COMPARATIVE INVESTIGATION OF THE PLASTIC MATERIALS RESPONSE TO THE HIGH-CURRENT ELECTRON BEAM OF THE KLMAR FACILITY IMPACT*

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At present, using high-power electron beams, the features of the destruction of metals [1], polymers [2], and composite materials [3] have been studied in sufficient detail. However, the behavior of polymer gels, using the example of igdantin, showed an interesting feature - under the powerful electron beam with an energy of more than 1 MeV impact, the decisive role in their destruction is played not by shock-wave, but by radiation-thermal processes [4].

This paper presents the results of a study of the Kalmar accelerator high-current electron beam impact on igdantin and low molecular weight nitrile butadiene rubber SKN-18-KTR, which has a rare network of chemical bonds between rubber macromolecules formed by quinol ether. The materials are similar in mechanical and physical properties, but differ in chemical structure. Peak electron energy was up to 350 keV.

The methodological features of carrying out experiments on the Kalmar setup (current up to 40 kA, voltage up to 350 keV, pulse duration ≈ 100 ns) are presented in [5]. The region of interaction between the beam and the target was determined from X-ray images obtained with a pinhole camera. Plasma expansion from the cathode and sample surfaces was studied by laser shadow probing. Before and after irradiation, the samples were weighed, which made it possible to estimate the weight loss during irradiation.

It is shown that, at a beam energy of less than 600 J, the destruction of igdantin begins to a depth significantly exceeding the electron range, while nitrile rubber withstands a load of more than 700 J without significant damage (Fig. 1). The absorbed dose distribution was estimated using the Monte Carlo methods. Qualitative differences in the destruction of the gel and low molecular weight rubber in the range of incident beam energies up to 800 J are found, and the obtained experimental dependences of the rate of expansion of the irradiated surface are discussed.

Fig.1. A sample of igdantin (left) and rubber (right) after exposure to an electron beam with an energy of 580-600 J.

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