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Powerchip Laser Series
Fine Processing of Transparent Materials

The Powerchip is a stand-alone laser delivering tremendous peak power >150kW and ultra-short <500ps pulses from a sealed package as compact as a shoe-box.

The laser performance, enhanced by the quasi-perfect TEM00 beam quality, allows processing virtually all materials with no or very little heat effect… at a fraction of the cost of competing picosecond or femtosecond laser systems.

The Powerchip's outstanding micromachining capabilities are illustrated in the following pages, with a focus on transparent materials processing where the Powerchip excels. The Powerchip laser is available with emission at 1064nm, 532nm, 355nm and 266nm.

If you need any further information, please get in touch at www.teemphotonics.com or contact your local representative.

Table

Why using Powerchip to process transparent materials?

The main advantages of the Powerchip for transparent materials processing are:

- the absence of micro-cracking or chipping
- the high resolution of the marking - typically in the 5-20µm range
- the ability to mark in the bulk of the material through non-linear absorption processes

The Powerchip laser is available with emission at 1064nm, 532nm, 355nm and 266nm.

Typical 1064nm performances are as follow:

Peak power:	>150kW
Pulse width:	< 500ps
Beam quality:	Gaussian TEM00 with M^2<1.1
Pulse to pulse stability:	σ <1%
Power stability:	< ±3% over 1h

High resolution marking in the bulk of BK7 sample – 355nm Powerchip

The rose pattern in fig.1 was realized in the bulk of a BK7 sample for demonstration purpose. It is composed of around 15000 dots with a few micron diameters (see the zoom on single dots inserted) for a total width of 1.2mm only.

The dots are generated inside the bulk thanks to a multi-photon absorption process at the beam focus. In the end, the laser-matter interaction generates a local refractive index change that provides the marking contrast without harming the immediate surroundings.
This picture was recorded using a phase-contrast microscope. It shows clearly there is no micro-cracking or residual stress in the bulk material after such a high density marking.

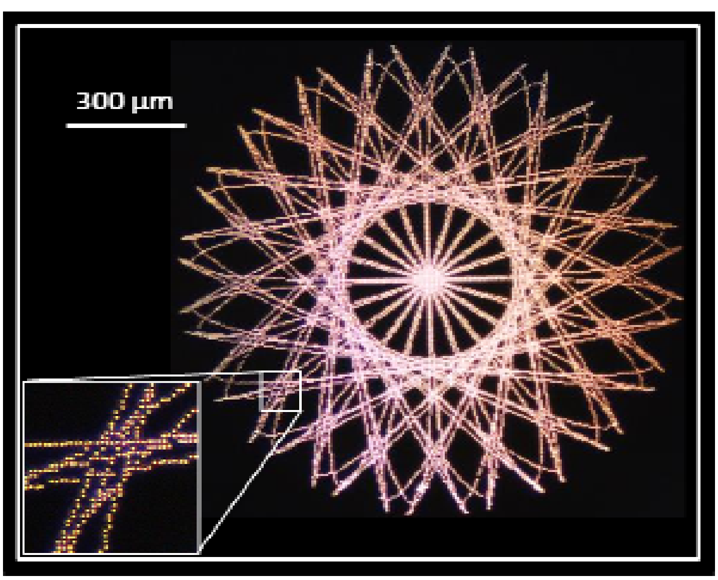

Figure 1: Rose pattern made of 15000 5-10 microns diameter dots marked in the bulk of BK7, showing no micro-cracking under phase contrast microscope observation

This capability can be directly applied to the making of semi-invisible information encoding for **identification or anti-forgery/counterfeit applications**. In these situations, the end-user is not seeing the code but the manufacturer needs to be able to control it on-site with readily available equipment (typically microscope).

Marking 2D codes on glass containers – 355nm Powerchip

Traceability of pharmaceutical and medical products has evolved into a major concern over the last years for public health, purposely supported by major policies like the UDI Act.

