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STUDY OF PLASMA DYNAMICS OF ELASTIC COMPOSITE TARGETS UNDER THE INFLUENCE OF A HIGH-CURRENT ELECTRON BEAM OF THE "KALMAR" INSTALLATION *)

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Experimental study of materials response to pulsepower action is a relevant task both from the point of view of fundamental research into the extreme state of matter and for a number of applied problems. The most relevant are the problems associated with the study of modern multicomponent materials for which equations of state and a full set of physical constants are not yet available. This paper presents a study of the dynamics of plasma emitted from the surface of an elastic composite material under the influence of a high-current electron beam of the Kalmar facility [1]. In the experiments, the beam current, the voltage on the diode, and the region of interaction of the beam with the material were recorded. Also, using electron-optical chronography, the dynamics of the diode plasma were recorded both in its own light [2] and in the laser shadow [3]. The beam energy in the experiments varied from 300 to 550 J. The degree of its focusing was also changed.

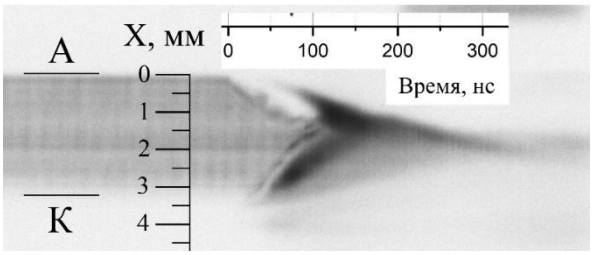

Fig.1 –Cathode and anode plasma dynamics in an experiment with an elastic composite

It was shown that with small diode gaps and sufficiently sharp beam focusing, the plasma spreads out quite uniformly and smoothly at a speed of 20 to 30 km/s, which is more typical for materials with a simpler chemical composition, such as PMMA, polystyrene or metal targets. Most likely, this is due to the high energy densities in the central region of the beam (more than 1.5 kJ/cm2), which led to the destruction of not only the complex geometric structure, but also most chemical compounds.

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References

[1]. Demidov B.A., Ivkin M.B., Petrov V.A., Fanchenko S.D. // Atomic Energy. 1979.Vol. 46. V. 2.P. 101–116.
[2]. Ananyev S.S., Bagdasarov G.A., Dan'ko S.A., Demidov B.A., Kazakov E.D., Kalinin Y.G., Kurilo A.A., Ol'khovskaya O.G., Strizhakov M.G., Gasilov V.A., Tkachenko S.I. Plasma Physics Reports. 2017. v. 43. № 7. p. 726-732.
[3]. Kazakov E.D., Kalinin Y.G., Krutikov D.I., Kurilo A.A., Orlov M.Y., Strizhakov M.G., Tkachenko S.I., Shashkov A.Y. Plasma Physics Reports. 2021. v. 47. № 8. p. 803-813.

*) abstracts of this report in Russian