

Hub of Application Laboratories for Equipment Assessment
In Laser Based Manufacturing

Editorial

Dear APPOLO newsletter readers,



Lasers can be used in diverse applications, including material processing. This diversity allows for innovative ideas for creating products and technologies and offers the equipment to realize them. A broad field is open for small companies in Europe with strong expertise in lasers and applications. The future of manufacturing is vital to European economic growth and sustainability. New ideas have to be transformed into new products and processes.

However, new application ideas, coming from universities and research institutions, are usually implemented by spin-off companies with limited resources for market penetration. Many of the manufacturing companies are SMEs and only a few of them have research capacity and the financial potential to implement high-risk innovative manufacturing technologies. A new support scheme from the European Commission and industrial organizations, the Private-Public-Partnership initiative "Factories of the Future", is targeted to the manufacturing industry and the development of new and sustainable technologies.

The APPOLO project, launched on September 1st, 2013 as part of the EC initiative "ICT Innovations for Manufacturing SMEs" seeks to establish and coordinate connections between the end-users, which have demand on laser technologies for fabrication, the application laboratories of the research institutes and universities, which have knowledge accumulated and the laser equipment manufacturers for novel lasers, beam control and guiding. Their integration serves a faster validation of the process feasibility and adaptation of the equipment for manufacturing conditions.

Assessment of the dedicated production processes is implemented by a virtual hub of laser application laboratories around Europe which accumulate knowledge and infrastructure as an easy-to-access environment for the development and validation of laser-based technologies.

The ultimate goal of our APPOLO project is to establish a Laser Certification Center which helps partners from the European photonics industry to preserve their competitiveness and penetrate new niches in the global market.

We hope you enjoy this edition of the APPOLO newsletter,
Gediminas Račiukaitis, Project Coordinator

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www.appolo-fp7.eu

Focus Topic

Aim of the APOLLO Project

Laser Applications

The APPOLO project focuses on laser applications for CIGS thin-film solar cells, in smart surface texturing for automotive, printing/decoration industries and for real-3D flexible electronics.

The Consortium

The consortium consists of 21 partners from eight different countries and was formed to cover all the expertise needed for the project. It is assembled from research institutions with active and experienced staff across Europe, connected to the Hub of application laboratories; SMEs companies producing equipment and components for laser material processing; system integrators with a global scope and end-users.

The hub of the application laboratories will work as a common entry point to the assessment service provider net. Core of the hub are laser centers, departments or application laboratories at the Center for Physical Sciences and Technology, Leibniz Institut of Surface Modification, Technical University of Madrid, Lappeenranta University of Technology and Bern University of Applied Science.

The equipment builders for automotive, photovoltaic, electronics and printing industries will benefit from faster integration of innovative technologies. These will provide new quality consumer products, including low-cost and high-efficiency solar cells, cars with comfortable interior and high functionality as well as smart sensors for environmental monitoring.

New Partners

The consortium is open for new partners, which work on laser-based material processing systems. It is ready to announce calls for new partners which want to implement their processes with lasers (assessment projects). Based on the experience of the application laboratories, the consortium will concentrate on the processes for photovoltaic, thin-film electronics and surface texturing. New topics of validation activities and partners will be selected through an open call in fall 2014.

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Time-Bandwidth Products acquired by JDSU

The acquisition of Time-Bandwidth Products strengthens JDSU's position as a leading provider of lasers for micromachining applications.

According to independent market research firm Strategies Unlimited, the market for micromachining is expected to grow to \$752 million in 2015, and the ultrafast laser segment of this market is expected to grow by 20 percent to \$183 million.

Use of ultrafast lasers for micromachining applications is being driven primarily by increasing use of consumer electronics and connected devices globally. Manufacturers are taking advantage of high-power and ultrafast lasers to create quality micro parts for consumer electronics and to process semiconductor chips for consumer devices.

Ultrafast lasers can rapidly and precisely process parts at high volumes and use very short light pulses during the manufacturing process to minimize heat, which can negatively impact the quality and functionality of the processed part.

