SHOCK WAVES DYNAMIC IN PRESSED ALUMINUM V-ALEX NANOPOWDER AT PRESSURES UP TO 2.4 GPa

S. Yu. Ananev[1], T. A. Rostilov[1], V. S. Ziborov[1], A. Yu. Dolgoborodov[1, 2], G. S. Vakorina[1], L. I. Grishin[1]

[1]Joint Institute for High Temperatures of the RAS, Moscow, Russia

[2]N. N. Semenov Federal Research Center for Chemical Physics, RAS, Moscow, Russia

The studies of the impact response of nanostructured systems are of great interest due to their advantageous properties provided by the ultra-small scale of the constituent elements. Numerous studies have investigated the high strain rate processes in various nanomaterials and nanoscale solids to gain a comprehensive understanding of their dynamic properties. In this work, the dynamic behavior of pressed aluminum nanopowder with 30% porosity was studied in plate-flip shock wave experiments at pressures and strain rates up to 2.4 GPa and $4 \cdot 10^7$ s^{-1}, respectively. The samples were prepared from commercially available V-ALEXTM nanopowder. The aim of the work was to study the effect of the extremely small powder grain size (100–200 nm on average) on the impact response of this nanomaterial. Plate impact experiments were carried out using a powder gun. A two-stage structure of the propagating compression shock waves was recorded using laser interferometry technique. It was shown that the properties of the precursor wave running in the material ahead of the main compression shock wave are determined by the grain scale. The parameters characterizing the structure of the main wave, the maximum strain rate, and the rise time also depend on the grain scale, but the shock state behind this wave in the studied pressure range is determined only by the initial porosity. In addition, the influence of pore morphology and the initial porosity of aluminum on the longitudinal sound velocity, the precursor velocity, and the Hugoniot elastic limit was described.

This work was funded by the Russian Science Foundation, Grant No. 24-19-00746.