High-Quality, High Throughput Engraving Using 100 W Nanosecond Pulsed Lasers

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Laser engraving has become an essential manufacturing route to generate permanently inscribed structures on the surface of various materials. Engraving has wide-ranging application in the automotive, aerospace, and electronic industries, where they are used for product identification and traceability.

Using lower average power nanosecond pulsed lasers (<50 W) to achieve high-quality engraving is an established technique. However, as with any manufacturing process, high throughput is a key requirement which demands the use of higher average power lasers (>50 W). Nonetheless, the increase in throughput does not always lead to high process quality, owing to laser-induced thermal accumulation in the workpiece. There is, therefore, a demand for optimised process parameters and scanning strategies which alleviate thermal load whilst providing high productivity at high quality during high average power engraving.

In this presentation, we investigate the influence of different process parameters such as pulse duration, energy dose, and pulse repetition frequency on the material removal rate, surface roughness and morphology using a pulse tunable 100 W nanosecond fibre laser. Also, building on our previous work on laser machining of glass [1,2] and stainless steel [3] using an interlacing method of scanning, we provide a finite element thermal model to examine the impact of different laser beam scanning strategies. Ultimately, we demonstrate that the interlacing mode of scanning alleviates thermal accumulation. In addition, high-quality engraving is achievable with high average power nanosecond lasers, using optimised laser beam scanning strategies and process parameters.

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[2] K.L. Wlodarczyk, J. Schille, L. Naumann A.A. Lopes, I. Bitharis, P. Bidare, S. Dondieu, P. Blair, U. Loeschner, A. J. Moore, M.M Maroto-Valer, D.P. Hand (2020) Investigation of an interlaced laser beam scanning method for ultrashort pulse laser micromachining applications, Journal of Materials Processing Technology, vol.285, pp.12

[3] S.D. Dondieu, K.L. Wlodarczyk, P. Harrison, A. Rosowski, J. Gabzdyl, R.L. Reuben, D.P Hand (2020) Process optimization for 100 W nanosecond pulsed fibre laser engraving of 316L grade stainless steel, vol.4, pp.110