STUDY OF THE STOCHASTIC CLUSTERING OF THE SURFACE OF REFRACTORY high-melt MATERIALS UNDER PLASMA loads IN the PLM device

1Budaev V.P., 1Fedorovich S.D., 2Martynenko Yu.V., 2Karpov A.V., 1Lukashevsky M.V., 1Gubkin M.K., 1Gerasimov D.N., 2Shestakov E.A., 1Lazukin A.V., Sviridov E.V., 1Rogozin K.A., 1Marchenkov A.I., 1Gvozdevskaya D.S.

1National Research University “MPEI”, Moscow, Russia, [budaev@mail.ru](mailto:budaev@mail.ru)  
2National Research Center "Kurchatov Institute", Moscow, Russia

Tests of tungsten targets, limiters, and devertor plates in modern tokamaks have shown the significant change in the surface structure under the powerful plasma loads [1]. For the of ITER, as well as the development of projects of fusion reactors TIN and DEMO, full-scale tests of the divertor and the first wall materials are required. It is extremely important to ensure adequate conditions for the plasma load on materials [1], in which the processes of changing the structure of the plasma facing surface should be investigated. For such purposes, the PLM device was constructed [2]. The facility is a linear magnetic trap with a multicusp magnetic plasma confinement scheme – an 8-pole multicusp. A feature of this device is the stationary plasma confinement, which is an advantage for testing materials of the divertor and first wall of a fusion reactor.

Using the Langmuir electric probe method, helium plasma parameters were measured in the PLM facility. Analysis of the current-voltage characteristics showed in the voltage range from   
–44 V to 0 the presence of two zones with different laws, which indicates two fractions of electrons with “hot” and “cold” temperatures. The obtained estimates of the temperature of the hot fraction of electrons were 40–50 eV, the cold fraction of electrons was from 7 to 10 eV. The electron density reached 2 x 1018 m–3. Spectroscopic measurements of the intensity of the spectral lines of atomic helium were carried out. Tungsten and molybdenum test plates were tested in stationary helium discharges in the PLM device. The duration of discharges in the PLM reached 200 minutes. The thermal load on the surface of the test plates was more than 1 MW / m2. The heating temperature of the plates reached 1000 ° C and more. After electron microscopy tests, a stochastic nanostructured surface with dimensions of structural elements less than 100 nm was observed on the plates.

This work was supported by the grant of the Russian National Science Foundation 17-19-01469, the production of the ASNI was supported by the Megagrant of the Russian Federation   
No. 14.Z50.31.0042.

References

1. Budaev V.P. VANT ser. Thermoyadernyi sintez, 38, 4, 5 (2015).
2. Budaev V.P. e a. VANT ser. Thermoyadernyi sintez, 40, 3, 23 (2017).