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Difference in Magnetic Field Threshold for Thermal Plasma Formation between Copper Alloys 145 and 101 Pulsed to Multi-Megagauss Surface Magnetic Field B.S. BAUER, S. FUELLING, V.V. IVANOV, T.M. HUTCHINSON, Univ of Nevada - Reno, K.C. YATES, University of New Mexico, T.J. AWE, Sandia National Laboratories — Understanding the impact of choice of metal alloy on plasma formation is important for plasma physics and applications (e.g., fusion energy). Thermal ionization by pulsed ohmic heating of Cu-145 (99.5% Cu, 0–0.7% Te, 0–0.012% P) has been compared with that of a purer alloy, Cu-101 (>99.99% Cu), via well-characterized experiments that avoided contamination by arcing. Copper rods were pulsed to 1.0-MA peak current in 100 ns, with the applied magnetic field rising linearly at 50–80 MG/μs, depending on the rod initial diameter (0.49–1.59 mm). The initial magnetic skin depth was much smaller than the rod radius, so surface plasma formation was observed while current was propagating into the conductor as a nonlinear diffusion wave. The rod surface finish was controlled (electropolished or not) and examined with optical and scanning electron microscopy. The expansion and ionization of the rod were observed with visible and EUV radiometry, time-resolved imaging, and laser shadowgraphy. Rods of both alloys explode when the applied magnetic field reaches 2 MG, well before plasma formation. Rods of both alloys expand at 3.5 km/s surface velocity. However, Cu-145 undergoes bulk surface ionization at 3.0 MG, whereas Cu-101 only turns to plasma when the magnetic field exceeds 3.5 MG.

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