Equations of State of Selected Armor Ceramics by In-situ High-Pressure X-ray and Ultrasonic Techniques: Comparison with Shock Wave Data

MURLI MANGHNANI, GEORGE AMULELE, ANWAR HUSHUR, University of Hawaii, Hawaii Institute of Geophysics and Planetology, Honolulu, Hawaii 96822 — Ultrasonic measurements of the sound velocity and elastic moduli, and their pressure derivatives for well prepared armor ceramics can provide accurate constraints for establishing their equations of state. Using in-situ high-pressure synchrotron X-ray diffraction and diamond anvil cell techniques at the Advanced Photon Source, we have investigated the compression behavior ($V/V_0$ vs $P$) for $\alpha$- and $\beta$-SiC, TiB$_2$, B$_4$C, WC and WC-6%Co to 65 GPa. Ultrasonic measurements of $K_o$ and $K_o'$ made to $\sim$15 GPa show excellent agreement with X-ray results. Together, these results are compared with published shock wave data in terms of $U_s$-$U_p$ slope, $K_o'$, compression behavior, elastic anisotropy, and material strength. No phase transition is found in these materials, except for B$_4$C, in which case some structural distortion is indicated.

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