Ultrafast_RAZipol Newsletter December 2015

Latest developments at Stuttgart University, Lumen and SLV

The Institut für Strahlwerkzeuge (IFSW) part of Stuttgart University (USTUTT) has successfully achieved and demonstrated the amplification of beams with radial polarization in a thin-disk multipass amplifier. An average output power in the range of 250-300W (using a 50W seed beam) at a repetition rate of 20 MHz and a pulse duration of 782 fs was obtained. The results have been presented as a post deadline paper at ASSL 2015 in Berlin [1]. Figure 1 shows the intensity distribution of the amplified beam at 250W without and with polarization analyser. Figure 2 shows a photo of the 60 mirrors array used for the experiments.

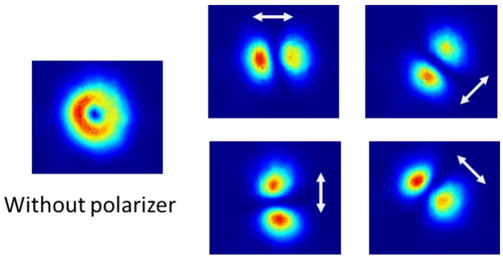

Figure 1

Furthermore, IFSW, has performed Raytracing calculations and first experiments in percussion drilling in order to develop a basic process model for laser drilling in steel. Both investigations show a benefit in using donut shaped laser modes for the drilling process.

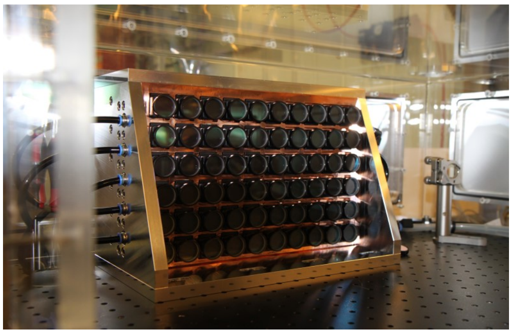
Figure 2

[1] A. Loescher, J-P. Negel, T. Graf, W. Pallmann, B. Resan, I. Martial, J. Didierjean, F. Lesparre, J.T. Gomes, X. Delen, F.P. Druon, F. Balembois, P. Georges, and M. Abdou Ahmed, "A 265W and 782 fs amplified radially polarized beam emitted by a thin-disk multipass amplifier," Postdeadline paper N° Ath3A, Advanced Solid State Lasers (ASSL) 2015, 4–9 October 2015, Berlin Germany

LUMENTUM

Lumentum (formerly part of JDSU) announced the completion of its spinoff from JDSU on August 1, 2015. Lumentum is now an independent, publicly-traded company. The spinoff results in a more focused and agile structure to better address the demands of the accelerating pace of technology and market change. Lumentum will be present at Photonics West 2016 .

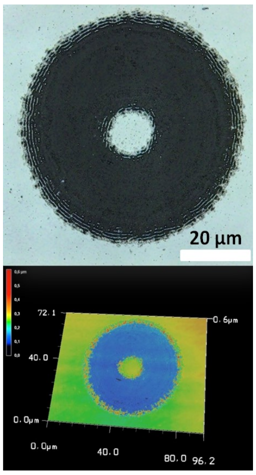

Figure showing the femtosecond ablation on a 100 nm thick platinum layer using radial polarization. Due to the polarization type, SLV were able to ablate about 15% more platinum as with linear polarization at the same pulse energy.

At SLV, by means of further trials, wide-ranging experiments using a femtosecond laser (TruMico 5050 femto, TRUMPF GmbH + Co. KG, Ditzingen, Germany) with different F-Theta-optics (f = 100 mm, f = 160 mm) as well as different polarization states (linear, radial, azimuthal) were performed. Due to the variation of significant process strategies and parameters like pulse energy, repetition rate, pulse overlap, focus position and scan speed a process model was developed. For wafer applications, different metallic nanolayers (copper, platinum, constantan and aluminium) with a thickness of about 100 nm on glass substrates were used. Thereby, ablation thresholds for the different metallic and dielectric layers for the different polarization states were determined.

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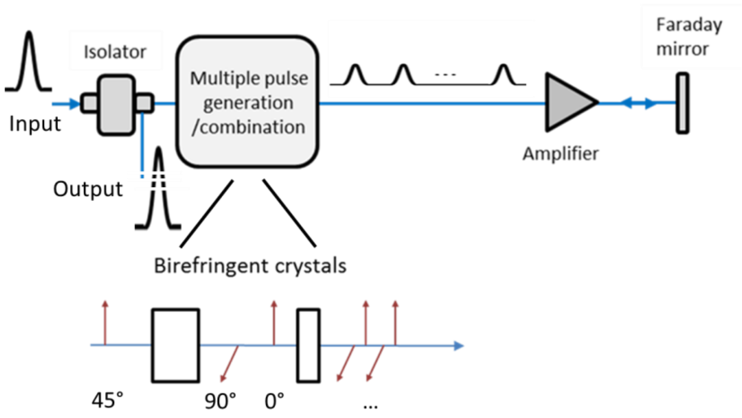
Single Crystal Fiber (SCF) - latest developments at CNRS & Fibercryst

