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LIA TODAY

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Focus:
LASERS IN MANUFACTURING

Laser Institute of America, the international society dedicated to fostering lasers, laser applications and laser safety worldwide.

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Laser Applications and Safety

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LIA TODAY

THE OFFICIAL NEWSLETTER OF THE LASER INSTITUTE OF AMERICA

LIA TODAY is published bimonthly to educate and inform laser professionals in laser safety and new trends related to laser technology. LIA members receive a free subscription to *LIA TODAY* and the *Journal of Laser Applications*® in addition to discounts on all LIA products and services.

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ABOUTLIA

Laser Institute of America (LIA) is the professional society for laser applications and safety. Our mission is to foster lasers, laser applications and laser safety worldwide.

We believe in the importance of sharing new ideas about lasers. In fact, laser pioneers such as Dr. Arthur Schawlow and Dr. Theodore H. Maiman were among LIA's original founders who set the stage for our enduring mission to promote laser applications and their safe use through education, training and symposia. LIA was formed in 1968 by people who represented the heart of the profession – a group of academic scientists, developers and engineers who were truly passionate about taking an emerging new laser technology and turning it into a viable industry.

Whether you are new to the world of lasers or an experienced laser professional, LIA is for you. We offer a wide array of products, services, education and events to enhance your laser knowledge and expertise. As an individual or corporate member, you will qualify for significant discounts on LIA materials, training courses and the industry's most popular LIA conferences and workshops. We invite you to become part of the LIA experience – cultivating innovation, ingenuity and inspiration.

CALENDAR OF EVENTS

Laser Safety Officer Training

Jun. 21-23, 2016	Memphis, TN
Dec. 6-8, 2016	Orlando, FL

Laser Safety Officer with Hazard Analysis*

Jun. 13-17, 2016	Philadelphia, PA
Sept. 19-23, 2016	Las Vegas, NV
Oct. 17-21, 2016	San Diego, CA
Nov. 7-11, 2016	New Orleans, LA

*Certified Laser Safety Officer exam offered after the course.

Industrial Laser Safety Officer Training

May 18-19, 2016	Novi, MI
Aug. 17-18, 2016	Novi, MI
Nov. 16-17, 2016	Novi, MI

Medical Laser Safety Officer Training*

Jun. 11-12, 2016	Philadelphia, PA
Aug. 27-28, 2016	New York, NY
Sept. 17-18, 2016	Las Vegas, NV
Oct. 15-16, 2016	San Diego, CA
Nov. 5-6, 2016	New Orleans, LA

*Certified Medical Laser Safety Officer exam offered after the course.

Lasers for Manufacturing Summit & LME®

Apr. 25 & 26-27, 2016	Atlanta, GA

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Oct. 16-20, 2016	San Diego, CA

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President's Message

It is my great pleasure and honor to have this opportunity to communicate with the laser community.

From February 29 to March 1, 2016, I chaired the LIA Executive Committee and LIA Board of Director's meetings in Orlando. A number of important strategic issues were discussed based on an analysis of the current strengths, weaknesses, opportunities and threats of the LIA business. Although LIA is USA based, the institute has long been a global association. Recognizing that the majority of laser-based manufacturing activities are in Asia and Europe, opportunities for LIA's presence and developing activities in Europe and Asia exist, and LIA should explore these opportunities. A strategy and action plan was discussed.

I would like to introduce the new LIA Executive Committee members: LIA Secretary, Professor Milan Brandt, Director of Centre for Additive Manufacturing at RMIT University, Australia, has been involved in LIA activities for nearly 30 years and successfully chaired one of the LIA's PICALO conferences in Australia. Another new member is Professor Minlin Zhong, Director of Laser Processing Research Centre at Tsinghua University, China. Minlin was the first person from Mainland China to participate in LIA activities and conferences and was the General Chair of PICALO in 2008 in Beijing, China. He is now the president of International Academy of Photonics and Laser Engineering (IAPLE). The third new member of the committee is Mr. Eric Mottay, founder of Amplitude Systemes, France. He has been involved in laser technologies, systems and applications for 30 years.

I would also like to welcome Mr. Clive Grafton-Reed, Global Laser Processes Owner at Rolls-Royce plc., to join the LIA Board of Directors.

I would like to congratulate Professor Yongfeng Lu for having been elected to receive LIA's 2016 prestigious Arthur L. Schawlow award in October. Professor Lu is a pioneer in several laser and photonic sciences and technologies; including fundamental theories in laser cleaning, laser production of diamonds and carbon onions, and non-linear optical spectroscopy.

While in Orlando, I attended the eighth annual Laser Additive Manufacturing (LAM®) Workshop, chaired by LIA President-elect Paul Denny. The majority of the technical presentations were from companies including end users such as GKN Aerospace, Rolls-Royce and GE, reflecting the fact that the industries are driving the rapid growth and applications of the 3D printing technologies. Additive manufacturing or 3D printing has seen the fastest growth (50-100 percent per year) over the last few years and this growth is expected to be sustainable over the coming years. A key challenge is to change the engineers' design strategy to fully utilize the new capability and opportunities provided by laser additive manufacturing and 3D printing. This includes the consideration of light-weight structures, cellular structures and functionally graded components that could not be realized in traditional manufacturing.

Finally, I encourage you to attend both the Lasers for Manufacturing Event® (LME®) on April 26-27, 2016, in Atlanta, and ICALEO which will be held on October 16-20, 2016 in San Diego.

Lin Li, President
Laser Institute of America

Executive Director's Message

The LIA Executive Committee and Board held meetings in Orlando prior to our eighth Laser Additive Manufacturing (LAM®) Workshop. During the meetings Neil Ball and Silke Pflueger were elected Fellows and 2014 LIA President Yongfeng Lu was selected to receive the 2016 Schawlow Award.

During the meetings encouraging progress was made by the task forces charged with developing our vision, re-evaluating our membership approach and ensuring adequate funding for LIA's growth as we approach our 50 year Anniversary in 2018.

There is still work to do, of course and the task forces will continue their work and report progress at the LIA Annual Meeting at ICALEO®.

Peter Baker, Executive Director
Laser Institute of America

Laser Manufacturing

Learn, Network & Explore the Possibilities

LME 2016
LASERS FOR MANUFACTURING EVENT®
Laser Institute of America's Lasers for Manufacturing SUMMIT

BY BETSY MARONE

In its fifth year, Laser Institute of America's Lasers for Manufacturing Event® (LME®) will continue its tradition of offering attendees a unique and comprehensive two-day look into the laser industry. Taking place at the Cobb Galleria Centre in Atlanta, GA, April 26-27, LME will serve as a one-stop shop for companies looking to integrate laser technology into their production. Since its inception, LME has filled a void in the laser industry by providing one event where attendees can see the latest advances in laser technology, network with elite members of the laser industry, discover solutions to both current and future manufacturing needs, and gain a better understanding of laser basics in free education sessions.

"It is hard to imagine that anyone involved in manufacturing is unaware that to be competitive we must use technology," says LIA Executive Director, Peter Baker. "One shining example is laser technology, and LME 2016 offers everything the beginner and early adopter needs to know."

From the Laser Technology Showcase and 'Ask the Expert' Booth to the keynote addresses, free educational courses and tutorials, LME was designed to meet the needs of individuals interested in utilizing laser technology within their companies. Not only can attendees learn about automation equipment, laser choices, beam delivery, safety considerations and applications development, but they can also meet attending suppliers who can teach these companies to integrate technology into their production. By connecting interested companies with the most helpful suppliers for their business, LME sets its attendees up for success.

"LIA's LME is recognized as the premier event for those interested in industrial lasers and peripheral equipment," states David Havrilla, Manager of Products and Applications for TRUMPF Inc., a loyal sponsor of LME. "Whether you are new to the industry or a veteran, LME gathers all the relevant suppliers and key technical spokespersons to present and advise you during this two-day exhibition and conference."

Over the years, LIA has strived to build upon its revolutionary premise in order to continuously meet the needs of its attendees. The organization proved this with the introduction of a one-day Lasers for Manufacturing Summit in 2014.

"LIA'S LME IS RECOGNIZED AS THE PREMIER EVENT FOR THOSE INTERESTED IN INDUSTRIAL LASERS AND PERIPHERAL EQUIPMENT."

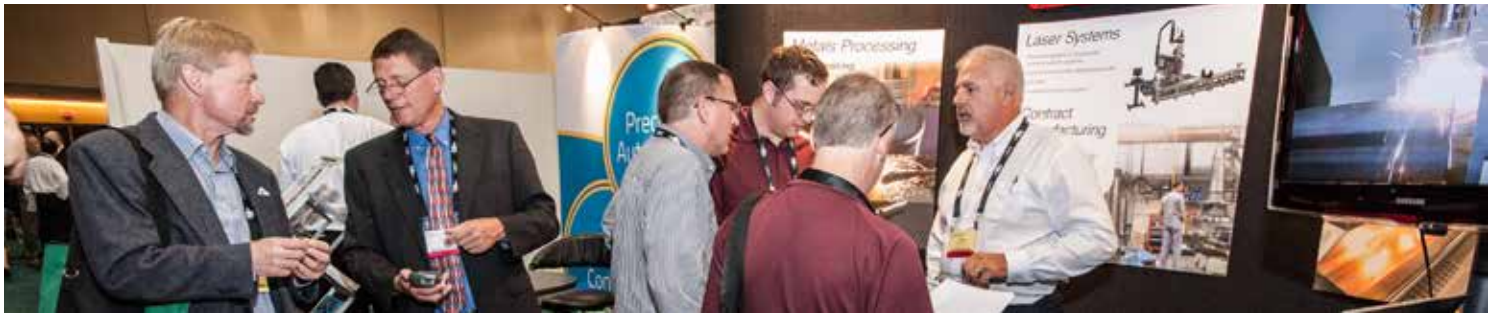
Connected to the Cobb Galleria Centre at the Renaissance® Atlanta Waverly Hotel on April 25, one day prior to LME, the Summit will provide a unique experience for those interested in expanding their understanding of lasers in the manufacturing marketplace.

