PRESS RELEASE

USP Lasers Conquer Macroprocessing

Ultrashort pulse (USP) lasers have become firmly established in science and micromachining. At this year's "UKP-Workshop: Ultrafast Laser Technology" in Aachen, a new trend has emerged: Macroprocessing. Since multi-100-watt USP lasers up into the kW range have become available, the industry is looking at them with great interest for large-area applications. For this purpose, the institute is developing the complete process chain right through to fully digitized processes.

The UKP-Workshop has grown once again: More than 170 participants from 14 countries came to Aachen this year to discuss the latest trends in the development of USP laser technology for industrial applications.

Already at the beginning of the event, Dr. Arnold Gillner told the participants "The USP laser has found its way into the industry". Gillner is head of the Ablation and Joining competence area at the Fraunhofer Institute for Laser Technology ILT and initiator of the UKP-Workshop. The next goal is to provide lasers with power as is the case with CO_2 and fiber lasers, which are currently used for material processing of macroscopic components. "The challenge is how to get the photons to the workpiece," Gillner described the core topic of the workshop.

Many innovative technologies for this were presented in the UKP-Workshop: The latest examples range from new laser beam sources through fast scanner systems and new beam shaping concepts all the way to fully automated and digitized processes.

Technology development in networks

There was a consensus on beam sources: Lasers up to 100 W have now made it to the market, systems with several 100 W are available and are already being integrated into the first machines. Soon to be added are USP lasers in the multi-kW range, such as those developed by the Fraunhofer Institutes for Applied Optics and Precision Mechanics IOF in Jena and Laser Technology ILT in Aachen in the Fraunhofer Cluster of Excellence Advanced Photon Sources CAPS. Both institutes have set new world records in recent months: The Jena group demonstrated 3.5 kW average output power from a fiber laser system and the Aachen 500 W at only 30 fs pulse duration from a Yb:Innoslab laser.

Altogether, 12 institutes are working in the Fraunhofer Cluster of Excellence Advanced Photon Sources CAPS. Together, they want to make newly developed beam sources

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available along with corresponding system technology for a wide variety of applications in two application labs in Jena and Aachen.

Laser developer Eric Mottay, Amplitude Systèmes, also emphasized that the system technology for the new lasers can only be developed when the different technology carriers cooperate closely. This became apparent in the following lectures on fast scanners, multi-beam systems and special optics: Together, laser manufacturers, scanner experts and users are working on a multi-beam concept in which an energy-rich laser pulse is split into multiple individual laser beams and guided parallel over the surface in order to efficiently process larger areas.

In detail, Stephan Brüning, of Schepers GmbH, tested the multi-beam concept for the structuring of printing rollers. Previously, four lasers were used in parallel; now the 500 W average power of a USP laser is distributed over 16 partial beams by means of a diffractive optical element. By means of acousto-optic modulators, the partial beams can be controlled independently and achieve significantly higher productivity.

The design of optics with up to 196 similar partial beams was explained by Oskar Hofmann from RWTH Aachen University. The challenge of developing these optical concepts lies in the compensation and correction of the different aberrations.

Benedikt Nohn, of Volkswagen AG, demonstrated how efficiency gains can also be achieved with individual beams. His example was the structuring of tools for embossing interior design elements. Optimized scanner technology more than doubled throughput.

Efficient simulation for digital process chains

"The laser makes a continuous process chain for digital photonic production possible" – this is the vision of the outgoing director of Fraunhofer ILT, Prof. Reinhart Poprawe. Not only is a close integration of the various processes required here, but also a deep understanding of the process and a fast and efficient simulation of the laser-material interactions. Markus Niessen from Fraunhofer ILT discussed the usual approaches and how to cut the computational time dramatically with a reduced model. Microscopic interaction processes and material effects are considered separately from macroscopic effects. In the long term, Niessen has a clear strategy: "Our goal is right-first-time production."

