COMPUTATIONAL AND THEORETICAL MODEL OF LASER-INDUCED SHOCK WAVE PROPAGATION THROUGH A FLAT LAYERED TARGET [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2023.50.2023.1.1.104

1Butusov E.V., 2Gus’kov S.Y., 2,3Kuchugov P.A.

1National Research Nuclear University MEPhI, info@mephi.ru
2P.N. Lebedev Physical Institute of the Russian Academy of Sciences, office@lebedev.ru
3Keldysh Institute of Applied Mathematics of the Russian Academy of Sciences,
 office@keldysh.ru

The results of computational and theoretical studies of the effect of pressure increase during the propagation of a shock wave through a system of flat layers of matter in the context of practical application to the problems of inertial confinement fusion and the equation of state of matter are presented. The main attention is paid to the generation of a powerful shock wave due to the action of a high-powerful laser pulse with an intensity of about 1014 W/cm2 on a multilayer under experimental conditions [1]. An analytical model has been developed for calculating the thermodynamic parameters of a substance behind the front of a shock wave passing through the contact discontinuity of two media and propagating from a substance with a lower density into a substance with a higher density [2]. The effect of a vacuum gap separating a layer of low-density matter and a layer of dense matter on the thermodynamic parameters of a shock wave in a dense substance is studied. Analysis of the results of numerical calculations showed that in the case when the incident wave is stationary, the presence of a gap has a negative effect - a decrease in the degree of pressure increase in the transmitted wave is observed compared to the case where there is no gap. In the case when the incident wave is laser-induced, the vacuum gap is able to increase the degree of pressure increase in the shock wave, and the gap has the maximum amplifying effect when, in a time equal to the duration of the laser pulse, the shock wave has time to reach the surface of the denser component of the target. For example, when pressure is transferred to aluminum, such an increase can reach 1.8 times. The research results are compared with experimental data [1]. The established dependences of the degree of increase in the pressure of the shock wave passing into the layer of dense matter on the gap width and on the duration of the laser pulse can be used to select and optimize the parameters of experiments on the generation of powerful shock waves.

The work was carried out in the interests of the scientific program in the direction of "Physics of high energy densities".

References

1. Belov I.A., Bel’kov S.A., Bondarenko S.V., et al., Shock-wave pressure transfer to a solid target with porous absorber of high-power laser pulse, Journal of Experimental and Theoretical Physics. 2022. Т. 134. № 3. p. 340-349.
2. Batani D. Balducci A., Nazarov W., et al. Use of low-density foams as pressure amplifiers in equation-of-state experiments with laser-driven shock waves //Physical Review E. – 2001. – Т. 63. – №. 4. – p. 046410.
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/It/ru/DC-Butusov.docx) [↑](#footnote-ref-1)