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イオン損傷タングステン中における水素同位体挙動
Hydrogen isotope inventory in ion damage tungsten

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1. Introduction

Plasma facing materials (PFM) are simultaneously exposed to intense flux of plasma ions and neutrons produced from DT fusion reactions. Tungsten is one of the most expected candidate materials for the divertor in ITER and future fusion reactors thanks to its high temperature strength. During fusion reactor operation, tungsten is expected to be exposed to high energy neutrons and receive irradiation damage. The neutron irradiation damage will be trapping sites for hydrogen isotope and increase tritium retention in tungsten. Tritium retention is a critical issue for the safety and continuous operation of ITER and future fusion reactors. Therefore, it is necessary to investigate the trapping properties produced by neutron irradiation damage and hydrogen isotope inventory in trap sites. But there are few experimental studies which dealt with tritium retention in neutron damage because it is difficult to produce intense flux of neutron with 14 MeV energy. In addition, the handling of tritium is difficult because tritium is a radioactive isotope. Therefore, most experimental studies investigated the influence of ion damage on the retention of deuterium in tungsten. In this study, ion damage by Fe^{3+} irradiation was used as a surrogate for neutron damage.

2. Experiment

Square-shaped tungsten samples with 7×7×1 mm size were used in this experiments. The samples were damaged by irradiation with 6.4 MeV Fe^{3+} ions at 473K by the tandem accelerator, DuET (Dual-Beam Facility for Energy Science and Technology), at the University of Kyoto. Four different damaged samples (0.7, 1.4, 2.2, 4.2dpa) were prepared by changing the ion fluences. After Fe^{3+} irradiation, the damaged samples were irradiated at 473 K using 1 keV deuterium ions by HiFIT (High Flux Irradiation Test device) at Osaka University up to a fluence of $1.5 \times 10^{24} D/m^2$. Following irradiation experiments, the deuterium retention and desorption behavior were analyzed by the TDS (Thermal Desorption Spectrometry).

3. Result

As dpa of the damage tungsten sample increases, the retention of deuterium in the sample increases. In addition, it is noted that damage in tungsten is saturated because the retention of deuterium do not increase as I surpass 2.2dpa.

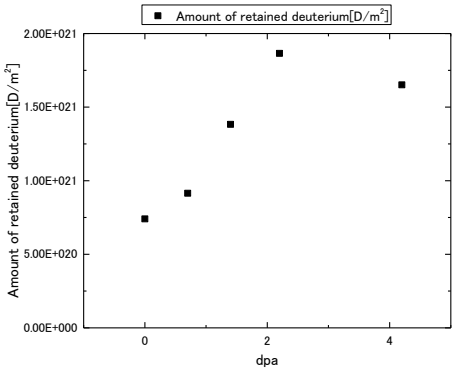

Figure 1:The D retentions for tungsten as a function of dpa.