THERMOMECHANICAL DESTRUCTION OF MATERIALS UNDER impact Of HIGH-CURRENT ELECTRON BEAM

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In connection with the active development of materials science and the creation of new structural materials based on polymers and composites with a complex structure, the question of studying the strength properties of such materials is highly relevant. Mathematical modeling of destruction processes for materials with a complex structure is extremely difficult, and existing models require verification. Therefore, experiments on the effect of powerful energy fluxes on polymeric materials represent some interest. Various polymers, multilayer structures and composites based on them are often used as protective screens in both laboratory plasma studies and in space technology.

The experimental results of the study of the dynamics of shock waves excited by a high-current electron beam on plexiglas specimens (thickness 8, 10 and 28 mm) and epoxy resin with a thickness of 40 mm are presented. A solid-state laser with an active element from yttrium orthoaluminate with neodymium was used for laser diagnostics.

The experiments were carried out on the Calmary high-current electron generator [1]. The generator worked in the following mode: electron energy E = 200–300 keV, electron beam current   
I = 16–45 kA, electron beam duration at half-height 100 ns. The average electron range at energies from 200 to 300 keV ranges from 0.52 to 0.73 mm [2]. The diameter of the focal spot of the beam, which was determined using an X-ray pinhole camera with an aperture of 1.5 mm in diameter and a decrease of 1.25, in various experiments ranged from 10 to 20 mm.

This study demonstrated that using shadow laser photography in combination with electron-optical chronography, one can obtain data on the propagation of a shock wave in samples of transparent polymers. In the experiments performed, the velocity of propagation of the shock wave front was measured, which was 3.8–7.5 km / s for plexiglas and 4 km / s for epoxy resin.

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References

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