Holographic Picosecond Laser Materials Processing with a Cooled Spatial Light Modulator exposed to 200 W Average Power.

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Spatial Light Modulators (SLMs) have become powerful tool in laser material processing with the potential for dynamic beam shaping, parallel processing and advanced polarisation control. The phase range of a SLM requires full 2π response for accurate phase modulation of the incident laser wavefront to create the desired structured intensity distribution. While cooled SLM's allow increased power exposures, degradation in performance occurs with average powers P>100 W in a Gaussian beam due to residual absorption and consequent heating of the liquid crystal (LC) layer which seriously limits the phase stroke and diffraction efficiency. By introducing a refractive flat top intensity generator ahead of a cooled SLM, we have extended the phase range to $\Delta\phi = 2\pi$ at incident power P=210 W with only a small light field depolarisation. The operational limit has therefore been extended significantly, allowing efficient, parallel laser materials processing with a high-power picosecond laser. The calculation and implementation of binary Damman gratings for multi-beam laser processing is also shown to be useful at high power exposure.