ANALYSIS OF “WINDOW” MATERIALS IN SHOCK-WAVE EXPERIMENTS ON LIGHT-GAS GUN

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In present-day experiments on studying the behavior of structural materials under shock compression, optical techniques are used for surface velocity recording, and a promising one is the use of “window” materials, transparent to probing laser radiation, in experiments. Such materials offer the advantage of directly recording particle velocity at the sample-window interface or shock-wave velocity in the window itself.

The reflecting surface movement is measured using the Doppler frequency shift effect. When laser radiation passes through a shock-compressed area of the window, its frequency changes, thus, the recorded (observed) surface velocity differs from its actual value. Therefore, it is essential to determine experimentally a correction to the recorded velocity in order to further update the resulting velocity profiles. The purpose of this work was to refine such corrections for PMMA (polymethyl methacrylate), sapphire, and lithium fluoride.

The current research was focused on loading pulse amplitudes ranging from 0.40 GPa to 16.32 GPa and impact velocities ranging from 0.22 to 0.89 km/s.

The experiments were carried out using 44-mm single-stage light-gas gun with flat samples. Shock wave processes were recorded using VISAR interferometry techniques with an operating wavelength of 532 nm and PDV with an operating wavelength of 1550 nm. Using these techniques, free-surface velocity profiles of the samples were obtained and particle velocity was measured. Free-surface velocity profiles of the samples were used to estimate strain rate in the compression wave, $\dot{\varepsilon}$, and Hugoniot elastic limit in lithium fluoride.

The experimental setup with probing of two parallel planes of the samples enabled the estimation of shock wave velocity, D, in them.