Based in Zurich, Switzerland, Time-Bandwidth Products adds innovative laser technology to JDSU that complements JDSU's current laser portfolio, while enabling Time-Bandwidth Products to leverage JDSU's high volume and low-cost manufacturing model, global sales team and channel relationships.

"For nearly twenty years, Time-Bandwidth Products has been developing ultrafast lasers that provide industrial-level reliability with the performance required for material-processing applications," said Kurt Weingarten, president and CEO of Time-Bandwidth Products. "Combining our expertise in ultrafast lasers for micromachining with JDSU's expertise at vertical integration and high-volume manufacturing will enable JDSU to bring powerful new laser solutions to the market."

Learn more about JDSU at www.jdsu.com

Source: http://www.time-bandwidth.com/upload/press/trendium_time-bandwidth_press_release_1-30-14.pdf

Meet the Consortium

Center for Physical Sciences and Technology (FTMC)

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CENTRAS



CENTER
FOR PHYSICAL SCIENCES
AND TECHNOLOGY

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The State research institute Center for Physical Sciences and Technology (FTMC) is the largest research institution in Lithuania. FTMC has 750 employees, including 230 researchers with PhD and 60 PhD students in 19 departments. The scientific scope of the Center covers both, research and technology development in laser technologies, optoelectronics, nuclear physics, organic chemistry, bio- and nanotechnologies, electro-chemical material science, functional materials, electronics and other research areas. The mission of the FTMC is to extend scientific research for the development of high-tech business and the creation of knowledge-based economy in the country. This inherent feature distinguishes the FTMC from universities.

The Center for Physical Sciences and Technology was established in 2010 by reorganization the Institutes of Chemistry, Physics and Semiconductor Physics in Vilnius and later, at the end of 2011, the Institute of Textile, located in Kaunas, joined in. The main idea of this reform was to establish a scientific institution which unites expertise of leading Lithuanian scientists in order to develop high-tech technologies and make complementary research as well as to compete for projects in European research area.

The main research topics include:

- New materials and their production and modification technologies
- Sustainable technologies; nuclear and alternative energetics
- Lasers and laser technologies

Interview...

... with Dr. Gediminas Račiukaitis, Head of Department of Laser Technologies at FTMC

What are the biggest challenges in the field of laser-based manufacturing today?

Helpful for our research is the EC Structural Fund as well as other public funds in Lithuania. A general good public opinion on lasers and laser manufacturing technologies in Lithuania allowed us to renew our entire research infrastructure in the field of photonics and providing cutting edge research potential. Close relations with Lithuanian laser industry is one of the channels to transfer technologies we are developing.

A challenge is the lack of local manufacturing industry for accumulating laser material processing technologies in Lithuania. This goes along with weak demand and limited feedback from the users, which is crucial for the development and validation of laser technologies.

To which extent APPOLO can help to face those challenges?

Our research center is a multidisciplinary institution which offers excellent possibilities for synergies in different fields of research, even though different departments have different goals and expectations. The APPOLO project hereby can help to cut borders within Europe. Even today, just launched APPOLO, we feel ourselves closer to many strong end-users and system integrators in Germany, Spain or Switzerland. The hub of our laser application laboratories in different countries with different infrastructure and expertise, makes us more attractive and powerful for new customers. We can feel this. Of course the new challenge now is to coordinate and manage all the activities.

In addition to the direct validation and assessment of selected technologies during the project, we have the chance to calibrate our knowledge and procedures for new emerging challenges in laser-based manufacturing.

- Optoelectronics, microwaves and terahertz electronics
- Time and space resolved spectroscopy
- Synthesis and application of organic compounds
- Formation, characterization and control of nanostructures
- Electro-chemical, catalytic and sorbic processes
- Chaos and self-organised phenomena in non-linear dynamic systems



Cutting edge research at FTMC

©FTMC

The spectrum of the center activities also includes other important and complementary tasks in parallel to the scientific research and development of technologies, i.e.:

- Organisation of PhD studies and postdoctoral internships, training of researcher to be able performing the high-level research and solve scientific problems
- Contract research on request of high-tech companies and industry
- Expertise and scientific consultations
- Dissemination of knowledge to a broad society facilitating creation of the innovation-based economy and educating the knowledge-open society

