§9. Hydrogen Retention and its Surface Temperature Dependence for Moving-surface Plasma-facing Components in Vehchle-1

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In order to operate fusion reactor in steady state, it is inevitable to control the plasma wall interaction (PWI).Especially particle retention in the co-deposited multi layer is crucial problem. Although it is considered that the elementary processes are functions of the materials, thickness, surface temperature so on, the on-line quantitative assessment of the amount of the retained particle is difficult. Recent interests in the fusion community are how the tungsten plays a role in particle retention.

The purpose of this research program is to establish the database of the particle retention in sprayed W as a function of the surface temperature. This program is complementary to the bi-directional research program between NIFS and Kyushu University, namely active recycling control with a moving surface PFC (rotating limiter) coated by Lithium.

The example of plasma spray W on SUS is shown in the fig.1 A diameter is 30 mm and thickness is mm.

Fig. 1 Plasma spray W plate

This sample is exposed in one hour to the RF plasma whose temperature is 2-5 eV and density is ~ 10^{16} m^{-3}.

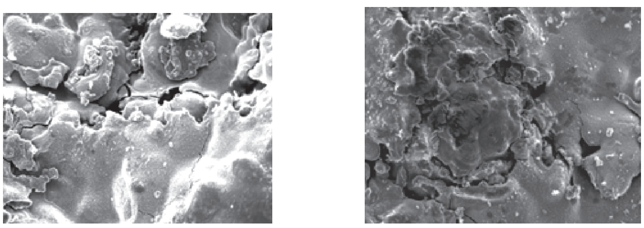

Fig. 2 SEM of the W surface (A) after exposure, (b) before exposure

The SEM photographs are shown for before (right) and after (left) plasma exposure. In order to promote the out gassing from the W layer, the SUS plate is heated at ~ 800 K by sheath heater.

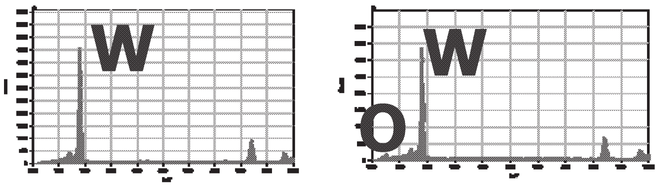

Fig.3 EDX before(right) and after (left) plasma exposure

Comparison with the EDX spectrum is shown in Fig.3. Before exposure O is found, however it disppears after exposure.

During one hour plasma exposure, the surface temperature of the W reaches ~ 750 K. At such high temperature particles are not considered to be retained in the W layer. The retention is measured after the sample is cooled down to ~ 300 K. The sample is heated up to 830 K for 25 min. however, no clear rise in mass spectrometer signals for H_2 and H_2O is found.

In order to release retained H-particles He plasma and biased plate are used. Just after He plasma production sharp rises in both H_2 and H_2O are found, as shown in Fig4.

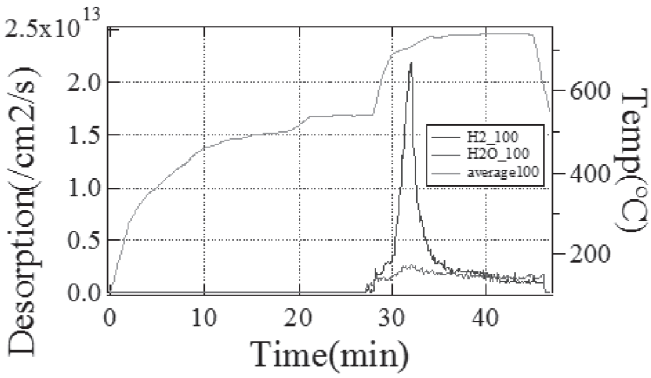

Fig. 4 Desorption flux and surface temperature are shown as a function of TDS and He plasma irradiation.

The results of bias voltage from 0 to 200 V are taken for the various W samples. Although the bias voltage is 0, the sheath accelerated He ions of 3 Te(< 15 eV) irradiate the W surface and retained H particles are released.

H-plasma irradiation and H retention from the plasma sprayed W layer have been studied at high surface temperature. Although it is not expected, the particle desorption flux of ~ 2 × × 10^{13} /cm^2/s is found above ~ 1000 K.