Glass packaging are widely use in these industries for their chemical stability and absence of interaction with the substances they contain. Marking glassy media is naturally a major requirement, with the additional constrains that this process should not affect the mechanical resistance of the glass barrier to avoid any risk of contamination.

Using a 355nm Powerchip laser, a 14x14 2D code with 400µm side was written on the surface of a sub-millimetre thick glass sample (fig.2). A single cell has a 28µm side and is free from any micro-cracking. The 2D code can be read by a simple smartphone with a 2D reader application.

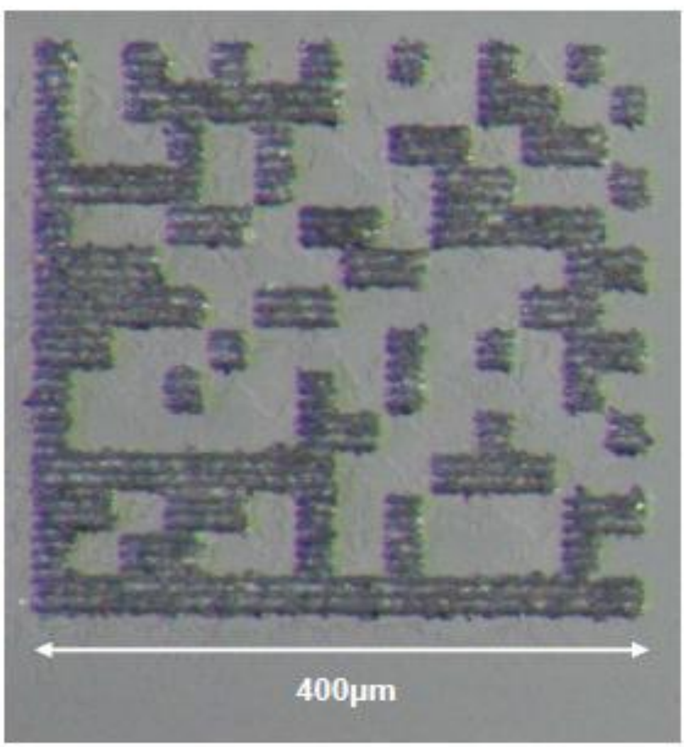

Figure 2: 400µm side 14x14 2D code marked on the surface of a glass sample with no micro-cracking

High resolution black marking in the bulk of crystal Polystyrene – 532nm Powerchip

Crystal Polystyrene (PS) is a very inhomogeneous material, composed of up to 30% of recycled PS that creates a high density of heat absorption centres. It is commonly used to manufacture cheap disposable containers for biochemical substances, for instance for blood analysis in the laboratories.

With nanosecond lasers, even in the UV, marking generates the random apparition of large cracks that are deleterious to the marking resolution and – of course! – to the overall marking quality. Furthermore, UV ns lasers do not achieve any marking in the bulk of the Petri dish sample, a feature of greatest **importance for biomedical or pharmaceutical applications** to minimize pollution in a clean-room production environment.

Figure 3: Alphanumerics and 2D code marking inside the rim of a crystal Polystyrene Petri dish

Using a 532nm Powerchip, thanks to its 100kW peak power and short 400ps pulse, bulk marking becomes accessible with high resolution and good contrast in the 800µm thick rim of the Petri dish as visible on Figure 3.

The 26x26 Aztec 2D code is 5mm large and easily readable with a bare smartphone and a 2D code reader application. Finally, it is worth noting that the crystal PS doesn't include any additives to trigger the laser black marking.

Selective coating ablation on eyeglass polymers – 355nm Powerchip

The objective here is to make a visible mark on a semi-finished eyeglass for **branding application** (fig.4). At this stage of the manufacturing process, the eyeglass has been coated and partially shaped. The laser has to selectively remove the micron-thick coating layer without triggering cracks or damaging the underlying polymer eyeglass.

Nanosecond UV lasers were firstly assessed but they did damage the eyeglass.
The 355nm Powerchip provides a similar peak power with one order of magnitude shorter pulse that enables to write the customer logo using 20µm diameter individual dots (fig.5) in a digital-like approach.

