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**Steady two-zone elastic-plastic shock waves in solids**[1]

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By decoupling time and length scales in moving window molecular dynamics simulations of steady shock waves, a new regime of shock wave propagation was observed. It is characterized by a steady two-zone elastic-plastic structure of a single shock wave, and consists of a leading low-pressure elastic zone followed by a high-pressure plastic zone. Both elastic and plastic shock fronts move with the same speed and have a fixed net separation that can extend to many 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 propagation. The two-zone elastic-plastic single wave is a quite general phenomenon observed in simulations of a broad class of crystalline materials. 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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