§74. Study of Hydrogen Depth Distribution in Tungsten Exposed with D Plasma and Then T_2 Gas Exposure

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Estimation of tritium inventory of Fusion reactor is a key issue of safety. Especially, a vacuum vessel, which has large tritium inventory, is an important object for estimation. Tungsten is going to be used as a material for the plasma facing components of ITER. Therefore, a lot of investigation has been carried out to evaluate tritium inventory in tungsten. Hydrogen isotopes inventory in tungsten was found to widely change by the manufacturing method and the plasma exposure condition. To reveal the reason of the change, tritium distribution on the surface after D plasma and then tritium gas exposure was already carried out[1]. In this study, how much depth of the tritium could be contributed to the distribution in Ref. 1 and the change of tritium concentration on surface at time were investigated by using the imaging plate (IP) and the etching method.

The W specimen exposed to plasma was the recrystallized W (A.L.M.T. Corp., Japan) with 99.99 wt% purity. D plasma exposure with low energy (38 eV), high flux (10^{22} $D^+/m^2/s$) was carried out to W at 550 K of specimen to the fluence of 10^{26} D/m^2. Tritium was introduced into the specimen thermally by exposure to hydrogen gas containing tritium. The exposure of tritium gas, in which the pressure of gas was 1 kPa, was carried out at 473 K in 5 hours. This gas exposure was carried out in 2009 and specimen was kept at room temperature. Tritium concentration on the surface of specimen was continuously measured by IP. After the IP measurement in 3 year later, the specimen was dipped into the etching solution in one minute and tritium concentration of the solution was measured by liquid scintillation counter to evaluate the amount of tritium removed by the etching.

Figure 1 shows the results of IP measurement on each year and after etching. The luminescence intensity was the mean intensity of the surface exposed to plasma and was standardized by using of 41 kBq/g tritium standard sample. Tritium concentration of the surface decreased until 2 years, however, there was no obviously change after 2 years. This result indicated that only tritium which strongly trapped exists in tungsten surface after 2 years. And it was found that the tritium distribution on the surface reported in Ref.1 was formed of tritium strongly trapped. Fig. 1 also shows the intensity drastically decreased after the etching treatment. From the measurement of weight loss after the etching, the region of 0.5μm depth from the surface was removed from the specimen. Therefore, many amount of tritium was found to exist near surface in the region of 0.5 μm depth of specimen. The amount of tritium in that region was 1900 Bq and it corresponds to 3800 Bq/μm tritium concentration. These results indicated that tritium could not penetrate into the depth that was enough for the observation of inner tritium distribution on W and suggested that higher temperature or longer time of tritium gas exposure should be required to enhance tritium penetration much deeper. On the basis of these results, tritium depth distribution in tungsten is planed to observe after the change of the tritium gas exposure condition.

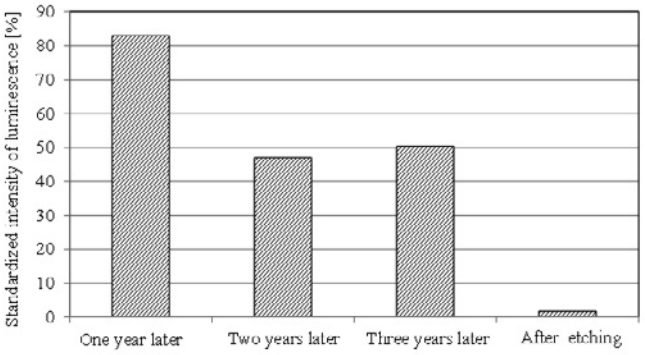

Fig. 1. Standardized intensity of luminescence on each year and after etching

1) Isobe, K. et al.: J. Plasma. Fusion Res.SERIES **10** (2013) 81.