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Production of Radiation-Damaged Tungsten and its Study in High Flux Deuterium Plasma

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Method of high-level radiation damage production in tungsten have been developed and studied on the facilities of the Kurchatov institute together with high flux plasma effect on the damaged material. The results of the experimental work for the last two years are presented in the paper. Radiation damage from DT neutrons is simulated with surrogate irradiations by high energy ions from accelerator. Tungsten W 99.95 wt.% was irradiated by different ions species on cyclotron –by helium ions He²⁺ at 3.5-4 MeV and by carbon ions C³⁺ at 10 MeV to the total fluence of 1021-1023 ion/m². The samples have been obtained with primary displacements in the range 0.1-600 dpa that covers the whole range according to the fusion reactors including the ITER and DEMO projects. The task was to find out the dependence of the result of the plasma action on tungsten with the presence of radiation damage in it. Radiation swelling effect for both ion species has been exhibited in tungsten by evaluation of linear dimension changes with profilometer (0.5-0.8 % in case of carbon ions). The irradiated samples were exposed to steady state deuterium plasma in the linear plasma device LENTA in the divertor and SOL simulated conditions. Erosion of the material surface as well as the surface and damaged layer microstructure changes have been studied in those condition. Important increase in deuterium retention in tungsten (by an order) has been found at the depth of maximal damage. Implanted helium content in the surface layer has been measured by Elastic Nuclear BackScattering.

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