Expansion of pulsed laser process limits through pulsed fibre lasers

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Abstract—This paper gives an overview of the new possibilities offered by the pulsed fibre laser technology with a particular focus on welding applications.

Keywords—pulsed fibre laser; laser technology; laser welding

Pulsed Nd:YAG lasers are the state-of-the-art for a large amount of micro-applications, and have shown remarkable performances from welding to drilling processes.

Thanks to the combination of several characteristics like its high beam quality, fast pumping diodes and high-speed electronic, a new generation of pulsed fibre lasers enables to stretch the processes and applications limits. It also allows answering some fundamental questions thanks to a constant beam quality, independent from laser parameters. However, thought Fiber laser and other Diode pumped systems took the hand for fine cutting applications, pulsed Nd:YAG laser are still the state of the art for both micro welding and drilling process.

Beginning already with the initial availability of industrial single-mode fiber lasers, attempts have been made to use them for precision welding. However, due to the specific characteristics of the laser, this was only partially successful. The excellent beam quality requires very precise seam preparations for joint welding. The increase of the focus diameter to limit the tolerance sensitivity of the welding process, results in a dramatic loss of intensity and a low effect on the effective welding width, therefore on the tolerances. [1]

This paper gives an overview of the new possibilities offered by the pulsed fibre laser technology with a particular focus on welding applications. Extensions of the process performance through further improvements of pulse shaping, as shown in figure 1, as well as a deeper evaluation of the beam quality and energy repartition’s influence on the welding results and metallurgy are presented. The remaining limitations are addressed and potential solutions evaluated.


Fig. 1. Comparison between the programmed pulse shape (a), the effective pulse for a QCW Fiber Laser (b) and a LPSSL (c) for a 200 µs pulse width