Abstract Submitted
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Shock response of nanoporous Cu—A molecular dynamics simulation FENGPENG ZHAO[1], Institute of Systems Engineering, CAEP — Shock response of porous materials can be of crucial significance for shock physics and bears many practical applications in materials synthesis and engineering. Molecular dynamics simulations are carried out to investigate shock response of nanoporous metal materials, including elastic-plastic deformation, Hugoniot states, shock-induced melting, partial or complete void collapse, hotspot formation, nanojetting, and vaporization. A model nanoporous Cu with cylindrical voids and a high porosity under shocking is established to investigate such physical properties as velocity, temperature, density, stress and von Mises stress at different stages of compression and release. The elastic-plastic and overtaking shocks are observed at different shock strengths. A modified power-law P-α model is proposed to describe the Hugoniot states. The Grüneisen equation of state is validated. Shock-induced melting shows no clear signs of bulk premelting or superheating. Void collapse via plastic flow nucleated from voids, and the exact processes are shock strength dependent. With increasing shock strengths, void collapse transits from the "geometrical" mode (collapse of a void is dominated by crystallography and void geometry and can be different from that of one another) to "hydrodynamic" mode (collapse of a void is similar to one another). The collapse may be achieved predominantly by plastic flows along the {111}slip planes, by way of alternating compression and tension zones, by means of transverse flows, via forward and transverse flows, or through forward nano-jetting. The internal jetting induces pronounced shock front roughening, leading to internal hotspot formation and sizable high speed jets on atomically flat free surfaces.

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