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Experimental Observations of the Electrothermal Instability on Thin Foils[1] ADAM STEINER, PAUL CAMPBELL, DAVID YAGER-ELORRIAGA, NICHOLAS JORDAN, Y.Y. LAU, RONALD GILGENBACH, University of Michigan — The electrothermal instability (ETI) arises whenever a current-carrying material has a resistivity that depends on temperature. When resistivity increases with increasing temperature, ETI causes striations to form perpendicular to the direction of current. On pulsed-power-driven, ablating metallic loads, this process can cause sections of the target to ablate earlier than the bulk material, creating a macroscopic surface perturbation on the plasma surface that can seed hydrodynamic instabilities, such as the magneto Rayleigh-Taylor (MRT) instability. Experiments have been performed to observe the self-emission of ablating planar aluminum and tantalum foils using a 12-frame ultrafast ICCD camera with 2 μm spatial resolution and 5 ns time resolution. Other diagnostics include voltage, current, and optical spectroscopy. Ablations of foils ranging from 0.4 to 2 μm in thickness are driven with a 4 kA, 600 ns risetime pulse generator. Striations of hotter, brighter material forming perpendicular to current are consistently observed. These measurements provide experimental evidence of the growth of ETI as a temperature perturbation on initially solid metal loads.

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