The results of scientific research are commercialised through Science and Technology Parks of the Center for

Physical Sciences and Technology and open-access facilities:

- Open-access center for electron microscopy, X-ray diffractometry and spectrometry
- Open-access center of Alternative fabrication technologies BALTFAB
- Public entity Science and Technology Park of the Institute of Physics
- Public entity Science and Technology Park

The FTMC has many international partners and is integrated in the European Research Area. The Center for Physical Sciences and Technology is in close collaboration with scientists from Germany, France, Great Britain, Poland, Taiwan, USA and other countries and by developing new technologies and innovative products it is involved in implementation of European and bilateral research projects. The Center and its researchers are members of numerous international organisations, including cooperative membership in EPIC (European Photonics Industry Association), OSA (Optical Society of America) and LIA (Laser Institute of America).

In 2004 the Department of Laser Technologies has been established for the development of laser technologies. Ever since then its main task was the validation of lasers for industrial processes. The staff includes 19 researchers with PhD degrees, 17 PhD students as well engineers and technicians with expertise in solid-state and fiber lasers, optical coatings, nano-photonics, application

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Daetwyler Graphics develops new degreasing solution for laser processes

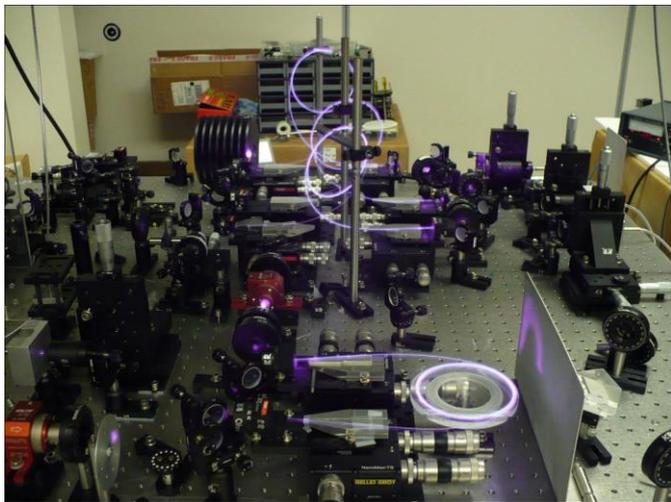
DG LP Cleaner ELS liquid is a highly concentrated, liquid degreasing solution which was developed for the electrolytic cleaning of copper and steel cylinders. It optimally cleans cylinder surfaces, thus ensuring the best possible results during subsequent copper or chrome plating. The product can also be used with laser processes.

Source: <http://www.helloscope.de/en/issue-03-2013/daetwyler/dg-lp-cleaner-els-liquid.html>

of lasers in material processing and technology development. Researchers of the department provide contract research for domestic and foreign companies and implement national and international projects related to photonics, lasers and laser applications in the precise material processing.

With the main goal to bridge the gap between basic research and commercial use of research results in laser and optical technologies, the Department of Laser Technologies offers service on:

- Development and implementation of laser technologies for surface and intra-volume marking, microfabrication, modification, scribing, dicing, cutting and drilling using ultra-short pulsed lasers
- Development of specialized solid-state and fiber lasers
- Development of deposition technologies, design and small-batch fabrication of dielectric optical coatings for diverse photonics applications
- Modeling of nano-photonic structures for light propagation in waveguides and photonic-crystal structures and the structures themselves



©FTMC

View into the Fiber Laser Lab

The laboratories of FTMC are equipped with modern devices for processing, control and analysis, including state-of-the-art ultra-short pulse lasers, laser processing workstations, streak cameras, ultra-fast oscilloscopes, AFM, SEM, TEM, XRD, micro-Raman. All these techniques can be used to validate new lasers and the re-

sults of their application in diverse material processing areas



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Modern equipment at FTMC laboratories

In the APPOLO project, the Department of Laser Technologies of FTMC is responsible for overall coordination of the project, managing the hub of application laboratories and is directly involved in the characterization of novel lasers and components and development of laser technologies for thin film selective ablation for monolithic interconnection of CIGS modules and new 3D-metallization techniques.

