THE OFFICIAL NEWSLETTER OF THE LASER INSTITUTE OF AMERICA

LIA TODAY

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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	
Jun. 12–14, 2018	Indianapolis, IN
Dec. 4–6, 2018	Orlando, FL

Laser Safety Officer with Hazard Analysis*	
Mar. 5–9, 2018	Marina del Rey, CA
Jun. 11–15, 2018	Niagara Falls, NY
Sept. 17–21, 2018	Kansas City, MO
Oct. 15–19, 2018	Orlando, FL

*Certified Laser Safety Officer exam offered after the course.

Industrial Laser Safety Officer Training	
May 16–17, 2018	Novi, MI
Aug. 15–16, 2018	Novi, MI
Nov. 14–15, 2018	Novi, MI

Medical Laser Safety Officer Training*	
Mar. 3–4, 2018	Marina del Rey, CA
June 2–3, 2018	Atlanta, GA
Sept. 15–16, 2018	Kansas City, MO
Oct. 13–14, 2018	Orlando, FL

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

Laser Additive Manufacturing Conference (LAM®)	
Mar. 27–28, 2018	Schaumburg, IL

Lasers for Manufacturing Event (LME®)	
Mar. 28–29, 2018	Schaumburg, IL

Industrial Laser Conference	
Sept. 12, 2018	Chicago, IL

International Congress on Applications of Lasers & Electro-Optics (ICALEO®)	
Oct. 14–18, 2018	Orlando, FL

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President's Message

Welcome to 2018 and the first edition of *LIA TODAY* for the year. This year is special for LIA and its members, but before I elaborate I would like to tell you a little about myself and my involvement with LIA. First of all, I am honored to be your president for 2018. It is the pinnacle of my involvement with LIA since 1986. For those who don't know me, I am a laser physicist by training and have been conducting research in laser macroprocessing and more recently additive manufacturing for the bulk of my professional career. In the past, I have been an LIA board member, served on the executive committee, and have worked in various capacities with ICALEO and LAM conferences. In 2004 and 2006, I ran the first two successful PICALO conferences in Melbourne, Australia, with the support of LIA, which focused on laser materials processing in the Pacific region.

I am following Paul Denney, LIA president for 2017, who did a fantastic job steering the association through the retirement of Peter Baker, the LIA's long-serving executive director, and the selection and appointment of our new executive director, Nat Quick. On behalf of all of us, we want to express a big "thank you" to Paul for his leadership and countless hours spent last year keeping the "LIA ship" on its course.

LIA is transitioning. In order to continually provide value, the association needs to respond to local and global changes impacting its members. Around the time of Peter Baker's retirement, this process began last year with the executive, board, and LIA staff examining all aspects of LIA operations. This includes increasing individual and corporate membership, increasing conference value to participants, and bettering publications and training to match the needs of members. I promise to work very closely with Nat Quick, the board, and LIA staff to continue implementing and refining these changes in 2018 for the association's benefit. My priority for the year will be to increase member involvement with LIA through updated membership benefits, policies and procedures.

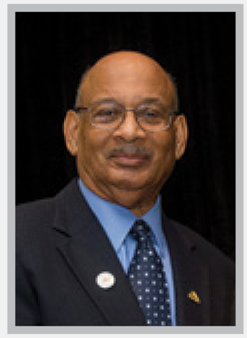
I mentioned at the beginning of my message that 2018 is a very special year for the association. LIA turns 50 this year. We are one of the oldest associations promoting and supporting lasers and applications globally. We should all be very proud of our member researchers and corporations who have contributed to the huge impact laser technology has made globally to date in so many industry sectors, a trend that continues to grow. As part of this, LIA will make various announcements throughout the year and plans to have a major celebration at ICALEO to commemorate this special occasion. I look forward to seeing you all there.

Finally, I wish you all a happy, healthy and prosperous 2018 and look forward to working with you to grow our association into the future.

M. Brandt

Milan Brandt, President
Laser Institute of America

Executive Director's Message



LIA has undertaken a bottom-up business assessment to better understand our current operations and to define areas for improvement to move the organization into a new period of growth and sustainability. The results from this assessment will help form LIA's strategic plan. Our strategic plan will include a realistic roadmap and timeline for what will be a multiyear effort. The primary objective is to continually improve the value and benefits we offer to our current and future members. We feel that as an organization who services innovative technologists, we must develop innovative solutions to provide value to our membership.

An outgrowth of the formulation of this effort is the digitization of all of LIA's journals and conference proceedings. This will allow the content to be accessed online in packages that scale with member size.

Digitization also branches into our education department where all safety programs can be accessed online and integrated into existing learning management platforms already in place at major companies. We are evaluating this teaming approach with Luminar, a LIDAR company developing autonomous car technology.

Bill Shiner and Jim Naugle recently developed a new corporate membership structure for the laser user community, which includes the commercial materials synthesizers and manufacturers. We must be aggressive in serving the user community.