Summit presenters will cover the economic outlook of the laser industry, the evolution and applications of laser welding, success stories, and more. Editor-in-Chief of *Industrial Laser Solutions* and LIA Past President, David Belforte, will moderate the Laser Manufacturing Forum, which features panelists from high-profile companies that manufacture with lasers. The Summit concludes with a VIP reception where attendees can meet and network with high-level executives and the Summit speakers.

"For manufacturing executives, the LME Summit provides business overviews of the technology, applications and market supplemented by a panel of industry experts who can guide you to profits," declares Baker.

After gaining this background from the Summit's events, attendees can then make effective use of their two days at LME, learning more about the industry and networking with suppliers who can help get them started.

Each day of LME 2016 will begin with courses that introduce attendees to the world of manufacturing with lasers. These educational courses will outline the basics of laser applications and the benefits of integrating lasers into their production.
"The free courses, taught by industry experts, cover the main types of lasers used in manufacturing, and the techniques for cutting, welding, marking, micromachining, additive



manufacturing and 3D printing," states Baker. "These applications are reviewed in key industries."

On April 26, attendees can begin their two days of educational sessions with Thomas Kugler, the Fiber Systems Manager at Laser Mechanisms, Inc., as he presents *Main Laser Types Used for Manufacturing: Key Properties and Key Applications* or Gravotech's Frederic Lallemand and his presentation, *State of the Art in Laser Marking*. Following these, Tracey Ryba, the Product Manager of Lasers at TRUMPF Inc. will share *Advances in Laser Cutting*, while Michael Scaggs from Haas Laser Technologies, Inc. presents *Beam Delivery: M^2, BPP, Spot Size, and Why You Should Care*.

The educational sessions on April 27 begin with *Laser Safety for Industrial Laser Systems* by LIA Education Director, Gus Anibarro, and *Applications of Laser Micro-Machining* by Henrikki Pantsar, Chief Technology Officer at Valoe Corporation. To conclude the day's sessions, Robert Mueller from Massiv Automated Systems will present *Economic Justification for Laser Applications: Choosing the Low-Cost Method of Manufacturing* and Geoff Shannon of Amada Miyachi America, will discuss the *Fundamentals of Laser Welding*.

LME also features 90-minute tutorials that offer a thorough overview of topics. On the first day, Paul Webster will present *Process Monitoring and Quality Control for Laser Applications*. On the second day, Alabama Laser's Wayne Penn will cover Laser Additive Manufacturing. An in-depth look at additive manufacturing in 3D printing, his presentation will discuss the endeavors and achievements in the 3D printing field, the challenges facing 3D manufacturing, future initiatives and more.

One of the most popular events at LME is the Laser Technology Showcase, where industry leaders give 30-minute keynote addresses that share the advantages of using laser technology. On the first day, LIA Past President, David Belforte, will present the Industrial Laser Market Overview, breaking down industrial laser revenues, discussing the state of market shares and the growth expected in the laser manufacturing marketplace. That afternoon, Shawn Kelly of EWI will discuss 3D Printing and Additive Manufacturing of Metals.

On the second day of LME, Ralf Kimmel of TRUMPF Laser and Systems GmbH will cover *Laser Applications in Automotive Manufacturing* in his keynote address. With a discussion on lightweight technologies, production processes, and materials used in car design, Mr. Kimmel will show numerous application examples, from new laser brazing technology to the welding of copper with new lasers at green wavelengths. GE Global Research's Marshall Jones will close the day with his keynote presentation on *Aerospace Applications*.

In addition to educational opportunities, LME allots time for networking on the exhibit floor. Here, attendees can glimpse the latest laser equipment while gaining valuable ideas from the field's leading producers. While the event's tutorials focus on improving quality, flexibility and efficiency, attending suppliers help make those qualities a reality in people's businesses.

For additional questions and insights, attendees can stop by the 'Ask the Expert' booth throughout the two-day conference. Headed by Neil Ball of Directed Light Inc., 20 industry leaders will rotate through the booth, providing constant assistance for anyone interested in gaining specific advice.

Through the guidance offered both in the educational sessions and on the exhibit floor, LME helps attendees not only learn crucial information on incorporating lasers into their production, but it helps them get started with instant access to top suppliers.

If you have never attended LME before, 2016 is the perfect time to register and take advantage of a brand new way to experience LME. This year, LIA presents the Laser Technology Tour — an easy way to explore the Event. Let one of our industry experts personally guide you through the exhibit floor and introduce you to different companies, all while discussing the latest technology and products showcased. To sign up, you must be registered for LME and then email a request to **lme@lia.org**.

"LIA's Lasers for Manufacturing Event is the premier exhibition in the United States where Engineers can attend and find out firsthand about laser materials processing applications and what equipment and companies are available to meet their production needs," says Bill Shiner, Vice President of Industrial Products at IPG Photonics Corporation. "Due to the high concentration of companies involved with laser technology, at a single location, there is no other event where an attendee can gain a comparable insight in the use of laser technology in manufacturing." ■

To learn more or to register for LME 2016 or its Lasers for Manufacturing Summit, visit **www.laserevent.org**.

Ultrafast Lasers

Powering the Photon Factory in New Zealand

BY MICHELLE STOCK

If you have ever been to Auckland, New Zealand, you know the natural beauty of its surroundings and the vibrancy of the city. What you may not know is that the campus of the University of Auckland is home to a unique facility, one that uses the power of intense pulses of light to manipulate, measure and machine matter — it uses photons as its 'machinery.'

The Photon Factory

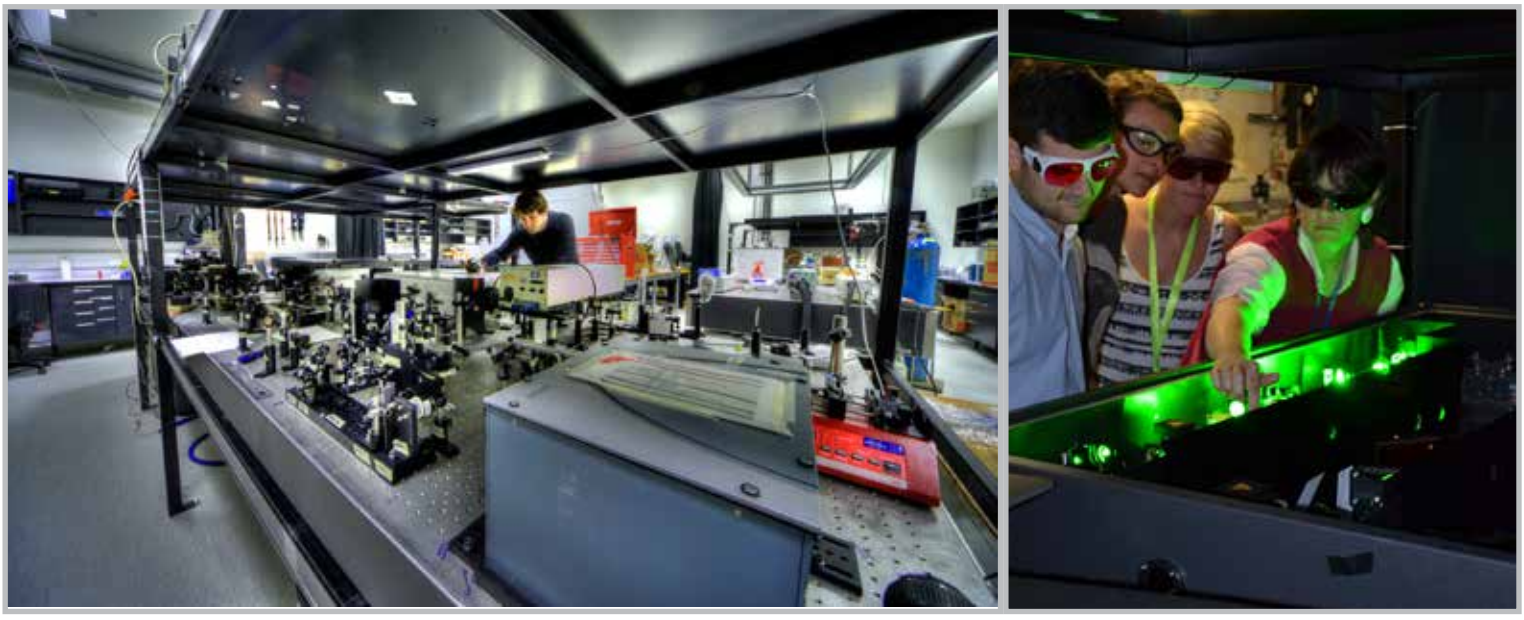
This unexpected find is the result of the efforts of Dr. Cather Simpson, who joined the faculty of the University of Auckland in 2007. Soon after arriving, Dr. Simpson challenged herself to "bring the rich versatility of high-tech ultrashort laser pulses to New Zealand academic and industry innovators." This challenge resulted in the creation of a facility dubbed the 'Photon Factory.' The Photon Factory fulfills multiple functions: it is a laboratory for education, research, innovation and even economic development.

