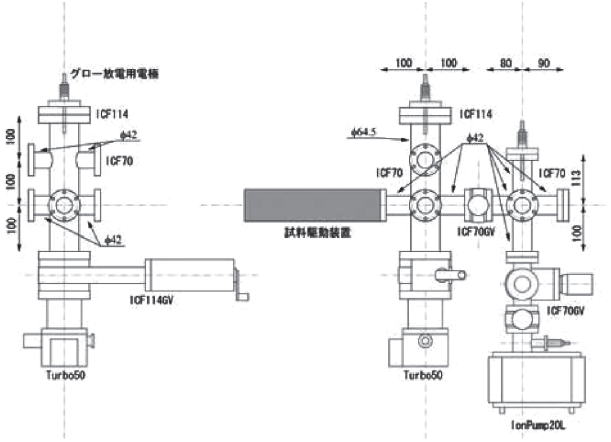

Fig. 1 Schematic diagram of the experimental device.

chamber is to be below the order of 10^{-10} atm cm^3 /s, and it was found that the present device thoroughly satisfies this requirement. A tritium-stored getter and a deuterium cylinder are connected with the device and the tests of tritium exposure and discharge cleaning will be conducted in the next step.

Prior to the above experiments, exposure tests of SS316 samples with molecular tritium by using another tritium handling device were carried out. The samples were exposed at 623K for 3 hours. Tritium gas used was diluted with deuterium and the tritium concentration was about 1 %. Total pressure of tritium was 0.13 and 1.2 kPa. After the exposure, the release rate and the chemical form of tritium were examined under argon atmosphere at room temperature. The chemical form of tritium species release from the sample was mostly that of water.

Change in the release rate of tritium with time is shown in Fig. 2. Just after the sample was taken out, the release rate was very fast. But it drastically dropped down and a steady rate was observed. It was almost same as 0.2 %/day of total inventory for both exposure pressures. Further tests are needed to clarify the behavior.

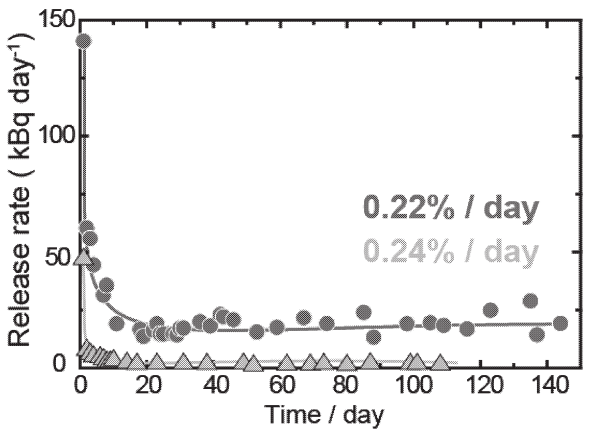

Fig. 2 Change in the release rates of tritium.