Visit <http://www.ftmc.it/en> to find out more.

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APPOLO Management Board Meeting in Berlin

A proof of the fruitful APPOLO work was given on December 5th, 2013 when the work package leaders of APPOLO met for their first regular Management Board Meeting in wintery Berlin. A look back showed first achievements of partners, and strategic positions regarding the HUB structure of APPOLO were set up. Next Management Board meeting will take place in June 2014 in Vilnius.

Next Scan Technology



©NST

Next Scan Technology (NST) delivers laser scanner modules to enable the highest throughput in the laser micromachining market. Even though this Dutch-Belgium start-up was only founded four years ago, the Next Scan Technology team already looks back on 20 years of experience in optical scanning devices. Based on proven engineering concepts a polygon scanner solution for ultra-fast pulsed lasers was developed including new to the world all mirror telecentric 'f-Theta' optics.

In 2013 they launched their first commercially available polygon scanner of laser micromachining, which can reach scan speeds of 25 – 100 m/s. This technology allows ultra-short pulsed lasers to be used in the industry to lower product manufacturing costs.

To service the laser processing community NST developed a scan technology platform, which can be scaled in size, speed and accuracy. However, when scan speeds increase timing becomes more crucial. A problem NST solved with a unique solution for high speed synchronization, which allows speed without compromising accuracy. Their SuperSync Technology guarantees spot addressability within a few microns. The latter enables a great advantage over traditional galvo based scan processes in the automotive, display and semicon industries. For the tooling and part manufacturing industry this scanning technology offers a roadmap to convert chemical processes like etching into laser based processing.

NST believes that the key to success lies in the simultaneous development of technology and application. Therefore they chose to co-develop process solutions and applications. NST is developing partnerships with industry leaders in system integration and complementary technologies for laser processing.

By joining the APPOLO project they aim to form strong relationships in licensing and engineering with the project partners as well as developing their technology into engine solutions for specific applications that can be used broadly.

Visit <http://nextscantechnology.com/> to find out more.

Interview...

...with Lars Penning, CEO of Next Scan Technology (NST)

What are the biggest challenges in the field of laser-based manufacturing today?

From our perspective I would like to focus the question on validation of laser based manufacturing. I think it's fair to say that our scanning technology is new in the world of advanced laser processing. In this view our biggest challenge is validation in different industries using laser. And although our value proposition is enabling micro features onto any material at unprecedented scan speeds, fact finding to value our company's resources is the key to success. We need to know what the future mainstream applications will be and who and where the key players and opinion leaders are in the near future.

With respect to our throughput proposition we receive an increasing interest from Asia and started validation through demonstration on site. This introduces cultural challenges as the way of problem solving differs from Europe. Companies, especially in Korea, have a much more agile approach than other countries. By hands-on they acquire data in the shortest period of time providing us valuable information which supports us to improve our performance on different levels and apply focus on key developments.

This feedback however introduces the next challenge: lead times of optical parts and electronics. As a European company we look out for European supply for a number of reasons. However, it takes too much time to get quotations and it gets even worse with lead times. This kind of delay puts pressure on feature releases losing opportunities or even worse, challenges our competitiveness.

To which extent APPOLO can help to face those challenges?

Offering a platform for process validation providing valuable feedback to (sub) system suppliers is one but the business case itself is just as important. Money rising for technology developments can be challenging but access to key manufacturing data is lacking. Providing product manufacturing costs based on laser processing versus traditional mechanical or chemical processing would be of great help.

This would also make people, responsible for financing working capital, understand what the value is of high end - laser based - manufacturing.

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Meeting of representatives of the innovative industry and the cantonal government at Empa

The Cantonal government of Zurich welcomed representatives from innovative industries on the Empa campus. Main topic of the event was the technology transfer between research and industry as well as an insight into the work at Empa. Around 70 members of senior managements of the innovative industry took part. The Empa campus was chosen due to its international reputation and its important representative location for Zurich as a business and research location. The Laboratory for Thin Films and Photovoltaics at Empa supplies materials for the APPOLO project.

