



THE OFFICIAL NEWSLETTER OF THE LASER INSTITUTE OF AMERICA

# LIA TODAY

Volume: 21 No: 5  
SEPT/OCT 2013

## HIGH-POWER LASER MATERIALS PROCESSING

PG 12

## ICALEO 2013: THE PREMIER CONFERENCE FOR INDUSTRY-LEADING LASER RESEARCH

PG 6

## LME 2013 EXPERTS PROVIDE INSIGHT INTO CONTINUED LASER MARKET GROWTH

PG 18

**FOCUS:**  
Research &  
Development

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

13501 Ingenuity Drive, Suite 128  
Orlando, FL 32826  
Phone: +1.407.380.1553  
[www.lia.org](http://www.lia.org)



**Laser Institute  
of America**

*Laser Applications and Safety*

# IN THIS ISSUE:

## FEATURES

ICALEO 2013: The Premier Conference For Industry-Leading Laser Research	6
High-Power Laser Materials Processing	12
LME 2013 Experts Provide Insight into Continued Laser Market Growth	18
A Review of the ANSI Z136.8 and Why You Should Be Using It	26

## DEPARTMENTS

Calendar of Events	2
Executive Director's Message	5
President's Message	5
Corporate Member Profile	28
Members In Motion	29
Member Innovations	29
New Corporate Members	29
ASC Z136 Update	30
BLS Update	31
Laser Insights	32
JLA Update	33
LIA Announces	34

## ADVERTISERS

AdiOptica GmbH	11
Aerotech, Inc.	16
ANSI Z136.2	11
ANSI Z136.8	27
ANSI Z136.9	23
Board of Laser Safety	31
Electro-Optics Technology, Inc.	15
Fraunhofer IWS	8
ICALEO 2013	4
IPG Photonics Corporation	36
Kentek Corporation	3
LAM 2014	24
Laser SOS Group	17
Laservision USA	17
LIA's EVALUATOR	32
LIA's In-House Training	30
LIA's Laser Safety Awareness Online Training	33
LIA's Laser U	25
LIA's LSO Training for R&D	10
Newport Corporation	11
PennWell (ILS)	16
PhotoMachining, Inc.	15
Photonics Media	27
Rockwell Laser Industries	13
SPI Lasers	10
TRUMPF, Inc.	10, 35

# 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.

The editors of LIA TODAY welcome input from readers. Please submit news-related releases, articles of general interest and letters to the editor. Mail us at LIA TODAY, 13501 Ingenuity Drive, Suite 128, Orlando, FL 32826, fax +1.407.380.5588, or send material by email to [lia@lia.org](mailto:lia@lia.org).

## 2013 LIA OFFICERS

President – Klaus Löffler  
TRUMPF Laser & Systems GmbH

President-Elect – Yongfeng Lu  
University of Nebraska – Lincoln

Past President – Reinhart Poprawe  
Fraunhofer Institute for Laser Technology

Secretary – Robert Thomas  
USAF Research Laboratory

Treasurer – Stephen Capp  
Lasera Technology Corporation

## EDITORIAL STAFF

Editor-in-Chief – Peter Baker

Managing Editor – Michelle Williams

Copy Editor – Barbara Sams

Contributing Editor – Geoff Giordano

## BUSINESS STAFF

Publisher – Jim Naugle

Advertising Sales – Andrew Morrison

If you are interested in advertising space in this newsletter or a subscription, call +1.407.380.1553/1.800.34.LASER or email [advertising@lia.org](mailto:advertising@lia.org).

## ABOUT LIA

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

Dec. 3-5, 2013	Orlando, FL
Feb. 25-27, 2014	Phoenix, AZ
Jun. 24-26, 2014	St. Louis, MO

### Laser Safety Officer with Hazard Analysis\*

Oct. 7-11, 2013	Miami, FL
Nov. 4-8, 2013	Los Angeles, CA
Jan. 27-31, 2014	Orlando, FL
Mar. 10-14, 2014	San Antonio, TX
Jun. 2-6, 2014	Boston, MA
Sept. 8-12, 2014	Washington, DC

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

### Industrial Laser Safety Officer Training

Oct. 29-30, 2013	Novi, MI
Dec. 11-12, 2013	Orlando, FL

### Laser Safety Officer for R&D Training

Nov. 19-21, 2013	Santa Clara, CA
------------------	-----------------

### Medical Laser Safety Officer Training\*

Oct. 5-6, 2013	Miami, FL
Nov. 2-3, 2013	Los Angeles, CA
Jan. 31-Feb. 1, 2014	Orlando, FL
Mar. 29-30, 2014	Chicago, IL
Jun. 7-8, 2014	Boston, MA
Sept. 6-7, 2014	Washington, DC

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

### Advanced MLSO Training

Oct. 17-19, 2013	Atlanta, GA
------------------	-------------

### International Congress on Applications of Lasers & Electro-Optics (ICALEO®)

Oct. 6-10, 2013	Miami, FL
-----------------	-----------

### Laser Additive Manufacturing (LAM®) Workshop

Mar. 12-13, 2014	Houston, TX
------------------	-------------

Visit [www.lia.org](http://www.lia.org) for all course and event listings.



# LASER SAFETY



Entry-Guard™ is a Safety Interlock System (SIS) that provides a failsafe Access Control System (ACS). Its primary function is to ensure that unauthorized personnel are prohibited from areas where laser radiation may be present. When the power to the controller is interrupted, critical outputs, such as door magnetic locks and laser interlocks, revert to a safe state: magnetic locks off, interlocks open.

## FLEX-GUARD™ EVER-GUARD® Laser Barriers



Flex-Guard™ heavy duty matte finish fabric is ideal for blocking diffuse and low power laser radiation. Durable and flame retardant materials are suspended from ceiling- or floor-mounted coated black steel track engineered for low-friction operation. Virtually any configuration is possible using curves, by-pass rollers and other accessories. Each system is rated up to 200W/cm<sup>2</sup> for 100 seconds and is available in stock and custom sizes.

Ever-Guard® laser barriers and retractable curtains are the most protective laser barriers available commercially. Designed for low and high power laser radiation, these curtains offer the flexibility of a fabric curtain with the protection of a metal barrier. Each system is built to individual requirements and is rated for 1200 W/cm<sup>2</sup> for 3 minutes. Available in stock sizes any width and height up to 8 feet. Custom sizes also available.

**KEN TEK®**  
Laser Smart Products™

components accessories containment signs/labels education eyewear

Int'l: 1 603-223-4900 • Fax: 603 435-7441 – Email: [info@kenteklaserstore.com](mailto:info@kenteklaserstore.com) • Web: [kenteklaserstore.com](http://kenteklaserstore.com)

*Inquire about our laser auditing, laser safety training, and laser consulting services presented by experienced laser experts.*



# SAVE THE DATE!

**Sheraton® San Diego • San Diego, CA USA**

**October 19-23, 2014**

# ICALLEO®

33<sup>rd</sup> INTERNATIONAL CONGRESS ON  
APPLICATIONS OF LASERS & ELECTRO-OPTICS

ICALLEO® brings together the leaders and experts in the field of laser materials interaction, providing the world's premier platform for sharing new ideas and discovering breakthrough solutions.

*Presented by:*



**Laser Institute  
of America**

*Laser Applications and Safety*



# PRESIDENT'S MESSAGE



Dear LIA members, friends, colleagues and readers of the *LIA TODAY*,

I hope you all have been able to enjoy the summer, perhaps on a laser welded cruise ship, and are ready to start with new ideas going into the Fall. The Fall is always packed with conferences, exhibitions and other interesting events all over the world. The Lasers for Manufacturing Event® (LME®) in Chicago (September 11 to 12) is just behind us and the next important event – ICALEO® 2013 – is just ahead of us. I don't want to

mention too much before you read the featured article concerning LME in this issue, but I will point out just one sentence. LME has established itself as the No. 1 event for lasers in manufacturing in North America despite the fact that some people believe that due to the internet, shows will no longer be of interest. The layout with educational classes, an exhibition and the possibility to talk to and get advice from experts, just hits the long existing demand. A big Thank You to the LIA Staff, all exhibitors and participants that made this happen and to Bill Shiner, who had the original idea and helped to get it to the level where we are today.

For ICALEO 2013, everything is on schedule and the response is great. Many presentations from around the world will have the potential to further enhance products that will make our life easier. The growth of the global laser market is in the low single digits, new applications are needed and ICALEO comes at the right time. The importance of the Photonic Industry is growing. EPIC just reported that the market volume of the European Photonic Industry totals \$100 billion in 2012 and is responsible for 377,000 jobs.

Beside the exciting femto- and pico-second laser applications, the biggest market for lasers is still high power laser processing, which is another focus in this *LIA TODAY* issue. There are rumors that one machine tool manufacture might have solved the 1 µm cutting performance issue in thick sheet cutting and this might be presented in November at the Blechexpo in Germany. The excitement continues.

And just to remind you, the prestigious Berthold Leibinger Innovation Price 2013 for innovative developments and applications in laser technology is open for applications until the end of the year.

I'm looking forward to seeing you all at ICALEO 2013 in Miami and don't forget your running gear for the morning run with the President in order to keep you and your business fit for the future.

I wish you good health, success in your business, and hope to see you at one of the LIA sessions or events.

Yours,

Klaus Löffler, President  
Laser Institute of America

# EXECUTIVE DIRECTOR'S MESSAGE



## The Evolution of Laser Technology for Manufacturing

As I write this, the small but mighty LIA staff is showing signs of overload. There are just a few short days before LME® then just three weeks after that we hold ICALEO®. To alleviate this pressure, we are working with the Charter Committee which guides LME with the aim of moving it to an earlier date, hopefully by 2015.

As I reviewed the programs for ICALEO and LME, it is interesting to see how an area of manufacturing, such as welding or additive manufacturing, is birthed at ICALEO. Here, the science of laser material interaction is developed, often over 20 years; then, when it is mature and understood, it becomes the basis for the processes and machines used in manufacturing.

We then use a forum such as LME or a workshop such as LAM® to help manufacturing professionals understand our technology and how to apply it profitably. We wrap it up with a bow by providing the Z136.9 *American National Standard for Safe Use of Lasers in Manufacturing Environments* to keep everyone safe.

Peter Baker, Executive Director  
Laser Institute of America

# ICALEO 2013: THE PREMIER CONFERENCE FOR INDUSTRY-LEADING LASER RESEARCH

By Geoff Giordano

With a new general chairman and the first female recipient of the Arthur L. Schawlow award, the 32<sup>nd</sup> International Congress on Applications of Lasers & Electro-Optics (ICALEO®) Oct. 6-10 in Miami, FL promises to yet again raise the bar on the laser industry's premier research conference.

Stefan Kaierle, who for the past two years has served as chair of the Laser Materials Processing Conference, takes the helm of the Laser Institute of America's signature event this year.

"My main concern was, as always, to put together a strong program of high interest for many participants," said Kaierle, head of the materials and processes department for Laser Zentrum Hannover. "We needed to have presentations and papers on the latest results and emerging applications. A good mixture from macro via micro to nano is important for ICALEO as we want to cover the whole range of laser manufacturing applications."

Planning for ICALEO 2013 began not long after the curtain fell on the 2012 conference in Anaheim, CA.

"We started right after the last ICALEO with the first meeting of the new conference board and met again during Photonics West," Kaierle explained. "These two meetings were primarily dedicated to the overall approach, to discuss what was good and where we wanted to set a new focus."

Of course, planning has involved "tons of emails" and even discussions via Skype. "I always found slots in my daily schedule to deal with the ICALEO issues. As I was in the fortunate position this year to select the people in the committees, I was sure to have colleagues around who are highly active and creative. We had lots of fruitful discussions about the program but always easily came to a good conclusion. It had never been easy to put together a good program, but from the experience of the former years I knew how important it is to have a dynamic committee — which we definitely have, and they all did an excellent job!"

## POWERFUL PLENARIES

ICALEO 2013 features another slate of information-packed opening and closing plenary sessions showcasing speakers with a wealth of expertise.

On Oct. 7, the first plenary talks focus on *Photonic Applications in All Dimensions* and get under way at 9 am. Ramesh Raskar of the MIT Media Lab will address *Femto-Photography: Trillion Frames per Second Imaging to See Around Corners*, while Boris Chichkov of Laser Zentrum Hannover will speak to *Laser-Based Nanotechnologies for Photonics and Biomedicine* and Huaming

Wang of the Beijing University of Aeronautics and Astronautics details *Laser Additive Manufacturing for High Performance Large and Complex Metallic Structural Components: Challenges and Progresses*.