Dr. Simpson became familiar with ultrafast lasers and their extremely short pulses (on the order of 100 fs = 100 x 10^{-15} seconds) while pursuing research in ultrafast energy conversion in molecules. She used them as a tool in her lab when she started her career as a professor at Case Western Reserve University (CWRU). Light can be converted by molecules into other forms of energy; by studying the dynamics of molecular complexes excited by light on femtosecond to microsecond timescales through both experiments and modeling, it is possible to learn how molecules direct the energy acquired in light absorption. The ultimate goal of these investigations is to understand how the structure and environment influence molecular functions so that photochemical and photophysical behavior can be both predicted and tailored.

Having achieved tenure at CWRU, she found the opportunity to move to New Zealand compelling, and there her research has flourished to span from fundamental spectroscopy to applied device development. The Photon Factory is the facility and resource she has developed to accomplish her research goals and to bring the power of laser light to New Zealand, and beyond.

A Factory of Ideas & People, Powered by Light

How did the Photon Factory come into being? When Dr. Simpson moved to New Zealand, the country was undergoing a transformation in how academic research was being funded. A newly-formed government was in the process of making structural changes, closing the Ministry of Research, Science and Technology and moving some of its functions to a newly created agency, the Ministry of Business Innovation and



The 'Photon Factory' at the University of Auckland (left) and Dr. Cather Simpson (right) along with members of her team of students, researchers, & entrepreneurs

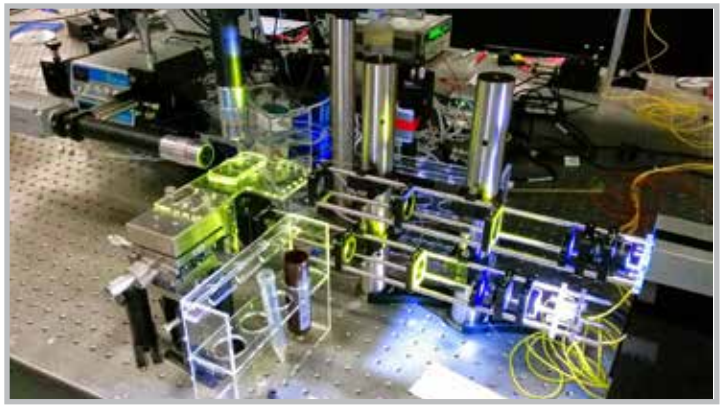
Employment. This signaled the new government's stance that science and technology were to be viewed as drivers of economic development. Because she arrived at this time and had no history with the previous methods of funding, Simpson was able to embrace and navigate the new system. She realized that the government wanted to use the academic community to fill a large gap in R&D spending that New Zealand companies were not filling — the level of spending on internal R&D was well below that of international companies, and nearly non-existent. She also realized that, unlike what she had encountered in America, funding sources would scrutinize how she engaged with industry and what type of business case there was for the proposed work as a key factor in whether her work would be funded or not. She began to pay attention to what companies were identifying as the problems they wanted to solve. But at the same time, she was eager to continue her ultrafast chemistry research.

Dr. Simpson recognized that the laser tools that she was using in chemistry were being used for other applications, some that might have more immediate use to industry. Her experience and interest in laser-matter interactions was a natural bridge into material processing applications. She also understood that there were challenges, such as slow machining speeds, that kept ultrashort pulsed machining from widespread use. With these ideas in mind, the multi-purpose, multi-user Photon Factory, was born.

Since its opening in 2010, the facility has grown to over 30 students and employees from physics, chemistry and engineering backgrounds who work on dozens of academic and commercial projects. These activities range from basic research stemming from Simpson's chemistry background, such as evaluating the photobehavior of improved solar energy harvesting molecules, to more industry-friendly applied research, such as fabricating photomasks for microfluidic chip production.

The Photon Factory generates commercial contracts and grants, and also serves as a test bed for science innovation and a training ground for future scientists and engineers. Interactions with New Zealand-based companies including Next Window, Rakon, Fisher & Paykel, Izon and others have produced such wide-ranging results as improved touch-sensitive displays, better locking nuts, more efficient designs for solar thermal energy harvesting, and new designs for GPS chips. Global companies like Intuitive Surgical (based in Sunnyvale, CA) have brought projects to the Photon Factory to develop laser-based surgery in difficult tissue. Such projects have yielded patent filings, and an increased ability to understand commercial opportunities. They have also created conditions for both students and Dr. Simpson herself to get involved in industry-sponsored and spin-off technologies.

Entrepreneurship has become a buzzword in academic circles, but in New Zealand, the Photon Factory takes the concept to heart. Two spin-off companies have already been generated by the work of the Photon Factory. The first, Engender Technologies, Ltd., was established in 2011 as a result of taking a serious look at the challenges faced by New Zealand's dairy industry. When approached by a venture capital firm with the five top problems in that sector, Dr. Simpson found one that seemed possible to address by photonics and then chose a team of students and engineers to find a solution. The problem she chose was that of improving sperm sorting by sex, to address the needs of dairy farmers who are turning to artificial insemination to control the numbers of bulls versus cows. The resulting microfluidic and photonic device is a huge departure from the state-of-the-art flow cytometry based solution, and one that could only be identified by people with a new set of tools at their disposal. A second spin-off is currently being formed to commercialize a new centrifugal microfluidic technology developed in the Photon Factory to analyze milk at "point of cow" in the milking shed. The new company already has backing from VC and other investors. It is probably no coincidence that both start-ups are addressing New Zealand's important agricultural sector.



Cell-sorting prototype developed within the Photon Factory

Transforming Matter & Lives

So, what has the Photon Factory achieved thus far? Besides new chemical insights, material processing to solve diverse problems, and generating novel concepts and devices, it has turned Dr. Simpson into an entrepreneur and led her to tackle questions that she previously would not have envisioned. Her passion for research has been applied to significant problems in diverse application areas, from touch sensor displays to challenges in dairy farming. And perhaps most importantly, this passion has been applied to developing future engineers and scientists with deep curiosity and an entrepreneurial spirit. All of these things have resulted from the fortuitous confluence of a researcher, with a specialized high-tech tool, finding interesting challenges and opportunities based on New Zealand's desire to develop more innovation to drive economic growth. Who knew that photons could be so powerful? ■

For more information, or to reach Dr. Cather Simpson, visit **www.photonfactory.auckland.ac.nz/en.html**.

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Laser Processing

Production of Lithium-Ion Batteries

BY WILHELM PFLEGING, MELANIE MANGANG, YIJING ZHENG, PETER SMYREK AND JOHANNES PRÖLL

Introduction

Thick film anodes and cathodes with thicknesses ranging from 20-300 µm, in state-of-the-art and future lithium-ion cells are complex multi-material systems consisiting of defined material components, grain sizes, porosities and pore size distributions in the micrometer and submicrometer ranges. State-of-the-art cells with pouch cell geometry for high power applications consist of thick film electrode stacks with capacities up to 40-50 Ah.

The development of three-dimensional (3D) cell architectures for electrodes in lithium-ion batteries is a promising approach to overcome problems like 1-dimensional lithium-ion diffusion, inhomogeneous current densities, power losses, high interelectrode ohmic resistances as well as mechanical stresses due to high volume changes resulting from lithium-ion insertion and deinsertion. By applying 3D battery architectures, one can achieve large areal energy capacities while maintaining high power densities at the same time. This feature is important, e.g., for thin film batteries where the lithium-ion diffusion is limited by the thickness of the compact film. A common approach for realization of 3D architectures in electrodes is the structuring of the substrate or current collector. An increased active surface achieved by 3D electrode architectures can induce large areal energy densities. Unfortunately, this approach is in a very early

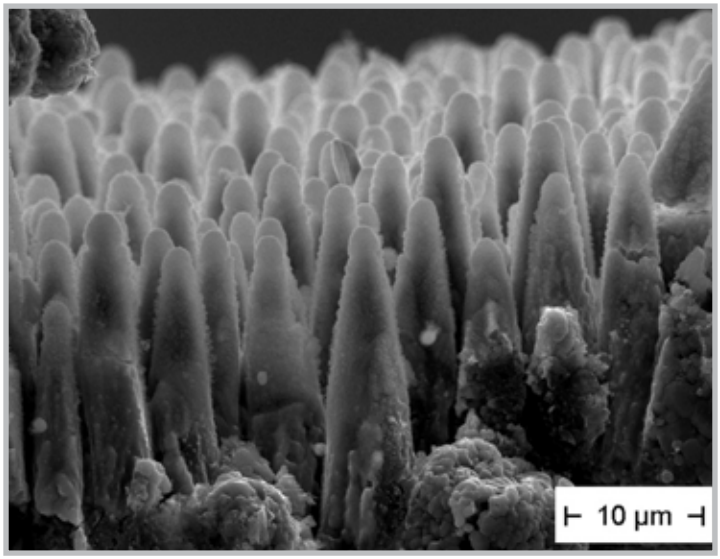

Figure 1. Laser-generated self-organized microstructure in composited electrode cathode material

