Effect of high-current relativistic electron beam on polymer targets

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On the Kalmar high-current electron accelerator (current up to 40 kA, voltage up to 350 kV, pulse duration about 100 ns), the features of shock wave propagation and destruction of transparent polymeric materials under high-power pulse of relativistic electron beam action were studied. In the experiments, the beam current and the voltage in the diode at the output of the step-up transformer of the setup were measured, which was used to determine the voltage in the accelerator diode. The size of the interaction region was determined using an X-ray pinhole camera. To study the propagation dynamics of shock disturbances, we used a streak shadow photography scheme based on a quasi-continuous laser [1]. Damage was observed in the thickness of the material. In this case, for some materials, an undamaged region was found near the surface, which was affected by the electron beam. The propagation velocities of disturbances significantly depend both on the material and on the energy density released in the near-surface zone of the sample, and amounted, for example, to 3.8 km/s for PMMA (28 mm) and 7.1 km/s for K8 glass (10 mm). The work was supported by the National Research Center "Kurchatov Institute" (Order No. 3026 dated November 26, 2021).

[1] Demidov B, Kazakov E, Kalinin Y G, Krutikov D, Kurilo A, Orlov M Y, Strizhakov M, Tkachenko S, Chukbar K and Shashkov A Y 2020 *Instruments and Experimental Techniques* **63** 370–374