METALS SURFACE MODIFICATION UNDER POWERFUL PLASMA RADIATION [[1]](#footnote-1)\*)

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The paper presents the results of an experimental study of the behavior of aluminum and corrosion-resistant steel under plasma radiation with parameters relevant to the mitigated disruption in ITER [1]. Radiation was generated by breaking an plasma stream of the quasi-stationary high-current plasma accelerator QSPA-T on a solid bar (target) [2]. The irradiated samples were installed at an angle of 45º to the axis of the accelerator on the side of the target, and were not directly exposed to the plasma stream. In paper [3], it was shown that such irradiation of corrosion-resistant steel 316L (N) -IG (supposed to be used as a plasma-facing material for the ITER diagnostic wall) leads to the formation on the sample surface of a regular wave-like structure with hills and valleyes with a characteristic scale along the surface of 1-3mm. In this paper the main attention was paid to the study of the dynamics of the surface modification process under the action of radiation flashes; for the first time, high-speed video recording of the formation of the surface relief was carried out.

The experiments were carried out on a quasi-stationary plasma accelerator QSPA-T. The target for plasma stream breaking was installed on the axis of the accelerator perpendicular to the plasma stream at a distance of 80 cm from the electrodes. The transverse size of the target was 160 mm, which is larger than the characteristic diameter of the QSPA-T plasma stream (~ 100 mm). The distance from the center of the irradiated sample to the center of the target was 100–150 mm. Hydrogen, helium, or nitrogen were used as the plasma-forming gas. The thermal load on the sample surface varied in the range of 0.5-1.0 MJ / m2 with a duration of 0.5-1.0 ms, the number of exposures to the sample was up to 10 pulses. High-speed registration of relief development processes was carried out using a Phantom video camera with a shooting speed of up to 200,000 frames per second and a frame size of 256 \* 256 pixels. After irradiation, the samples were examined using optical and electron microscopy.

As a result of the experiments carried out, the moment of the beginning of material melting on the sample surface was determined. It was found that a dark-colored film is formed on the aluminum surface, which cracks during irradiation, while the formed islands of the film move over the surface of the molten metal until it solidifies. The surface relief is practically unchanged. On the contrary, on the surface of steel samples, a strong development of the relief was found, the formation of which occurs directly during the irradiation pulse.

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References

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