The Laboratoire Charles Fabry (CNRS and Institut d'Optique Graduate School) applied a coherent combining technique to Single Crystal Fiber (SCF) amplifiers for the first time. Initially developed with fiber amplifiers, passive coherent techniques based on Sagnac interferometers schemes or divided pulse approaches allow to scale up peak power and pulse energy. The basic principle is to split the pulse in several sub-pulses during laser amplification to reduce the peak power and the energy per pulse to limit non-linearities and avoid damages [2]. Pulse replicas are recombined coherently after amplification. Divided pulse amplification, (see diagram below) has been successfully implemented in a SCF amplifier with eight replicas, demonstrating that the peak power could be scaled by a factor of eight with a simple and compact experimental setup. The latest experimental results will be presented at Photonics West 2016 [3].



[2] Y. Zaouter, L. Daniault, M. Hanna, D. N. Papadopoulos, F. Morin, C. Hönninger, F. Druon, E. Mottay, and P. Georges, "Passive coherent combination of two ultrafast rod type fiber chirped pulse amplifiers," Opt. Lett. 37, 1460-1462 (2012)

[3] F. Lesparre, J.T. Gomes, X. Delen, I. Marial, J. Didierjean, W. Pallmann, B. Resan, F. Druon, F. Balembois, P. Georges, "Yb:YAG single -crystal fiber amplifiers for picosecond lasers using divided pulse amplification technic," Solid State Lasers XXV: Technology and Devices, Photonics West (2016)

As a partner of the project Ultrafast_RAZipol, Fibercryst has been developing integrated ultrafast laser amplifiers. Ultrafast lasers are definitely the tool of the future for micromaterial processing operations, but wide acceptance is slowed down by poor reliability and high cost. Fibercryst proposes to remove these two locks using Single Crystal Fiber technology. Two industrial lasers were developed, called PICO and FEMTO for material processing applications. All optical components, including the pump diodes and the mode-locked oscillator, are located in the laser head, thus avoiding the need for a sensitive fiber coupling between head and power supply. Thanks to its simple design, PICO and FEMTO are easy to produce in volume and offers the best price/performance ratio.

Single Crystal Fibers, thermal dissipation modules and innovative pumping scheme are the three core technologies of these lasers, each covered by patents. The Single Crystal Fiber combines the best of two worlds, fiber laser and bulk crystal laser, without their respective limitations. Single Crystal fibers can deliver tens of MW of peak power. Combined with dissipation modules, they can also reach several tens of Watts of average power without thermal beam distortions. Pump guiding enables to optimize the extraction efficiency while keeping the excellent beam quality of the laser. These innovations lead to a simple, compact and robust laser architecture. PICO and FEMTO have been presented at Laser World of Photonics 2015.

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Next Scan Technology announcing two new head models

Next Scan Technology announces two new scan head models enabling smaller spot sizes and 300 mm wide full telecentric processing. These projects are sponsored by EU grants to unlock applications requiring more throughput without compromising accuracy.

The LSE300STD design translates into the benefit that it is now possible to avoid time consuming or complex stitching while maintaining spot size and beam quality. In addition, High NA optics for the LSE170HNA are released to enable smaller spot sizes and improve processing quality and smaller features. Utilizing their integrated, full telecentric, mirror optics the set up allows for a compact all-in-one, ready-to-use scanner head. Proprietary SuperSync™ and TrueRaster options fulfill the requirements regarding repeatability and accuracy, ready to meet micromachining requirements at highest performance which is part of the Ultrafast_RAZipol project planning.

To complete the LSE product range extension a plethora of advanced control features are provided such as:

Streaming mode: bitmaps of any length can be processed enabling non stop roll-to-roll processing.

Enhanced surface quality: for super smooth surface quality in 2.5D micromachining by smart scanning strategies

Interleave mode: for line based material processing such as drilling, grooving and cutting interleaving enables using lower rep-rate lasers at high scanning speeds, or alternatively, material inter-pulse temperature control when using high-rep lasers and large spot overlaps

LSE170HNA

LSE300STD

Next Scan Technology will be attending the following events in 2016:

