experimental ivestigation of mechanichal phenomena in interaction of relativistic electron beam with polymeric materials

B.A. Demidov, V.P. Efremov\*, Yu.G. Kalinin, E.D. Kazakov, S.Yu. Metelkin\*\*, A.I. Potapenko\*\*, V.A. Petrov

National research center “Kurchatov Institute”, Moscow, Russia, kazakoved82@gmail.com
\*Institute of high energy densities of RAS, Moscow, Russia, dr.efremov@gmail.com
\*\*12 Central research Institute MD PF, Sergiev Posad, Russia, a.patapenko@mail.ru

Investigation of the interaction of ionizing radiation with polymeric materials is relevant as for basic research (mathematical modeling of polymeric materials behavior in extreme conditions, testing the state equations), as for practical applications (for testing of protective coatings for space research and laboratory facilities). A lot of experiments for investigating mechanical properties of different polymeric materials, and shock waves impact to them have been carried out as yet Experimental results often contradicted preliminary calculations. This fact demonstrates that presented problem was not researched properly enough. It should be noted that PMMA and polystyrene impact adiabat are well known [1], but there not enough data on destruction mechanisms of epoxy resins , PMMA , polystyrene and other polymers in the literature. In particular, the study of the process of the destruction of polystyrene and PMMA under the influence of the shock wave demonstrated difference in the spatial position of their destruction area [2, 3] in spite of the closeness of the many physical and technical parameters of these two polymers.

This paper presents the results of experimental studies of the interaction of polymeric materials with a relativistic electron beam produced by a high-current electron accelerator "Kalmar". "Kalmar" installation can provide a wide range of electron beam parameters : diameter - 10-15 mm , the voltage on the diode up to 300 kV , the current through the diode up to 30 kA. Polymeric materials were chosen as objects for research due to their practical use in various fields of technology and also suitable for optical diagnostic properties - high transparency and homogeneity. A new original method for the mechanical kick impulse measuring based on piezoelectric vibration sensor was presented. The dependence of the mechanical kick impulse from the incident beam energy was obtained. The maximum measured value of the impulse was 0.57 N×s with a beam energy of 810 J.

References

1. Bushman A.Vv// RAS Pap., 1993, v. 329, № 5, p 581- 584.
2. Demidov B.A., Efremov V.P., Ivkin M.V., et. al// Journal of Surface Investigation. X-ray, Synchrotron and Neutron Techniques. 2008. № 8. p. 55.
3. Demidov B.A., Efremov V.P., Petrov V.A., et. al. // Journal of Surface Investigation. X-ray, Synchrotron and Neutron Techniques. 2009. № 9. p. 1