SURFACE AND bulk DAMAGES OF mockups of protective coating of the ITER divertor dome under heat PLASMA LOADS relevant to ITER ELMs AND disruptions

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The paper presents the results of testing of mockups of protective coating of the ITER divertor dome under the action of powerful pulsed plasma flows generated by the quasistationary plasma accelerator QSPA-T [1]. The mockup consisted of 8 elements with a size of 24.6 x 24.6 x 6 mm3 made of polycrystalline tungsten of purity ≥99.95% with a preferential orientation of the grains perpendicular to the plasma facing surface. The tungsten elements were soldered with bronze solder to a 19 mm thick copper base and were arranged in two rows of 4 elements with a gap between neighboring elements of about 1 mm. The thickness of the solder was 2 mm. The total area of the plasma facing surface of the mockup was 100 x 50 mm2. The plasma exposure was carried out in two modes: in the first mode, the angle between the plasma flow axis and the sample surface α was 30º, the maximum thermal load on the plasma flow axes was Qmax = 1.5 MJ/m2, the total number of the plasma pulses was N = 100, and in the second mode – α = 90º, Qmax = 2.5MJ/m2, N = 20. The duration of a plasma exposure in both modes was ~ 1 ms. Deuterium was used as a working gas. The temperature of the samples before each plasma pulse was maintained at 250 ºС.

During the tests the mockups were periodically removed from the vacuum chamber for intermediate studies: the mockups were weighed and their surfaces were examined using optical and electron microscopy. After a full cycle of irradiation metallographic studies of mockups were carried out aimed at identifying structural changes and bulk damage both in tungsten and in the tungsten-cooper interface. As a result of the investigation the mass loss of the mockups were determined depending on the irradiation regime and the number of pulses. Characteristics of cracks both on the surface and in the bulk were measured.

References

1. Zhitlukhin A., Klimov N., Landman I. et al., J. Nucl. Mater. 2007. p. 363–365.