§63. Tritium Absorption of Co-deposited Carbon Film and Tungsten

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Tritium retention in plasma facing materials is one of major issues for next generation of fusion devices, since it significantly affects its safety and operational schedule. Carbon and tungsten will be used as the divertor material. Carbon material is easily eroded by fuel hydrogen ions and then the sputtered carbon atom co-deposits with hydrogen isotope ion/atom on the wall. It is known that the hydrogen isotopes retention in the carbon film made by co-deposition process is significantly high. However, the tritium gas absorption behavior of such the film has not been sufficiently investigated. In the present study, the tritium gas absorption experiments are conducted for the co-deposited carbon films, polycrystalline tungsten and graphite (IG-110U)[1]. The co-deposited carbon films were prepared by using deuterium arc discharge with carbon electrodes. Numerous films were prepared by changing the deuterium pressure and the substrate temperature. In this study, two carbon films with deuterium concentrations of D/C=0.11 and 0.35 were used for the tritium gas absorption experiment. The thickness of the carbon films was several μm. The thickness of the tungsten and the graphite was 0.1mm. The tritium gas absorption experiment was carried out by changing the sample temperature and the exposure time.

Fig. 1 shows the apparatus of tritium gas absorption device. Four samples were placed in the sample chamber. The tritium gas was produced by heating the tritium gas chamber. The tritium gas pressure was kept 10 Pa. Fig. 2 shows the amount of absorbed tritium as a function of sample temperature. The absorption amount increased with the temperature. The absorption amount of the co-deposited carbon films was two orders of magnitude larger compared with the case of tungsten or graphite. The absorption amount of the high density carbon film was several times larger than that of the low density carbon film. The low density carbon film has very high deuterium concentration, so that the number of trapping site might have been smaller compared with the case of the high density carbon film. Fig. 3 shows the absorption amount against the exposure time. The absorption amount increased with the exposure time. Even if the exposure time is 5 hr, the absorption amount still increases. Namely, the absorption did not saturate yet for 5 hr exposure. Further long exposure time is needed for the tritium absorption to saturate.

In summary, the tritium gas absorption amount of the co-deposited carbon film was two orders of magnitude larger than that of tungsten or graphite. The absorption amount became large for the carbon film with low deuterium concentration since there is a lot of trapping site for tritium.

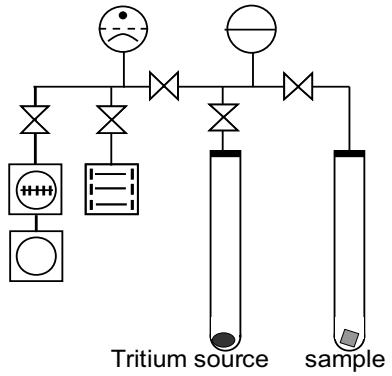

Fig. 1 Apparatus of tritium gas absorption device.

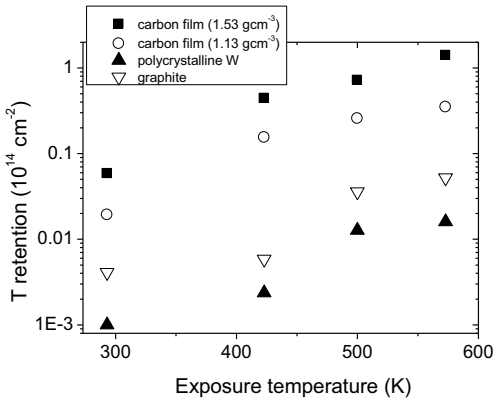

Fig. 2 Amounts of absorbed tritium as a function of exposure temperature (exposure time: 1 h).

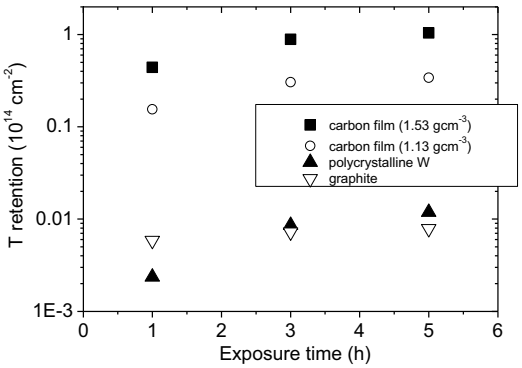

Fig. 3 Exposure time dependence of the amount of absorbed tritium at 423 K.

1)Y. Nobuta, Y. Yamauchi, T. Hino, S. Akamaru et al, Tritium absorption of co- deposited carbon films and polycrystalline tungsten, Presented 10th Inter. Conf. on Tritium, Nara, 2010.