Since the formation of LIA, we have interacted with the industrial sector of advanced material processing. Reinhart Poprawe and now Yongfeng Lu have led the continuous improvement in the quality of the *Journal of Laser Applications (JLA®)* content, giving us an anchor in the applications development space. We plan to continue to grow and expand in this sector.

In a subsequent phase, we will explore the electronic/semiconductor sector which has constituents, particularly INTEL, who have expressed interest in becoming more involved in LIA functions.

As we transition and formulate our strategic plan for the future, we are receiving perspectives from technical associations which have gone through same processes to engage in the 21st century. We welcome any input that the LIA membership may have.

Nat

Nat Quick, Executive Director
Laser Institute of America

Meet LIA's New Executive Director

Nat Quick

BY BRANDON KALLOO

After nearly three decades, the Laser Institute of America (LIA) made a massive change, appointing Dr. Nathaniel Quick, founder of AppliCote Associates, LLC and former LIA President, as its new executive director.

Nominated by LIA's board of directors, Quick succeeds Peter Baker, who retired May 2017; he is expected to lead the association for the next several years.

"I welcome this opportunity to guide LIA in this phase of its innovative growth," Quick said. "LIA has been a tremendous laser materials processing knowledge-base for my company, inspiring the creation of our patented laser-based technologies for new industrial applications. Now, I can return the favor."

Quick earned several degrees in Materials Science and Engineering from Cornell University, including a Doctor of Philosophy in 1976.

After completing his education, Quick held a position as the Vice President of Washburn Wire Products, Inc., where he focused on quality control and laboratory operations. Eventually, Quick cofounded AT&T Coatings, an entrepreneurial spin-off with a focus on technological applications.

"The most rewarding part of working in the sciences is that you are going through a continuous learning process," Quick said. "There is no end. The more you learn, the more you understand that you don't know. It keeps you humble."

Between 1985 and 1989, Quick was the CEO and chief scientist for his own company, Applications Technology of Indiana, Inc., where he developed clad-coat micro-composited powders for powdered metal and conductive polymer electronic applications. From 1990 to 2002, Quick occupied leadership positions within several companies focused on materials processing and research development. For several years he continued to hone his skills as a negotiator and a project developer before founding his self-financed company, AppliCote Associates, LLC, in 2003.

"My experience gave me the necessary skills to analyze situations," said Quick. "I am able to corral a problem and create what I call a solution-path, which is logical. It has also taught me to listen and observe before responding and to approach things with factual information before making decisions."

LIA's Executive Director Nat Quick with four of LIA's directors outside the office in Orlando, FL.

His honors and awards include the Minority Engineers Outstanding Contributions award; Cornell University's Outstanding Achievement Business/Professions Center for Leadership and Development award; and the Indianapolis Indiana and EG&G Award of Excellence Rocky Flats (twice). Additionally, Quick holds 62 U.S. patents and has more than 60 publications to his name.

"I have a responsibility to society," Quick said. "Education has provided me with the skills, direction and opportunities to influence change and to give back."

He is a fellow of the African Scientific Institute, a past guest NIST researcher and a past member of the Army Science Board. He is chairman of the UCF Materials Science and Engineering's industrial advisory board, and is currently a graduate faculty scholar. He is also currently a member of ASM International and the Materials Research Society.

"LIA is embarking on the next 50 years by undertaking initiatives to modernize the brand," Quick said. "By accelerating the digitization of our publications, we intend on providing an easily assessable library of knowledge to our members. Additionally, we are improving courses by redesigning and expanding the course content. LIA will also collaborate with UCF to develop a course curriculum focused on laser processing of advanced materials." ■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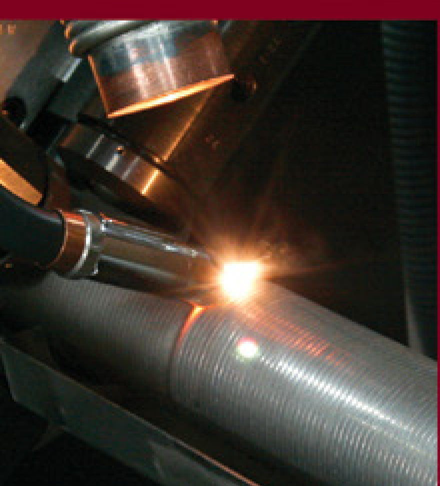
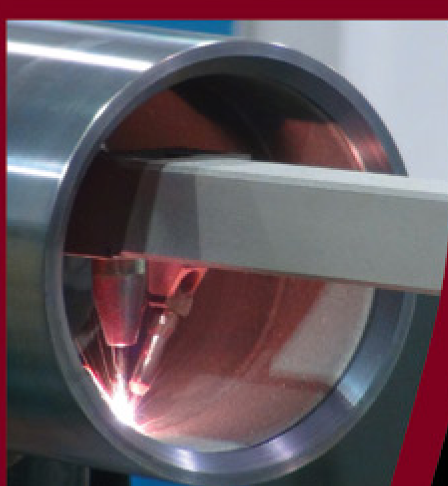