Source: <http://www.empa.ch/plugin/template/empa/1351/142557/---/l=1>

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Abengoa Solar receives the CSP Today Industry Choice award

Abengoa, an international company that applies innovative technology solutions for sustainable development in the energy and environment sectors and is a large global integrator in the APPOLO Project, has been granted the Industry Choice Award in the last edition of the international CSP Today Awards Sevilla. This is the only award voted by the leading solar industry representatives. It recognizes the work of outstanding companies in the development and construction of solar thermal power plants. This is the second CSP Today Industry Choice Award awarded to Abengoa in 2013, after receiving the CSP Today Industry Choice USA in July. The awards ceremony took place on November 12th in Seville (Spain) during the CSP Today Concentrated Solar Thermal Power Summit. The meeting, which brought together more than 350 professionals and leading international companies in the sector, has served as a stage to present the many possibilities for industrial applications, energy programs of countries like Saudi Arabia and Jordan, as well as foster partnership and business development.

Source: http://www.abengoasolar.com/web/en/acerca_de_nosotros/sala_de_prensa/noticias/2013/abe_20131115_1.html

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APPOLO partners arouse great attention at Photonics West 2014

The APPOLO project was strongly represented by various consortium partners at Photonics West in San Francisco on February 1st - 4th, 2014. Our laser suppliers Ekspla, Onefive and Time Bandwidth Products attained huge number of visitors highly interested in the innovations presented by the companies. It was extremely difficult even to pass nearby a small booth of Next Scan technologies - always crowded by interests of polygon scanners for high-speed texturing.

At LASE conference 8 talks on laser texturing and laser technologies for photovoltaics were given by project partners. They increased the awareness of the APPOLO project and already start to promote the HUB activities.

Leibniz Institute of Surface Modification



Leibniz Institute of
Surface Modification

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The Leibniz Institute of Surface Modification was founded in 1992 by recommendation of the German Science Council. The mission of the institute is to carry out application-oriented fundamental research in the field interaction of radiation with matter. For this purpose, typically low-energetic ions, electrons, plasma as well as VUV and UV photons are utilized to modify different kinds of materials and thin films for the development of new technical applications. The institute is divided in a chemical and a physical department and has currently approximately 150 employees including more than 25 PhD students.



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The main buildings of the IOM Leipzig in the center of the science park of Leipzig, Germany.

An important goal of the IOM is to transfer the results of the basic research and technical development into innovative technological applications. Therefore, the institute closely collaborates with companies, especially of the optical, chemical, and semiconductor industry. The IOM has close connections to universities, institutes, and

research centers in Germany and abroad. Therefore the institute collaborates in a large number of cooperative projects in national and international alliances and is involved in the education of young academics. The intense technology transfer of the IOM resulted in the creation of several spin-off companies in the past few years. Hence, within the spin-offs of the IOM currently more people are employed than working in the institute.



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LenA - the Leipziger nano-Analytikum – provides highly sophisticated techniques for morphological, structural, and chemical investigations of surfaces and films.

The objective of the institute is to bridge the gap between basic and applied research and to support activities in transferring the generated knowledge into companies.

The activities of the IOM focus on the following research areas:

- Ion Beam Assisted Technologies
- Non-conventional Ultra-precision Surface Machining
- Ion Sources / System Development
- Laser Structuring
- Structure Determination / Electron Microscopy
- Inorg. / Organ. Interfaces / Thin Films
- Electron Beam und Photonic Technologies
- Chemical Analysis
- Functional Coatings
- Membrane Modification
- Light and Energy Conversion
- Bio-functional Surfaces

Infrastructure and equipment of the institute are state of the art; in addition to scientific laboratory and analytical equipment especially the widely installed systems engineering allow application-oriented research.

Interview...

...with Dr. Klaus Zimmer, research associate at the Leibniz Institute of Surface Modification

What are the biggest structural challenges in the field of research for laser-based manufacturing today?

The problems are complex. Financing and money are always most important. All other factors are arranged depending on the aim. For industrial, application-oriented research the most important aspects are the available equipment, the accumulated know-how, the environment (e.g. the analysis of the laser results), and of course trust. It is hard to rate these. It is best if all aspects are covered in certain parts.

