INDUSTRIAL MARKING AND ENGRAVING APPLICATIONS WITH HIGH-ENERGY UV LASERS

Industrial ultraviolet (UV) laser marking and engraving is an important field with a wide range of applications and requirements. We previously described UV laser marking applications with demanding requirements for precision (applications note no. 45) as well as in the food and beverage segment (applications note no. 48). Driven by the success of UV laser marking and engraving applications, this technology is on the rise in many different market segments, and engineers are striving to find solutions to benefit from the high flexibility of such marking and engraving systems. On the other hand, new material, geometries, throughput, costs, and compliance requirements are driving the laser industry to develop new solutions especially in dynamic markets such as mobile devices with 5G technology, electric vehicles, and renewable energy.

Recently, MKS released a high energy UV laser, the Spectra-Physics Explorer® One™ HP HE 355-200 capable of delivering 200 µJ of pulse energy (see Figure 1). In the range of 10 to 50 kHz, this laser provides more power and pulse energy than previous models, making it the ideal laser in marking and engraving applications where high pulse energies are needed. As depicted in Figure 2, high pulse energies enable new processes and improve throughput, engraving depth, maximum cutting thickness, and processing area.

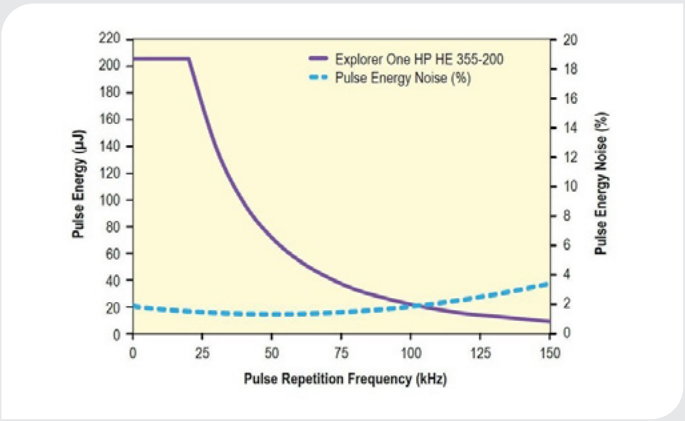

Figure 1. Explorer One HP Energy Curve

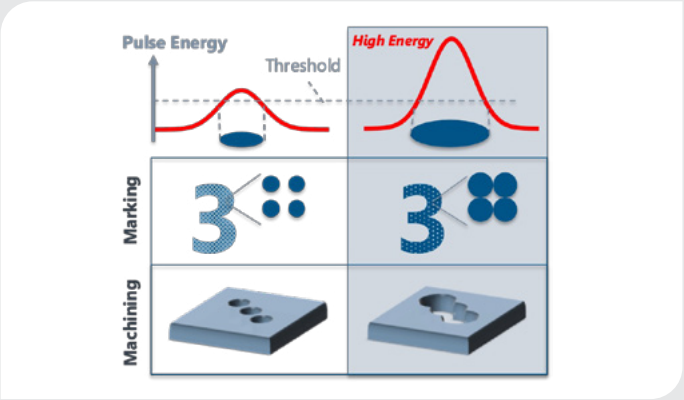

Figure 2. High pulse energies can enable improved visibility of laser markings and increased throughput in micromachining

Along with the other Explorer models, MKS offers a very flexible solution in UV marking and engraving. For example, the Explorer One HP 355-6 delivers 6 W of UV power and has identical mechanical mounting, optical beam property, analog interface and software commands to the Explorer One HP HE 355-200.

High UV pulse energy supports various types of laser micromachining such as:

- Scribing and patterning of thin films and metal foils
- Trimming of electrical components, such as resistors and capacitors
- Scribing of sapphire substrates
- Removing insulating materials, e.g. wire stripping
- High-speed marking of plastics, glasses, metals, sapphire, semiconductors, and thin films
- Marking of semiconductors

High pulse energy and highly absorptive UV wavelengths can be utilized for deep marking and engraving of metals and ceramics (see Figure 3). Semiconductor marking has been proven with excellent contrast and surface quality. Ceramic engraving is demonstrated with clean and sharp edge quality.

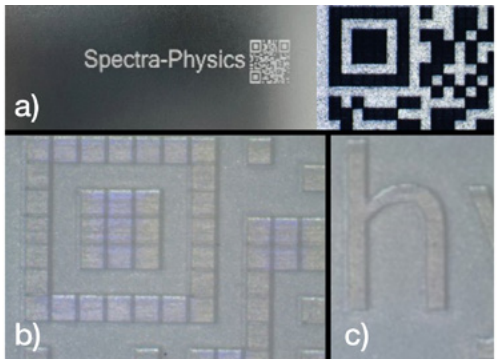

Figure 3. Marking of a) silicon wafers and engraving of b) 2D-matrix codes and c) characters in ceramics

Further tests show marking on plastics, where clear processing can be confirmed for transparent plastics with minimal thermal effects on the processing periphery. As shown in Figure 4, a 2D barcode marked with the Explorer One HP HE laser is successfully recognized and read. The laser, with its high pulse energy and short pulse width of <15 nanoseconds, minimizes undesirable thermal damage even when processing transparent plastic.

Finally, the laser was tested on different metal materials. As shown in Figure 5, the Explorer One HP HE is capable of black marking on a stainless-steel battery pack with an exceptionally high contrast and white marking of anodized aluminum sheet metal.

Figure 4. Marking on transparent plastics

Figure 5. a) black marking on a battery pack and b) white marking of anodized aluminum

In summary, the new high-energy Spectra-Physics Explorer One HP HE 355-200 is capable of enhancing industrial marking and engraving processes in a wide variety of materials and applications to satisfy dynamic market requirements.

PRODUCT

Explorer One

The Explorer One laser series is the most compact actively q-switched laser series in the power range up to 6 W UV and 5 W of green output. High performance standards, such as excellent beam quality with M^2 of 1.1 typical, short pulses and high peak powers, as well as capability for fast power modulation and fast rise times, ensure optimal process quality in customer applications. High quality standards, including tight system-to-system specifications, long operating life, and rugged design, ensure lowest cost-of-ownership. Software features and the compact size result in fast and cost-efficient integration and ensure our customers a fast time-to-market with their own products.

	Explorer One HP 355	Explorer One HP HE 355	Explorer One XP 355	Explorer One XP 532	Explorer One 355	Explorer One HE 355	Explorer One HE 532
Wavelength	355 nm	355 nm	355 nm	532 nm	355 nm	355 nm	532 nm
Power	4 W @ 80 kHz 6 W @ 100 kHz	4 W (200 µJ) @ 20 khz	2 W @ 80 kHz	5 W @ 80 kHz	800 mW, 300 mW @ 50 kHz	80 µJ @ 10 kHz	200 µJ @ 10 kHz
Repetition Rate	Single shot to 500 kHz	Single shot to 200 kHz	Single shot to 300 kHz	Single shot to 500 kHz	Single shot to 200 kHz	Single shot to 60 kHz	Single shot to 60 kHz
Pulse Width	<12 ns	<15 ns	<10 ns	<12 ns	<10 ns	<15 ns	<15 ns

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