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Plasma Parameters in Short-Pulse-Heated Buried Tracer Layers via Fits of High-Resolution X-ray Spectra[1] B.F. KRAUS, A. CHIEN, Princeton University, LAN GAO, K.W. HILL, M. BITTER, P.C. EFTHIMION, Princeton Plasma Physics Laboratory, M.B. SCHNEIDER, R. SHEPHERD, HUI CHEN, Lawrence Livermore National Laboratory — A quartet of high-resolution x-ray crystal spectrometers was deployed at the Titan laser to measure thermal self-emission of heated Ti and Mn layers. Solid targets were produced with thin (0.1–1 μm) layers of mid-Z tracer elements sandwiched between Al foil and a thin Al tamp (0–4 μm). When exposed to the relativistic-intensity laser pulse (>100 J in 1 ps), targets heat comparably to undoped Al foils, but only the thin tracer layer emits fine structure x-rays visible to spectrometers. By shooting a set of targets with varied tracer layer (Ti, MnAl, or both), tracer thickness, and tamp thickness, the time-integrated x-ray flux can be measured at many localized depths in the target. The fine structure spectra of He- and Li-like Ti and Mn is gathered by spherically-curved crystals in the focusing Johann geometry. The spectra, composed of both isolated and overlapping line emission, are fit to a multi-Gaussian model by a genetic algorithm, extracting line widths, heights and positions. These parameters are compared to atomic physics calculations, populations of excited electronic states from collisional-radiative models, and line width predictions from Stark, Doppler and opacity broadening, all of which are used to infer plasma conditions in the buried layer region.

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