"All our three (opening) plenary speakers have a high reputation in their domains," Kaierle noted. "The diversity of the talks owes to the fact that we want to address issues of interest for all attendees. While we are listening to different areas, we may have the opportunity to learn new things we even didn't think about and could be possible to transfer into our own research and development work. It is always fruitful to hear about different domains in the laser field — for example, about short-pulsed lasers, which are still rather hard to find in industrial applications but might become a tool for large-scale applications in the near future."



ICALEO 2013 will conclude on Oct. 10 with a six-speaker plenary session, the theme of which is *Digital Photonic Production Across All Scales*. Beginning at 1:30 pm, the slate of invited experts will update attendees on topics like laser nano component buildup, additive manufacturing in micro scale, and AM in aerospace and other applications.

"Laser-based additive manufacturing represents one of the biggest potentials of all laser applications," Kaierle asserted. "We can see that, for example, in the repair of turbine blades for aero engines or in the repair and manufacture of individual (metallic) parts in many industries, like dentistry or automotive. The progress of these applications is amazing. That makes me proud and happy to be part of this community."

## MORE THAN 300 TALKS

Between the opening and closing plenary sessions are the traditional Laser Materials Processing, Laser Microprocessing and Nanomanufacturing Conferences. Silke Pflueger of DirectPhotonics takes a new role, switching from leading the



Laser Solutions Short Courses to overseeing the materials processing sessions. Kerstin Kowalick of Ruhr University Bochum takes over the short courses. Henrikki Pantsar of Cencorp retains leadership of the microprocessing track, while Yongfeng Lu of the University of Nebraska-Lincoln and Xianfan Xu of Purdue once again spearhead the nanomanufacturing program.

Pantsar will be attending his 13<sup>th</sup> consecutive ICALEO. He has chaired microprocessing sessions since 2007 and is in his third year heading up the full microfabrication program.

“I am looking forward to the micro and nano joint plenary session with two invited presentations on additive manufacturing,” Pantsar said. “Novel optics and laser sources always give a good indication on what are the hot topics in future equipment development and surface engineering has been a popular topic for many years.”

That joint session is slated for Oct. 7 at 1:30 pm and features presentations by Konrad Wisenbach of Fraunhofer ILT (*Micro Scale Laser Based Additive Manufacturing for Metals*) and Philippe Delaporte of Aix-Marseille Universite (*Laser Printing for Micro and Nanomanufacturing*).

Keeping laser professionals in touch with key industry developments is job No. 1 for ICALEO.

“The laser industry is moving fast,” Pantsar said. “A lot of innovation is happening in areas such as health care and in micromachining in general. The energy sector has been slower since 2009, but I am expecting a new boom in the field, especially as solar companies seem to begin a new round of investment.

**FOR THE MORE  
EXPERIENCED, STATE-OF-  
THE-ART TECHNOLOGY IN  
DIFFERENT FOCUS TOPICS  
WILL BE PRESENTED.**

Laser micromachining has been and will be a fast-moving area due to its nature as a set of enabling technologies instead of only technologies that are replacing previous manufacturing methods.”

## BIG DAY FOR SHORT COURSES

In chairing the short courses session for the first time, Kowalick had a tall order. Her “main motivation was to cover a broad spectrum of today’s laser topics from more traditional applications such as macro welding, which has not lost any of its relevance, to leading-edge technologies,” she said. “The selection of topics was driven by the idea to provide insight not only into laser and process technology but also system technology — in particular motion systems and laser beam shaping.”

For newcomers, “the talks will provide a good overview of the possibilities available and give enough information to understand and judge the different aspects that influence a laser process,” she explained. “For the more experienced, state-of-the-art technology in different focus topics will be presented.”

The short courses, held all day Sunday before the welcome celebration, last about 50 minutes each.

When she’s not chairing sessions or presenting, Kowalick will join other attendees in gleaning as much information as she can in areas outside her scope of research.

“Laser micro applications are my main interest, in particular laser micro welding,” she noted. “However, ICALEO offers the opportunity to get a glance into many different aspects of laser application processes and technology. It gives me the chance to see what else is out there and in which direction we, as the laser applications community, are heading.”

## BUSINESS TIPS FROM EXPERTS

This year’s Business Forum and Panel Discussion, to be chaired on Tuesday by LIA President Klaus Löffler of TRUMPF, will instruct attendees on *How to Turn Your Laser Idea into a Sustainable Business*. He has chosen five businesses — Begneaud Manufacturing, Joining Tech, Innovative Laser Technology, AdValue Photonics and BOS Photonics — to share real-world challenges and successes. The panel’s experience runs from running a laser-based sheet metal job shop to application R&D, systems for manufacturing medical devices, developing lasers and components like 2 μm laser resonators, and business dealings in China.

“The main application with lasers is in 2D flat sheet cutting,” Löffler said. “This market is close to being saturated. The

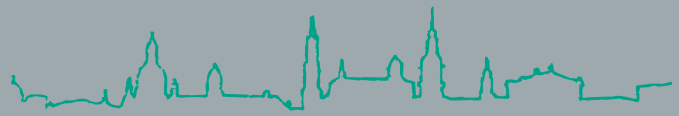
*(Continued on page 9)*



# Fraunhofer

IWS

Dresden



TECHNISCHE  
UNIVERSITÄT  
DRESDEN

DRESDEN  
concept



# REGISTER NOW!

INTERNATIONAL LASER SYMPOSIUM  
"FIBER, DISC, DIODE"

&

INTERNATIONAL SYMPOSIUM  
"TAILORED JOINING"

**February 27 - 28, 2014**

International Congress  
Center Dresden, Germany

We are pleased to invite you to the ultimate laser event!  
The 8<sup>th</sup> International Laser Symposium in Dresden combines the "FiSC", the "Diode Laser Workshop" and the "Tailored Joining Symposium" into one unique conference. Even now many exhibiting companies, speakers and participants are showing vivid interest in the upcoming opportunity to exchange their ideas and to discuss novel research results.

**Come and join the discussion about these subjects:**

- Laser technology systems and components
- Laser cutting, joining and build-up welding with fiber/diode lasers
- Hybrid procedures
- Hardening with diode lasers
- Laser microprocessing
- Current developments in innovative joining procedures

Fraunhofer IWS Dresden

Phone +49 351 83391-0, [info@iws.fraunhofer.de](mailto:info@iws.fraunhofer.de)

[www.iws.fraunhofer.de/en.html](http://www.iws.fraunhofer.de/en.html), [www.lasersymposium.de/en.html](http://www.lasersymposium.de/en.html)







fabrication companies need to move into 3D laser work like tube or formed parts and need to move into laser welding of sheet metal structures. Dollar-wise, this will be one of the largest and steady growth areas for lasers. Due to our life expectancy increasing, the global need for medical implants and others will grow — and with it laser demand. The real new kid on the block, ultrashort pulse lasers in different wavelengths, will mean the biggest change to engineering, products and our lives.”

Löffler also leads LIA's Laser Running Club, which started four years ago. This year's morning “Run with the President” is an official part of the program, “and all of us are very happy,” he enthused. “During the runs we talk about what is new in lasers” as well as more general topics. “We are all friends after one run and start working together to get lasers to the next level.”

#### A SCHAWLOW FIRST

Prof. Dr. Ursula Keller, this year's recipient of the Arthur L. Schawlow Award, is the first woman to win the honor. Keller, a pioneer in ultrafast laser research, will be presented with the award during Wednesday's awards luncheon.

“My fundamental mission is to explore and push the frontiers in ultrafast science and technology, using interdisciplinary understanding of the physics of lasers, semiconductors and measurement technologies,” Keller said of her work. “One of my current focuses is on high average power ultrafast lasers, where we push the performance frontier with SESAM mode-locked thin-disk lasers into the multi-100 W average output power regime.”

Löffler remembers hearing her speak about 10 years ago. “Listening to her talk, presented in such an energetic way, will always be in my memory. (She) has seen already, in a very early stage, the potential of disk laser-based resonators for ultrashort pulse lasers.”

Keller has also blazed a trail for female laser researchers. “Laser science and technology is traditionally a very male-dominated field, probably because it comes from electrical engineering and physics,” she explains. “I hope we can attract more women into these areas in the near future because we cannot afford to keep losing half of our young talent pool. I always loved lasers, and I very much have enjoyed building and improving them.”

Kowalick has noticed a change in industry attitudes: “Speaking for Germany, there clearly is a positive trend in research. Many programs in lasers and photonics are increasingly addressing women and actively seek to attract women to pursue related studies. There is also a positive tendency in the number of PhD students and in their representation at conferences. This year's

ICALEO is a very good example. It is striking that an increasing number of women have taken a prominent role, for example as session chairs.”



#### ICALEO LEADS THE FIELD

For the 32<sup>nd</sup> year, LIA's industry-leading conference will bring together top minds from many areas of laser research, bridging the gap between traditional and cutting-edge practices.

That's certainly clear in Pflueger's Materials Processing Conference, during which about 40 percent of the presentations will focus on welding, 40 percent on additive manufacturing and 20 percent on other realms. In keeping with the idea of starting with a flourish, she's put together an LMP plenary session on Monday at 1:30 pm “instead of the afternoon breaking up into four or five different tracks” from the get-go. The four talks in that time slot will range from *Advanced Welding Techniques with Optimized Accessories for High Brightness 1µm Lasers* to *Vertical-Down Hybrid Welding in Ship Building – The Next Innovation Step*.

Taking on this new role has reiterated to Pflueger the eye-opening experience of ICALEO. “I saw that there were really exciting things going on in welding. There are many new things on diagnostics and welding and understanding how the weld works.” She's mostly looking forward to Raskar's opening presentation as a perfect example of how ICALEO can get attendees “looking outside our own material processing world.”

That said, ICALEO “continues to be the biggest and most important laser material processing conference,” she asserted. “It's all because the speakers are motivated, and they can meet great people there and have good discussion.” ■

For more information or to register to attend, visit [www.icaleo.org](http://www.icaleo.org).

**SPI Lasers**

## Power & Control

### 500W Fiber Laser

The redPOWER® R4 series of fiber lasers from SPI has been designed to meet the highest standards of reliability, performance, repeatability and user safety. SPI's R4 lasers are constantly finding new cutting, welding and materials processing applications in markets including industrial, medical devices, electronics and printing.

Visit us at ICALEO 2013, or for more information come to our website >> [www.spilasers.com](http://www.spilasers.com)

**TRUMPF**

## Micro-processing with the speed of light.

**TRUMPF TruMicro Lasers**  
Micro technology. Mega productivity.

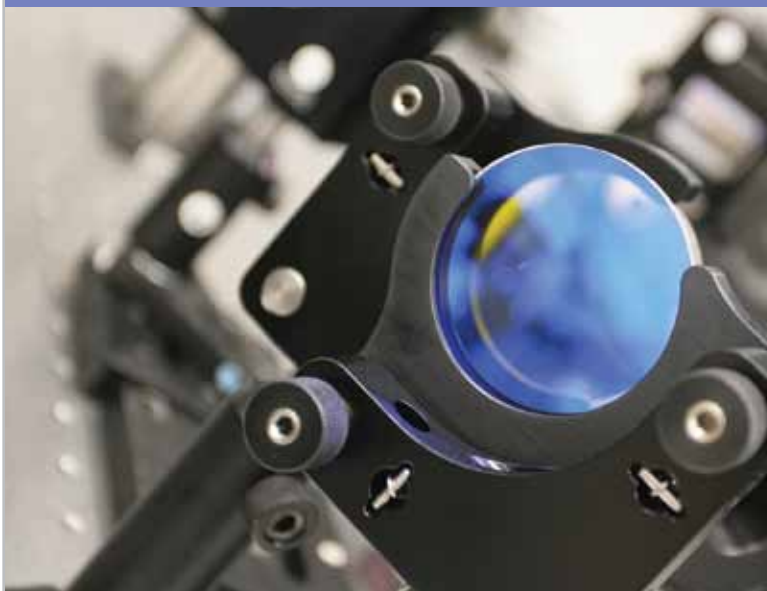
TRUMPF's TruMicro lasers feature lightning fast production speeds in laser micro-processing with low operation costs and high duty cycles resulting in the lowest cost per part. The TruMicro Series 5000 and 7000 offer the highest speed and highest quality in cutting, drilling and ablating of a variety of materials.

[www.us.trumpf.com](http://www.us.trumpf.com)

For more information scan the QR code with your smartphone.

