§25. Plasma Wall Interactions under Inert Gas Puffing for Reduction of Heat Flux

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In order to decrease heat flux to divertor tiles, gas puffing using inert gas or nitrogen to the divertor plasma has been conducted in fusion devices. Plasma-wall interactions in gas puffing condition has not be clarified yet. The aims of the present study are the evaluations of erosion, surface modification and gas retention of plasma-facing wall exposed to deuterium plasma with the gas puffing using plasma exposure devices.

First, a sample holder with gas puffing system in the vicinity of the samples were manufactured. Figure 1 shows a photograph of the manufactured holder. Gas such as argon can be introduced thorough pores punched near the samples. The sample holder has a heater. The maximum temperature of the sample was estimated to be approximately 300°C.

Fig. 1. Photograph of manufactured sample holder. The gas can be introduced through pores near samples.

The sample holder was installed in a glow discharge device[1], and then plasma-exposure experiments with argon gas puffing were carried out. The sample used was SS316L. The sample was mechanically polished, cleaned using ethanol, and then degassed in 1000°C for 1hr. After the degassing, the sample was exposed to deuterium plasma with argon gas puffing. The deuterium gas pressure was 8 Pa. The argon pressure was changed from 0 to 1.7 Pa. The discharge voltage was 300 V, namely the maximum incident energy of ion was 300 eV. The discharge time was 1hr. The ion fluence was approximately 8×10^{16} cm^{-2} estimated from the sample current density during the exposure. After the plasma exposure, the erosion and the deuterium retention was estimated by weight loss method and thermal desorption spectroscopy.

The erosion was under a detection limit in all cases. This might be owing to small ion fluence and low incident energy of ions. During the thermal desorption measurement, retained deuterium was desorbed in forms of HD, D_2 and water. The dominant desorption species during the measurement was HDO. Figure 2 shows thermal desorption spectra of HD for the plasma-exposed samples. HD desorption in the range from 400 to 500°C largely decreased in the cases of argon gas puffing. Figure 3 shows thermal desorption spectra of HDO for the plasma-exposed samples. In the cases of argon gas puffing, HDO desorption during the measurement increased. These results suggest that the argon gas puffing results in the change of the trapping sites for deuterium. The amount of retained deuterium increased slightly with argon gas puffing rate. The enhanced diffusion caused by surface cleaning and/or energy deposition by argon might be responsible for the increase of the retention in the case of argon gas puffing.

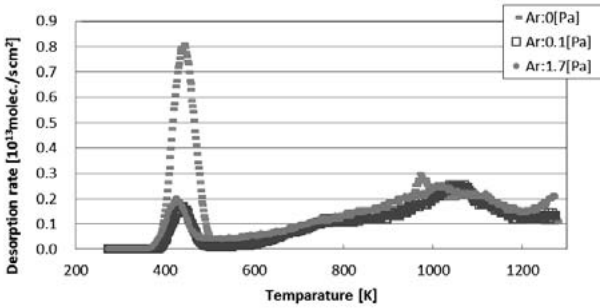

Fig. 2. Thermal desorption spectra of HD for the plasma-exposed SS316L.

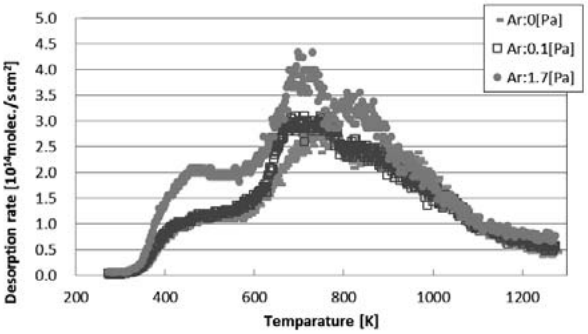

Fig. 3. Thermal desorption spectra of HD for the plasma-exposed SS316L.

1) Yamauchi, Y. et al. : J. Nucl. Meter. **390-391** (2009) 1048.