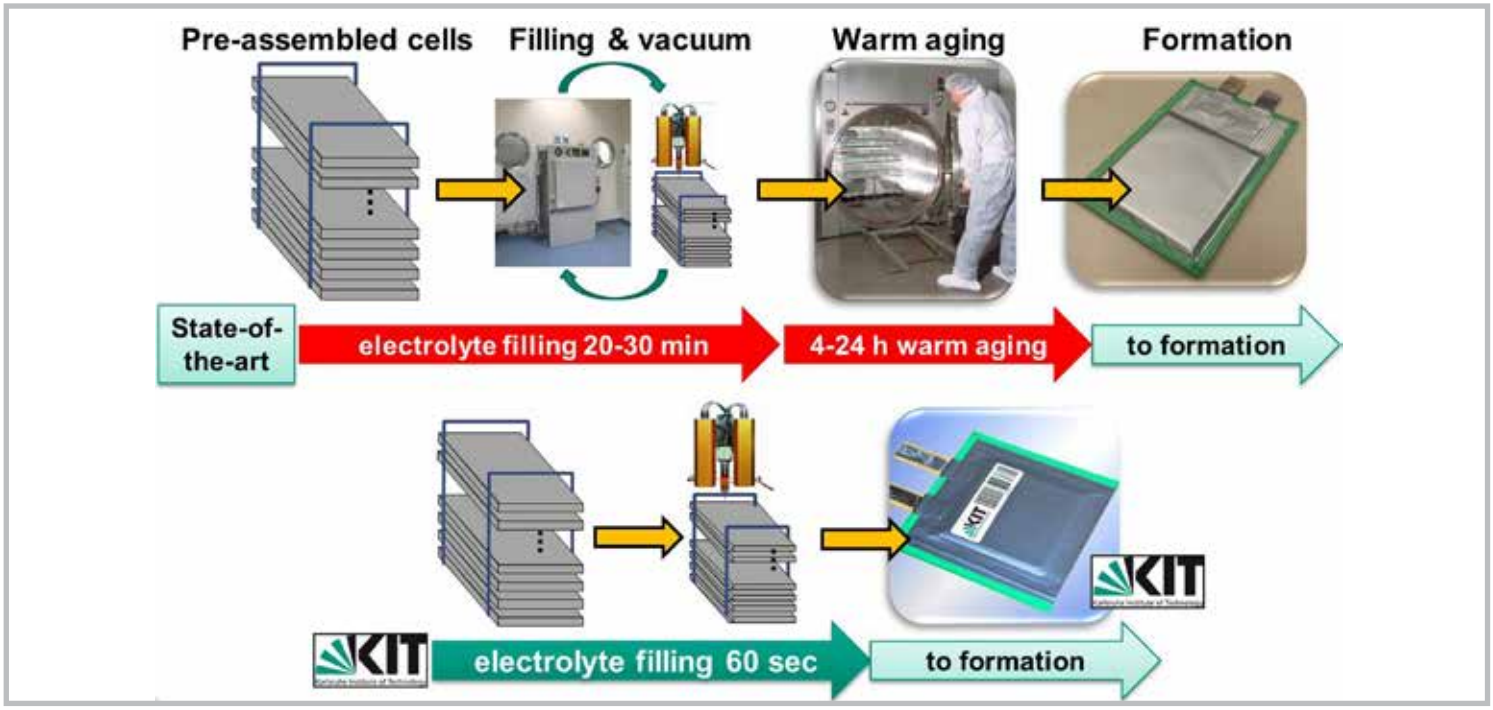

Figure 2. State-of-the-art processing route for liquid electrolyte filling of lithium-ion cells with time-consuming warm aging (top) and KIT process without warm aging due to laser structured battery materials (bottom)

stage of development and in general it is not feasible for state-of-the-art electrodes.

At the Karlsruhe Institute of Technology (KIT), a new process for the generation of 3D electrode designs has been created by developing two processes; 1.) Laser-assisted self-organized structuring (Fig. 1) and 2.) direct structuring of tape cast electrodes [1-3].

In each case, the laser structured electrodes exhibit a significant improvement in liquid electrolyte wetting as well as in electrochemical performance after laser treatment. During the manufacturing process of lithium-ion cells, liquid electrolyte filling is a cost- and time-consuming process. Insufficient electrolyte wetting in turn can lead to unexpected cell failure under challenging cycling conditions. At KIT, a cost efficient laser-based technology for the realization of 3D architectures in thick-film tape-cast electrodes was developed to accelerate the wetting process and to also shorten the time-span for cell manufacturing (Fig. 2).

In addition, an improved cell operation with extended life-time and increased capacity retention at high charging and discharging currents could be achieved. For the development of advanced laser processes in battery manufacturing, a complete lithium-ion cell manufacturing process cycle has been built-up which includes electrochemical characterization of lithium-ion cells (Fig. 3).

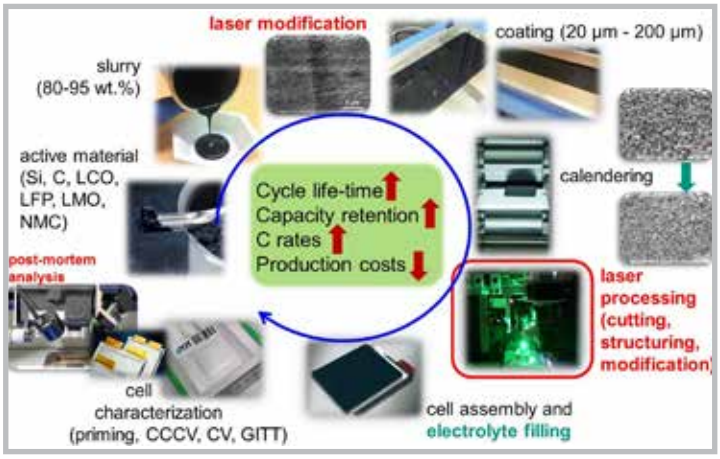

Figure 3. Process chain for cell fabrication and testing including laser processing of battery materials

Experimental Setup

Different types of electrode materials were already investigated such as $LiCoO_2$ (LCO), $LiMn_2O_4$ (LMO), SnO_2 (SnO), fluorine doped SnO_2 (FTO), $Li(NiMnCo)O_2$ (NMC), silicon (Si), graphite (C) and $LiFePO_4$ (LFP). Thin films as well as thick films were applied. Thick film electrodes are composite materials which consist of active material, carbon black, graphite and binder. All lithium-ion cells were assembled either in an argon-filled glove box or in a dry room. An ultrafast fiber laser system (Tangerine, Amplitude Systèmes, France), a ns fiber laser system (YLPM, IPG Photonics, Germany), or an excimer laser system (ATLEX-1000-I, ATL Lasertechnik GmbH, Germany) were used to manufacture 3D architectures into the thin or thick film electrode layers.

The Results

In general, electrolyte filling of lithium-ion cells is realized by time and cost consuming vacuum and storage processes at elevated temperatures. Nevertheless, by applying state-of-the-art electrolyte filling processes, insufficient wetting of electrode and separators is one drawback resulting in a certain production failure rate accompanied with a lowered cell capacity or a reduced cell life-time. Laser structuring has been developed for the formation of capillary micro-structures in thick film tape-cast electrodes which resulted in the acceleration of electrolyte wetting in comparison to unstructured electrodes (Fig. 4). The removal of the complete electrode material from the ablation zone delivers the most efficient capillary transport [4].

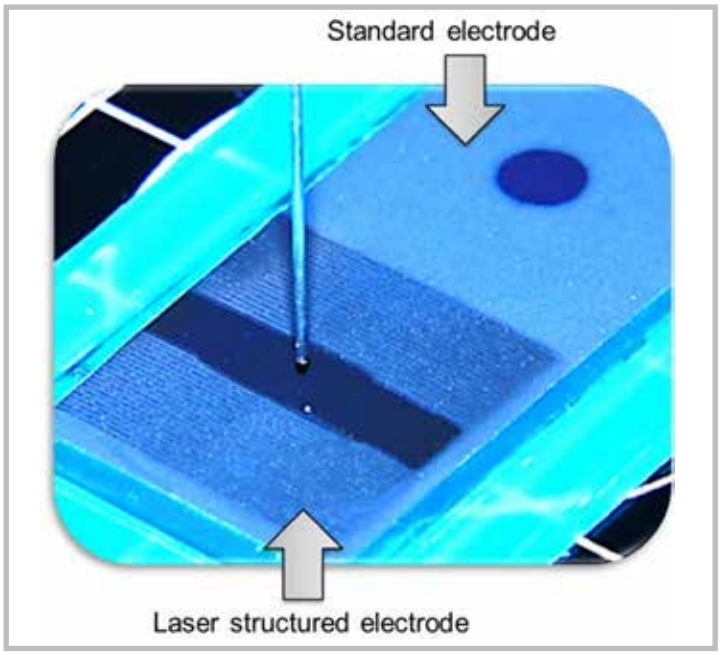

Figure 4. Rapid wetting of laser structured electrodes

For the formation of capillary structures, ns-laser ablation as well as ultrafast laser processing was investigated.

For ns-laser radiation (λ =1064 nm, pulse length 200 ns) the laser beam energy is absorbed at the material surface and,

(Continued on page 14)

due to heat conduction, the temperature of the surrounding composite material increases. The binder material for tape-cast electrodes (~5 wt%) is PVDF which has a low decomposition temperature in the range of 250–350° C [5]. Therefore, the PVDF binder matrix spontaneously evaporates and active particles are removed from the laser beam interaction zone.

With ns-laser radiation, structure widths of about 40-55 µm can be achieved (Fig. 5a & 5b). The current collector for cathodes are made of aluminium with a thickness of 20 µm and for anodes they consist of copper with a thickness of 10 µm. Laser structuring with a ns-laser can be realized without damage of the current collector (Fig. 5a). Laser structuring can be realized even for double-side coated aluminium substrates, which is a required processing step for process up-scale for manufacturing of lithium-ion cells with high capacities [4].