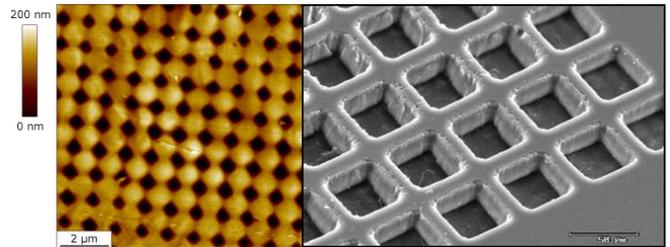
To which extent APPOLO can help to face those challenges?

Providing complementary experimental possibility is a major aspect. The building of a structure in the form of the consortium and the possibility to become visible in connection with the partners and through APPOLO is important as well. One can hope for networking, partnership, and quality.

The newly established laboratory "Leipziger nanoAnalytikum" financed by the Free State of Saxony and the European Union houses high-performance electron microscopes, like STEM and SEM, powerful instruments in material science for studies down to atomic levels.

The core competences of the IOM are scientific and applied research in the field of interaction of radiation with matter, especially the utilization of low-energetic ion and energetic electron beams, plasma jets as well as VUV and UV photons for surface modification and thin-film technology.

The experience of the IOM's Laser Processing Group is focused on micro- and nano processing of materials and thin films, and covers such laser technologies as etching, ablation, scribing, joining, embossing, and surface modification.



© IOM

Examples of laser-machined surfaces: left: micron patterned copper surface by inverse laser embossing, right: array of laser-etched cavities in a fused silica sample.

The work on laser-based material processing can be combined by standard micro-technical methods like photolithography, wet and dry etching, thin film deposition, and other beam technologies of the IOM. The experimental work is supported by the extensive analytical capabilities of the IOM and simulation competences.

The experimental experiences in laser material processing are:

- Laser etching, laser-induced back side/front side etching
- Laser CVD
- Laser ablation by ns-, ps- and fs-lasers
- Laser scribing of thin films and functional devices
- Laser microjoining by welding, soldering or form fit
- Laser embossing of micron and submicron structures
- Modification of surfaces by pulsed laser irradiation
- 3D patterning of surfaces by mask projection and direct writing
- Beam shaping, beam splitting, and interference technologies for pulsed lasers
- Laser-induced self-assembly by ultrashort and short pulsed laser irradiation

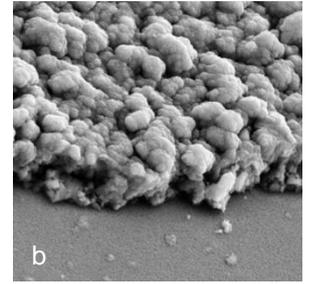
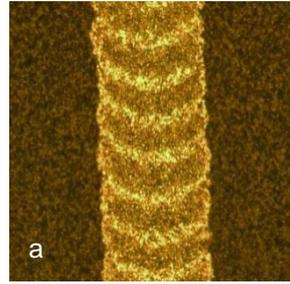
To perform scientific and technical research at the IOM various laser workstations are available including a kHz UV Excimer laser, a MHz ps-laser, and a kHz fs-laser system.



©IOM

View to the recently opened technical laser center at the IOM.

The IOM laser activities are mainly involved into two work packages of the APPOLO project that are related to laser-scribing of CIGS thin-film solar cells (WP3) and to high-speed surface texturing by lasers (WP4). Various laser scribing technologies for performing the scribes to fabricate monolithic integrated interconnections for solar modules are available. The challenge is not only to achieve small dead areas of the interconnection region but also to reduce the electrical losses due to the current observed laser-induced shunt formation during laser-scribing.



©IOM

Examples of laser-scribed CIGS thin-film a) low damage P3 scribe with ultrashort laser pulses and b) melt-free scribed CIGS thin-film stack.

Visit <http://www.iom-leipzig.de/> to find out more.

