§87. Studies on Removal/Recovery Techniques for Residual Tritium in Materials

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It is well known that control of fuel particles in the reactor core is indispensable to make a steady operation for a long term. A part of energetic particles of deuterium and tritium is implanted into the plasma-facing materials (PFMs) and simultaneously released from them during the operation. Therefore, from viewpoint of stable fuel balance, it is of a great important issue to make clear isotope effects on absorption/desorption rate of hydrogen isotopes.

From these viewpoints, new irradiation device of tritium ions was prepared in our laboratory, and isotope effects on desorption behavior of hydrogen isotopes implanted by glow discharge into stainless steel as a model material have been studied using temperature-programmed desorption spectroscopy.

The outward appearance of a newly established ion irradiation device is shown in Fig. 1. Main features of the new device are as follows:

(1) Energy range: 0.5 to 3 keV

(2) Ion Flux: *ca.* 1x10^{13} ions/s (depending on gas species)

(3) Heating temperature: < 800 K

(4) Ion species: Hydrogen isotopes, helium and so on.

In addition, to examine the isotope effects on desorption behavior of hydrogen isotopes, implantation of hydrogen isotopes into samples of type 316 stainless steel (SS316) was carried out using a specially designed glow discharge device.

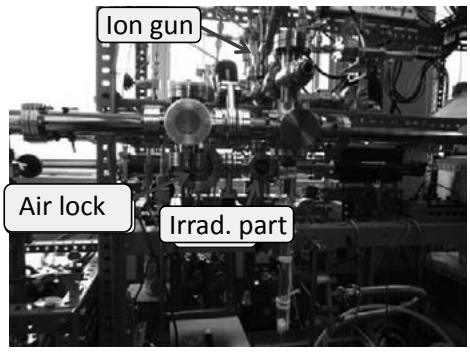

Fig. 1 New irradiation device of tritium ions.

Figs. 2 and 3 show examples of desorption spectra observed for glow discharge experiments in tritium gas, which is a mixture of hydrogen, deuterium and tritium. Concentration of tritium was 4.7%.

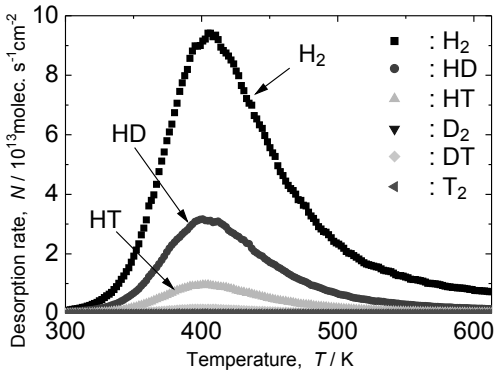

Fig. 2 Desorption spectrum observed for SS316 exposed to glow discharge in tritium gas.

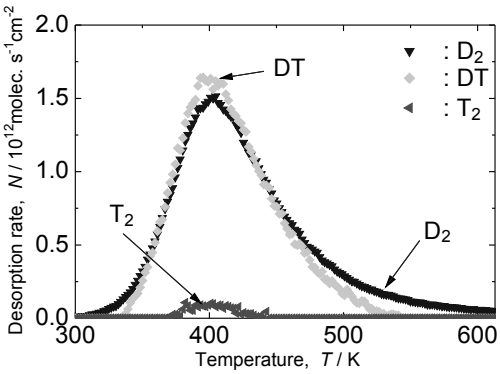

Fig. 3 Miner peaks in the desorption spectrum observed in Fig. 2.

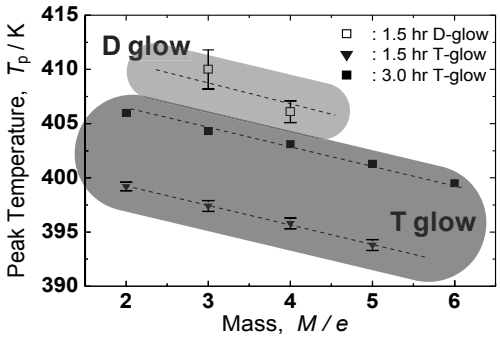

Fig. 4 Peak temperature vs. mass of desorption species.

Desorption spectrum consists of 6 peaks, and major desorption peaks are H_2, HD, and HT. It is known that desorption rate of these peaks is limited by a diffusion process. Peak temperature in each desorption species was determined by fitting with a fourth order function. As a result, peak temperature shifted to the low temperature side with mass of desorption species as shown in Fig. 4. It was seen from numerical analysis that such a peak shift is due to the difference in the activation energy of diffusion.