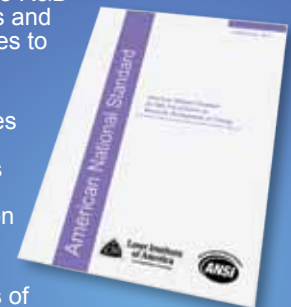
# LASER SAFETY OFFICER TRAINING

## IN RESEARCH & DEVELOPMENT ENVIRONMENTS



**Based on the newly written ANSI Z136.8 standard.**

- Learn how to characterize R&D laser devices, set up labs and establish control measures to mitigate hazards.
- Discover the unique duties of the R&D LSO, as well as traditional laser basics for the health and safety professional embarking on the role of LSO.
- Understand the elements of a sound safety program and how to respond to potential accidents.



[www.lia.org/education](http://www.lia.org/education)  
**1.800.34.LASER**

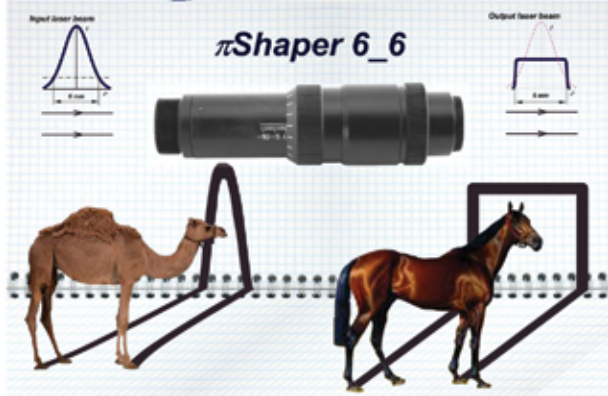
Presented by:



**Laser Institute of America**  
Laser Applications and Safety



# $\pi$ Shaper<sup>®</sup>



### Features:

- Telescope or Collimator
- In: TEM<sub>00</sub> or Multimode
- Out: Flattop, Donut
- Achromatic Design
- $\lambda$  from 200 nm to 12  $\mu$ m
- CW and ultra-short pulses
- Spot size from  $\mu$ m to cm
- Working with Scanners
- Easy integration

### Applications:

- Micromachining
- Scribing, Marking
- Welding, Cladding
- Annealing, Hardening
- Laser Pumping
- SLM illumination
- Holography
- Spectrometry
- Laser Heating, etc...



info@adloptica.com  
www.pishaper.com



**NEW!**

# ANSI Z136.2

Safe Use of  
Optical Fiber  
Communication  
Systems Utilizing  
Laser Diode and  
LED Sources



**YOUR SOURCE FOR  
LASER SAFETY  
COMMUNICATION**

**LIA.ORG/ANSI.2**  
**1.800.34.LASER**

Presented by:



**Laser Institute  
of America**  
*Laser Applications and Safety*

## The Best Moves in Laser Micro Machining

The first choice in motion control delivers a new stage of performance and reliability in laser micro machining. Newport provides high-performance linear motor stages, industry-leading motion controllers, and G-Code conversion software to address a variety of applications from marking to nano-patterning.

Discover the reliability and performance of Newport Stages. Visit [www.newport.com](http://www.newport.com) and Search **Stages-14** or call **800-222-6440**.

**For Motion, Think Newport™**



Experience | Solutions

**Newport** Family of Brands – ILX Lightwave<sup>®</sup> • New Focus<sup>™</sup> • Ophir<sup>®</sup> • Oriol<sup>®</sup> Instruments • Richardson Gratings<sup>™</sup> • Spectra-Physics<sup>®</sup> • Spiricon<sup>®</sup>



# HIGH-POWER LASER MATERIALS PROCESSING

By Eckhard Beyer and Achim Mahrle

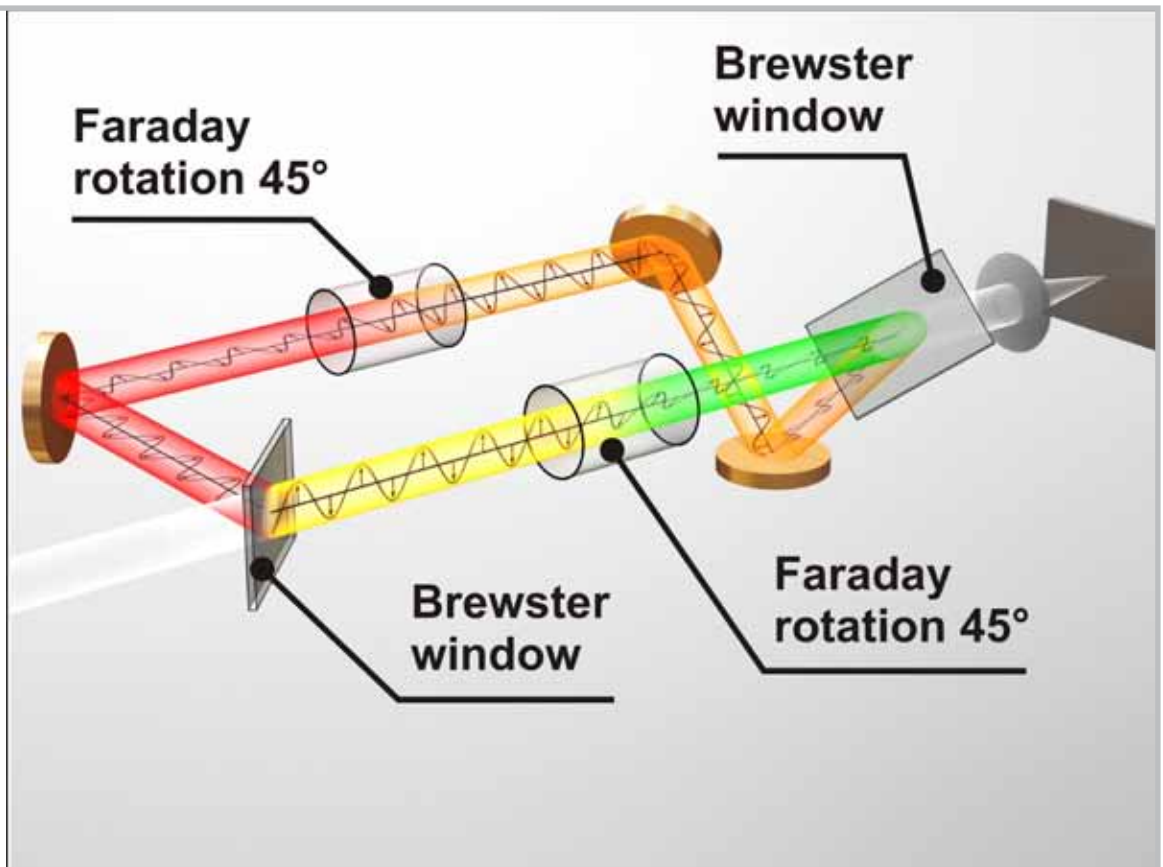
The high power laser market has been remarkably influenced by the introduction of high-brightness lasers, i.e., laser sources offering a high optical output power in combination with a high beam quality or a low beam parameter product, respectively. These features are primarily exhibited by fiber and disk laser systems, but diode lasers are also increasingly available with improved beam quality and higher output levels. The development of new processes that make use of the advantages of high-brightness lasers was intensively pursued in recent years and some examples of innovative solutions were given in this paper.

On the other hand, the advent of high-brightness lasers also gave rise to some technical challenges, which still need a reliable solution. One point concerns the optical feedback due to back reflections during processing highly reflective materials. Another serious and often discussed topic, is the occurrence of unacceptable focus shifts when working with high-intensity laser beams.

## OPTICAL FEEDBACK CONTROL

Laser material processing of highly reflective metals requires high laser intensities. This need is met by high brightness laser beam sources due to their good focusability. However, back reflections during the initial stage of the process in which the absorption of laser radiation is still rather low, are an important technical issue to contend with. The reflected laser light is capable of destroying fiber ends, coupler modules and splice connections. Research at the Fraunhofer IWS was aimed at preventing such back reflections to the optical components of the laser system. As a result, an optical diode was developed, allowing a blocking of back reflections to a minimum of 20 dB. Figure 1 shows how the optical diode does work. The emitted randomly polarized laser beam is initially split into two polarized laser beams with polarization planes perpendicular to each other. The Faraday rotators shift the orientation of these beams by 45 degrees. Finally, the two beams are united to the working beam focused onto the surface of the workpiece. In case of optical feedbacks, the reflected beam goes the same way backwards. The additional rotation of 45 degrees during the passing of the Faraday rotator enables the uncoupling of optical feedbacks.

FIG. 1: SCHEMATIC ILLUSTRATION OF THE FUNCTIONAL DESIGN OF THE OPTICAL FEEDBACK CONTROL.



# Laser Enclosure Design and Manufacturing



RLI offers custom design and manufacturing of laser enclosures for either manually operated or fully automated installations. RLI can also ensure that those producing their own enclosures will meet all domestic and international standards regulations.

Services include:

- Complete Design Engineering utilizing 3D modeling, Manufacturing and/or Installation
- Review of client's existing design and/or installation for compliance
- Certification, as appropriate, to 21 CFR / ANSI Z-136
- Design criteria includes conformity with ANSI B11.21 *Safety Requirements For Machine Tools Using A Laser For Processing Materials* and IEC/ISO 11553 *Safety of Machinery - Laser Processing Machines*
- Industrial capabilities include mechanical & electronic interface for interlocks and other safety features & controls

## Barriers and Curtains

LAZ-R-SHROUD™ is a laser barrier system that provides protection against beams emitted and scattered from various laser sources.

- Complaint with ANSI and EN Standards for exposures up to 300 W/cm<sup>2</sup>
- Ceiling, frame mount or custom designs



## Your One Stop Laser Safety Shop

Rockwell Laser Industries is a global provider of education and training, consulting services and laser safety products.

- Regional, online and on-site laser safety training
- Laser safety and compliance consulting
- Laser safety products including entryway control, eyewear, signs, labels and windows

**Rockwell Laser Industries**

(800) 94-LASER  
www.rli.com



### FOCAL SHIFT DEVICE

The use of high-brightness laser sources can cause changes of the refraction index and the shape of lenses due to thermal interactions. In this way, deviations of the focal length as a function of the applied laser power occur. The resultant shift of the focal position can provoke a lower machining quality or, in extreme cases, a breakdown of the process. Corrections by moveable optical elements are possible but require a priori the instantaneous determination of the actual focal plane position. For this purpose, a measurement device was developed that uses the small amount of laser radiation reflected from the protection glass. This part is guided to a sensor which allows the calculation of the focal length on the basis of a ray transfer matrix calculation.

### REMOTE CUTTING

A very promising application area for high-brightness lasers is remote cutting of thin-section metals. In this cutting variant, the melt removal from the cut kerf is done by the action of the recoil pressure of evaporating material. An additional gas jet, like in conventional fusion cutting, is not necessary, and this feature allows the very fast movement of the laser beam along the cut contour by using scanner mirrors. Cutting speeds up to 800 m/min are realizable in this way. An outstanding application field of the innovative remote cutting process is cutting electrodes and separators of lithium-ion cells. The electrodes are made of two different composite materials with thicknesses of about 100  $\mu\text{m}$ . The cathode is a coated aluminum foil whereas the anode consists of a coated copper foil. Typical electrode geometries can be cut in less than a half second with very acceptable cut edge qualities, as shown in Figure 2.

### LASER WELDING WITH BEAM OSCILLATION

The excellent beam quality of high-brightness laser beam sources allows welding applications with spot sizes in the range of between 20 and 40  $\mu\text{m}$  and intensity levels higher than those of electron beams. Issues related to these small spot sizes and high intensity levels are, however, very narrow weld seams with high aspect ratios of penetration depth and weld seam width, as well as severe weld spatter formation, in interaction with such high-intensity laser beams. One successful remedy is the possibility to apply beam oscillation techniques by use of highly dynamic scanning optics. The melt pool dynamics, the solidification behavior, and the resultant weld seam geometry can be strongly influenced by time- and power-controlled laser beam oscillations. Investigations on flux-coated aluminum components demonstrated that high-frequent beam oscillations considerably reduce the risk for splatters, pores and melt pool eruptions as shown in Figure 3. Similar improvements of the process characteristics were also achieved for welding steel.

FIG. 2: SEM IMAGES OF THE CUT EDGES IN ELECTRODE MATERIALS OF LITHIUM-ION CELLS MADE BY REMOTE LASER BEAM CUTTING.

