Measurement OF DYNAMICS of diffraction of synchrotron radiation on tungsten single crystal under pulsed heating by laser radiation [[1]](#footnote-1)\*)

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In a thermonuclear reactor under the action of pulsed plasma loads, pulse heating of the diverter wall occurs. Inhomogeneous temperature distribution leads to the appearance of elastic and plastic deformations and mechanical strains. The temperature gradient and significant strains lead to an increase in hydrogen accumulation, mechanical destruction of structures and other factors harmful to the reactor [1].

The BINP SB RAS is developing dynamic diagnostics of material deformation based on the method of fast diffractometry [2]. To diagnose the irradiated material, the scattering of synchrotron radiation from the VEPP-4 accumulator in the Siberian Center of Synchrotron and Terahertz Radiation is used. The developed diagnostics has three principal features: measurements with a temporal resolution, measurements inside the material and measurements with spatial resolution.

To implement the diagnosis, the Laue diffraction scheme is used on a tungsten single crystal up to 500 microns thick. The thermal load is simulated by an Nd:YAG laser with an energy reserve of up to 50 J and a pulse duration of about 140 microseconds. Under such a thermal load, the crystal plane is deformed, on which the diffraction of synchrotron radiation occurs. This leads to a change in the shape and position of the diffraction peak. The dynamics of changes in the shape and position of the diffraction peak is measured by the DIMEX detector [3], which shoots 30 frames with a duration of 10 microseconds. By changing the shape of the peak, it is planned to restore the dynamics of deformation distribution in the material under pulsed thermal load. Now, the measurement of the dynamics of the diffraction peak shape is demonstrated.

To normalize deformation measurements, it is necessary to know the temperature distribution of the material surface. A pyrometer has been developed to measure the temperature dependence on the heating time.

The pyrometer consists of a photodiode, a transimpedance amplifier, and an optical system that collects scattered thermal radiation from a heated area on the sample surface and directs it to the photodiode. In addition, an aiming system has been developed that allows the laser to accurately hit the desired area on the sample and greatly saves time to prepare for the experiment.

When pulsed tungsten is heated by laser radiation, the diffraction peak of synchrotron radiation is shifted. The temperature dependence measured by the pyrometer allows estimating the specific displacement of the diffraction peak.

References

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