PRESS RELEASE

The era of multi-kilowatt lasers has begun

Laser technology is breaking into new dimensions: Ultrashort-pulse and continuous-wave lasers with average powers in the multi-kilowatt (kW) range promise to boost efficiency for material processing and pave the way for entirely new fields of applications. At the AKL'26 - International Laser Technology Congress, taking place from April 22 to 24, 2026, in Aachen, several sessions will focus on multi-kW lasers.

"The average power of Ultrashort pulse (USP) lasers is reaching the double-digit kilowatt (kW) range thanks to developments at the Fraunhofer Cluster of Excellence Advanced Photon Sources – CAPS," says Dr. Jochen Stollenwerk, acting director of Fraunhofer ILT in Aachen. The power of continuous-wave (cw) lasers is already in the range of several hundred kW. Such power levels make the laser attractive for previously unattainable target markets. In tunnel and deep drilling or in mining, high-power lasers could help shatter rock and massively accelerate existing processes. In shipbuilding and plant construction, high average powers enable more efficient and precise drilling, cutting, and joining processes for thick materials and high-strength steels. High-power lasers are also needed to process and functionalize large metallic, glass, and ceramic surfaces in parallel using multi-beam methods or optical stamps. Stollenwerk is convinced that "these methods will trigger a surge in efficiency in laser material processing." Laser processes could then also be used to maintain rail networks or pipelines.

Dr. Hagen Zimer, CEO of Laser Technology and a member of the Executive Board of TRUMPF SE + Co. KG, speaks of a "new era of laser technology." Industrial lasers with 50 kW and more are now a reality, and the first 100+ kW applications are already on the horizon. The ultra-high-power (UHP) lasers developed for this purpose will not only accelerate processes, but fundamentally transform them. The expert sees users of laser technology at a strategic turning point: "Much of what previously failed at the limits of feasibility is now becoming a reality," he says. This also applies to cost structures as prices for laser systems are falling.

AKL'26 highlights market potential

Both experts will delve deeper into this trend at the AKL'26 - International Laser Technology Congress in Aachen. In the Gerd Herziger Session, they will also discuss the

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economic and technological potential of high-power and high-energy lasers together with top managers from Coherent, IPG Photonics, and Amplitude Laser.

High-energy lasers, particularly diode-pumped solid-state lasers (DPSSLs), are a key technology for future fusion power plants since they provide high pulse energy, great energy efficiency, and excellent beam quality. They are also increasingly in demand as drivers for compact secondary sources capable of generating extreme ultraviolet (EUV), X-ray, or neutron radiation. Given the wealth of new applications for high-power, high-pulse-energy lasers, Prof. Constantin Häfner, Executive Board Member for Research and Transfer at the Fraunhofer Society, sees "huge, still completely untapped markets for photonics." He estimates their long-term revenue potential at several hundred billion euros. "Laser research is far from over. On the contrary—60 years after its invention, things are just really getting started!" he explained at AKL'24. The renowned fusion expert will use AKL'26, taking place from April 22 to 24, 2026, to take stock of progress to date, shedding light on the status of fusion research and the development of industrial supply and process chains.

High laser power requires process and application expertise

Fusion power plants and secondary sources require high pulse energy and high average power with high efficiency and high pulse contrast. Industrial manufacturing processes, in contrast, need reliable pulsed and continuous-wave lasers with high average power and excellent beam quality at moderate pulse energies. These technologies are paving the way for more efficient laser processing, when combined with innovative—and in some cases AI-supported—process strategies, as well as robust fibers, optics, and coatings. In particular, parallelization promises significant productivity gains. To achieve this, the beam from the high-power source is split into dozens of individual beams that can be directed independently of one another. Implementing such multi-beam approaches requires fast, precise beam guidance systems. This is where a novel planar galvanometer scanner developed at Fraunhofer ILT comes into play, which the institute's latest spin-off will present at AKL'26. The miniaturized system is particularly well-suited for multi-scanner systems and operates significantly faster and more precisely than previously available solutions.