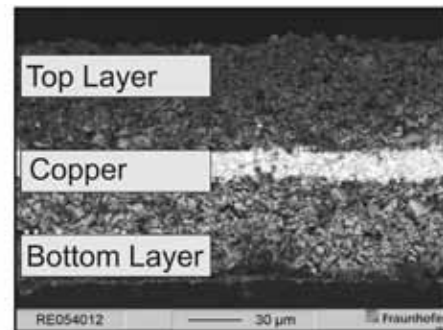
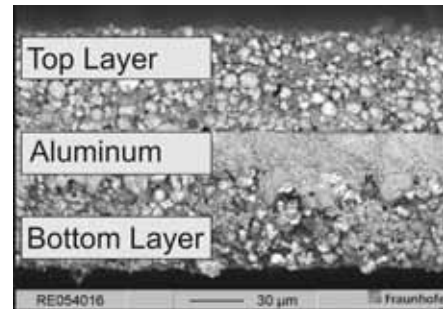
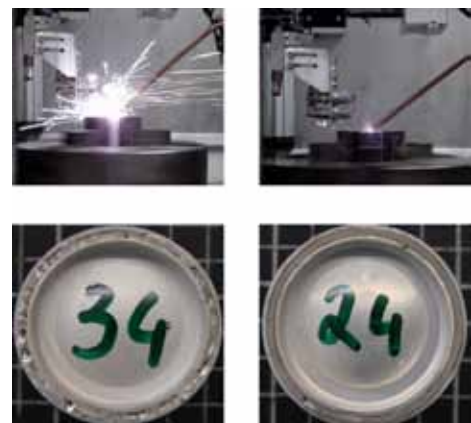


FIG. 3: IMPROVEMENT OF THE PROCESS CHARACTERISTICS (TOP) AND THE RESULTANT WELD SEAM QUALITY (BOTTOM) FOR LASER BEAM WELDING FLUX-COATED ALUMINUM COMPONENTS WITH HIGH-FREQUENT BEAM OSCILLATION. WITHOUT SCANNING (LEFT), CIRCULAR BEAM OSCILLATION (RIGHT), DIAMETER = 400  $\mu\text{m}$ , FREQUENCY = 3000 HZ.





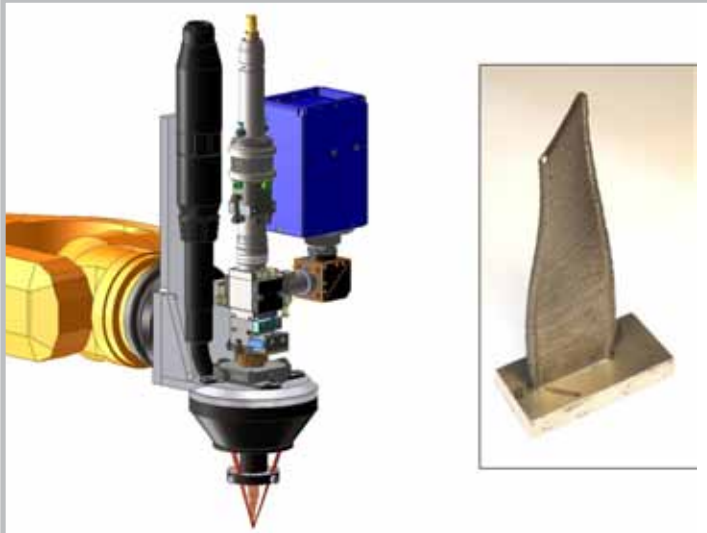


FIG. 4: LASER CLADDING HEAD WITH COAXIAL WIRE FEED (LEFT) AND GENERATED TURBINE BLADE (RIGHT). PARAMETER: FIBER LASER POWER = 1200 W, FOCUS DIAMETER = 3 MM, WIRE DIAMETER = 1 MM, TRAVEL SPEED = 1 M/MIN, WIRE MATERIAL = INCONEL 625, DEPOSITION RATE = 0.63 KG/H, BLADE HEIGHT = 118 MM, BLADE WIDTH = 47 MM (BOTTOM) AND 61 MM (TOP), PATH WIDTH = 2.6 MM.

### LASER CLADDING WITH WIRE DEPOSITION

The use of metal wires instead of powder materials is considered as a promising solution for prospective laser cladding applications in prototype or tool and mold construction. The process enables a material utilization of 100 percent without the risk of contaminations with impurities during the deposition process. Exemplarily, a multi-beam laser head with centric wire feed and a generated turbine blade are shown in Figure 4. The head developed at Fraunhofer IWS allows omni-directional 3D processing with higher processing speeds, higher deposition rates and much better material utilization than a comparable powder laser cladding process and is available for fiber and disk laser beam sources.

Issues and applications in the field of high-power laser material processing with recent laser sources and latest system components were presented. Most of these developments would have hardly been possible to realize without use of the advantages of recent high-power and high-brightness laser systems. The advent of these laser beam sources has had a noticeable impact on research and development activities in laser material processing. ■

*Dr. Eckhard Beyer is the Executive Director of Fraunhofer IWS, Dresden and Dr. Achim Mahrle is a Research Fellow at Dresden University of Technology.*

Optical Isolators from

**EOT**

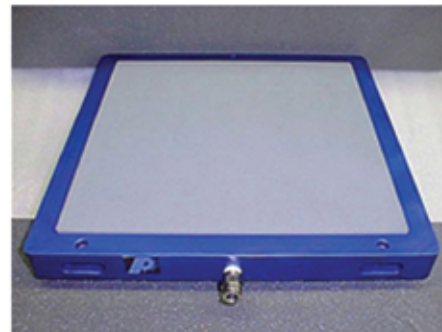


**The Leader in High Power  
Optical Isolators**

Electro-Optics Technology, Inc.

www.eotech.com • sales@eotech.com • 231-935-4044

### Porous Ceramic Vacuum Chucks



**6" and 12" square in stock!  
Standard pore size 20 microns!  
Custom sizes and shapes available.**



www.photomachining.com/inventory/  
sales@photomachining.com  
603-882-9944

# INDUSTRIAL LASER SOLUTIONS

FOR MANUFACTURING.

Magazine • Website • Newsletters



## The International Resource for Laser Materials Processing

Industrial Laser Solutions delivers timely, knowledgeable information on industrial laser materials processing to end users in manufacturing who are interested in understanding the technical and cost benefits of these processes prior to their implementation in production environments.

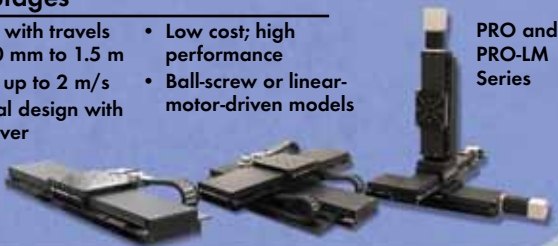
## Subscribe Today!

Log on to [www.ils-subscribe.com](http://www.ils-subscribe.com)



### Linear Stages

- Models with travels from 50 mm to 1.5 m
- Speeds up to 2 m/s
- Side-seal design with hard-cover
- Low cost; high performance
- Ball-screw or linear-motor-driven models



PRO and PRO-LM Series

### Nmark® CLS

### Nmark® AGV-HP



### Integrated Servo/Scanner Systems

- Wide range of focal lengths and apertures
- Industry best accuracy and thermal stability
- Laser firing based on real-time scanner/servo position

## Micromachining shouldn't be a giant task

Get our FREE brochure Capabilities in Laser Processing and Micromachining at [www.aerotech.com/about-us/brochures.aspx](http://www.aerotech.com/about-us/brochures.aspx)



### Cylindrical Laser Machining Systems

- Integrated linear/rotary motion platform
- Advanced control architecture
- Single- or dual-spindle configurations

Vasculathe® DS



### Linear Motor Gantry Systems

- Velocity to 3 m/s and acceleration to 5 g
- Exceptional accuracy and performance for improved throughput and yield
- "Sealed" versions and custom options to suit your application



AGS Series



Dedicated to the Science of Motion

Ph: 412-963-7470  
Email: [sales@aerotech.com](mailto:sales@aerotech.com)  
[www.aerotech.com](http://www.aerotech.com)

Aerotech Worldwide

United States • France • Germany • United Kingdom  
China • Japan • Taiwan

AH1212D\_LM

# laservision

WE PROTECT YOUR EYES

## LASER SAFETY CURTAINS

*Widest selection of large area protection | Fastest lead time for custom projects*

**We tailor curtains to your needs.** Our design options include a variety of protection levels, curtain colors, installation hardware, filtered windows, clean room and added ESD protection. **Providing fastest lead time - try us!**

1-800-393-5565  
info@lasersafety.com  
www.laservision-usa.com

GSA Contract Holder (GS-07F-0455X) • ISO Compliant

©2013 Laservision USA, LP. All Rights Reserved.



### Affordable:-

- Retrofit Laser & IPL Components
- Diode Pumped Lasers Upto 100 Watts
- Lamp Pumped YAG Lasers Upto 650 Watts
- Fiber Laser Marking And Cutting Lasers Upto 1000 Watts
- IPL & Laser Aesthetic Systems

## *LASER SOS GROUP*

**A World Class Service From a World Class Company**

Laser SOS Ltd | Unit 3, Burrell Road | St.Ives Industrial Estate | St.Ives | Cambridgeshire | PE27 3LE | United Kingdom  
t: + 44 1480 460990 f: + 44 1480 469978 e: sales@lasersos.com w: www.lasersos.com



# LME 2013 EXPERTS PROVIDE INSIGHT INTO CONTINUED LASER MARKET GROWTH

By Geoff Giordano

Expanded exhibit space, new exhibitors and networking opportunities, and more working laser systems took the third annual Lasers for Manufacturing Event® (LME®) to a new level of impact for the laser community.

The Laser Institute of America's unique event, held Sept. 11-12 at the Schaumburg Convention Center, showed more signs that it is maturing as a must-attend event. Bringing together laser makers, systems integrators and providers of all manner of related equipment and services, LME 2013 gave attendees the know-how they need to get laser-based manufacturing projects up and running.

Once again, the Laser Technology Showcase Theater at the front of the active exhibit hall drew many standing-room-only crowds for industry experts including:

- LIA Past President David Belforte, who noted big opportunities for laser sales and applications, particularly in microprocessing, production of SUVs and composite-heavy narrow-body passenger jets and their engines, gas and wind turbines, smart phones and even agricultural equipment.
- Prabhjot Singh of GE Global Research, who challenged the laser community to meet the growing global need for additive manufacturing productivity, which will require hundreds of new laser-based devices.
- Magnus Bengtsson of Coherent, who addressed ultrafast lasers advances, including cataract surgery with femtosecond lasers and dicing sapphire wafers to make LEDs with picosecond lasers.
- Silke Pflueger of DirectPhotonics, who demonstrated the advantages ultra-high brightness direct diodes bring to the table.
- Jason Hillenbrand of Amada of America, who compared the cost and process differences between fiber and CO<sub>2</sub> systems in cutting applications.

LME continues to brilliantly serve its primary function: to bring together those seeking the bottom-line benefits of laser technology face to face with the providers of that technology. Attendees were treated to expert analysis of the full spectrum of available options and considerations — fiber, CO<sub>2</sub>, ultrafast, macro and micro processing, and more.

They also received updates from nearly 40 exhibitors who presented details of their latest products and services on the exhibit hall stage. For example, Visotek founder and CEO Sheila Jensen discussed the company's diode-based MetalPass unit, developed in conjunction with the Navy for laser cleaning and cladding corrosion-prone areas in one pass. The company has added five Fraunhofer engineers and will expand its Livonia, MI,

facility by 10,000 square feet. And Laserage of Waukegan, IL, detailed the broad range of work it does with an inventory of 70 lasers, including cutting of tubes and coronary stents, forms and plastics.

On the show floor were some newer products, including updated CO<sub>2</sub> devices by ALKRAS, which the company touted as costing 50 percent to 80 percent less than other devices, with 50 percent more efficiency and 40 percent to 50 percent more cutting speed and quality than fiber lasers. Meanwhile, Ophir brought its new BeamWatch monitor, which the company says measures very high-power lasers without having to intercept or disrupt the beam. Attendees also saw the compact Tangor ultrafast lasers by Amplitude Systemes, which even has a couple of customers doing nanosurgery with its devices.

"My professor recommended that we come down here and check it out just to see all the applications that lasers are doing," said Mark Hopping, who entered a laser program at the College of Lake County in Grayslake, IL, about two weeks before LME. "It's blown me away and reassured me that this is a good field to get into," said the former financial analyst. "Everyone was really helpful in describing everything they do and what the lasers they use are for."

## IT'S ABOUT THE ECONOMICS

"It wasn't too long ago that lasers were considered a laboratory curiosity," noted Patrick Grace of TRUMPF in his address *Cost Advantages of Laser Processing*. How far has laser-based manufacturing technology come in the past 10 to 20 years — and how much business is at stake? Consider:

GE puts about 20 additively manufactured fuel nozzles in each of its new LEAP engines for the latest generation of the 737, Singh noted. Manufactured through direct metal laser melting on machines featuring 200- to 400-watt fiber lasers, each nozzle takes about a day to make on one machine. With more than 5,000 engines sold, GE needs to fabricate close to 100,000 nozzles. "We probably need a few hundred machines to support production." He said GE has about 20 machines with more on the way.