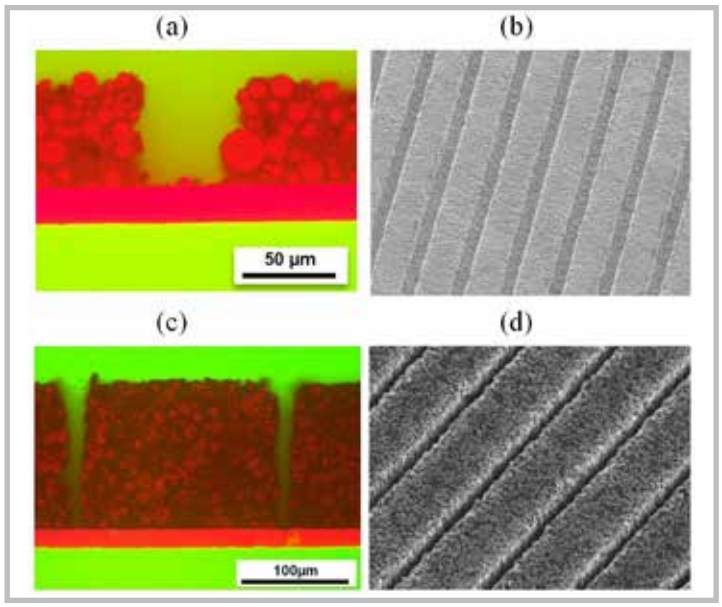

Figure 5. Capillary structures in NMC electrodes. Cross section and SEM top view of ns- (a & b) and fs- (c & d) laser structured NMC (pitch of capillary structures: 200 µm, pulse lengths: 200 ns, 350 fs)

Nanosecond laser ablation is not appropriate for each type of electrode material. For example, ns laser structuring of LFP electrodes always leads to melt formation and therefore to an undesired modification of the active material. Furthermore, the ablation efficiency of LFP increases by a factor of 3 by using femto- or pico-second laser ablation in comparison to ns-laser ablation [6]. Another aspect is the loss of active material due to the ablation process. For the application of structured foils in batteries, it is important to reduce the amount of ablated material which in turn means that small capillary widths and high aspect ratios are preferred. By using ultrafast laser ablation it could be shown that the aspect ratio could be significantly increased (Fig. 5c & 5d) and that the loss of active material can be reduced from 20 percent down to values below 5 percent [7].

Capacity retention and cell life-time can be illustrated by plotting the cell voltage as function of discharge capacity for different cycle numbers. For the lithium-ion cell with the structured NMC electrode, the 80 percent capacity limit of the initial discharge capacity is reached after 2290 cycles (Fig. 6). While the cell life-time for the lithium-ion cell with unstructured electrodes is reached after 141 cycles. Furthermore, the discharge capacity of the cell with the laser-structured NMC electrode reaches a value of 108 mAh/g after 2290 cycles indicating that efficient liquid electrolyte transport due to micro capillary structures

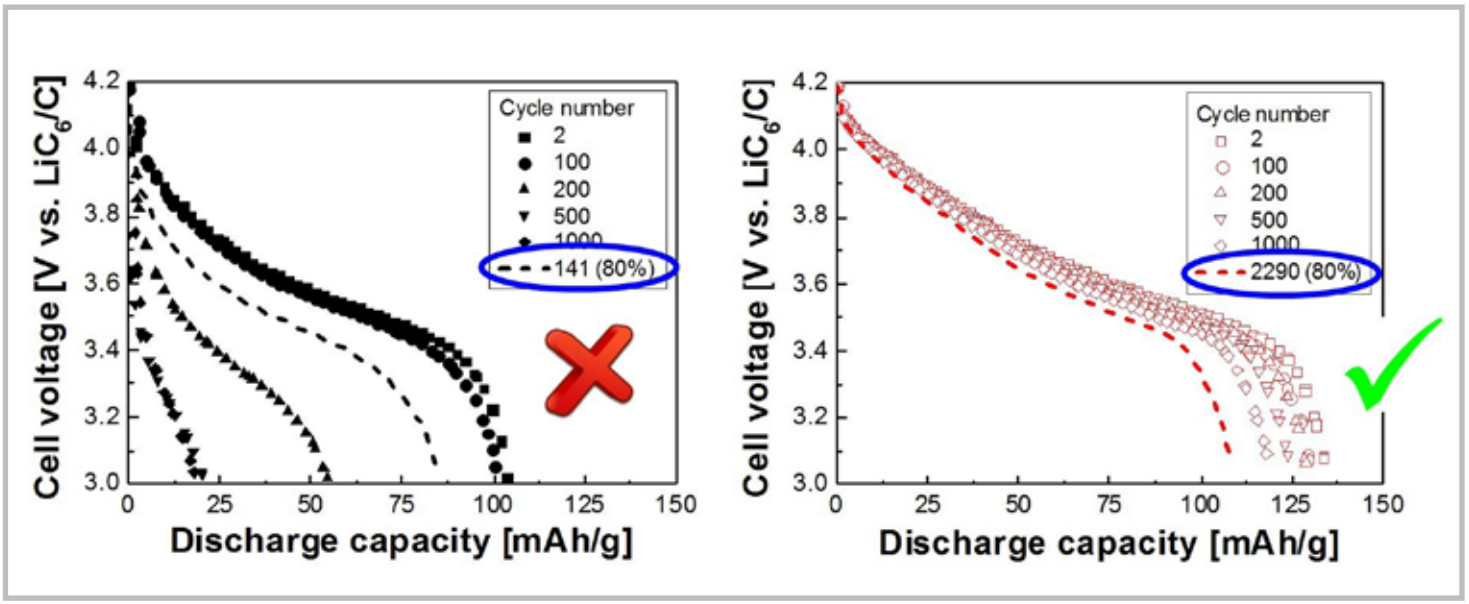

Figure 6. Cell voltage versus discharge capacity for pouch cells with laser-structured (right) and unstructured (left) NMC electrodes and without storage [4]

improves the electrochemical performance for cell without cost- and time-consuming storage procedures.

Summary & Conclusion

A new technical approach of using laser-generated capillary structures in electrode materials was presented. This technology can be applied in order to increase cell reliability during the production process, to shorten production times of lithium-ion cells as well as to increase the cell life-time during cycling. Due to an improved cycle life-time and increased capacity retention, the use of high power batteries in 2nd life applications becomes interesting. Cost-efficient ns fiber lasers can be applied for carrying out the structuring process for several types of electrode materials. Nevertheless, regarding the structuring of LFP, a further reduction of active mass loss, and an up-scaling of the structuring process, the use of ultrafast laser processing becomes necessary. ■

Wilhelm Pfleging, Yijing Zheng, Peter Smyrek and Johannes Pröll are all with the Karlsruhe Nano Micro Facility in Germany. They are joined by Melanie Mangang in their work at Karlsruhe Institute of Technology (KIT).

References

1.) J. Pröll, H. Kim, A. Piqué, H.J. Seifert, W. Pfleging, J. Power Sources, 255(0) (2014), 116-124.
2.) J.H. Park, R. Kohler, W. Pfleging, W. Choi, H.J. Seifert, J.K. Lee, RSC Adv., 4(9) (2014), 4247-4252.
3.) R. Kohler, J. Pröll, M. Bruns, S. Ulrich, H.J. Seifert, W. Pfleging, Appl. Phys. A, 112(1) (2013), 77-85.
4.) W. Pfleging, J. Pröll, J. Mater Chem A, 2(36) (2014), 14918-14926.
5.) J. Choi, E. Morikawa, S. Ducharme, P.A. Dowben, Mater Lett, 59(28) (2005), 3599-3603.
6.) M. Mangang, H.J. Seifert, W. Pfleging, J. Power Sources, 304 (2016), 24-32.
7.) P. Smyrek, J. Pröll, H.J. Seifert, W. Pfleging, J. Electrochem Soc, 163(2) (2016), A19-A26.

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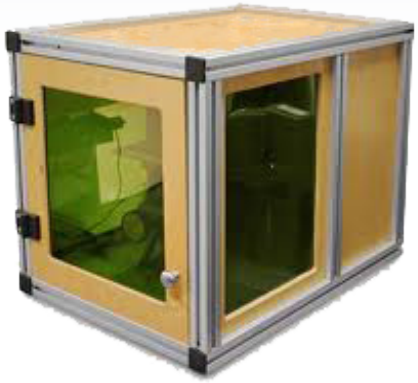

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LAM 2016

An In-depth Look at AM's Challenges & Successes

LAM® LASER ADDITIVE MANUFACTURING WORKSHOP

BY BETSY MARONE

The eighth year of Laser Institute of America's Laser Additive Manufacturing (LAM®) Workshop brought together over 170 attendees from 14 countries. The successful event gathered these individuals – over half of whom attended for the first time – who are involved in the manufacturing of complex, lightweight, metal and various other structural materials. From 3D printing and cladding to rapid manufacturing and sintering, presentations covered a plethora of revolutionary Additive Manufacturing (AM) methods that continued the workshop's tradition of building enthusiasm in the industry.

The event, which was held at the Embassy Suites in Orlando, FL, March 2-3, featured numerous speakers from key companies involved in the industry. Presenters hailed from companies including Keystone Synergistic Enterprises, Inc., Fabrisonic LLC, Rolls Royce and General Electric as well as universities around the world who are making important advances in additive manufacturing.

LAM General Chair Paul Denney of Lincoln Electric led the 2016 workshop, along with co-chairs Ingomar Kelbassa from Siemens and Jim Sears from GE Global Research Center. Together, they designed the program to not only look at how people are using AM in the industry today, but also the situations in which lasers provide the best solution when compared to other technologies.

"New this year was a session dedicated to technologies (electron beam, arc welding and ultrasonic) that compete against lasers for additive manufacturing," said Paul Denney. "We also had presentations from end users that addressed when and why they select a technology for AM. These two sessions were designed to make those involved with laser additive to understand the 'competition' and to help people selecting additive processing to choose lasers if it makes sense for their needs."

The first day of the workshop began with the session on alternative technologies, which featured a keynote presentation by Professor Sudarsanam Suresh Babu from the University of Tennessee at Knoxville. His presentation focused on recent advances in metal additive manufacturing, as well as the role in-situ process monitoring, computational monitoring and advanced characterization play in the field. Professor Babu's discussion of AM's benefits, compared to traditional manufacturing methods, gave way to an overview of the additive manufacturing process – from geometrical conformity and topography optimization to size specific properties and beyond.

