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Examination of rapid phase change in copper wires to improve material models and understanding of burst JOSEPH OLLES, CHRISTOPHER GARASI, J. PATRICK BALL, Sandia National Laboratories — Electrically-pulsed wires undergo multiple phase changes including a postulated metastable phase resulting in explosive wire growth. Simulations using the MHD approximation attempt to account for the governing physics, but lack the material properties (equations-of-state and electrical conductivity) to accurately predict the phase evolution of the exploding (bursting) wire. To explore the dynamics of an exploding copper wire (in water), we employ a digital micro-Schlieren streak photography technique. This imaging quantifies wire expansion and shock waves emitted from the wire during phase changes. Using differential voltage probes, a Rogowski coil, and timing fiducials, the phase change of the wire is aligned with electrical power and energy deposition. Time-correlated electrical diagnostics and imaging allow for detailed validation of MHD simulations, comparing observed phases with phase change details found in the material property descriptions. In addition to streak imaging, a long exposure image is taken to capture axial striations along the length of the wire. These images are used to compare with results from 3D MHD simulations which propose that these perturbations impact the rate of wire expansion and temporal change in phases. If successful, the experimental data will identify areas for improvement in the material property models, and modeling results will provide insight into the details of phase change in the wire with correlation to variations in the electrical signals.

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