"To our knowledge, as things stand today, most of the vendors that supply these machines are small, and the supply chain is just beginning to take hold," he noted. "The potential of this technology is so huge that we need your help to try and mature the supply chain so we can take this technology into production. Lasers are a big part of it; materials handling is a big part of it. And this is just one component; we have a range of components that we are interested in making (with this process)." The engine is slated to enter production in 2016, "which means I need to get all these parts ready for assembly onto an engine in 2015.



We are looking for high throughput on our machines; we are looking for much higher reliability, and that's where you guys can all help us achieve our goals."

These goals also include additively manufacturing components like valves and ducting. By redesigning multipart components into one piece and manufacturing them with powder-bed processes, Singh estimates GE can save a few hundred pounds per engine — which translates into billions of dollars less in fuel consumption for his customers. In a recent design challenge GE issued, about 700 engineers competed, with the most successful able to remove up to 80 percent of the weight of an engine bracket.

"The number of applications this technology will eventually enable is huge," he asserted. "This is just one GE business. Our land-based gas turbine business is very interested, as is oil and gas."

In his tutorial on microprocessing, CEO Ron Schaeffer of PhotoMachining in Pelham, NH, noted that the medical device market can be lucrative for job shops. Although it is hard to get into the sector, it is easy to stay in once qualified because large firms want to avoid having to recertify new vendors. He also noted that, even though his is one of three job shops within 10 miles of one another, they rarely overlap competitively because of the volume of work available. (As Belforte noted, \$2.8 billion worth of stents were sold in the US last year.)

And since lasers are the only way to manufacture many complex medical devices and components like stents, catheters and diagnostic tools, profits can be generous. For example, diabetes test strips include a thin conductive layer of metal or ink patterned with lasers. "This has been a big area for us; we've got laser systems doing this in several of the top manufacturers of these devices."

In an exhaustive study of system and operating costs, Schaeffer noted that picosecond lasers are coming down in price to the point where they are as attractive as nanosecond devices for machining. He also emphasized that CO<sub>2</sub> lasers, the most common in the industry, are the most inexpensive on a dollars-per-photon basis, although fiber lasers can approach those prices depending on power range.

Expanding on the conversation about pico- and femtosecond lasers, Bengtsson detailed how ultrashort-pulse processing produces extraordinarily clean work thanks to diminished heat-affected zones. For example, picosecond lasers can drill crisp holes in 300 μm stainless steel in about five seconds, at a cost of about \$0.014 per hole. But "it's not like ultrafast lasers are always better; they will be, typically, slightly slower in removing

material." However, he noted rates can be increased by 10 to 14 times using pulse bursting with 50 watt lasers processing steel and silicon.

Underlying the efficiency of laser manufacturing is process monitoring, which Markus Kogel-Hollacher of Precitec surveyed in his 45-minute tutorial. While norms are hard to come by in this area, he cautioned, an array of new technology and methods is refining pre-, in- and post-processing assessments — vital to maintaining profitability.

### MATH OF THE MARKETS

While metal processing dominates the industry and photovoltaic production has slowed globally, LIA Past President David Belforte forecasted significant growth in microprocessing applications in his state-of-the-markets address.

"North American manufacturers are continuing to beat the odds," he said. "Even the fiscal restraints in the United States have not slowed growth. Exports to China were offset by slower European market growth a bit, but even so it was a good year and looks like it's going to finish up a good year for exports."

In metal processing, "over \$1.5 billion of industrial lasers go into that marketplace, overwhelming the other sectors of marking, engraving and microprocessing." But, with double-digit growth, "microprocessing looks to be the market which is really going to drive this business in terms of ultrafast pulsed lasers, both solid state and fiber, and other lasers used for semiconductor, solar cell and flat-panel display work. Overwhelmingly it's printed circuit boards and hybrids that consume most of the lasers that were used in microprocessing."

Fiber lasers have had a significant impact. "The industrial laser technology forecast has been looking pretty good since we came out of the recession in 2008," Belforte said, thanks to fiber lasers. "Because of the second quarter performance of IPG Photonics — 26 percent revenue growth in the industrial laser market — it raised the entire industrial laser market by two percent." Furthermore, fiber laser revenue grew 17 percent in 2012 and is projected to hit 21 percent this year, "which will lift the entire industry to about six percent growth for this year."

While the usual areas showed robust growth — from the jet engine turbine blades that require millions of laser-cut cooling holes to the displays of smart devices — a particular surprise was agriculture. "The industry is booming again," he said, with \$27 billion in equipment produced in the US by 1,000 companies using lasers to weld, cut and additively repair components.

*(Continued on page 22)*

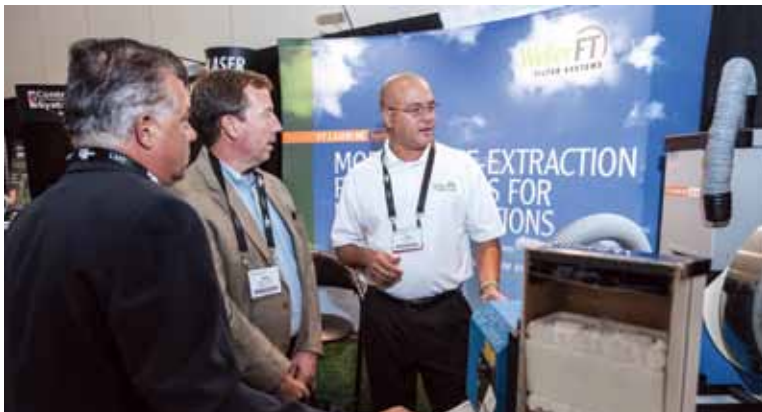




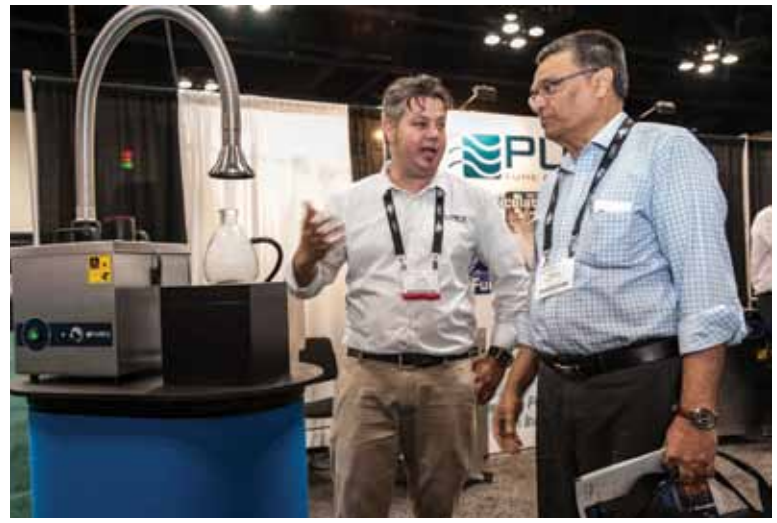
PATRICK GRACE, FROM TRUMPF, INC., EXPLORED THE COST ADVANTAGES OF LASER PROCESSING IN HIS COURSE PRESENTATION



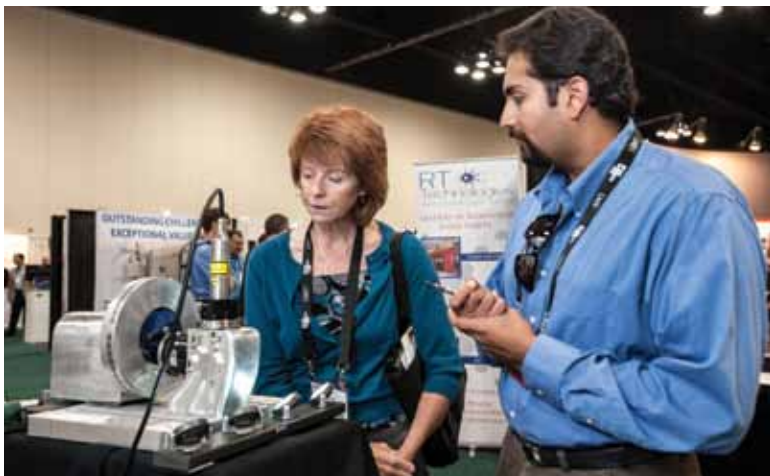
KEYNOTE PRESENTER, DAVID BELFORTE, ILLUMINATED THE AUDIENCE BY EXPANDING ON THE PROJECTED GROWTH OF THE INDUSTRIAL LASER MARKET







**LME 2013** EXHIBITORS CONSISTED OF MANY PROMINENT COMPANIES IN THE FIELD OF LASER TECHNOLOGY AND APPLICATIONS PRESENTING THE LATEST THE INDUSTRY HAS TO OFFER RIGHT ON THE SHOW FLOOR.







## BASICS AND BEYOND

LME's three levels of courses — 101 and 102 level instruction on laser types, systems, safety and cost considerations; extended tutorials; and cutting-edge keynotes — supplemented the real-world knowledge attendees gleaned from exhibitors.

Tom Kugler of Laser Mechanisms offered an updated version of his survey of lasers and their properties and applications, including more examples of ultrafast applications and UV wavelength processes.

"A couple of people asked questions about composite cutting, so mostly graphite composites for aerospace," he said. "There were also a couple of questions about removal of conductive layers off polymer-glass substrates." Back in the exhibit hall, he fielded questions related to certain products and best options for certain processes. "We're meeting potential new customers or existing customers with new projects — the whole gamut."

Pflueger later addressed an emerging revolution in diode lasers, which constituted about half of the overall \$7.5 billion laser market in 2012, she said. Laserline has driven much of that growth, she noted, having achieved up to 20 kilowatt fiber-coupled devices that in prototypes demonstrate 48 percent efficiency, vs. 40 percent for previous direct diodes. "In the past three years, we and TeraDiode have pushed up the brightness level" of diodes significantly with fewer components. "The highest power diodes available are at the 900 to 1,000 nanometer range," she explained. "I think it's where everything is going to go sooner or later — not for the ultrafast (but) for the plain CW get-a-lot-of-power-onto-the-workpiece type of applications." The high efficiency, low maintenance and straightforward technology of ultra-high brightness direct diode devices make them ideal for cutting and remote or keyhole welding, she said.

## FRIENDS IN THE BUSINESS

Connecting with old friends in the laser "family" and introducing newcomers to the fold is one of the key reasons people come to LME, which provides a venue for such contact unlike any other in the industry. No matter one's level of acquaintance with the technology, experts in all areas were on hand to point attendees in the right direction to find solutions to their business needs.

"We're getting a steady stream of questions and a wide variety of questions," said Rob Mueller, who oversaw a rotating cast of industry insiders who took 45-minute shifts at the *Ask the Experts* booth at the exhibit hall entrance. The curious asked about "everything from materials for the optics to processes to systems to the full gamut. There are people here who are just starting their investigations; they know they need to get into lasers. They know that their competitors are doing it (and) they

feel like they're behind the 8-ball and they're trying to catch up. (LME) is a great spot to do it."

Schaeffer noted that in his time at the experts booth, he encountered a potential Miami-based customer who had purchased a laser system only to find it didn't work — and the seller had gone out of business. Since company representatives will be in Boston, near Schaeffer's facility, they plan further discussions to address their need.

## BANG FOR YOUR BUCK

LME often makes a notable impression on first-time attendees like Dr. Funsho Ojebuoboh of Phoenix Infrared in Lowell, MA, which makes components for CO<sub>2</sub> lasers.

"(LME) achieved its objective," he said. "To have the presentations going on at the same time, kind of on an a la carte basis, works quite well. I'm surprised at the trend toward fiber lasers. Most of what I've got is insight into the direction of the markets; it's not something we get without talking with these kinds of people, and it's nice to have all of them here together and see if you can reconcile the information you get from different parties."

LME was also an eye-opener for Jeff Foster, an engineer for Dana Holding Corp. in Lisle, IL. "I came here to see what was new and maybe learn a little something about additive manufacturing and ultrafast lasers." He found out about a novel approach for cutting thin stainless steel, which is what he does in manufacturing multilayer steel gaskets.

"This is a really good show (and) a really good venue," enthused TRUMPF's Grace. "We got a lot of good leads and a lot of good projects. There's a value here; this is going to lead to selling lasers." When he saw an acquaintance from Universal Laser who wondered if he should exhibit at LME, Grace was emphatic: "Yes, definitely, you should be here!" (The first day) was super busy. Ken Dzurko from SPI said the same thing, and so did DirectPhotonics: "I don't know what the rest of the show looked like; I was busy all day. When you can't get out of the booth because there are people who keep coming in, that's a good thing."