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Onefive completes 1000th ultrafast laser

The Onefive GmbH closes 2013 with the completion of its 1000th ultrafast laser system since the first one was shipped back in 2006. This achievement demonstrates that the company, which supplies lasers for the APPOLO project, has established itself as one of the leading suppliers in the ultrafast laser market and has become a preferred choice of industrial-grade OEM solutions for both femtosecond and picosecond applications.

Onefive CEO, Lukas Krainer, summarizes the S/N 1000 milestone: "We are very proud of reaching this milestone, especially when considering that we are one of the few players in this niche market with neither venture capital nor having been acquired by any of the big players. It proves that industry leading performance, quality and volume can be successfully handled by small, privately owned companies".

Source: <http://www.onefive.com/pdf/20140117%20Press%20Release%20Onefive%201000th%20laser.pdf>

Upcoming Events 2014

21.04. – 25.04.	Santa Fe, NM, USA	High Power Laser Ablation
07.05. – 09. 05.	Aachen, Germany	AKL-International Laser Technology Congress
10.06. – 12. 06.	San Jose, CA, USA	Conference on Lasers and Electro-Optics 2014
17.06. – 20.06.	Vilnius, Lithuania	15 th International Symposium on Laser Precision Microfabrication
24.06. – 25.06.	Stuttgart, Germany	Stuttgart Laser Technology Forum
8.09. – 11. 09.	Fuerth, Germany	8 th International Conference on Photonic Technologies
22.09. – 29.09.	Amsterdam, Netherlands	29 th European Photovoltaic Solar Energy Conference and Exhibition
29.09. – 03.10.	Matsue, Japan	International Conference on Photo-Excited Processes and Applications
19.10. – 23. 10.	San Diego, CA, USA	International Congress on Applications of Lasers & Electro-Optics 2014

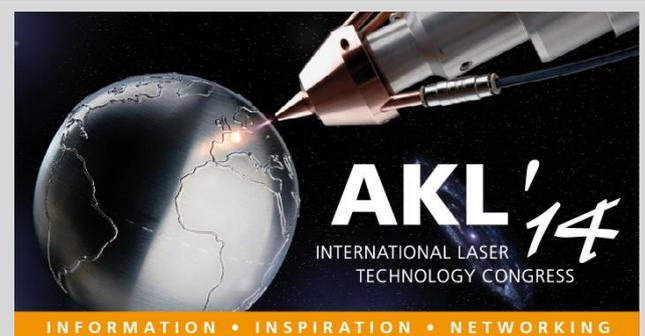
We invite you to meet us at these events and to get to know more about APPOLO and the partners!



© Blue52 Productions

Since 1998, the **International High Power Laser Ablation Symposia** have provided a unique forum for exchange of ideas on the physics and application of high power laser-materials interaction, including advances in relevant high power laser sources and problems of beam propagation and detection, in a collegial atmosphere. This will be the tenth meeting. Since 2002, the **International Symposia on Beamed Energy Propulsion** have brought together organizations and individuals interested in developing beamed-energy propulsion vehicles, engines, schemes and concepts into space transportation systems of the future. BEP includes microwave sources as well as lasers as drivers. These meetings offer an exceptional opportunity for researchers in the BEP field to present the current results of their studies. In 2014, for the first time, these meetings will be combined.

<http://www.usasyposium.com/hplabep>



© Fraunhofer ILT

For the tenth time, laser manufacturers and users from different sectors will be gathering at the **International Laser Technology Congress AKL'14** in Aachen. At the last AKL, over 600 participants took advantage of this platform for applied laser technology, located centrally in Europe, to catch up on the latest developments in this sector and to collect ideas for future activities.

<http://www.lasercongress.org/en/home/>

CLEO:2014

Laser Science to Photonic Applications

© The Optical Society

Well-known for its world-renowned peer-reviewed program, the **Conference on Lasers and Electro-Optics (CLEO)** unites the field of lasers and electro-optics by bringing together all aspects of laser technology and offers high-quality content featuring break-through research and applied innovations in areas such as ultrafast lasers, energy-efficient optics, quantum electronics, biophotonics and more.

