Influence of preliminary helium irradiation on trapping of Deuterium in tungsteN [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2020.47.1.181

Harutyunyan Z.R., Gasparyan Yu.М., Ryabtsev S.A., Pisarev A.A.

National Research Nuclear University MEPhI, Moscow , Russia, [arutyunyan@plasma.mephi.ru](mailto:arutyunyan@plasma.mephi.ru)

Studies of the accumulation of hydrogen isotopes and the effect of helium on this process are of particular interest from the point of view of assessing the behavior of plasma-facing materials of a fusion reactor. Due to such qualities as high melting point and high threshold energy of physical sputtering, tungsten is one of the promising materials for use as plasma-facing material of the divertor. As a result of the combustion of the nuclear fusion, tungsten will be irradiated with intense fluxes of deuterium and tritium, as well as by helium, which will be formed as a result of a D-T thermonuclear reaction.

In this work, the experiments were carried out on the ultrahigh vacuum double-beam installation MEDION, which allows for sequential irradiation of samples placed in the chamber with a monoenergy mass-separated deuterium beam and a helium ion beam. The presence of a differential pumping system allows the analysis of helium and deuterium trapping by thermal desorption spectroscopy (TDS) directly in the irradiation chamber without contact with the atmosphere. In the experimental series, 6×6 mm2 samples were used, cut from polycrystalline tungsten foil with a thickness of 50 microns and a purity of 99.95% (produced by Plansee, Germany). To reduce the concentration of natural defects, all samples were pre-annealed at a temperature 2200 K for 30 minutes. First, tungsten was damaged by a mass-separated helium ion beam with an energy of 3 keV to doses of 1×1019-1022 He/m2 at room temperature. Such irradiation conditions correspond to active surface modification and saturation of the tungsten surface layer with helium. An hour after the end of the helium irradiation, deuterium ions were irradiated with an energy of 2 keV (0.67 keV/D, which is below the threshold for the formation of Frankel pairs) at a dose of 1 × 1019 D / m2 to study the interaction of deuterium with the defects created by helium particles in the surface layer. TDS analysis was performed 120 minutes after irradiation of the sample with deuterium ions. A series of irradiations with a gradual increase in the dose of helium ions was performed sequentially with one sample. The maximum heating temperature did not rise above 1000 K to minimize the change in defect structure. The gas output from the sample was recorded using a quadrupole mass analyzer with high resolution, allowing separation of the D2 and He signals.

At a dose of pre-irradiation with helium above 1021 He/m2, the efficiency of deuterium trapping fell sharply, which correlates with the saturation of the helium concentration in tungsten.

This work was supported by the Russian Science Foundation, project no. 17-72-20191.

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVII/E/ru/IF-Arutyunyan.docx) [↑](#footnote-ref-1)