Investigation of laser beam scanning strategies for 100 W nanosecond pulsed fibre laser engraving of metals

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Laser engraving using high average power nanosecond pulsed fibre lasers is an increasingly popular technique to generate high-quality permanent inscribed structures in the surface of a variety of materials, in particular metals. As with any manufacturing process, overall speed is always critical and new higher average power laser systems offer the attractive prospect of reducing process time and hence cost. As a multi-pass process, however, laser engraving is a complex combination of peak and average power and thermal accumulation in the material; hence the fundamental laser process parameters of pulse energy, scan speed etc must be re-optimised when translating the process to a higher average power laser system.

We demonstrate in this paper that scanning strategies and parametric selection can remediate the thermal issues associated with high average power nanosecond laser applications. In particular, building on our earlier work on laser machining of glass, we demonstrate that interlaced laser beam scanning can provide a better-optimised solution than conventional raster scanning approaches. We investigate the impact of scanning patterns on the material removal rate, surface roughness and morphology during laser engraving of aluminium, brass and stainless steel. Ultimately, we demonstrate that high-quality engraving is achievable with high average power (100W) nanosecond pulsed fibre lasers using optimised scanning strategies and optimised pulses through SPI's pulse tuning capability.