THE RESEARCH OF THE GENERATION OF SHOCK DISTURBANCES IN TRANSPARENT POLYMERS AFTER AN IMPACT OF HIGH-CURRENT ELECTRON BEAM WITH LOW ENERGY FLUENCE [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2021.48.1.153

1,2,3Kazakov E.D., 1Kalinin Yu.G., 1Kurilo A.A., 1Krutikov D.I., 1Orlov M.Yu., 1,3Smirnova A.R., 1Strizshakov M.G.

1National Research Centre "Kurchatov Institute", Moscow, Russia, [Kazakov\_ED@nrcki.ru](mailto:Kazakov_ED@nrcki.ru)  
2National Research University "MPEI", Moscow, Russia, [universe@mpei.ac.ru](mailto:universe@mpei.ac.ru)  
3MIPT(National Research University), Moscow, Russia, [info@mipt.ru](mailto:info@mipt.ru)

Recently, various polymeric materials, due to their lightness, relative cheapness and, most importantly, unique mechanical and strength characteristics, are widely used in aviation and rocket and space technology. At the same time, it is known that polymers under the influence of ionizing radiation of various nature are capable of changing the structure and other properties, including mechanical ones, and the accompanying heating of the substance further complicates the scenario of changing the characteristics of materials. For example, in non-metallic materials (polymers), heating even by several tens of degrees can significantly change the parameters (for example, reduce the speed of sound).

Experimental results of studying the propagation of disturbances caused by a high-current electron beam in transparent polymers when the accelerator is operating in the low-energy regime are presented. In this work we used laser sounding in combination with the electron-optical image intensifier tube that operates in chronographic mode to obtain various data on the shock disturbances arising in transparent materials and to look into the specifics of sample destruction.

The experiments were carried out on the Calmary high-current electron generator [1]. The generator operated in the following mode: the electron energy E = 150-300 keV, the electron beam current was I = 2-12 kA, the pulse duration at half-height 100-150 ns. We used a solid-state laser that operates in the mode of intracavity second harmonic generation with a radiation output at a wavelength of 540 nm and a pulse energy of 90 mJ as a probe radiation source. To detect the shadow of the laser radiation coming through the sample we worked with the electron-optical streak camera SFER-6, which operates in chronographic mode. The applied shadow diagnostics and the sensitivity of the method are described in more detail in [2]. As targets, we used samples of PMMA, polystyrene, epoxy resin with a thickness up to 30 mm, and optical glasses of the LK-5 and TF-7 brands with a thickness of 30 mm.

This work demonstrates that shadow method allows obtaining various data (for example, front velocities, geometric dimensions of the disturbance, the moment of occurrence of mechanical damage) on disturbances in transparent samples at low-energy operating conditions of the facility. It is shown that the disturbances are predominantly acoustic in nature.

This work was supported by a grant from the National Research Center "Kurchatov Institute" (Order No. 1569 dated July 16, 2019).

References

1. Demidov B.A., Ivkin M.V., Petrov V.A. et al. //Atomnaja Energija, 1979 vol. 46, № 2, p. 101—116.
2. Demidov B.A., Kazakov E.D., Kalinin Y.G. et al.// Instrum. Exp Tech, 2020 vol. 63, p.370–374. DOI: 10.1134/S0020441220030094

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVIII/Pt/ru/GW-Kazakov.docx) [↑](#footnote-ref-1)