COMPARATIVE STUDies OF THE COMPLEX STRUCTURE MATERIALS DESTRUCTION UNDER HIGH-CURRENT ELECTRON BEAM impact FOR CASES OF VOLUME AND near-SURFACE ENERGY deposition

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The study of THE complex physicochemical structure materials destruction under powerful impulse loading is an important and interesting task from a fundamental point of view, and, at the same time, is very important for a number of applications. Currently there are no universal models and equations of state describing these processes. Taking this into account, an extensive set of experimental data is required for as many materials as possible at different depths of energy absorption. Such an effect can be achieved using high-current electron accelerators, providing a wide range of electron energies. In this regard, the use of relativistic electron beams in the field of the complex physicochemical structure materials properties investigation is of particular importance.

The paper presents a comparative experimental study carried out at the Kalmar [1] and PC-20 accelerators [2], which provide electron energy of 150–300 keV and 800–1500 keV, respectively. Such wide range makes it possible to investigate the destruction of materials at a fairly wide range of energy release depths. For example, for polystyrene, the average range of electrons with an energy of 200 keV is about 400 microns, and a little less than 7 mm at 1500 keV [3]. For the convenience of analyzing the destruction of the first stage, samples of transparent or translucent polymers — polystyrene, plexiglass, epoxy resin, and igdantin — were investigated. It is demonstrated that in the case of a volume energy absorption, a shock wave is more efficiently formed, which leads to significantly greater damage. So in an extremely elastic low-modulus polymer igdantin, after irradiation, macrocracks were found, which could not be obtained either by surface exposure using exploding foils or in the case of near-surface energy absorption upon irradiation at the Kalmar facility.

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References

1. Demidov B.A., Ivkin M.V., Petrov, V.A., Fanchenko, S.D. //Soviet Atomic Energy. 1979. 46 (2), p. 111–116.
2. Dolgachev G.I., Kazakov E.D., Kalinin Y.G., Maslennikov D.D., Tkachenko S.I., Shvedov A.A. // Bulletin of the Russian Academy of Sciences: Physics. , 2018. V. 82, Iss. 4. P. 394–398.
3. <https://physics.nist.gov/PhysRefData/Star/Text/ESTAR.html>