<http://www.cleoconference.org/home/>



© FTMC

The **15th International Symposium on Laser Precision Microfabrication (LPM 2014)** will take place on June 17th to 20th, 2014 in Vilnius, Lithuania. LPM is the world's number one meeting of the laser user community where the most advanced developments and recent trends in laser application for fine and precise fabrication of diverse materials are discussed between industry, research and academia.

The upcoming APPOLO Management Board Meeting and Workshop for Industrial Laser Users will be organized in conjunction with LPM 2014.

<http://www.lpm2014.org/>



© IFSW Universität Stuttgart

Highlights and innovations in the field of industrial laser-based manufacturing will bring together experts and users at the eighth **Stuttgart Laser Technology Forum (SLT)** from June 24th -25th, 2014. The SLT is organized by the IFSW and takes place in conjunction with the International Trade Fair for Laser Material Processing (LASYS) at the Trade Fair Centre Stuttgart (Airport).

The Stuttgart Laser Technology Forum which takes place on a biannual cycle is aimed at knowledge transfer and is recognized as an essential international user forum of the laser branch.

<http://www.slt.uni-stuttgart.de/>



© Bayerisches Laserzentrum GmbH

The **8th International Conference on Photonic Technologies** will take place on September 08th to 11th, 2014 in Fürth, Germany.

Modern research has to act on social, economical and environmental developments to provide solutions for the existing and upcoming global challenges. To meet this challenge, LANE 2014 offers a platform for an international exchange of ideas, opinions, perspectives, results and solutions concerning photonic technologies.

<http://www.lane-conference.org/>



The **29th European Photovoltaic Solar Energy Conference and Exhibition (EU PVSEC)** will take place from September 22th to 26th, 2014 at RAI Convention and Exhibition Centre in Amsterdam, the Netherlands.

The five-day Conference is complemented by the three-day Exhibition, held from October 23th to 25th, 2014.

The EU PVSEC is held annually at changing European locations. This unique PV solar event constitutes the world's leading science-to-science, business-to-business and science-to-industry platform for the entire PV value chain.

While Photovoltaic (PV) Solar Energy is becoming a major electricity source on a global level, the 29th European Photovoltaic Solar Energy Conference and Exhibition (EU PVSEC 2014) further extends its focus to application- and policy-oriented topics.

<https://www.photovoltaic-conference.com/>

ICEPEPA

The **9th International Conference on Photo-Excited Processes and Applications (ICEPEPA)** will take place from September 29th to October 3rd, 2014 in Matsue, Japan. The topics range from fundamental laser-material interactions, theory and modeling to applications with nanoparticles and nanophotonics as well as new trends in photo excitations. The conference intends to create an atmosphere for scientific presentations at the forefront of the field and an informal exchange of ideas in a relaxing environment.

<http://icpepa9.com/>

ICALEO

The **International Congress on Applications of Lasers & Electro-Optics (ICALEO[®])** has a 32 year history as the conference where researchers and end-users meet to review the state-of-the art in laser materials processing and predict where the future will lead. From its inception, ICALEO has been devoted to the field of laser materials processing and is viewed as the premier source of technical information in the field.

<http://www.lia.org/conferences/icaleo>

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Industrial Laser Solutions reports APPOLO Website Launch

The Launch of the APPOLO Website did not go unnoticed. David Belforte, the Chief Editor of Industrial Laser solutions made his readers aware that "after a successful kick-off event" the APPOLO project has just launched its website. The on- and offline magazine Industrial Laser Solutions claims itself providing news about "all lasers, all the time". It is being read by decision-makers in over 145 countries.

Source: <http://www.industrial-lasers.com/articles/2014/01/laser-based-microfabrication-project-launched-last-year-progresses.html>

Consortium



<http://appolo-fp7.eu/>

Coordinator

State research institute Center for Physical Sciences and Technology (FTMC)

Department of Laser Technologies
Savanoriu Ave. 231, LT-02300 Vilnius, Lithuania

Tel.: +370 5 264 9211, 266 1640/1643,
Fax: +370 5 260 2317

Contact Person

Dr. Gediminas Račiukaitis

Head of Department of Laser Technologies, FTMC

Tel.: +370 5 264 4868

E-Mail: graciukaitis@ar.fi.lt

