Study of surface modification and deuterium retention in tugsten exposed to ELM-like pulsed DEuterium plasma flows with noble gas impurities [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2023.50.2023.1.1.265

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At future fusion facilities, to mitigate the pulsed thermal loads arising from transient processes in plasma (ELM events, disruptions) on facing materials, it is planned to use a method based on the injection of a certain amount of noble gas (neon, argon, krypton) into the plasma [1]. At PISCES, PSI and other devices it was shown that the presence of such impurities can affect both the modification and erosion of PFMs, and the deuterium (D) retention in them [2-4].

The paper presents the results of study of the tungsten surface modification and deuterium retention in it after exposure to pulsed plasma flows. Material samples were made of tungsten grade V-MP. Part of tungsten samples differed by the initial presence of He-induced nanostructures on the surface (tungsten "fuzz"). Deuterium and deuterium with additions of helium, argon, and neon mixtures acted as plasma-forming gases. Plasma pulsed flows irradiation of material samples was carried out on the quasi-stationary high-current plasma accelerator (QSPA-T) [5]. The chosen experimental parameters reflect the conditions of ELM events expected in ITER [6]: the heat energy density absorbed by tungsten surface was 0.7 MJ/m2 with the pulse duration of 1 ms (the surface heating temperature was below the melting threshold of tungsten). The number of pulses was varied in the range from 1 to 10.

Addition of Ne and Ar impurities into plasma slightly affected the nature of tungsten surface modification. The study of D capture in tungsten by the method of thermal desorption spectrometry showed that the accumulation of deuterium increases as the atomic mass of the impurity increases: when irradiated with Ar-doped plasma, the highest retention rates are observed.

Exposure of tungsten with "fuzz" to plasma with He and Ne impurity led to the melting of nanostructures. As a result, the initial nanofibers agglomerated into thicker fibers. A similar effect was observed earlier when irradiated with D plasma without impurities [7]. The D retention was smaller compared to the results obtained on tungsten without the presence of nanostructures. As a result of exposure to plasma with the addition of Ar, the presence of “fuzz” fibers is not observed, and residual spherical nanostructures are present on the surface. In this case, the amount of trapped D becomes approximately equal to the values obtained by irradiating tungsten without “fuzz” with pure D plasma.

This work was supported by Russian Science Foundation (RSF) grant № 20-12-00203.

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