Application Note #15

Temporal Pulse Shaping of Millisecond High Pulse Energy Fiber Lasers

Introduction

IPG's New Quasi continuous wave (QCW) high pulse energy fiber laser has entered one of the last areas of flash lamp-pumped laser technology – high pulse energy, low duty cycle laser processing. The 150 w baseline model shown in Figure 1 produces 15 Joules at 10 Hz in a pulse length typical of that from a flash lamp-pumped laser of 10 ms. Trials have shown that this laser is capable of high quality spot welds with a standard square shaped pulse (Application Note #08) but it is also capable of cutting thick, high reflectivity materials such as aluminum and copper up to several millimeters thick (Application Note #05.)

Experimental Work

The latest addition to the capability of the quasi simultaneous wave laser is the Pulsed Signal Generator (PSG), a sophisticated laser control package that allows an almost infinite number of complex temporal pulses to be programmed (Figure 2, Right) Temporal pulse control was widely applied to flash lamp-pumped lasers many years ago and was seen as essential for certain spot welding applications. This need first arose when a slow ramp-down was required at the end of the laser pulse to prevent porosity associated with the collapse of the pseudo keyhole at the end of a seam of overlapping laser spot welds.

The fiber laser's advantage is the pump diodes have a much shorter switch-on time than the conventional flash lamp-pumped lasers' hence smaller increments or sectors of pulse length and more complex shapes are possible.

WELDING APPLICATION

Figure 1: Quasi-Continuous Wave High Pulse Energy Fiber Laser

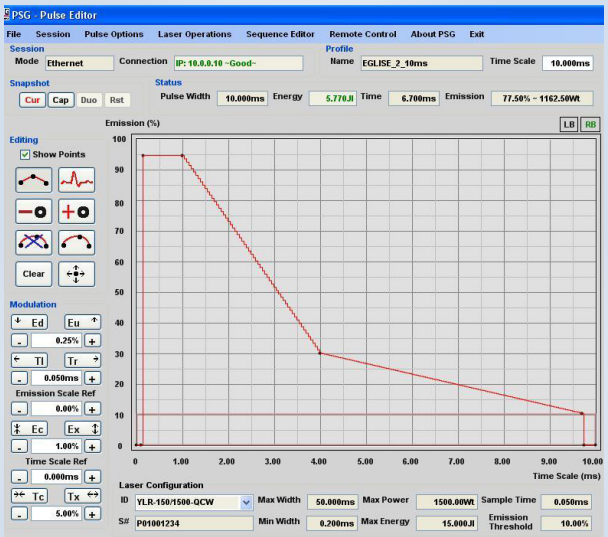

Figure 2: Eglise Pulse Shape using Pulse Shaping Generator (PSG)

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This pulse shaping capability is essential for micro-welding techniques such as dissimilar metal welding and welding of high reflectivity metals; a demonstration of the effect of two temporal pulse shapes is shown in Figures 3a & 3b (Below.) Solidification conditions are modified by this temporal pulse shaping and individual pulses can be finely tuned for each weld application.

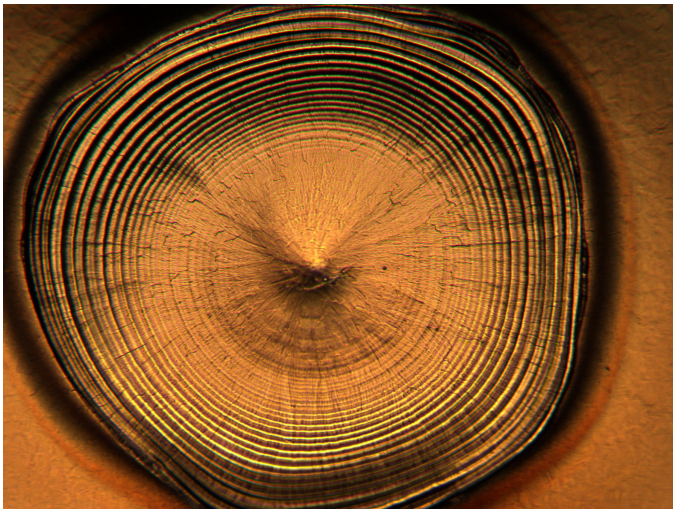

Figure 3a: Standard 10 ms Pulse

Summary

The lack of frozen-in concentric ripples and reduced piping in the center of the single shot spot weld shown in Figure 3b (Below) suggest that the longer tail at the end of the pulse has produced damping during the solidification process.

IPG looks forward to helping our customers with their laser applications and future plans.
A laser solution should evaluate all project aspects including feasibility, productivity, metallurgy and part fixturing before a laser type and optical configuration is selected. Contact IPG's applications facilities for expert sample evaluation or process development.

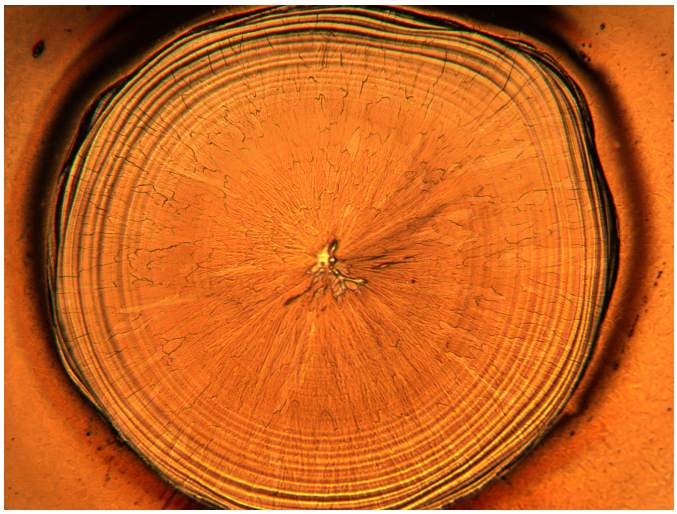

Figure 3b: 10 ms Eglise Pulse Shape with 8 ms Tail

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