COMPUTATIONAL AND THEORETICAL ANALYSIS OF EXPERIMENTS ON ISENTROPIC COMPRESSION OF HEAVY ELEMENTS ON HIGH-POWER LASER FACILITIES

K. E. Mikheev, A. S. Gnutov

FSUE «RFNC – VNIIEF», Sarov, Russia

Analysis of isentropic compression of substances is an important direction in the studies of equations of state of matter. There are several possible options for experiments to study them, but the main one is the use of laser facilities with a high pulse energy of the order of 0.1–1 MJ and a duration of several tens of nanoseconds. Many leading scientific countries, such as the USA (NIF) [1] and China (SG-III) [2] and others, use laser facilities for isentropic compression. In Russia, this direction is developed at FSUE RFNC – VNIIEF. For the analysis and development of isentropic compression experiments, it is extremely important to conduct preliminary numerical simulations to predict thermodynamic response of matter to compression and the maximum achieved pressure.

This work considers numerical simulations of possible experiments on isentropic compression of heavy elements, such as gold and platinum, on a future domestic laser facility. Various target configurations and laser pulse profiles are considered. The results include laser pulse energies necessary to achieve a particular level of compression of matter and analysis of the experiments.

Figure 1 shows a general target layout with the test material for isentropic compression.

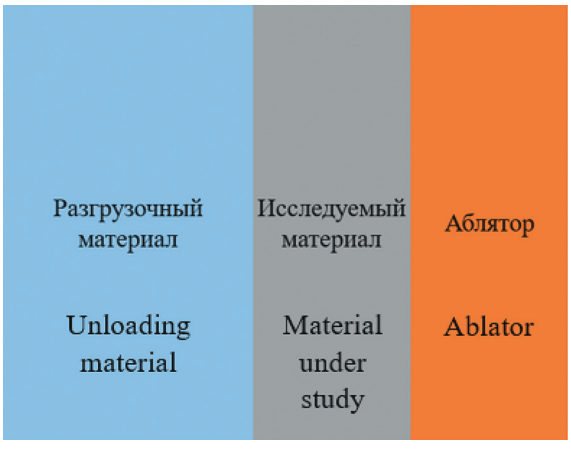

Fig. 1. General target layout in the isentropic compression experiment

References

1. **Gorman, M. G.** Ramp compression of tantalum to multiterapascal pressures: Constraints of the thermal equation of state to 2.3 TPa and 5000 K [Text] / M. G. Gorman et al. // Physical Review B. – 2023. – Vol. 107, No. 1. – P. 014109.

2. **Wang, F.** Ramp-Wave Compression Experiment with Direct Laser Illumination on ShenGuang-III Prototype Laser Facility [Text] / F. Wang et al. // Chinese Physics Letters. – 2017. – Vol. 34, No. 3. – P. 035201.