LME is indispensable for staying in touch with trends, said Gary Yearwood of Prodomax Automation in Ontario, Canada: "My partner and I are at a point where we need to do some outside investigation. We don't want to just rely on going to the guys that we know for information; we want to learn it ourselves. Our customers are coming back to us for (such knowledge)." As a go-to integrator, he says, his clients rely on his firm to be a step ahead. ■

See page 34 for information on LME 2014 & 2015.

**NEW!**

# ANSI Z136.9

## Safe Use of Lasers in Manufacturing Environments

### PROTECT YOUR GROWTH AND PROFITS!

The **NEW** standard for manufacturing can help ensure that your customers and employees stay safe.

The ANSI Z136.9 *Safe Use of Lasers in Manufacturing Environments* standard is the latest in the line of laser safety guidelines stemming from the parent Z136.1 standard. This standard provides reasonable and adequate guidance for the safe use of lasers and laser systems that operate at wavelengths between 180 nm and 1 mm. Intended to protect individuals with the potential for laser exposure when lasers are used in manufacturing environments, this standard includes policies and procedures to ensure laser safety in these areas where lasers are used in manufacturing, both public and private industries, as well as product development along with testing settings.

The new standard comes at a critical time, as lasers continue to populate more processing lines in the aerospace, automotive, energy, defense and health care industries. Order your copy today!



**LIA.ORG/ANSI.9**  
**1.800.34.LASER**

Published by:



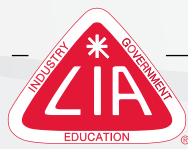
**Laser Institute  
of America**  
Laser Applications and Safety





Join us for LIA's sixth annual **Laser Additive Manufacturing Workshop (LAM®) 2014** to learn from industry specialists from around the world with the goal of applying this state-of-the-art process (cladding & rapid manufacturing) to today's manufacturing challenges. LAM 2014 offers quality technical sessions and networking opportunities to discuss equipment and applications with vendors and your peers.

*Presented by:*



**Laser Institute of America**  
*Laser Applications and Safety*

 **LAM**<sup>®</sup>  
LASER ADDITIVE MANUFACTURING  
WORKSHOP

**March 12-13, 2014**  
Hilton® Houston North • Houston, TX USA

**Save the Date**

**Laser Additive Manufacturing Solutions!**

# The Global **Laser** Education PORTAL

[www.lia.org/laseru](http://www.lia.org/laseru)

Providing Practical Online  
Training for All Laser Users!



1.800.34.LASER

*Presented by:*



**Laser Institute  
of America**

*Laser Applications and Safety*

# A REVIEW OF THE **ANSI Z136.8** AND WHY YOU SHOULD BE USING IT

By Ken Barat

The researcher and Laser Safety Officer (LSO) in a research, commercial or academic setting, face many challenges and frustrations. One that they should not have to deal with is laser safety guidance that does not represent their work environment. To this end, a new ANSI standard has joined the Z136 laser safety series. It is the Z136.8 *Safe Use of Lasers in Research, Development, or Testing* standard. ANSI Z136.8 works in conjunction with the ANSI Z136.1 *Safe Use of Lasers* standard to provide improved guidance to users and LSOs at facilities where research, development and testing of lasers and laser systems are actively performed. This type of laser usage can present many challenges to an LSO due to the large variations in use by the facility's personnel and their routine need to manipulate the optical set up.

These challenges may include:

- Production of homebuilt lasers that have not been certified (CDRH) laser products
- Research lasers with varying output characteristics and beam path set-ups
- Custom built housings, barriers and curtains
- Large volume of users to train and oversee
- Ensuring the use of proper techniques and personal protective equipment (PPE) during alignment procedures
- Operating a user facility

The information in the Z136.8 introduces new guidance specific to research, development and testing that will help an LSO and user meet the challenges faced at their facility. In addition, guidance pulled from the Z136.1 has been reorganized into a format that is more specific to R&D and makes it easy for LSOs and users to quickly and clearly reference information in the standard.

## IS Z136.8 ACCEPTABLE TO REGULATORY AUTHORITIES?

The Z136.1 standard allows guidance from specialized application standards, such as the Z136.8, to take precedence within the scope of that standard.



Therefore, guidance from the Z136.8 can be used for R&D specific applications that may not have been fully addressed or are in conflict with Z136.1 and it is up to the discretion of the LSO to determine which specialized standard(s) apply to the particular environment. Just as an outdoor range officer will look toward the Z136.6 *Safe Use of Lasers Outdoors* standard rather than the Z136.1. Remember the ANSI Z136.1 is a horizontal standard and was designed to encompass a wide range of laser applications; expect the generation of vertical/application standards to provide more specific and germane guidance.

Some of the new items you will find in Z136.8 include:

- Discussion of Alignment Eyewear
- Fiber Optic Section, non-telecommunication
- Information on Export Controls
- Full Color Signage and Diagrams
- New Appendices
  - Sample Forms, lab audit and program forms
  - CDRH rules
  - Frequently reported incidents
- On the Job Training
- New Approach to Hazard Analysis

## WHERE ARE THE MAXIMUM PERMISSIBLE EXPOSURE (MPE) VALUES?

The Z136.8 deliberately does not contain any MPE values, why? Since the Z136 series does not get published in unison, an application standard that contains MPE values may be out of sync with the latest MPE values. For Z136.8 to avoid giving outdated information, its standard subcommittee decided to leave these values and charts out. The subcommittee felt that the Z136.1 was the proper home for MPE values. This does mean one would have to buy two standards to get R&D guidance and the current MPE numbers.

ANSI Z136.8 manages to include all the relevant information from Z136.1 in a condensed format that, in conjunction with newly added guidance specific to R&D, acts as an invaluable tool to LSOs at R&D facilities. The standard allows for quick reference to proper guidance on the issues that an R&D LSO faces on a daily basis. It provides the LSO with better professional judgment and support as well as increasing their ability to be an effective safety consultant in the constantly changing world of research and development. ■

*Ken Barat is a Certified Laser Safety Officer (CLSO) with Laser Safety Solutions and chaired the subcommittee which developed the ANSI Z136.8 standard.*

**OTHER SPECIAL APPLICATION STANDARDS WITHIN THE Z136 SERIES MAY DEVIATE FROM THE REQUIREMENTS OF THIS STANDARD. EACH DEVIATION IS VALID ONLY FOR APPLICATIONS WITHIN THE SCOPE OF THE STANDARD IN WHICH IT APPEARS.**



**New**

# ANSI Z136.8

**2012**  
Safe Use of  
Lasers in Research,  
Development,  
or Testing



**We've Done the Research  
So You Don't Have To.**

Published By

**LIA.ORG/ANSI.8**  
**1.800.34.LASER**



**Laser Institute  
of America**  
*Laser Applications and Safety*

**PHOTONICS** MEDIA  
THE PULSE OF THE INDUSTRY

## Read the Industry's Leading Magazines

*Because staying informed has never been so critical.*

Photonics Media publications are referred to worldwide by the largest audience of engineers, R&D professionals, OEMs, systems integrators and clinicians – providing the latest business and research news, cutting-edge products, innovative applications and breakthrough design trends from your industry and your part of the world.

Industry leaders look to us to stay ahead and deliver.

**Subscribe Today!**

**[www.Photonics.com/MPNPWBLI13](http://www.Photonics.com/MPNPWBLI13)**  
or call (413) 499-0514

Now available as **FREE** mobile  
apps for subscribers



# CORPORATE MEMBER PROFILE

## LASER ZENTRUM HANNOVER E.V.



The Laser Zentrum Hannover e.V. (LZH) is an independent non-profit institute committed to research and development in photonics and laser technology.

As an active partner in many regional, national and international networks, the LZH partners with customers to provide innovative research, development, training and consulting for a variety of purposes. Alongside the LZH's contribution to the laser industry worldwide, these efforts have helped pave the way for Germany's continued innovations in laser technologies, making the LZH an essential stakeholder covering the whole range from basic research to industrial application.

"Founded in June 1986 under the patronage of the German State Ministry of Economics, Labour and Transport in Lower Saxony, our institute was the first approach in Germany to combine research and development in the fields of optics, material science and production technology," says Dr. Stefan Kaierle, Head of the Materials & Processes Department at the LZH and Conference Chair of this year's ICALEO®. Since then, the LZH has put their R&D expertise to use by cultivating partnerships with many nearby universities and institutions. The LZH has also aided in the foundation of multiple spinoff companies in various sectors of the laser industry. Employing a total of 175 professionals as well as approximately 100 student assistants, the LZH is located in Hannover, state capital of Lower Saxony, Germany.

Six R&D departments combining expertise in optics, material science and production technology focus on both basic and applied research with the aim to create innovations in the fields of optical components and systems, optical production technologies and biomedical photonics.

In addition to contributions on the production side of laser industry, the LZH furthers the development of future technologies and applications by providing technical and scientific consulting as well as expert training in the operation of laser systems. The LZH views their educational activities as an important means to transfer new technologies from research to production and industrial application.

"Unique to LZH is the interdisciplinary cooperation between physicists, engineers, biologists, medical scientists and others which enables the institute to develop exceptional solutions for our partners," explains Kaierle.

"LZH is continuously working on the forefront of laser-related research and therefore always picking up the newest trends,

thus developing state-of-the-art solutions. In fact, inspiration for new processes and applications comes, for the most part, from our customers in the continuously growing automotive, aerospace, electronic and medical industries. At the beginning, there is usually an unconventional idea from a customer which leads to a feasibility study and in case of success then often turns into a full development project. In this regard, it is LZH's daily business to respond to industry changes," adds Kaierle.



COVERING THE WHOLE RANGE OF LASER MATERIAL PROCESSING FROM MACRO TO MICRO TO NANO: MINI STATUE OF LIBERTY CREATED BY LZH

An LIA member since April 2000, the LZH enjoys the wide range of benefits offered by a global laser network.

"Since LIA is one of the most important organizations worldwide in the field of laser technology, it is essential to be part of this "laser family." The conferences, exhibitions and meetings organized by LIA are excellent opportunities to meet and exchange ideas with colleagues in the laser research field and industrial companies. It is our pleasure and responsibility to support LIA in the best possible way," concludes Kaierle. ■

For more information, visit [www.lzh.de/en](http://www.lzh.de/en).

# MEMBER INNOVATIONS

## INTEGRATED XY LINEAR MOTOR STAGE FOR UNPARALLELED GEOMETRIC PERFORMANCE

Aerotech's PlanarDL-series stages offer excellent geometric and dynamic performance in a compact, low-profile and cost-effective package. Available in nine different travel and performance configurations, this stage is the ideal solution for applications ranging from high-accuracy surface profilometry to high-speed semiconductor and LED wafer scribing. With an optimized structure, components with exacting precision, Aerotech's own direct-drive motor technology and an integrated cable management system, the PlanarDL debuts as an industry leader in planar performance. For more information, visit [www.aerotech.com](http://www.aerotech.com).

## LIFTSYS PROTOTYPE MACHINE FOR TRANSFERRING BIOMATERIALS

At the Fraunhofer Institute for Laser Technology ILT, an interdisciplinary team of researchers is working on a method for transferring biomaterials and on innovative systems technology. Now the scientists in Aachen have managed to manufacture a machine for medical and pharmaceutical research based on the laser-induced forward transfer (LIFT) method. The system is to be used mainly for the selective transfer of hydrogels, living cells and other biomaterials.

The LIFT method can be used whenever tiny amounts of material need to be applied onto receiver substrates with pinpoint precision. One broad field of application for the technology is medical and pharmaceutical research, for instance, where diseases and active pharmaceutical ingredients are studied in specially made test structures. For more information, visit [www.ilt.fraunhofer.de](http://www.ilt.fraunhofer.de).

## NUTFIELD TECHNOLOGY INTRODUCES THEIR LATEST IN GALVANOMETER-BASED OPTICAL SCANNERS, THE QS-7 OPD

The QS-7 OPD moving magnet galvos combine strong performance with cost-effective value. Nutfield's mechanical design incorporates ceramic ball-bearing motors for high durability in a compact package, reflecting Nutfield's attention to design detail and scanning performance. High strength magnets, the strongest available, allow for dramatically reduced package size. When combined with low resistance/low inductance coils, the QS-7 OPD provides a 40 percent increase in scanning speed with optimized thermal characteristics. A high output Position Detector generates four times the output signal for high signal/noise ratio and outstanding accuracy. Patent-pending selectable stops are available. For more information, visit the Nutfield Technology website at [www.nutfieldtech.com](http://www.nutfieldtech.com) or call +1.603.893.6200.

