NON-CONTACT METHOD OF STUDY OF RESIDUAL STRESSES IN A TUNGSTEN plate ARISING AS A RESULT OF FAST TRANSIENT HEAT LOADS ON ITS SURFACE [[1]](#footnote-1)\*)

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One of the key problems of the ITER international project is the erosion of tungsten divertor armor caused by pulsed thermal loads associated with ELMs. Fast heating of the plate is the reason of tensile stresses appearance in the thin surface layer of the metal, which causes deformation and cracking of the surface during cooling. In experimental modeling of the effect of pulsed thermal loads on tungsten samples on the BETA facility [1] at Budker Institute of Nuclear Physics, a residual bending was found, which correlates with the evaluated residual stresses. To characterize the stresses, a non-contact, non-destructive diagnostic system has been developed that allows observing the dynamics of deformations of the studied tungsten plate.

The operational principle of the system is based on observing a change in the position of the focal point of the laser beam reflected from the polished surface of the tungsten plate, back to heated. As a parameter characterizing the deformation, the radius of curvature of the investigated plate surface is considered. The front side of the plate is heated by an electron beam with a duration of 0.1−1 ms, having a Gaussian shape with FWHM of about 20 mm and creating a heat flux of 10−40 MJ ∙ m-2 ∙ s-0.5.

The experimental results show that the residual curvature of the surface of the tungsten plate (as well as the value of maximum bending during heating) correlates with the magnitude of the heat load. It grows with increasing load, so do the residual tensile stresses that arise in the surface layer. When irradiated with a constant power and exposure time, the residual curvature is set to a constant value after several acts of exposure. Cracking of a tungsten plate is accompanied by a decrease in the absolute value of the residual deformation, which indicates partial stress relief. A theoretical study of the process of deformation and stress accumulation was carried out, which is consistent with the experimental data obtained on the BETA facility. Studies of samples with different thicknesses are carried out under different scenarios and heat load values.

References

1. L.N. Vyacheslavov et al., Phys. Scripta 93 (2018) 035602

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVII/E/ru/IK-Cherepanov.docx) [↑](#footnote-ref-1)