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6.44 Laser and pulsed power x-ray backlighters for electron density imaging using a Talbot-Lau x-ray deflectometer

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A Talbot-Lau X-ray interferometer can map electron density gradients in High Energy Density (HED) samples. In the x-ray deflectometry configuration a single Moiré image can provide refraction, attenuation, elemental composition, and scatter information. In order to make the diagnostic available for a wide range of HED experiments, pulsed power and high power laser produced x-ray sources were evaluated as potential backlighters for an 8 keV Talbot-Lau x-ray deflectometer consisting of free standing ultrathin gratings. For pulsed power experiments, single ($2 \times 64 \mu\text{m}$) and double ($4 \times 25 \mu\text{m}$) copper x-pinch were driven at $\sim 1 \text{ kA/ns}$. For high power laser experiments, K-alpha emission was obtained by illuminating copper targets ($500 \times 500 \times 12.5 \mu\text{m}^3$ foils, $20 \mu\text{m}$ diameter wire, and $>10 \mu\text{m}$ diameter spheres) with a 30 J, 8-30 ps laser pulse and a 25 μm Cu wire with a 60 J, 10 ps laser pulse. Grating survival was assessed along with fringe formation and contrast for all x-ray sources. Electron density profiles were obtained while the diagnostic and detector performance (x-ray film, CCD, and imaging plates) was analyzed in context of high energy density sample characterization. The results demonstrate the potential of TXD as an electron density diagnostic for HED plasmas.

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