# MEMBERS IN MOTION

## FRANCE-CHINA FOUNDATION VISITS AMPLITUDE SYSTEMES

The France-China Foundation brings together high potential individuals of both countries, and helps to promote long term exchanges between France and China. Modelled on the "French American Foundation," launched in 1976 by French President Valery Giscard d'Estaing and US President Gerald Ford, the France-China foundation was created in Summer 2012, and has on its strategic board business and political figures such as Jean-Paul AGON (CEO, L'Oréal), Jacques ATTALI (CEO, Planet Finance), Alain MERIEUX (Merieux Foundation President and Investor of Amplitude Systèmes) Jean-Pierre RAFFARIN (Former Prime Minister of France), Wang YAN (CEO of SINA.com) and Hung HUANG (CEO, China Interactive Media Group). For more information, visit [www.amplitude-systemes.com](http://www.amplitude-systemes.com).

## SUFFOLK IDA ANNOUNCES HI TECH MANUFACTURER PHOTONICS INDUSTRIES TO EXPAND

Suffolk County Executive Steve Bellone is proud to announce that Photonics Industries International, Inc. will be expanding their operations in Suffolk County in conjunction with the Suffolk County Industrial Development Agency (IDA). Photonics Industries, headquartered in Bohemia, NY is the pioneer of intra-cavity solid-state harmonic lasers, the highest output power of lasers available and provides various types of lasers to industrial and scientific customers.

The company will be investing \$6.3 million in a new building and manufacturing equipment and will be creating 40 new jobs that will bring more than \$2 million in new payroll dollars for the County. For more information, visit [www.photonix.com](http://www.photonix.com).



## WELCOME NEW CORPORATE MEMBERS

**Catholic Health Partners**  
Cincinnati, OH

**Picosys Inc.**  
Santa Barbara, CA

For a complete list of corporate members, visit our corporate directory at [www.lia.org/membership](http://www.lia.org/membership).



A membership ballot for Accredited Standards Committee (ASC) Z136 was conducted during August and the following applicants were overwhelmingly approved for membership:

Welcome **College of Dentistry, University of Illinois at Chicago**, as an organizational member of ASC Z136! **Dr. Michael Colvard**, Director of the College of Dentistry's Dental Emergency Medicine Responder Training (DEMRT) Office and the Oral Medicine and Pharmacognosy Laboratory (OMPL) within the Department of Oral Medicine and Diagnostic Sciences will be representing the College on both ASC Z136 and standards subcommittee 3 (SSC-3) for the safe use of lasers in health care. Dr. Colvard is a Board Certified Fellow in Dental Surgery (FDS) in the Royal College of Surgeons of Edinburgh, UK; a Board Examined Academic Fellow in Oral Medicine by the American Academy of Oral Medicine; and a Board of Laser Safety® (BLS®) Certified Medical Laser Safety Officer (CMLSO®).

**Dr. H. Ray Jalian** – UCLA Division of Dermatology, Los Angeles, CA, Dr. Jalian will be replacing Dr. Mark Nester as the representative for the American Academy of Dermatology (AAD).

**Dr. Harvey Wigdor** – Dr. Wigdor, who previously participated on SSC-3, will be replacing Dr. Joel White as the representative for

the American Dental Association (ADA) on ASC Z136 as well as returning to active participation on SSC-3.

**Dr. Ken Sullins** – Marion DuPont Scott Equine Medical Center, Leesburg, VA, Dr. Sullins will be replacing Dr. Ken Bartels as the representative for the American Veterinary Medical Association (AVMA).

**Ms. Patti Owens, RN, MHA, CMLSO** – Patti has been asked by, and graciously agreed to change her membership status on ASC Z136 from individual to alternate representative for the American Society for Laser Medicine and Surgery (ASLMS). She will be replacing Dr. Brian Biesman in this capacity. Patti is currently the secretary of SSC-3.

Additionally, the committee approved the recommendation to remove **Dr. Hong Chen** from ASC Z136 membership due to inactivity. This action was discussed at the March 2013 Annual Meeting, at which time it was verbally agreed to terminate the membership.

If you are interested in participating on ASC Z136 or any of its subcommittees, please contact Barbara Sams at +1.407.380.1553 or email [bsams@lia.org](mailto:bsams@lia.org). To view committee activities or apply online, go to [www.z136.org](http://www.z136.org).

**ONSITE TRAINING**

BRING CUSTOMIZED  
**Laser Safety Training**  
TO YOUR FACILITY

To receive a quote, call today!  
**1.800.34.LASER**

**Laser Institute of America**  
Laser Applications and Safety

[www.lia.org/education/inhouse](http://www.lia.org/education/inhouse)

Time to think again about ways to earn certification maintenance (CM) points before the end of the year arrives; blink twice and the winter holidays will be upon us. For CLSOs® and CMLSOs® with terms ending this calendar year, time is of the essence. Reach your CM point goal with continuing education opportunities that are available online, choose either traditional laser safety courses or now application-based courses through LIA's Laser U Portal.

A second way to earn CM points is by writing laser safety or laser application related articles published external of your organization. In addition to peer-reviewed papers in journals and proceedings, online magazine or newsletter submissions are an easy way to acquire that elusive last CM point.

The following are excerpts from the *BLS® News & Review*, summaries of Laser U courses from a few CLSOs who saw the advantages of gaining knowledge in a field related, if not specific to, their own area of expertise and then sharing their insights with their colleagues.

---

William Hoak on *The Basics of Ultrafast Laser Machining*,  
Speaker – Reinhart Poprawe

“The website is professionally done and purchasing the course for viewing is straightforward. The course presentation materials and synchronized video of the speaker are presented in a split screen arrangement. The video and audio are of good quality and the presentation slides can be viewed in enlarged [view] or with several on the page together. The interface allows you to jump back and forth in the presentation making it easy to repeat an important point. The system also allows you to take notes online in a separate dialog box.”

“I found Dr. Poprawe’s [presentation] to be very interesting, educational and professionally done. While its emphasis was not on laser safety, it did enlighten me as to how many applications ultrafast lasers have... One could easily foresee that machining operations using ultrafast lasers will make a good compliment to the revolution that is happening in 3D laser printing of engineering prototypes. It is likely that ultrafast lasers will become much more common in the research and manufacturing environments and it is important for laser safety professionals to both understand the applications and have the necessary tools and knowledge to ensure safety of those involved with their use.”

---

Stu Hutchinson on *Main Types of Lasers Used for Manufacturing - Key Properties and Key Applications*, Speaker – Tom Kugler

“Tom Kugler is a dynamic speaker who doesn’t drone on. He speaks to slides but doesn’t read them to you, which I really appreciated. The transcript of the speaker is useful for when he says something that isn’t on the slides. The course presents a lot

of information in the slides, which would be useful for additional study or future reference.”

---

Mary Jo Handy on *Fundamentals of Laser Robotics*, Speaker – Doug Hixon

“This presentation thoroughly explores the issues inherent to laser robotics applications, which is demonstrated to be vastly different from the typical robotic applications. It is evident that the speaker, Douglas Hixon, is an expert in this realm of laser application based on his experience and the content presented. The lesson moves through an organized series of informational media, mixing standard slides with video clips that are supportive of the topic. The videos provide the viewer with examples of cutting-edge trends within the field of laser robotics, showing several processed-based applications...”

For access to the complete list of Laser U course overviews, please contact the BLS office at +1.407.985.3810 or email [bls@lasersafety.org](mailto:bls@lasersafety.org).

## Certification for Laser Safety Officers

Providing Professionals a Means for Improvement in the Practice of Laser Safety



**Gain a Competitive Advantage by Becoming Certified Today!**

**BLS**  
Board of Laser Safety

**CLSO**  
Certified Laser Safety Officer

**1.800.34.LASER**  
+1.407.985.3810  
[www.lasersafety.org](http://www.lasersafety.org)

# LASER INSIGHTS

Laser Insights is a feature to give insight into the very latest developments in laser safety and the possible applications of laser materials processing. These overviews are designed to give you insight into the content and applications of the papers presented at our conferences and workshops. Visit [www.lia.org/laserinsights](http://www.lia.org/laserinsights) to begin your search. View complete articles of the abstracts below online under the Featured Category.

## FEATURED ABSTRACTS

### A TECHNICAL AND COMMERCIAL COMPARISON OF FIBER LASER AND CO<sub>2</sub> LASER CUTTING

By John Powell, Alexander Kaplan

Since the advent of commercial fiber and disk laser cutting machines, there has been a lot of controversy about the performance of these devices – particularly in comparison to their more established CO<sub>2</sub> counterparts. In the early days, the sales staff promoting fiber technology would often declare that the new lasers would completely take over from CO<sub>2</sub> technology very quickly – but this has not happened. Even taking into account the entrenched position of the older technology, fiber and disk lasers have not been as widely accepted as was predicted, although they have been proven to out-perform CO<sub>2</sub> lasers in certain important areas.

### LOCAL LASER JOINING OF GLASS AND SILICON

By Assi Hansen, Isamu Miyamoto, Tiina Amberla, Yasuhiro Okamoto

One of the most employed material combinations in microtechnology is the glass-silicon pair. Since the huge growth of the microelectromechanical devices, sensors and micro-fluidic devices, bonding of this couple has become more and more

critical issue. Many of these glass-silicon bonding processes, for example anodic bonding, fusion bonding and eutectic bonding, have reached their limits in terms of flexibility. Compared to conventional methods, local laser joining technique can provide many advantages, such as localized and flexible joining, non-contact manufacturing, high precision and repeatability, easiness and minimization of heat effects.

### WELDING CHARACTERISTICS OF FOTURAN GLASS USING ULTRASHORT LASER PULSES

By Isamu Miyamoto, Yasuhiro Okamoto, Kristian Cvecek, Michael Schmidt, Henry Helvajian

Recently, ultrashort laser pulse (USLP) has brought a new wave of laser welding that enables crack-free welding of dielectric material like glass without pre- and post-heating. The advantages of USLP welding of glass are provided by embedded molten pool due to the unique laser absorption mechanism of nonlinear process. It has been shown that the stress due to the thermal shrinkage of the weld bead can be in principle prevented in USLP welding of glass where molten pool is embedded in bulk glass.

**THE EVALUATOR™**  
LIA's LASER SAFETY HAZARD ANALYSIS SYSTEM

- Designed for Today's LSO
- Enhanced Accessibility
- Easier Navigation
- Automatic Updates to System
- Save Time and Money!

[www.LSEval.com](http://www.LSEval.com)

Developed By  
**Laser Institute of America**  
Laser Applications and Safety



# JLA UPDATE

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](http://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.

## RESEARCH HIGHLIGHT

### EXPERIMENT INVESTIGATION ON MICROSTRUCTURE AND MECHANICAL PROPERTIES OF TC17 TITANIUM ALLOY TREATED BY LASER SHOCK PEENING WITH DIFFERENT LASER FLUENCE

By Xiangfan Nie, Weifeng He, QiPeng Li, Nidong Long, Yan Chai

In this paper, microstructure, microhardness and residual stress of TC17 titanium alloy treated by laser shock peening (LSP) with different laser fluence were examined and compared by x-ray diffraction, scanning electron microscope, transmission electron microscope, microhardness test and residual stress test. The results of microstructure point out that microstrains and grain-refinement are generated in the material surface layer which is a severe plastic deformation layer. In relation to the microhardness and residual stress, the results indicate that LSP can obviously improve the hardness and introduce a great compressive residual stress which also has a good thermal stability.

## SUBSCRIPTION INFORMATION

### BY PHONE

For non-members of LIA, call the American Institute of Physics at 1.800.344.6902 for subscription information.

### ONLINE

Sign up at [jla.aip.org/alerting\\_services/table\\_of\\_contents\\_alerts](http://jla.aip.org/alerting_services/table_of_contents_alerts) to receive your *JLA* table of contents email alerts.



## Laser Safety Awareness ONLINE TRAINING

### Convenient Training For All Laser Personnel

Learn basic physics, biological effects, control measures for safe laser environments, and beam and non-beam hazards.

Understand the ANSI Z136 standards and regulations that apply to your unique laser environment.

Access the course anywhere and work at your own pace.

The course administrator is able to keep track of all records and certificates upon completion.

