Study of shock compressibility and shock-induced temperature of oxides by Mach cumulative explosive generators

Nikolaev Dmitry N.,* Shutov Alexandr V., Lomonosov Igor V.

[1] *Institute of Problems of Chemical Physics RAS, 142432, Chernogolovka, Russia*

** E-mail: nik@ficp.ac.ru*

The development of generators of shock waves, based on Mach reflection of shock wave, started in early 1970-s. In this talk, the results of last 10 years of our efforts is presented. The number of improvements were introduced. Fully cylindrical design with sophisticated detonation distributor make possible to generate the conical imploding detonation wave, using easy-to-made cylindrical geometry of explosive charge and metal liner. Detonation distributor, produced by CNC milling machine, provides perfect symmetrical convergence of shock wave. The realized double Mach reflection (DMR) regime provides flat and steady 1-D shock wave in a sample. Also, the 2-staged generators were developed, providing the further rise of shock parameters. The experimental development was supported by 3-D numerical simulation of explosion devices. Now a set of generators make possible to achieve pressures from 200 to 2000 GPa, competing with laser shock and electromagnetic launching techniques.

In addition, a set of diagnostic tools was developed, including fast optical fiber-gauges to measure wave velocities, and optical pyrometry.

The results of study of shock wave properties of Earth mantle oxides such as Al2O3, TiO2, MgO, FeO is presented. In porous samples the shock compressibility was measured. In monocrystalline, optically transparent samples, the Hugoniot temperatures were also measured. Data obtained was compared with calculated equations of state and with other available experiments, made possible some conclusions about high-pressure melting curves of studied substances. Work was supported by Russian Ministry of Science, contract with JIHT 075-15-2020-785. Experiments were carried out using the instrumentation base of the Moscow Regional Explosive Centre for Collective Use, IPCP RAS.

This work is supported by the Ministry of Science and Higher Education of the Russian Federation (Institute for High Temperatures of the Russian Academy of Sciences Project No: 075-15-2020-785). All the experiments were carried out by using the equipment of Moscow regional explosive Center for collective use of the Institute of Problems of Chemical Physics RAS.