

# クエスト高温プラズマ対向壁における水素同位体滞留挙動評価 Hydrogen isotope retention behavior in QUEST high temperature plasma facing wall

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## 1. Introduction

Tungsten (W) is a major candidate for plasma facing materials (PFMs) in fusion reactors because of its higher melting point and lower sputtering yield. During the plasma operation, impurities deposition and introduction of radiation damage are proceeded on the W surface by plasma wall interaction (PWI). The investigation of hydrogen isotope behavior in W under plasma operation is essential from the viewpoint of fuel recycling. In this study, W sample was located in Q-shu Univ. Exp. with Steady-State Spherical Tokamak (QUEST) and exposed to hydrogen plasma. Thereafter, X-ray photoelectron spectroscopy (XPS) was applied to evaluate the chemical state of the sample surface. Additionally, the effect of hydrogen isotope retention behavior was evaluated by thermal desorption spectroscopy (TDS).

## 2. Experimental

Polycrystalline W samples (10mm $\phi$ , 0.5mm $^t$ ) purchased from A.L.M.T. Co., Ltd were used. To remove impurities and damages introduced by polishing process, the sample was heat-treated at 1173 K under ultrahigh vacuum ( $<10^{-6}$  Pa). The samples were placed on the top wall (erosion dominated area) and the bottom wall (deposition dominated area) of QUEST and exposed to hydrogen plasma during 2015AW (Autumn-Winter) campaign. After picking up these samples from QUEST, the surface chemical states were studied by XPS. In addition, 1 keV deuterium ion ( $D_2^+$ ) was implanted with the ion flux of  $1.0 \times 10^{18} D^+ m^{-2} s^{-1}$  up to the ion fluence of  $1.0 \times 10^{22} D^+ m^{-2}$  at room temperature. TDS measurements were performed from room temperature up to 1173 K to evaluate the hydrogen isotope desorption behavior.

## 3. Results and discussion

The XPS results showed that the deposition layers of carbon and impurities at the bottom wall were thicker than that at the top wall. Fig. 1 shows the  $D_2$  TDS spectra for W samples placed to the top and bottom wall. The spectra of the top wall had two major desorption peaks at 400 K and 600 K. The peak at 400 K was attributed to desorption of D absorbed on the sample surface or trapped by dislocation loops [1]. The peak of 600 K was considered to be derived from desorption of D trapped by vacancies [2]. In addition to

the above-mentioned peak, the additional desorption was found at the temperature between 700 K and 1000 K. It indicates that D was trapped by the carbon-deposited layer and formed a stable chemical bond (C-D bond) [3], which was consistent with XPS results. In this presentation, based on the chemical state of the elements and depth profile of the impurity in the deposited layer, the correlation of impurity deposited layer, radiation damage, and hydrogen isotope retention behavior is reported.

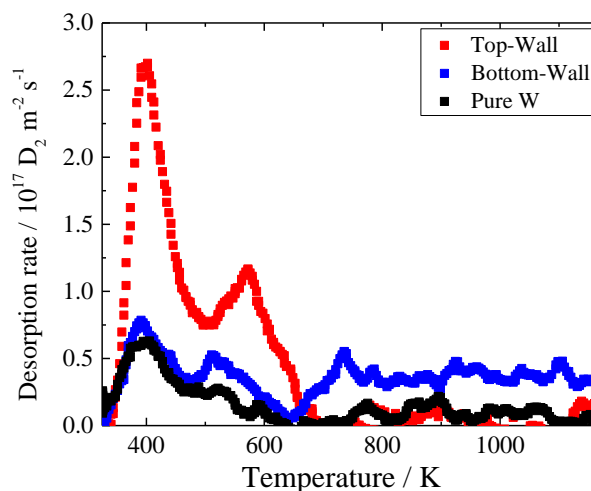


Fig.1  $D_2$  TDS spectra for  $D_2^+$  implanted tungsten samples exposed to 2015AW experimental campaign.

## References

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