Presented by:



Laser Institute  
of America  
Laser Applications and Safety

[www.lia.org/education](http://www.lia.org/education)  
1.800.34.LASER

# LIA ANNOUNCES



## BECOME A LAM 2014 EXHIBITOR OR SPONSOR TODAY!

Mark your calendars now for LIA's Laser Additive Manufacturing (LAM®) Workshop, which will be returning to Houston, TX, March 12-13, 2014. LIA's sixth annual LAM will bring industry specialists, executives, users and researchers from around the world to show how laser additive processes can be applied effectively and affordably to today's manufacturing challenges. This workshop will have a significant impact on the widespread industrial implementations of laser additive manufacturing. Sign up today to participate as a LAM 2014 exhibitor or highlight your company through one of the Workshop's multiple sponsorship opportunities. For more information, visit [www.lia.org/lam](http://www.lia.org/lam) or call 1.800.34.LASER.



**LASER U**  
INDUSTRY • GOVERNMENT • EDUCATION

## LASER U: CONVENIENCE IN CONTINUING EDUCATION

Have you missed one of LIA's conferences or events or would you like to sample a course before you register for an upcoming workshop? LIA's newest course offering – Laser U — is a new and easy way for laser professionals of all levels of experience to access the best presentations from LIA's industry-leading conferences and workshops. Laser U users will be able to follow the text and audio of each speaker's presentation at their own pace — over the course of several hours, even several days — with the option to follow each slide in order or jump forward or backward as they wish. Online “attendees” can feel more confident interacting with major players in the laser industry and discussing how different lasers and systems can benefit their manufacturing operations. Twelve new presentations from LIA's Laser Additive Manufacturing (LAM) Workshop and LIA's International Laser Safety Conference (ILSC®) this year are now available to sample or purchase. For further information or to sign up for modules as they become available, visit [www.lia.org/laseru](http://www.lia.org/laseru) or call 1.800.34.LASER.

## NAMII, CIMP-3D TOURS KICK OFF LIA INDUSTRY WATCH FEATURE

When President Barack Obama took a moment in his State of the Union address earlier this year to mention the converted warehouse in Youngstown, OH, that is home to the National Additive Manufacturing Innovation Institute, he made Kevin Collier's life a little more hectic.

But Collier, factory manager of NAMII, doesn't seem to mind. During a special tour for the Laser Institute of America that

lasted more than an hour on Aug. 23, he proudly displayed the broad range of machines and materials he and his interns employ to push the boundaries of laser-based AM.

CIMP-3D — the Center for Innovative Metal Processing Through Direct Digital Deposition — and NAMII are busy incubators for the AM processing, products and technology that LIA stresses at its industry-leading conferences like LAM and LME®. Visit [www.lia.org/blog](http://www.lia.org/blog) for more information.

## REGISTER NOW TO ATTEND THE LSO FOR R&D COURSE IN NOVEMBER

Due to its high demand and popularity, LIA will be hosting its next Laser Safety Officer for R&D course at Coherent in Santa Clara, CA on Nov. 19-21, 2013. This two-and-a-half day course provides the individual appointed as Laser Safety Officer (LSO) with reasonable and adequate guidance for identifying laser hazards and implementing control measures for these hazards. The course is based on the newly released *American National Standard for Safe Use of Lasers in Research, Development, or Testing*. The main goal of this new course is to prepare LSOs to oversee the safe use of lasers in oftentimes ad hoc situations. For more information, or to register, visit [www.lia.org/education](http://www.lia.org/education) or call 1.800.34.LASER.

**LME® 2013**  
LASERS FOR MANUFACTURING EVENT®

## SAVE THE DATE FOR LME 2014 & ITS BIG MOVE IN 2015!

With the success of LIA's third annual Lasers for Manufacturing Event® (LME) still resonating, LIA will be hosting its fourth LME the same time next year on Sept. 23-24, 2014. Conveniently located in Schaumburg, IL, at the heart of the country's automotive industry, LME draws world famous authorities that provide attendees with the latest in laser technology applications, including cutting, robotics and additive manufacturing. Attend the expanded FREE educational sessions covering the main laser types, laser systems, ROI and safety. LME is a one-stop shop for companies interested in integrating laser technology into their production and will connect you with the suppliers, right on the show floor, who can help you to benefit from using lasers in your manufacturing.

In 2015, LIA will be making a switch and plans to celebrate LME's fifth anniversary by moving the Event to the ever-growing metropolis of Atlanta, GA. However, LME 2015 will not be taking place in the Fall, as it has in the past, but will also be transitioning to May/June – with the final date still to be determined. For more information on the upcoming 2014 education track, available sponsorship opportunities or the impending dates of LME 2015, please visit [www.laserevent.org](http://www.laserevent.org) or call 1.800.34.LASER.



# Invest in the Best

## TRUMPF Lasers Experience, Innovation, Versatility

Manufacturing lasers since 1971, TRUMPF has more than 4 decades of experience with industrial lasers and their applications. As the biggest industrial laser company in the world with the largest laser installed base of any manufacturer, TRUMPF has the most comprehensive product portfolio ensuring the right tool for the job. We offer the most extensive customer support structure of any laser supplier. Our vast experience in applications and process development, training, spare parts and service is at your disposal. Invest in a TRUMPF laser and invest in the best.

[www.us.trumpf.com](http://www.us.trumpf.com)



For more information  
scan the QR code with  
your smartphone.

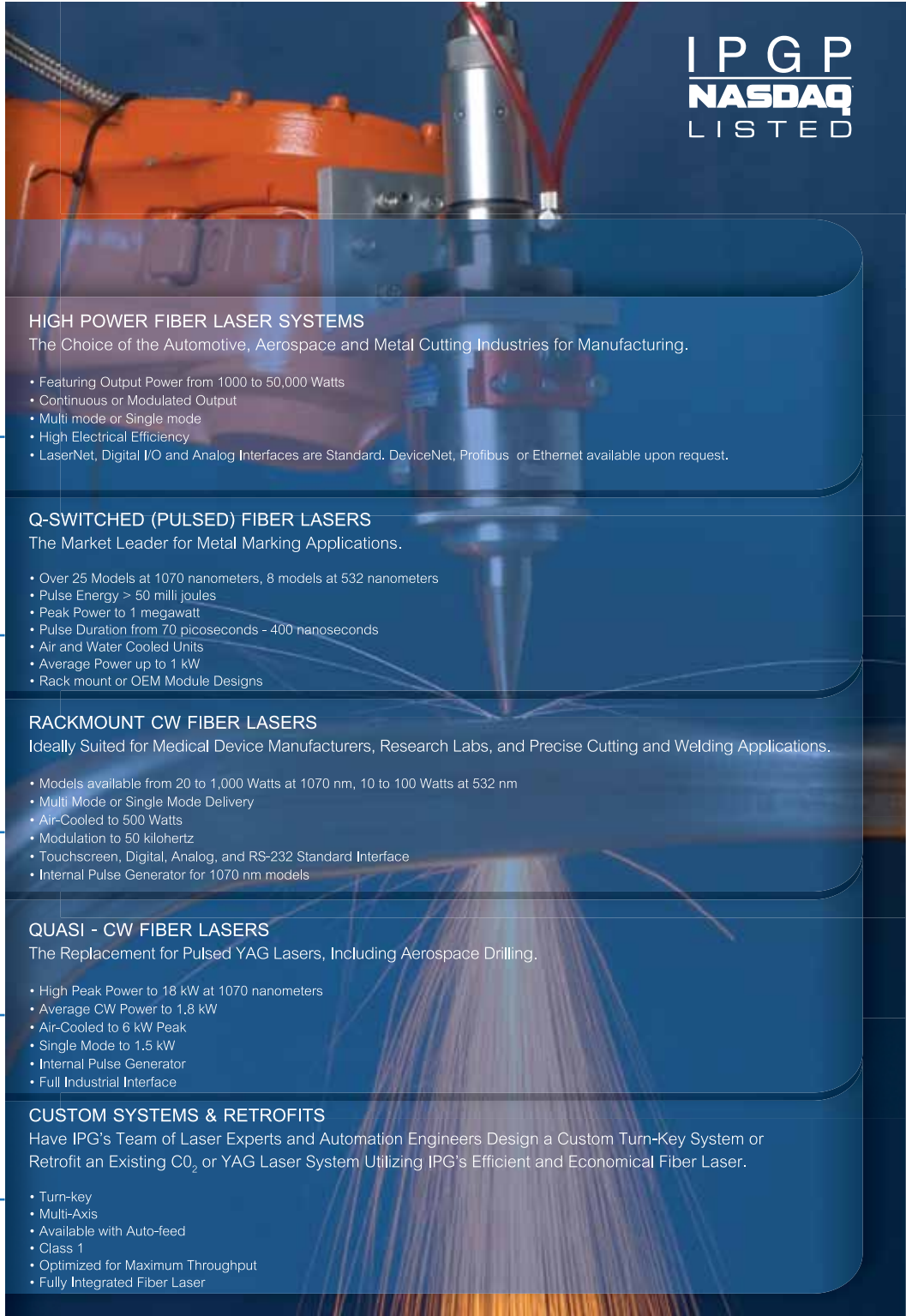
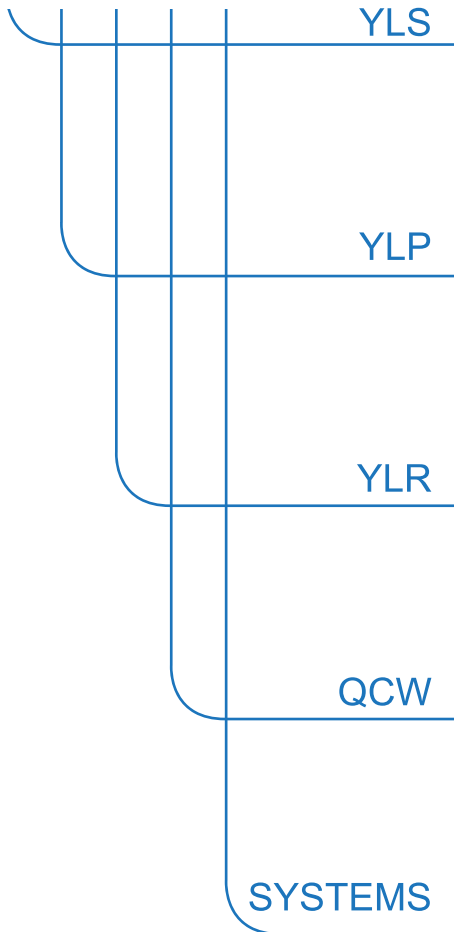






FROM THE  
**INNOVATOR**  
AND LEADING  
**SUPPLIER OF**  
FIBER LASERS FOR  
MANUFACTURING

Offering the most complete line of fiber  
lasers for all production applications



**HIGH POWER FIBER LASER SYSTEMS**

The Choice of the Automotive, Aerospace and Metal Cutting Industries for Manufacturing.

- Featuring Output Power from 1000 to 50,000 Watts
- Continuous or Modulated Output
- Multi mode or Single mode
- High Electrical Efficiency
- LaserNet, Digital I/O and Analog Interfaces are Standard. DeviceNet, Profibus or Ethernet available upon request.

**Q-SWITCHED (PULSED) FIBER LASERS**

The Market Leader for Metal Marking Applications.

- Over 25 Models at 1070 nanometers, 8 models at 532 nanometers
- Pulse Energy > 50 milli joules
- Peak Power to 1 megawatt
- Pulse Duration from 70 picoseconds - 400 nanoseconds
- Air and Water Cooled Units
- Average Power up to 1 kW
- Rack mount or OEM Module Designs

**RACKMOUNT CW FIBER LASERS**

Ideally Suited for Medical Device Manufacturers, Research Labs, and Precise Cutting and Welding Applications.

- Models available from 20 to 1,000 Watts at 1070 nm, 10 to 100 Watts at 532 nm
- Multi Mode or Single Mode Delivery
- Air-Cooled to 500 Watts
- Modulation to 50 kilohertz
- Touchscreen, Digital, Analog, and RS-232 Standard Interface
- Internal Pulse Generator for 1070 nm models

**QUASI - CW FIBER LASERS**

The Replacement for Pulsed YAG Lasers, Including Aerospace Drilling.

- High Peak Power to 18 kW at 1070 nanometers
- Average CW Power to 1.8 kW
- Air-Cooled to 6 kW Peak
- Single Mode to 1.5 kW
- Internal Pulse Generator
- Full Industrial Interface

**CUSTOM SYSTEMS & RETROFITS**

Have IPG's Team of Laser Experts and Automation Engineers Design a Custom Turn-Key System or Retrofit an Existing CO<sub>2</sub> or YAG Laser System Utilizing IPG's Efficient and Economical Fiber Laser.

- Turn-key
- Multi-Axis
- Available with Auto-feed
- Class 1
- Optimized for Maximum Throughput
- Fully Integrated Fiber Laser

