HOLLOW STRUCTURE FORMATION IN THE DENSE CORE IN NANOSECOND WIRE EXPLOSION

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The existence of long-lived dense cores within lower density coronal plasmas during nanosecond explosions of single wires or multiwire arrays is now well established. However, the physical state of the core material and the processes occurring there is still a matter of conjecture. Using the technique of high resolution x-ray radiography,[1] a complex small-scale structure has been observed in the exploding wire cores of both single-wire and multiwire loads.[2,3] The radiographs show features implying that the core has become a foam-like, liquid-vapor mixture that is a result of cavitation of the molten metal by tensile stress exceeding the tensile strength of the liquid metal. In recent experiments on the COBRA pulser with Ni wire arrays, hollow structures were observed in the dense cores. The same structures were found in earlier experiments with single wire explosions. In order to simulate fast radial expansion of molten metal and processes induced by strong tensile stress, the molecular-dynamics (MD) approach was applied using an interatomic potential suitable for simulation of metals in extreme conditions.[4] The MD simulations of the explosion of a small-diameter metal cylinder shows that cavitation of the cylinder core results in formation of foam surrounded by a liquid cylindrical shell at early stage. Later the foam decays and yields a mixture of vapor and liquid droplets, but the liquid shell survives considerably longer. Simulated density profiles demonstrate good qualitative agreement with the experimental data.

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