Abstract Submitted
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Shock-induced plasticity in bcc metals.[1] E. BRINGA, J. HAWRELIAK, P. ERHART, H. LORENZANA, Lawrence Livermore National Laboratory, J. WARK, Oxford University — It is often assumed that a shocked material will evolve from a state of uniaxial (1D) strain towards a state of nearly hydrostatic (3D) strain due to shock-induced plasticity. We recently simulated the case of fcc copper, where dislocation nucleation and activity leads to a final state close to 3D strain after ∼0.1 ns, as confirmed by simulated X-range diffraction. Simulations with up to 350 million atoms, including defective crystals and ramp loading, were needed to reach such 3D state. This 1D to 3D transition has not been as studied for bcc metals. Although there are several studies of shocks in bcc Fe, a phase transition happens before shock-induced plastic activity appears. We have carried atomistic simulations of shocks in tantalum, using 0.5-50 million atoms, with samples nearly 1 micron long. Our samples include perfect single crystals, defective single crystals, and polycrystals. We find agreement with the experimental Hugoniot up to ∼15% compression, but the complex elastic-plastic shock wave structure does not lead to full 3D relaxation within the 0.2 ns of simulated time.

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