Fraunhofer ILT is also advancing new beam-shaping approaches to optimally adapt beam shapes to components and machining processes. Using optical neural networks, among other technologies, the Aachen-based researchers can create virtually any three-dimensional beam profile or optical stamp. In this process, the laser spot no longer scans the workpieces in fine lines. Instead, the light structures entire areas, which in some cases speeds up processing by a factor of five. "What makes optical stamping special is the combination of speed, precision, and flexibility," explains Sönke Vogel, team leader for 3D structural ablation at Fraunhofer ILT. In principle, the USP

process—in which a spatial light modulator (SLM) shapes the beam into an optical stamp—is suitable for any application requiring periodic microstructures, whether in metal, hard ceramic materials, or glass. In addition to the multi-beam method and optical stamping, the Aachen-based institute is pursuing further approaches for converting high average laser powers into more productive material processing: These include precisely controlled pulse durations to optimize energy input and beam intensity, or the periodic generation of laser beam bursts for highly efficient material ablation with minimized thermal stress on the workpieces. The tiny pauses between bursts also help to effectively extract smoke and ablated material so that it does not get between the laser and the workpiece during the next burst.

Fraunhofer ILT supports industry with its expertise

Although the new era of multi-kW lasers is just beginning, researchers in the Fraunhofer ILT laboratories are already working intensively on process strategies that will help industrial users fully exploit the potential of UHP lasers in the future. "Laser material processing will take place at a far higher level of productivity than ever before," emphasizes Institute Director Stollenwerk, "and it is foreseeable that AI and other computational methods will play a central role in this." Fraunhofer ILT has been systematically building and expanding its digital expertise for years to make the laser technology know-how it has generated over four decades usable for future industrial processes. The goal is highly productive, laser-based "first-time-right" production. Stollenwerk is convinced: "Where laser technology is breaking into new dimensions—for example, drilling 1,000 holes with a single shot, functionalizing square meters of metal and glass surfaces per minute, or precisely cutting and joining centimeter-thick steel—it will also break into new markets." Fraunhofer ILT stands ready with its expertise to support industrial users in this new era. "AKL'26 is an excellent opportunity to look toward the future of high-performance laser material processing, and to engage in conversation with our experts," Stollenwerk says.

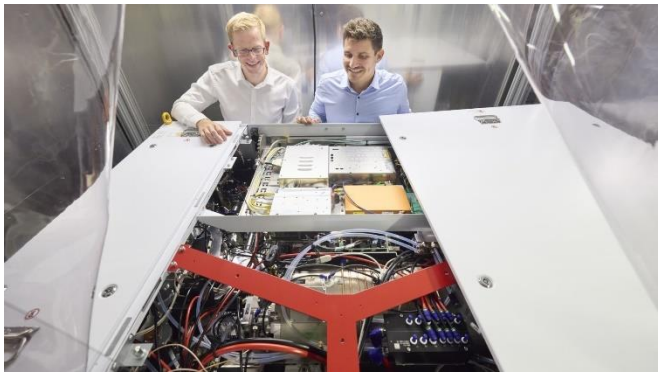

Image 1:
Dr. Dennis Haasler of Fraunhofer ILT (left) and Steffen Rübling of TRUMPF with TRUMPF's first industrial 1 kW UKP laser. To harness its full potential, the Aachen-based institute is currently developing suitable process strategies.
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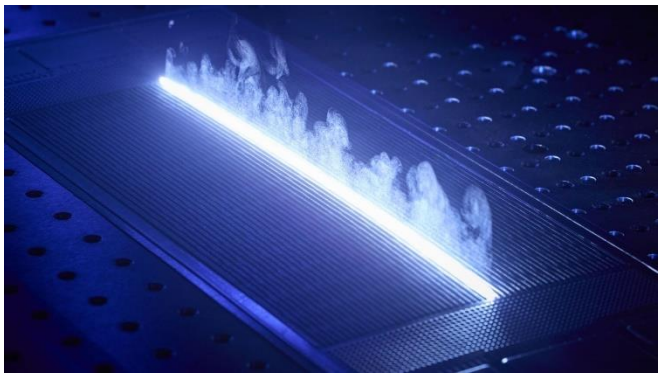

Image 2:
When de-coating compound bipolar plates, the Fraunhofer ILT is already making full use of the 1 kW UKP laser's power potential.
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Image 3:
"Medium power levels in the multi-kilowatt range make lasers attractive for previously unattainable target markets," says Dr. Jochen Stollenwerk, acting director of Fraunhofer ILT. Coupled with new AI-based process strategies, this will boost efficiency in material processing.
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Image 4:
On the panel of the Gerd Herziger Session at AKL'24 in Aachen, Prof. Constantin Häfner, Executive Board Member for Research and Transfer at the Fraunhofer-Gesellschaft, and Dr. Hagen Zimer, CEO Laser Technology and Member of the Executive Board at TRUMPF SE + Co. KG, turned a spotlight on the future of the photonics industry. They will continue the discussion at AKL'26 – International Laser Technology Congress. © Fraunhofer ILT, Aachen, Germany / Andreas Steindl.

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