# Hydrogen isotopic exchange in tungsten by plasma irradiation

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Accumulation of tritium in the first wall of future thermonuclear reactors is an important problem. Plasma discharge cleaning is considered as tritium removal method [1]. During the discharge cleaning tritium concentration in the surface layers can be reduced by hydrogen isotopic exchange. In this study, hydrogen isotropic exchange in alternate plasma irradiations of D and H has been investigated by spectroscopic measurements and TDS analysis.

One sample, made of tungsten polycrystalline foil (Nilaco, thickness 0.1 mm, annealed at 900 C for 1 h) was exposed to D RF plasma in APSEDAS device [2] at the ion energy of about 25 eV, the ion flux density of about $3\times10^{21}$ D/m$^2$sec, the fluence of $2\times10^{25}$ D/m$^2$, the sample surface temperature of about 500 K. In one experiment after D implantation the sample was irradiated by H plasma for 10 min ($8.7\times10^{23}$ H/m$^2$), and for 2 h ($1.2\times10^{25}$ H/m$^2$) in another experiment. The surface temperature during H irradiation was slightly less (~10 K) than during D irradiation. $D_\alpha$ and $H_\alpha$ emission spectra were measured at the point of 1 cm above the sample in order to observe D atoms release during H irradiation. After irradiations the sample was moved in TDS facility, where it was heated linearly up to 1170 K to analyze thermal desorption spectra and total retention of D. Also, for comparison, TDS spectra were measured after only D irradiation at the same conditions. D retention was calculated taking into account $D_2$ and HD signals.

TDS spectrum of $D_2$ consists of two peaks at about 500 K and 650 K. The amplitudes of these peaks were decreased after H irradiation. Reduction of 500 K peak amplitude can be attributed to D release due to temperature increase up to about 490 K during H irradiation. Reduction of the 650 K peak amplitude, where almost all D usually desorbed in TDS, can be caused by hydrogen isotopic exchange during H plasma irradiation. TDS spectra showed, that contribution of HD molecules to total D release was increased, as well as hydrogen retention, with exposure time of hydrogen plasma. Nevertheless, total D retention was decreased: 10 min H irradiation resulted in about 23% decrease of D retention and 2 h in 70% decrease.

Reference

[1] V. Philipps et al., Proceedings of the 22nd IAEA Fusion Energy Conference 2008, FT/4-2Ra

[2] Sakamoto M, Miyazaki T, Higashizono Y, et al., Physica Scripta T138 (2009) 014043