Standard parts are already being manufactured

The progress of the USP laser technology can now be read off the quality of the applications. This is also the case for Claus Dold, EWAG AG, an expert in the manufacture of tools made of ultra-hard materials. In the workshop, he explained how

well the USP laser can process polycrystalline diamonds or carbide materials. Especially for the production of carbide drills, he presented a complete manufacturing system, where the operator only has to enter the geometrical data and insert blanks. The laser machine itself selects the necessary settings and produces the drills with micrometer precision. The machines can be fully automated and operated in a global network. In a digital marketplace, production capacities can be controlled globally and adapted to demand.

More power and more applications

The USP laser technology is increasingly becoming accepted by the industry. After glass cutting and applications in measuring and medical technology, the large-surface processing of surfaces is gaining ground.

Now that laser sources in the multi-kW range are becoming available, the main advantage of the USP technology – an extremely high precision in processing – will lead to its more widespread use. Efficient process technology and a very good understanding of the process are prerequisites for industrial application. New applications from generation of EUV radiation to quantum technology are on the rise. A new challenge must be the protection against X-rays.

The "UKP-Workshop: Ultrafast Laser Technology" reached its capacity limits in 2019 in its exclusive venue: The lounge of the Aachen soccer stadium. On April 21 and 22, 2021, the 6th UKP-Workshop will take place, then probably at a new location with larger premises.

www.ultrakurzpulslaser.de

Fraunhofer ILT at LASER World of PHOTONICS

More USP technology will be available from June 24 to 26. 2019 at the joint Fraunhofer booth A2.431 at the LASER World of PHOTONICS in Munich.

Image 1: Dr. Arnold Gillner: The challenge is to get the photons to the workpiece. © Fraunhofer ILT, Aachen, Germany.

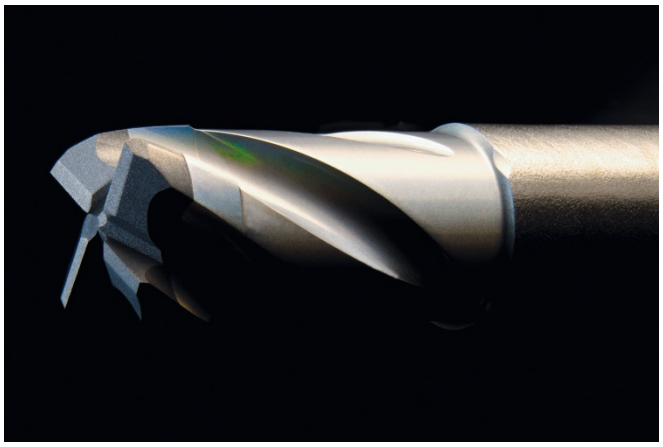

Image 2: Carbide drills can be produced fully automatically from simple blanks. The machine receives blanks and geometry data – the laser parameters are automatically selected. © Dr. Claus Dold, EWAG AG, 2018.

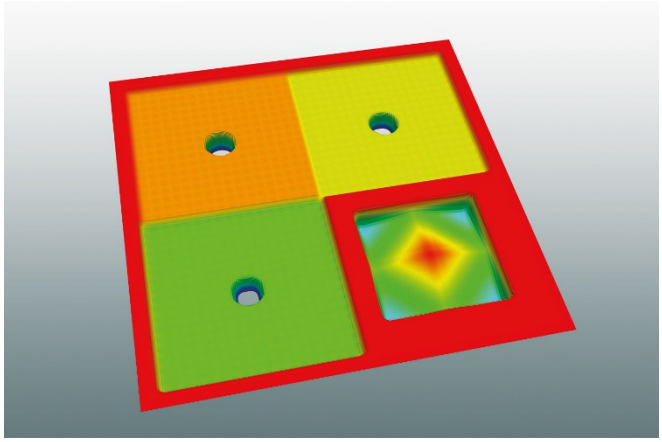

Image 3: Multiscale simulation for digitizing the USP structuring process of metallic foils.
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