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MD simulation of cavitation and formation of foam-like material inside the exploding wire VASILY ZHAKHOVSKY, University of South Florida, SERGEY PIKUZ, TATIANA SHELKOVENKO, PATRICK KNAPP, CHARLES SAYLOR, DAVID HAMMER, Cornell University, SVETLANA TKACHENKO, Moscow Institute of Physics and Technology, PAVEL SASOROV, Institute for Theoretical and Experimental Physics — Large-scale molecular-dynamics simulations of exploding aluminum and nickel wires with radii between 50 and 200 nm show that rapid Joule heating causes bulk melting and internal pressure build-up. A radial rarefaction wave propagates towards the center of the wire and increases in amplitude until stress inside the wave reaches the dynamic tensile strength of melt. At this point, cavitation starts within the wire and converges towards the center, resulting in the formation of a low-density foam-like material surrounded by a dense liquid cylindrical shell. As the wire expands further, this foam decays and yields liquid droplets, while the liquid shell survives for a considerably longer period of time. Mechanism of wire explosion obtained from MD simulations has been confirmed by hydrodynamic modeling and experimental data. Simulated spatial distributions of density demonstrate good qualitative agreement with hollow structures visible in high resolution X-ray radiography images.

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