High-Energy X-Ray Radiography: OMEGA EP was designed to facilitate radiography with high-energy (>10-keV) photons. This will make it possible to probe targets made from moderate and high atomic numbers. The first high-energy x-ray radiography experiments on OMEGA EP were taken in January. Short-pulse (<100-ps) lasers produce high-energy photons when high-energy (nonthermal) electrons generated by laser–plasma interactions impact the target. These electrons are contained by the potential created by the mass-limited target and, therefore, transit the target many times, thus increasing the K_α x-ray production. Through this mechanism, the entire target body becomes the backlighter source, not just the spot irradiated by the laser. While this is beneficial for x-ray production, it is detrimental if a small source is required for good spatial resolution. A small source size can be produced by viewing a thin wire or a thin-foil end-on, with the latter enabling high resolution in only one dimension. To demonstrate these techniques, researchers from LLE, LLNL, LANL, LULI, and NRL conducted experiments on the OMEGA EP Laser System. Backlighter targets were irradiated with 80-ps pulses having up to 1000 J of IR energy in ~80-μm square focal spots. The targets were 100-μm squares made of Ag and Mo to produce 22-keV and 17.5-keV K_α sources. Figure 1(a) shows an experimental setup where a radiographic test grid is backlit with 22-keV x rays from an edge-on Ag target (thickness ~5 μm). Figure 1(b) shows the radiograph of that grid, which contains various line spacing. Since an edge-on foil target was used, the horizontal lines are resolved quite well, but not the vertical. Figure 1(c) shows a horizontal lineout through the center of that image with well-resolved 10-μm features. Figure 2(a) shows the configuration of a dynamic experiment: radiography of a shock wave within an Al sample. One UV OMEGA EP beam drove a shock in a 1-mm square, 250-μm-thick Al target. The 80-ps IR beam irradiated a Mo target (thickness ~5 μm) 4 ns later, and the 17.5-keV x rays produced an image of the spherically expanding shock in the Al target [Fig. 2(b)]. The diffuse nature of the shock image results from nonuniformities in the target and beam (no beam smoothing) and temporal blurring. These results suggest that high photon-energy radiography will be an important tool for HED experiments on OMEGA and the NIF. The success of these experiments is a credit to the diverse and experienced experimental team from the five participating laboratories.

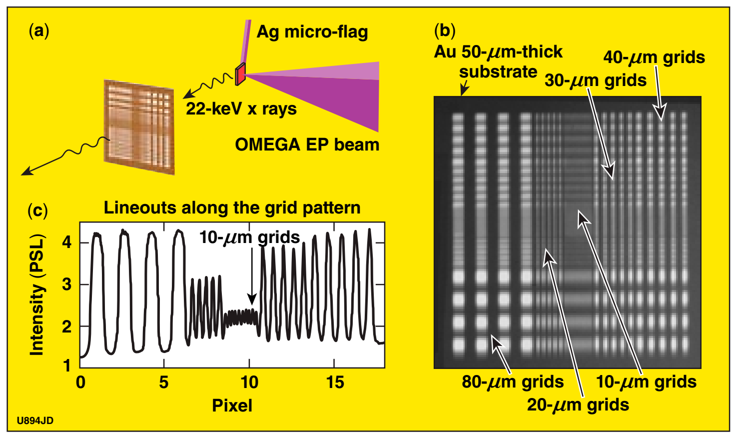

Figure 1. (a) Schematic of OMEGA EP high-energy x-ray radiography test; (b) radiograph of test grid; and (c) horizontal lineout through the center of the grid image.

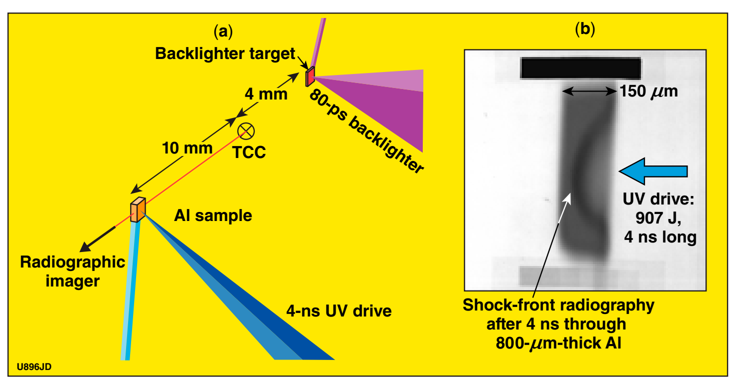

Figure 2. (a) Schematic of experimetal configuration used to record radiograph of shock-front in Al target. (b) Radiographic image of expanding shock in an Al target.

OMEGA Operations Summary: The OMEGA facility conducted a total of 125 target shots in January (109 on OMEGA and 16 on OMEGA EP) with an overall experimental effectiveness of 94.8% (94.5% for OMEGA and 96.9% for OMEGA EP). The NIC accounted for 81 target shots (69 on OMEGA and 12 on OMEGA EP) carried out by teams led by LLNL, LANL, and LLE scientists. A total of 44 shots (40 on OMEGA and 4 on OMEGA EP) were taken for HED, NLUF, and LBS campaigns led by teams from LLE, LLNL, the University of Nevada, Reno, and the University of California, Berkeley.

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