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Single two-zone elastic-plastic shock waves in solids VASILY ZHAKHOVSKY, MIKALAI BUDZEVICH, University of South Florida, NAIL INOGAMOV, Landau Institute for Theoretical Physics, Russian Academy of Sciences, IVAN OLEYNIK, University of South Florida, CARTER WHITE, Naval Research Laboratory — A new regime of shock wave propagation in solids, corresponding to a single two-zone elastic-plastic shock-wave, was discovered using a novel moving window molecular dynamics technique. Both leading low-pressure elastic and trailing high-pressure plastic fronts move with the same speed and have a fixed separation that can extend to several microns. The material in the elastic zone is in a metastable state, having a pressure that substantially exceeds the critical shock strength characteristic of the onset of the well-known split-elastic-plastic, two-wave regime. The single two-zone elastic-plastic shock wave is a quite general phenomenon observed in our simulations for a broad class of crystalline materials, including aluminum, nickel, diamond, and Lennard-Jones crystals. It is the existence of the two-zone, elastic-plastic regime that allows for a consistent explanation of the anomalously high elastic wave amplitudes observed in recent experiments.

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