Raymond Walker from Keystone Synergistic Enterprises, Inc. – a company that has been involved in AM for over 20 years and is currently focused on cost-reduction and the use of additive manufacturing to make larger scale products – discussed the large-scale robotic pulsed-arc the company is developing. The robotic arc prototype Walker presented to the crowd has several benefits that make it a promising alternative technology. Not only is it stable and uniform, but it has in-process sensors for process verification and can calculate melt pool for monitoring, record events away from the control, and provide uniform conditions throughout the build.

Robert Salo of Sciaky, Inc. also presented a session on alternative technologies, discussing Electron Beam Additive Manufacturing (EBAM™). Sciaky, Inc. has continuously worked on its EBAM™ Systems and Services as a contract service company for Electron Beam Welding, Pulse Additive Welding and EBAM™. Salo demonstrated simulations of Electron Beam Additive Manufacturing and discussed the benefits of the method, including the way in which the high power couples with metals easily, its use of basic inputs, its large system designs and its high deposition rates.

The Focus of LAM 2016

Two of the missions of LAM 2016 were to give attendees a thorough understanding of the benefits and challenges of laser-based additive manufacturing while establishing what technologies in the industry need to be further developed or improved. Numerous presentations from the two-day event worked toward these goals, including David Bourell's *Materials Issues in Laser-based Additive Manufacturing*. Bourell, who works at the University of Texas at Austin, presented data that estimates exponential growth in materials sales in upcoming years. Though some project the growth will reach $1 billion by 2025, materials issues still remain a concern in the industry. Bourell discussed the four major material issues that currently pose problems: proper form feedstock, fabricator process

ability, post-process ability as needed, and acceptable service properties.

Kirk Rodgers from GE Corporate discussed supply chain challenges, which include certain qualities AM lacks and specific issues that exist with design skill and rules. His presentation also touched on the needs of the processes, such as material standards, consistency, reliability and material delivery systems. He explained the importance of optimizing lasers for time by utilizing offline or automated loading and unloading, as well as offline or automated material recovery. While recognizing that machines have hardly changed in the last 20 years, Rodgers offered some solutions for issues he discussed, but also stated that some problems may be solved over time or through specific training.

Focusing on the continued benefits and success of additive manufacturing, RMIT University's Milan Brandt presented AM research that is being conducted in Australia. Looking at current procedures for bone-specific implants, RMIT hopes to improve traditional implants by replacing them with a 3D object constructed from a CT scan. With this technology, RMIT believes mass customized vertebral implants could be created in order to help people with disk damage from accidents. Brandt explained that continued research and promising technology like this has ensured the growth of laser additive manufacturing in Australia.

Additive Manufacturing Across Industries

Similar to previous years, numerous industries were represented at this year's LAM Workshop. From laser 3D printing and oil and gas to the military and bio-medical, LAM once again showed that laser additive manufacturing plays a key role in a variety of industries.

During a session on selecting the correct additive process, the main focus centered on the aerospace industry. Brian Thompson from GKN Aerospace presented *Additive Process Evaluation for Aerospace Applications*, during which he reviewed the industry's adoption of additive manufacturing, including what he considers today's method – the net shape production of prismatic shapes – and next generation optimized structures, which he considers tomorrow's method. Explaining that the aerospace industry has seen an increase in AM over the years, Thompson also acknowledged the qualification barrier for certain materials and processes and discussed the use of powder bed methods for smaller parts and directed energy deposition for larger parts.

> **"IF YOU'RE USING LASERS FOR AM, YOU DON'T WANT TO MISS LAM."**

Overall, the wide array of presentations provided attendees with an informative and helpful workshop. Alex Zappasodi from Polymet Corporation remarked, "[LAM is] a great show! Valuable information, great attendees, and meticulously organized." James Tomic, a fourth-year attendee, agreed, saying, "If you're using lasers for AM, you don't want to miss LAM."

In addition to the educational sessions that made up the majority of the event, attendees were also given the chance to network with key individuals in the industry during the Exhibitor Reception. This opportunity ensured that attendees not only received the chance to expand their knowledge of the latest advances in additive manufacturing at LAM, but were also encouraged to make connections with people who can help them make the most of the process.

"We're looking forward to LAM 2017, when we return to Houston, TX," said Denney. "While the Oil and Gas Industry is suffering from lower oil prices, we feel that there will still be a strong interest in laser cladding – a form of laser additive manufacturing – because it can lower production costs." ■

Visit **www.lia.org/lam** *for updates on LAM 2017.*

(Images continued on page 20)

LAM GENERAL CHAIR PAUL DENNEY INTRODUCING ROBERT SALO FROM SCIAKY, INC, WHO ELABORATED ON THE CAPABILITIES OF ELECTRON BEAM ADDITIVE MANUFACTURING

COREY DUNSKY, OF CONCEPT LASER, INC., PRESENTED METAL AM: TOWARD FACTORY-SCALE IMPLEMENTATION

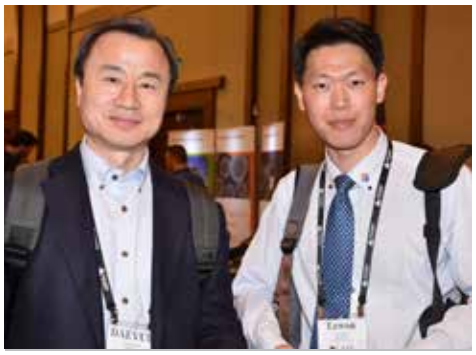
ATTENDEES WERE ENCOURAGED TO ASK HOW LAM WILL MEET INDUSTRY-SPECIFIC CHALLENGES

DANIEL CAPOSTAGNO FOCUSED ON FIBER LASER WELDING & CLADDING

CLIVE GRAFTON-REED, FROM ROLLS ROYCE, PRESENTED MEETING THE AEROSPACE CHALLENGE

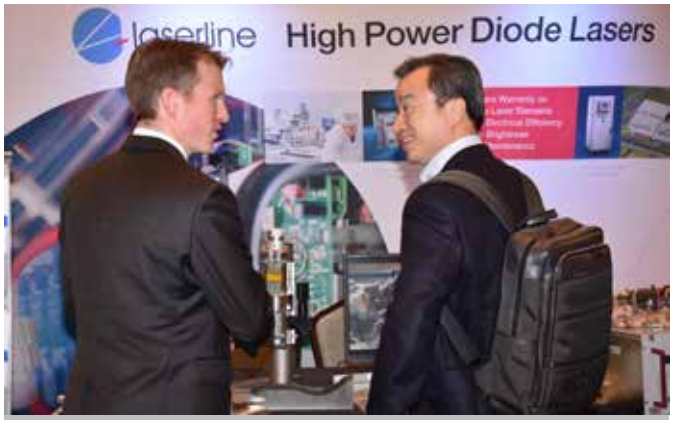
OPTOMEC INC'S JIM CANN DISCUSSED LENS PROCESSING USING GLOVEBOX VERSUS OPEN ATMOSPHERE SYSTEMS

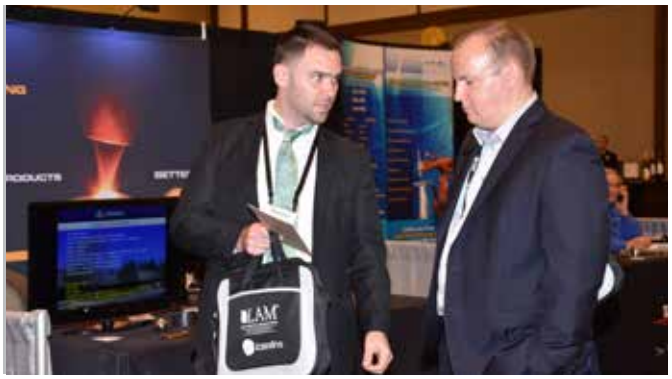
LAM 2016 WORKSHOP SESSIONS WERE PACKED WITH ATTENDEES LOOKING FOR THE LATEST IN LASER ADDITIVE MANUFACTURING TECHNOLOGY & APPLICATIONS

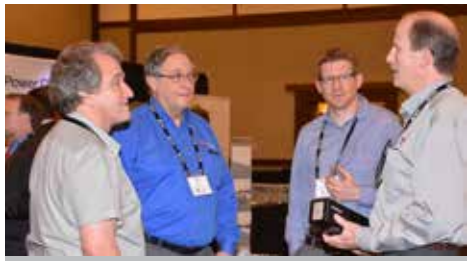


LAM 2016

Attendees connected with key exhibitors to learn how to make the most of the Laser AM process







Lasermet Inc.

An Integral Part of the Laser Safety Industry

BY BETSY MARONE

Lasermet Inc. is a global leader in the design, manufacture and installation of laser safety cabins. While the company, located in Schaumburg, IL, specializes in all areas of laser safety and provides customers with products that meet the IEC 60825 and ANSI Z136.1 laser safety standards, it also offers laser safety consultancy, laser safety training and laser testing and classification as a UKAS accredited company. The Lasermet Group, which consists of Lasermet Ltd., Lasermet Inc. and the Lasermet Ltd. Manufacturing Facility, reaches from the UK to the United States. The Lasermet Group's influence also extends globally, with authorized distributors in numerous countries, including Germany, Spain, Italy, Australia, China and more.

Established in 1987, Lasermet Inc. is currently owned by Managing Director Paul Tozer, President Steve Geldard, and the company's founder, Professor Bryan Tozer. An expert in his field, with 20 years of experience developing the IEC 60825-1 and 60825-2, Professor Tozer began the company with the goal of designing, manufacturing and installing laser safety systems and equipment.

