

# Sound velocity measurements in shocked metals such as Ta, Mo, Cu, and Zn

**Yakunin A.K.<sup>1</sup>, Kovalev A.E.<sup>1,®</sup> and Pankratov D.G.<sup>1</sup>**

<sup>1</sup> Federal State Unitary Enterprise "Russian Federal Nuclear Center — All-Russia Research Institute of Technical Physics named after Academician E.I. Zababakhin", Vasilieva str 13, Snezhinsk, 456770, Russia

® vniitf@vniitf.ru

The result of measurements of longitudinal,  $C_L$ , and bulk,  $C_B$ , sound velocities are presented for shocked high-purity reference metals such as high-purity tantalum (according to TU 95 234-80), pure molybdenum (according to TU48-19-247-93), copper M1 (according to GOST1535-2016), and zinc Ts0 (according to GOST1180-2021) within the range of pressures 20...380 GPa obtained by the photoelectric method [?, 1]. A brief description of the principle of operation of the method, the setup, and the results of the experiment implementing the rarefaction overtaking technique is provided.

The general dependencies (Berch law) of the sound velocity on density behind the shock front in the solid phase are established, additionally including those in the liquid phase for Zn:

Ta:  $C_L$  [km/s] =  $0.274 \rho$  [g/cm<sup>3</sup>] - 0.465 ( $11 \leq \sigma_{xx} \leq 272$  GPa).

Mo:  $C_L$  [km/s] =  $0.521 \rho$  [g/cm<sup>3</sup>] + 1.494 ( $97 \leq \sigma_{xx} \leq 381$  GPa).

Cu:  $C_L$  [km/s] =  $0.813 \rho$  [g/cm<sup>3</sup>] - 2.384 ( $11 \leq \sigma_{xx} \leq 237$  GPa).

Zn:  $C_L$  [km/s] =  $0.781 \rho$  [g/cm<sup>3</sup>] - 1.491 ( $49 \leq \sigma_{xx} \leq 93$  GPa).

$C_B$  [km/s] =  $1.509 \rho$  [g/cm<sup>3</sup>] - 10.239 ( $133 \leq \sigma_{xx} \leq 187$  GPa).

[1] McQueen R G, Hopson J W and Fritz L N 1982 *Rev. Sci. Instr.* **53**(2) 245–250