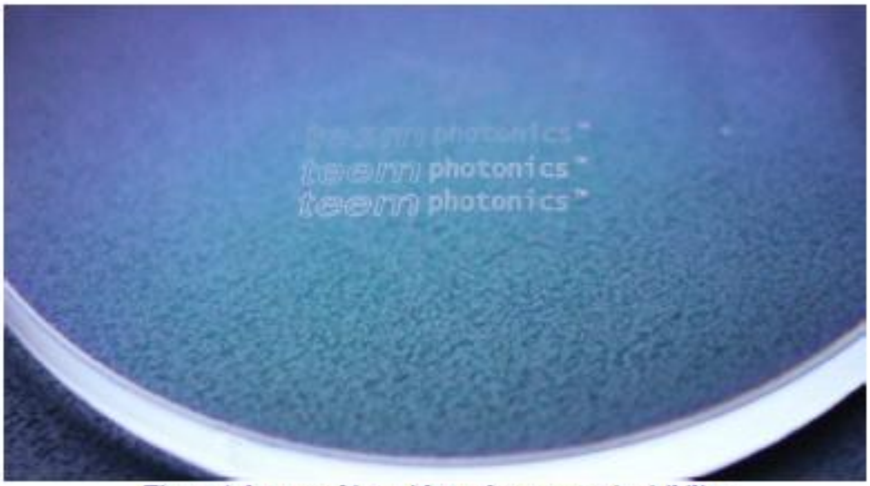

Figure 4: logo marking with good macroscopic visibility

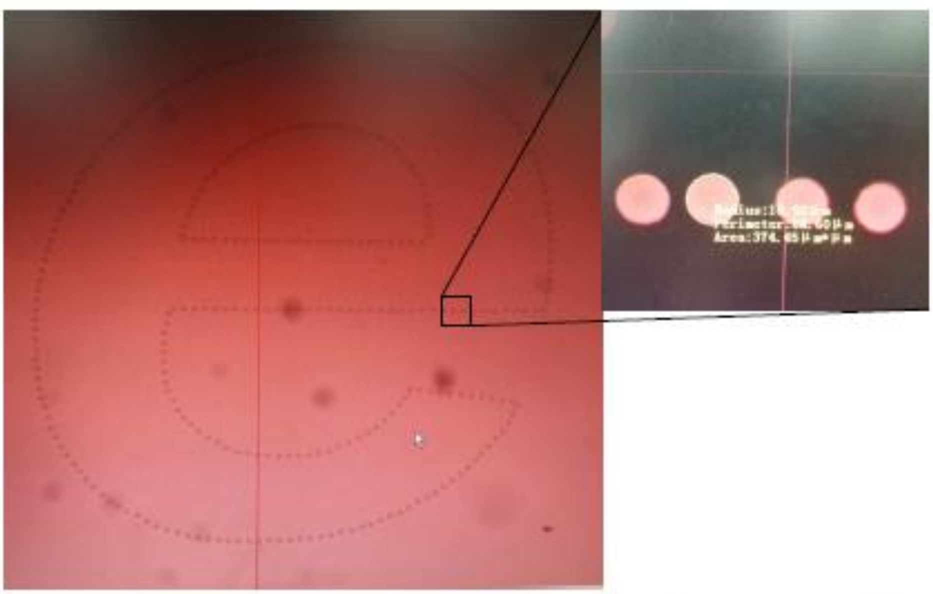

Figure 5: Zoom on a character, with extra zooming on the 20μm individual dots in insert

The same approach can obviously be applied to mark semi-invisible patterns for identification or authentication purposes.

Fine processing of thermoplastics – 532nm and 355nm Powerchip

Polyethylene Terephthalate (PET) is one of the most common thermoplastic polymers. It is widely used for **food and drink packaging, but also as a flexible substrate for thin-film electronics or photovoltaic applications**.