At the time of its inception, Lasermet offered products and services centered on the measurement of lasers and the safety requirements associated with them, including warning devices – such as signs – and interlock control systems, specifically designed to prevent unintended laser radiation exposure. In addition to laser safety cabins that fully enclose lasers with interlock control, the company developed laser blocking curtains, screens and roller blinds during this time.

Today, Lasermet Inc. remains dedicated to producing the most up-to-date laser safety products. The interlock control systems and laser shutters that Lasermet Inc. designs, manufactures and installs meet the ISO 13849-1 PL 'e' standards and the company's certified laser blocking cabins, curtains, screens and roller blinds are CE marked and certified to EN 60825-4. In addition to Lasermet's active and passive laser safety cabins, which also conforms to IEC 60825-1, the company provides dual color LED warning signs, laser power meters and laser safety calculation software.

While the team at Lasermet Inc. creates numerous products that prove integral to the laser industry, two of their most important products are the ICS-6 Interlock Controller and the Laser Castle. The Laser Castle – a modular, rapid-build certified laser safety cabin – can withstand 5 kW lasers or, with the option of active guarding, can withstand 100 kW lasers.

Lasermet Inc.'s ICS-6 Interlock Controller provides an engineered laser safety solution that applies to the laser installations that the company completes. Used at numerous locations including research establishments, hospitals, manufacturing establishments and universities, this compact and versatile unit controls laser interlocks, door locks, illuminated warning signs, and other equipment. With feedback monitoring and fault detection, it can operate beam shutters and laser power, and can be interfaced to access control and fire detection systems. In addition, the ICS-6 is fitted with an override that allows controlled access through interlocked doors and also accepts emergency stop inputs. Its easy-to-use control panel, which can be wired directly to unlimited interlocks, its fault detection, which meets the latest standards, and its full dual channel architecture all ensure that the ICS-6 provides the highest levels of safety and functionality.

Driven to constantly develop new products that meet customer needs, Lasermet Inc. has recently unveiled the active laser guarding system, "Laser Jailer," and active filter windows, "Glaser Jailer," in addition to derivatives of these two products. These patented, failsafe laser safety systems are able to detect an inadvertent laser strike and isolate the laser safety input in fewer than 50 ms, through the interlock controller.

A member of Laser Institute of America (LIA) since 2014, Lasermet Inc. has taken part in the organization's various trade exhibitions, including the annual Lasers for Manufacturing Event® (LME®). According to Lasermet's Marketing Manager, Phil Jones, "LIA has major recognition in the US and it helps Lasermet in being part of the laser industry. It is influential and respected." ■

For more information, visit **www.lasermet.com**.

Member Innovations

Laser Cutting Technology adds Value to Textile Manufacturers

More often than not, laser cutting has been involved in textiles and products you might not readily think of: apparel, accessories, footwear and home furnishing manufacturers. Especially within the category of apparel manufacturers, this technique encompasses a broad spectrum of applications for example, lasers are used in the creation of high performance activewear.

Laser-cut designs are also showing up on fashion ramps around the world. Laser cuts, complemented by technological advancements that facilitate mass production, are now showing off intricate and irreproducible designs — across all types of fabrics. For textile manufacturers, lasers are now a necessary and valuable piece of the process.

For more information, visit **www.rpmclasers.com**.

Nufern Introduces a 100 W NuQ Pulsed Fiber Laser for Industrial Marking and Related Application

Nufern, a leading US manufacturer of specialty optical fibers, fiber lasers and amplifiers, and fiber optic gyro coils, announces a new high power 100 W NuQ™ industrial pulsed fiber marking laser.

The latest addition to the NuQ series is a 100 W average power, air cooled Q-switch fiber laser. The 100 W NuQ features a Gaussian pulse shape and excellent beam quality. It has a rugged, air cooled, monolithic architecture that provides an extremely long life expectancy with no maintenance requirements.

For more information, visit **www.nufern.com**.

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Members In Motion

Green Photonics Award

During this year's Photonics West conference in San Francisco, DirectPhotonics and Technical University of Berlin were awarded with the Green Photonics Award for their joint project about energy efficient resonant pumping of Er:YAG lasers with wavelength stabilized high brightness diode lasers of the DirectPump1500 series. The SPIE Photonics West Green Photonics Award recognizes outstanding contributions to green photonic technologies that enable a saving of energy or waste and a better protection of the environment.

The paper *Comparative Study of Broadband, Narrowband & Multi-wavelength Resonant Pumping of Er:YAG Lasers* is recognized for its impact on the worldwide monitoring of the etiological and accelerating factors of global warming. In order to enable an even better observation of the global warming gases carbon dioxide and methane, satellite based sensing is an important contribution. The new highly efficient, multiple wavelength diode pumping of Er:YAG lasers enables the building of compact, lightweight and less energy consuming lasers for space born LIDAR measurements.

For more information, visit **www.directphotonics.com**.

Successful Partnerships Lead to Innovative Solutions for Medical Device Manufacturing

At Medtec 2016 ROFIN showcases new solutions developed in close cooperation with leading medical device manufacturers. From April 12-14 the laser specialist not only presents the new autoloader for the StarCut Tube SL but also integrated systems for all aspects of laser material processing in medical device manufacturing, like CNC- and joystick-controlled fine welding with MPS and Select, and efficient marking solutions for traceability of medical devices.

The new autoloader is a direct result of ROFIN's long-term cooperation with leading manufacturers of medical devices, endoscopes, stents and hypotubes. The space-saving system has been specifically designed for automated handling of flexible tubes with diameters from 0.3 to 1 mm (optionally 4 mm). Typical cutting times for hypotubes are less than a minute, which requires frequent reloading of sensitive tube material. The length-adjustable storage container accommodates several hundred tubes. A pneumatic/magnetic operating gripper picks up each tube and transfers it to the StarCut Tube processing system. As the autoloader and the StarCut Tube SL both require very little floorspace, an area of 3.2 x 1 mm is big enough to accommodate two complete laser processing systems with automatic parts loading.

For more information, visit **www.rofin.com**.

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Questions received by Laser Institute of America pertaining specifically to the meaning or intent of a portion of a standard are reviewed by the officers of ASC Z136 to determine whether the inquiry is deemed an explanation (simple clarification) or interpretation (related to intent). An interpretation is a unique form of commentary on a standard; it can only discuss, address and clarify what the standard currently says — it is not an explanation of what the standard should have said and cannot change the meaning of a standard as it currently exists.

A formal interpretation is vetted through the specific subcommittee responsible for the standard section in question. Concurrence of the response is required by two-thirds affirmative vote from the associated subcommittee. For this reason, the response time for a formal interpretation is somewhat lengthier than that for an explanation.

A recent inquiry to LIA deemed to be an interpretation, *"Is compliance with the ANSI Z136.7 required by an accredited lab or is a self-certification process acceptable?"* has been reviewed and the formal response is as follows:

"Accredited" constitutes a lab that can evaluate a sample with the same fidelity as specified in ANSI Z136.7. By definition, an accredited lab can provide an analysis and concurrence that equals or exceed the criteria as specified in the Z136.7 sections 3 and 4. In addition, to be approved, certificates of recent calibration on the key instruments shall be accompanied by a sample of full form, fit, and function as well as the data as measured by your facility.

If your laboratory meets the requirements specified in the paragraph above, then yes, self-certification is acceptable and your laboratory would be viewed as an accredited lab.

The working website for ASC Z136 is **www.z136.org**. Among the public pages of the website is a downloads page entitled ANSI Z136 Clarifications and Interpretations, where committee resolved explanations and interpretations can be viewed. Any inquiries relating to the committee or a standard should be directed to LIA; contact Barbara Sams at +1.407.380.1553 or email **bsams@lia.org**.

Several years ago, certification maintenance (CM) categories were revised in an effort to expand the ways CLSOs and CMLSOs could obtain the required ten CM points over their three-year maintenance cycle.

As another maintenance cycle comes to a close, a new CMLSO had this question regarding certification maintenance renewal, "According to the CMLSO manual (page 3, category 12), can I maintain my certification for an additional three years by passing the exam again any time prior to the end of my three-year cycle, forgoing the obligation to obtain the 10 CM points?"

Category 12 was created as a final measure for those CLSOs and CMLSOs who were not able to achieve the 10 CM points any other way. Retaking the exam is not intended as a replacement for maintaining certification. In addition to the specified limitations:

a) the exam must be taken and passed prior to the end of the three-year cycle (before Dec. 31),
b) exam payment is due prior to retaking the exam, and
c) the individual has not participated on a BLS Review Board or proctored an exam during the three-year period,

the following has been added for clarity:

d) the ability to retake the exam is only available in year three of the individual's CM cycle.

It is important to remain knowledgeable in current industry standards and informed of upcoming technological advances. When in year one of the CM cycle, the CLSO/CMLSO should be working toward the goal of achieving the required 10 CM points.

Suggestions for CM points include participating on ASC Z136 or one of its subcommittees, presenting at the 2017 International Laser Safety Conference (ILSC®) (abstract submission is now open!), and/or membership in a laser safety-related professional organization. Review certification maintenance requirements on the BLS website at **www.lasersafety.org/certification-maintenance**, contact the BLS office at +1.407.985.3810 or email **BLS@lasersafety.org**.

LIA is committed to keeping the workplace safe from hazards associated with lasers. LIA formed an Alliance with the Occupational Safety and Health Administration (OSHA) to help achieve these goals.

OSHA and LIA recognize the value of establishing a collaborative relationship to foster safer and more healthful American workplaces. This Alliance provides LIA's members and others, including small businesses, with information, guidance and access to training resources that will help them protect employees' health and safety, particularly in reducing and preventing exposure to laser beam and non-beam hazards in industrial and medical workplaces. In addition, the organizations will focus on sharing information on laser regulations and standards, bioeffects lasers have on the eyes and skin, laser control measures and laser safety program administration.

