SHEAR STRENGTH OF BERYLLIUM OXIDE UNDER DYNAMIC LOADING

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It is known that a two-wave configuration consisting of elastic precursor and plastic flow occurs in elastic-plastic bodies under dynamic loading. Examples of such bodies are various types of ceramics. Beryllium oxide with strong elastic precursor is a prominent representative of such ceramics.

The paper presents the results of studying shear strength of beryllium oxide in the region below 100 GPa, where elastic-plastic flow still exists.

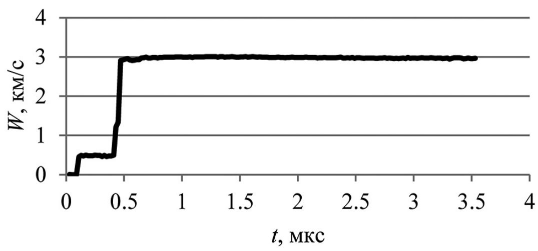

Fig. 1. Example of $W(t)$ profile recorded using PDV method

Beryllium oxide samples were loaded using previously elaborated explosive loading device with 12Cr18Ni10Ti stainless steel impactor at the flight velocity of 2.64 km/s at a radius of 15 mm from the sample axis. Samples of thicknesses from 6 mm to 18 mm were studied.

The signals were recorded using PDV method. The PDV experimental results were processed by the fast Fourier transform method.

Figure 1 shows the representative free-surface velocity profile, $W(t)$, of beryllium oxide obtained in the experiment with the sample 18 mm thick.

The free-surface velocity at the front of the elastic precursor was derived from $W(t)$ profiles. The elastic precursor amplitude was calculated from the known relation:

$$\sigma_{HEL} = \frac{1}{2}\rho_0 W_{elast} C_{L0}, \tag{1}$$

where σ_{HEL} is the elastic precursor amplitude (σ_{1HEL} is the one at the front of the elastic precursor, σ_{1HEL} is the one at the base of the plastic wave), ρ_0 is the initial density of beryllium oxide, W_{elast} is the free-surface velocity at the elastic precursor (W_{1elast} is the one at the front of the elastic precursor, W_{2elast} is the one at the base of the plastic wave), and C_{L0} is the ultrasonic wave velocity.

Then the shear strength was determined using the formula:

$$Y = \sigma_{HEL}\frac{1-2\nu}{1-\nu}, \tag{2}$$

where Y is the shear strength, and ν is the Poisson's ratio.

The velocity of ultrasonic waves, C_{L0}, in beryllium oxide was determined in separate experiments to be 11.89 ± 0.09 km/s, and the Poisson's ratio was $\nu = 0.18$ [1].

Thus, the elastic precursor amplitude, σ_{HEL}, and the shear strength, Y, for two cases (at the front of the elastic precursor and at the base of the plastic wave) were determined in the experiments.

The experiments also revealed the tendency of shear strength dependence of beryllium oxide samples on their thickness.

References

1. **Belyaev, R. A.** Beryllium oxide [Text]. – The second edition (revised and expanded). – M. : Atomizdat, 1980. – 224 p. (in Russian).