§33. Analysis of Hydrogen Isotope Retention into Dust Particles

Asakura, N. (JAEA),
Ashikawa, N.,
Hayashi, T., Fukumoto, M. (JAEA)

Accumulation of metallic dust such as tungsten (W) and beryllium (Be) as well as carbon (C) will potentially affect tritium retention in thermonuclear fusion devices such as ITER. In particular, hydrogen isotope retentions on the co-deposition layers and dust particles at shadow areas under the lower temperature condition will become problem. In this study, we measured hydrogen isotope retention in small amount of tungsten dust (W-flakes). This result will be applied to estimate tritium inventory in the vacuum vessels of ITER and future fusion devices.

W-flakes was bought at Nilaco Corp., and the amount was about 0.1 mg with averaged size of 1 μm, including smaller W-dust particles. The W-flakes were exposed to deuterium plasma produced by RF wave (13.65MH, 5kW) injected from a helical antenna into APSEDAS [1] under the magnetic field of 500G. Electron energy was about 30 eV and the total fluencies of deuterium were about 10^{25} D/m^2. The linear plasma discharge was produced in the vertical direction, and a target plate was installed at the bottom. The W-flakes were set on the target plate of 10 mm x10 mm with the thickness of 2-3 mm. The plate surface temperature was measured by a thermographic camera and average temperature was increased from room temperature to 350 °C at the end of the plasma exposure.

Figure 1 shows the deuterium desorption rate in the W-flakes using Thermal Desorption Spectrometry, which was directly performed in APSEDAS after exposure to the deuterium plasma. The peak temperature of desorption rate is observed at about 1000 K. In previous experiment, deuterium desorption rate in bulk W (A.L.M.T. Corp.) was analyzed using similar plasma parameters in APSEDS, and these results are shown in Fig.2. The peak temperatures of desorption rate are about 600 K, and the peaks were independent of the plasma fluencies. For the other tungsten materials such as vacuum plasma spray (VPS) tungsten, the peak temperature was reported at 1000 K in APSEDAS experiment [3], which was similar to that for the dust W-flakes. These results suggested that the peak temperature of desorption rate for porous structure of tungsten surface is higher than that for the bulk W. On the other hand, the total amount of desorbed deuterium in the dust W-flakes was smaller than that in the bulk W, and the reason was not determined

In future works, comparison of fluence dependences and analysis of impurity contamination on dust W-flake and bulk W surfaces are planned.

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[1] M. Sakamoto et al., *Phys. Scr.* T138 (2009) 014043.
[2] K. Honda, A. Rusinov, M. Sakamoto et al., JSPF meeting (2010).
[3] A. Rusinov, M. Sakamoto, private communication.

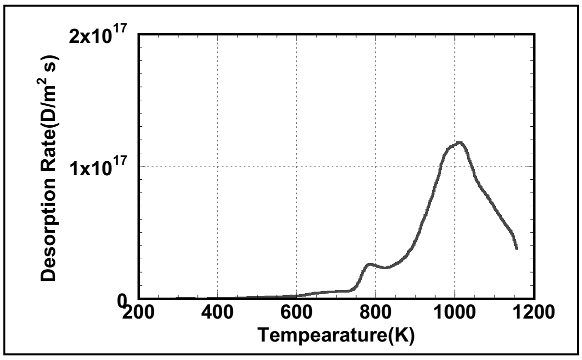

Fig.1 Deuterium desorption rate in dust W-flakes using Thermal Desorption Spectrometry after exposed to deuterium plasma.

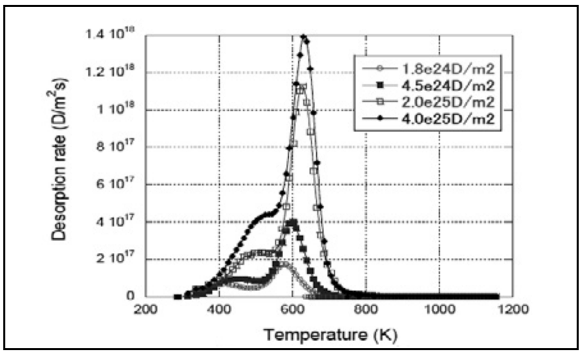

Fig.2 Deuterium desorption rate in W bulk using Thermal Desorption Spectrometry after exposed to deuterium plasma [2].