US Labor Department Announces Final Rule to Improve US Workers' Protection from the Dangers of 'Respirable' Silica Dust

The US Department of Labor's Occupational Safety and Health Administration announced a final rule to improve protections for workers exposed to respirable silica dust. The rule will curb lung cancer, silicosis, chronic obstructive pulmonary disease and kidney disease in America's workers by limiting their exposure to respirable crystalline silica.

"More than 80 years ago, Labor Secretary Frances Perkins identified silica dust as a deadly hazard and called on employers to fully protect workers," said US Secretary of Labor Thomas E. Perez. "This rule will save lives. It will enable workers to earn a living without sacrificing their health. It builds upon decades of research and a lengthy stakeholder engagement process – including the consideration of thousands of public comments – to finally give workers the kind of protection they deserve and that Frances Perkins had hoped for them."

OSHA estimates that when the final rule on Occupational Exposure to Respirable Crystalline Silica becomes fully effective, it will save more than 600 lives annually and prevent more than 900 new cases of silicosis – an incurable and progressive disease – each year. The agency also estimates the final rule will provide net benefits of about $7.7 billion per year.

"The previous exposure limits were outdated and did not adequately protect workers," said Assistant Secretary of Labor for Occupational Safety and Health Dr. David Michaels.

For more information, visit **www.osha.gov**.

JLA | Editor's Pick

The Laser Institute of America's official refereed publication, the *Journal of Laser Applications® (JLA)*, an online-only journal, is complete with new features for a broader audience. *JLA* is hosted on AIP Publishing's robust Scitation online platform, providing the journal with great functionality and the ability to leverage a wide range of valuable discoverability features. *JLA* features nine topic sections, a faster peer-review process and a more functional website (**jla.aip.org**) that makes content easier to access and more interactive. Readers will find full-text HTML rendering featuring inline reference links and the ability to enlarge tables and figures by clicking on them. Among the new features are enhanced search functions with more options and better controls to explore returned content in more useful ways.

Use of a Diffractive Optic for High Power Laser Cutting

BY PAUL A. HILTON, DANIEL LLOYD AND JOHN R. TYRER

There is a current interest in using laser cutting for nuclear decommissioning applications. The benefits of using lasers for this application include the high speeds available, the tolerance of the process, the lightness of the cutting head, the lack of a reaction force with the part being cut, and the ease of automation of the laser cutting process. Of course laser cutting is a thermal process and a potential detriment, is that the residual laser beam, passing through the kerf, might damage or indeed set fire to something positioned behind the part being cut. This paper describes the use of a diffractive optical element in the laser beam forming optics, designed to extend the depth of focus of the system, without increasing the focal length of the focusing optic.

To continue reading more about this paper, visit **jla.aip.org**.

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ILSC
INTERNATIONAL LASER SAFETY CONFERENCE

Announcing ILSC 2017 Call for Papers
Now is the time to submit your abstract for LIA's International Laser Safety Conference (ILSC®), which will take place Mar. 20-23, 2017 in Atlanta, GA. ILSC is a comprehensive four-day conference covering all aspects of laser safety practice and hazard control. Scientific sessions will address developments in regulatory, mandatory and voluntary safety standards for laser products and for laser use.

The Practical Applications Seminars (PAS) complement the Scientific Sessions by exploring everyday scenarios that the LSO and MLSO may encounter. Professionals in all fields and applications will find ILSC 2017 a tremendous source for information and networking opportunities.

The conference provides vital information for people in industry, medicine, government and academia with laser safety responsibilities including: LSOs, MLSOs, Industrial Hygienists, Application Engineers, Educators, Safety Product Manufacturers, Nurses and much more!

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Go to **www.LSEVAL.com** for more information.

ICALEO
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Save the Date for ICALEO 2016
Mark your calendar to attend the International Congress on Applications of Lasers & Electro-Optics (ICALEO®), which will be returning to San Diego, CA on Oct. 16-20. ICALEO has a 34 year history as the conference where researchers and end-users meet to review the state-of-the-art in laser materials processing, laser microprocessing and nanomanufacturing as well as predict where the future will lead. From its inception, ICALEO has been devoted to the field of laser materials processing at macro, micro and nanoscales and is viewed as the premier source of technical information in the field.

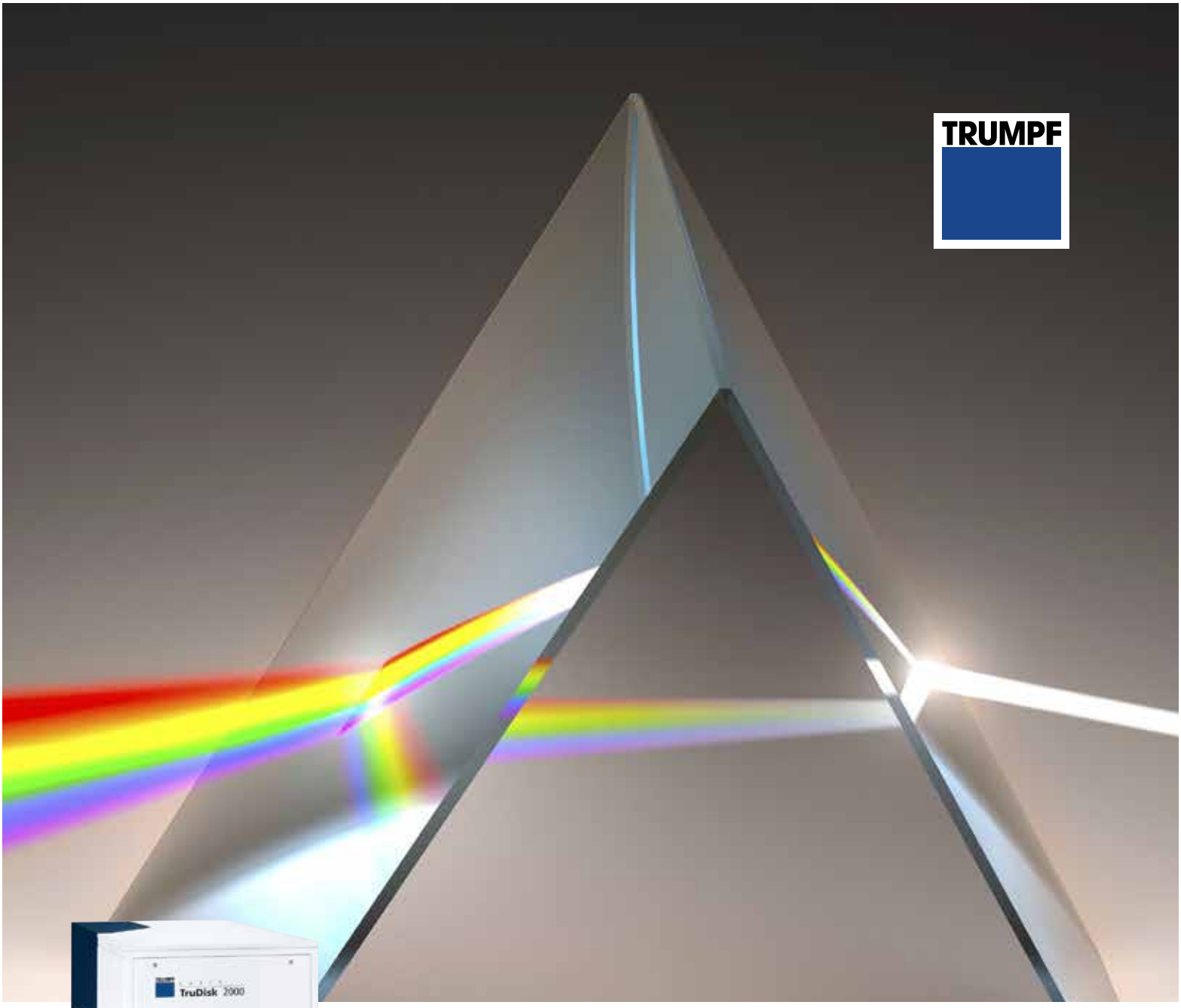
Each year ICALEO features areas of topical interest. This year's featured sessions include diode lasers for processing and pumping, laser process monitoring and control, laser processing of biological materials, lasers in nanotechnology and environmental technology, laser hybrid processing, laser manufacturing for alternative energy sources and laser business development.

For more information, visit **www.icaleo.org**.

Train Employees Easily & Effectively with the Updated Mastering Light: An Introduction to Laser Safety & Hazards Video
With the ever-increasing number of laser end-users, companies are continuously looking to implement cost-effective and efficient laser safety programs for new and current employees. In an effort to offer Laser Safety Officers (LSOs) the best training tools available, Laser Institute of America (LIA) has updated its 2009 *Mastering Light: An Introduction to Laser Safety & Hazards* training video. LIA aims to provide the best methods for successful laser safety training in the constantly changing, fast-paced field of laser technology and has done so once again with the 2016 edition of *Mastering Light: An Introduction to Laser Safety & Hazards.*

For years, the DVD version has provided LSOs with a training tool that is not only easy to administer, but also effective in properly training employees, researchers and students alike. Like its predecessor, the new version will still outline the important safety rules and regulations employees must know in the field. However, the latest edition of the video will now feature new footage and updated information to provide employees with the best safety training possible. In addition, LIA is continuing its tradition of striving to improve the training process – both for trainees and the LSOs tasked with the critical job of educating employees – by offering both a DVD and a digital version with the purchase of the video. The digital version will be available for viewing at lia.org, where it will appear under users' downloads.

To pre-order online, visit **www.lia.org/store**.



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