Comparative **black marking tests on white PET substrate** demonstrated clearly the advantage of the sub-nanosecond regime to mark thermoplastics with an optimal resolution and quality.
The individual cells of the 2D code shown in fig.6 are 280µm large. Their edges are sharply defined and show no sign of melting, contrary to the other technologies (IR 10ns and 100ns, cw CO2) that were used in the study to realize the same pattern.

Figure 6: comparative black marking on white PET

Another example is the **cutting of a 15µm thick PET foil** with 355nm Powerchip (fig.7). The cut edges of the 40-100µm structures are sharply defined, with no sign of carbonization or melting under microscope observation.
Avoiding carbonization is of greatest importance for the application where PET has to have a minimal electrical conductivity, for instance when it is used as a **substrate for flexible electronics**.

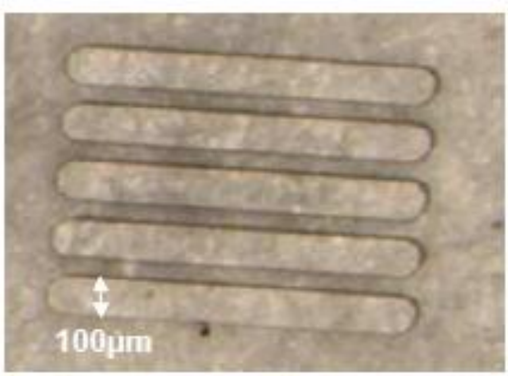

Figure 7: melt-free and carbonization-free cut in a 15µm thick PET foil

Scribing logo onto glass substrate – 532nm Powerchip

The objective here was to engrave the logo of the Limoges lace museum onto a soda lime glass slide. Side-lighting was applied and guided by internal reflexion inside the slide to achieve an appealing visual effect.
This complex pattern is well defined and contrasted under microscope observation, despite a 10µm linewidth (fig.8). There is no visible sign of micro-cracking.

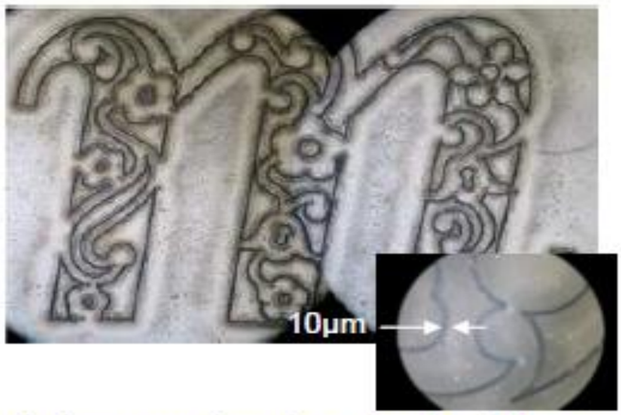

Figure 8: Complex logo engraved onto the surface of a soda lime sample with high accuracy and no micro-cracking.

Drilling sub-micron diameter holes in BK7 – 532nm Powerchip

The results below are extracted from a PhD work at the University Joseph Fourier in Grenoble.

Using a 532nm Powerchip and a strong focusing (NA=0.64, x40 objective), **sub-µm holes were drilled in BK7**, without material splash and only a sub-micron lips around the holes.