Photonic west '16 16-18 February

WOP Shanghai '16 15-17 March

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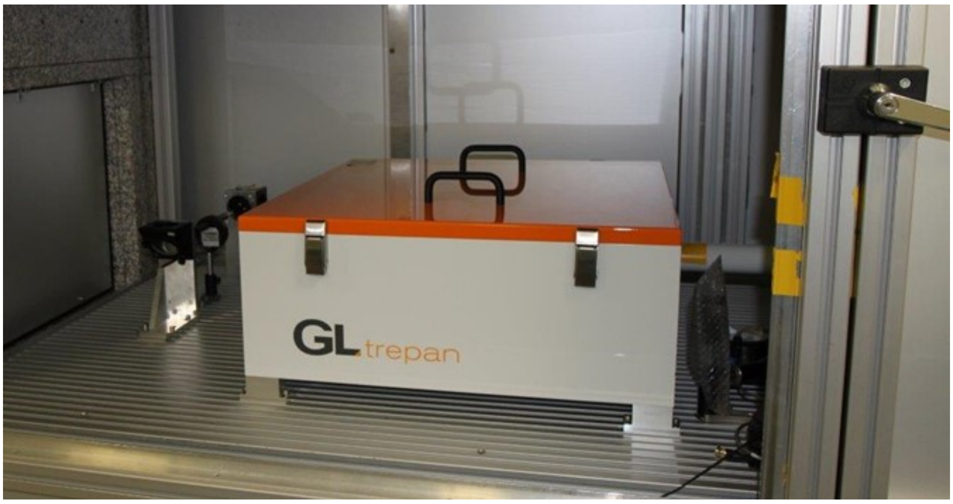
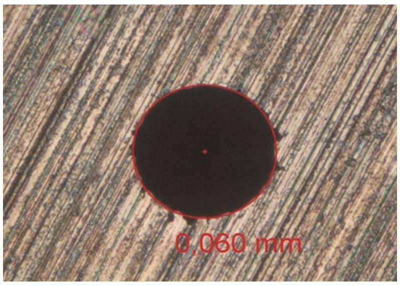
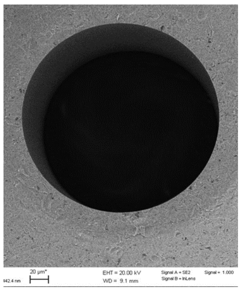
Integration of drilling optics GL.trepan in machining system at IFSW



GL.trepan integrated into IFSW machining system

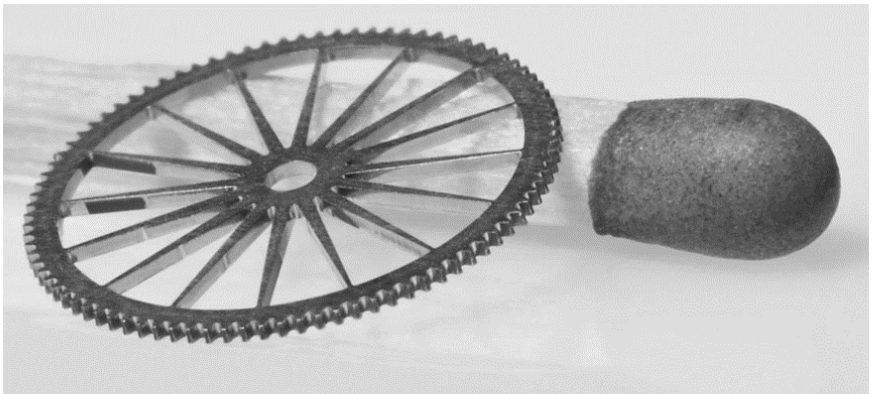


Φ 60µm in 0.5mm heavy metal for textile industry; drill time 3s with 515nm

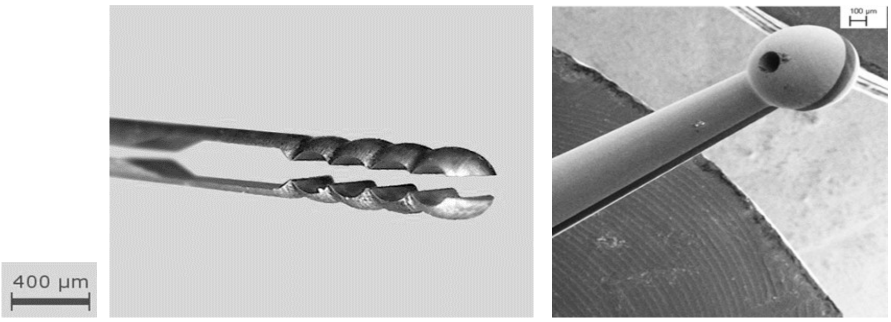


Cylindrical hole in 300µm steel for fuel injection applications, drill time < 1.5s

The drilling optics GL.trepan has been installed in a machining centre at the "Institut für Strahlwerkzeuge" of the University of Stuttgart. It is based on a rotating cylinder lens telescope and allows to drill holes with diameters from 50µm to 600µm with positive and negative taper as well as cylindrical holes and other advanced hole geometries. Angles up to +20° and -5° are possible. The rotating beam may also be used for cutting to control the cut width and angle of the cut. Within the project it will be used for experiments to consolidate the theoretical modelling.



Brass micro gear wheel for watches cut with sub-picosecond laser and GL.trepan; feed rates from 10 – 200mm/min depending on material and material thickness



Stainless steel micro tweezers for medical industry, laser turned, cut / drilled with GL.trepan

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