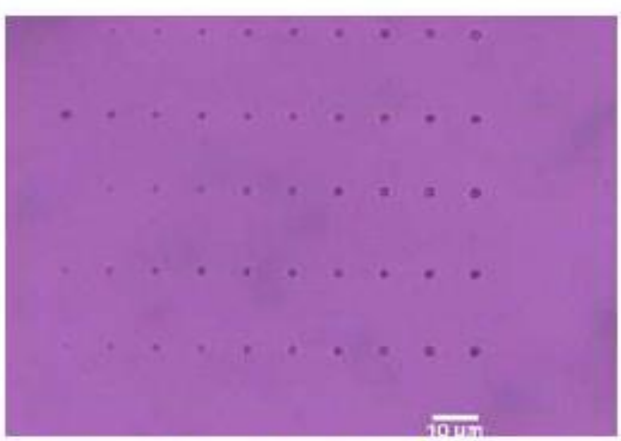

Figure 9: micron scale holes drilled in BK7 with increasing energy

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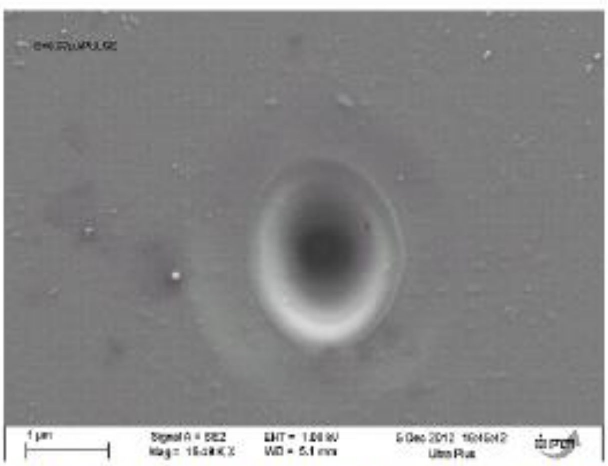
The holes diameter ranged in [0.8-1.5]µm and increased quasi-linearly with the pulse energy on the [1-3]µJ range (fig.9)
Holes depth ranged in [0.8-1.5]µm and did exhibit the same quasi-linear evolution.

The holes are slightly elliptical due to the absence of divergence compensation in the setup. There is no micro-cracking and no melted material splash up to 2µJ (fig.10).

Finally, the University team estimated that the **ablation efficiency and removal rate was similar to those previously reported using a 200fs laser**.



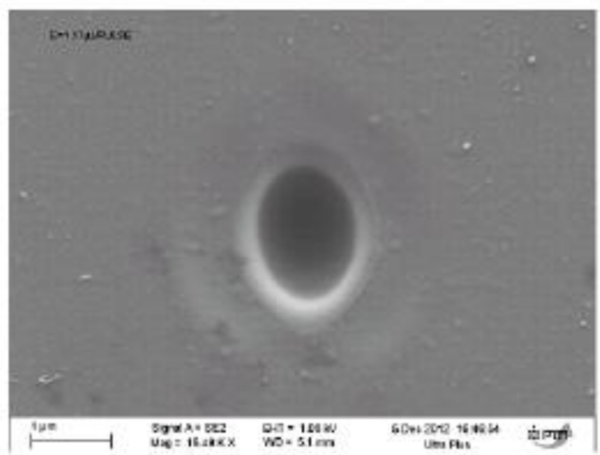


Figure 10: Sub-micron diameter holes under SEM microscope observation - No splash and only a sub-micron ridge (left: 0.97µJ ; right: 1.17µJ)

안녕하세요! OptiLase 입니다.

OptiLase는 Optical engineering 과 Laser를 기본 아이템으로 하여 Laser를 포함한 다양한 Light Source 및 광학부품, 광학시스템을 공급하고 있습니다.

주요 아이템은 아래와 같습니다.

Laser (He-Ne, He-Cd, Ar, YAG, Fiber, CO2, Excimer 등..)

- He-Ne Laser
- He-Cd Laser
- Ar / Kr Laser
- Ar/Kr Laser replacement
- Diode Laser (375nm – 905nm)
- YAG Laser (1064, 532, 355, 266nm)
- Fiber Laser
- Excimer Laser
- CO_2 Laser
- Femto secend Laser

광학 부품, 모듈(OEM)

- Mirror, Lens, Beam Splitter, Filter, Polarizsers, Multi-element optics, prisms, Windows,
- Laser Optics (OC, HR, Rod, Beam expander & component)
- Objective Lens
- OEM module

매뉴얼, 오토 스테이지 등 각 종 광학부품 마운트 류

- 매뉴얼 스테이지, 오토 스테이지, 크로스 롤러,
- 광학 부품 마운트
- 광학 테이블

PL, Raman System, Laser application을 포함한 R&D 지원

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