How Powder Characteristics Influence

the Part Properties of Laser Beam Melted Titanium

BY VANESSA SEYDA, DIRK HERZOG, CLAUS EMMELMANN

Nowadays, Laser Beam Melting (LBM) has become a true option for series production of functional parts. Metallic materials may be processed from the powder bed to fully dense parts. However, the use of LBM for industrial applications also requires reliable quality assurance methods. Besides monitoring and controlling the process, this implicates a thorough understanding of the relationship between the powder characteristics and the properties of the manufactured parts. Therefore, the investigations presented here address the influence of particle size distribution and morphology, chemical composition and flowability of a titanium powder on the density, static strength and hardness of LBM-processed specimens.

Material and Methods

Powders from different suppliers and production routes are studied. The production routes comprise the following:

- Inert Gas Atomization (IGA)
- DC Plasma Atomization (DC-PA)
- Induction Coupled Plasma Atomization (IC-PA)

All powders are ordered to be of the chemical composition Ti-6Al-4V. According to the suppliers´ certificates, the three selected powders feature similar particle size distributions, ranging from 20 μm - 53 μm (DC-PA and IC-PA) to 20 μm - 63 μm (IGA).

The powders received are initially analyzed for their particle morphology using a scanning electron microscope. The particle size distribution is determined by laser diffraction.

To assess the chemical composition, four different methods are applied in order to cover all relevant elements. Ti, Al and V content are determined by Optical Emission Spectroscopy using Inductively Coupled Plasma. The Fe content is analyzed using Flame Atomic Absorption Spectrometry, while O, H and N are detected by carrier gas hot extraction. C content is detected by combustion analysis.

In order to assess the flowability of the powders, different methods are used and compared. These include the following:

- Hall flow (set-up close to DIN EN ISO 4490)
- Angle of repose (in accordance with ISO 4324)
- Avalanche angle (Powder Revolution Analyzer)
- Hausner Ratio (tap density / apparent density)
- FT4 Powder rheometer

For the LBM process itself, a commercial LBM system (EOS M270) is used with a fixed parameter set optimized to process fully dense titanium parts. The density of the specimens was determined according to the Archimedes method. Additionally, tensile tests are performed and Yield strength YS, ultimate tensile strength UTS and elongation at break ε are determined. For this, the specimens are left in the as-built condition to preserve potential differences in microstructure and surface.

Results and Discussion

Powder morphology and particle size distribution are presented in Figure 1.

The DC-PA and IC-PA powders have the most spherical appearance, but the DC-PA powder has a smoother surface and a smaller number of satellites. The IGA powder features some irregular and rounded particles and has a rather rough surface by comparison. Regarding the particle size distribution, the IC-PA powder tends to have finer particles while the IGA powder appears coarser.

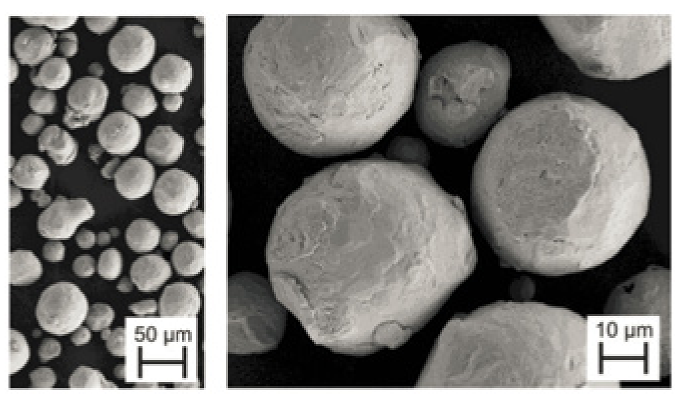

Figure 1a: SEM overview of IGA powder (left) and detail of morphology (right)

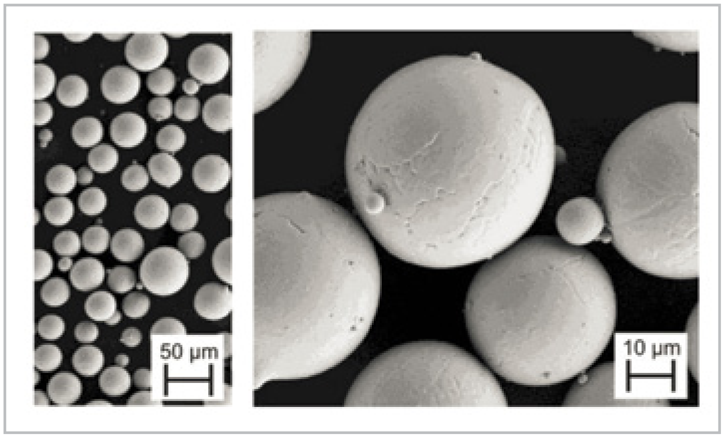

Figure 1b: SEM overview of DC-PA powder (left) and detail of morphology (right).

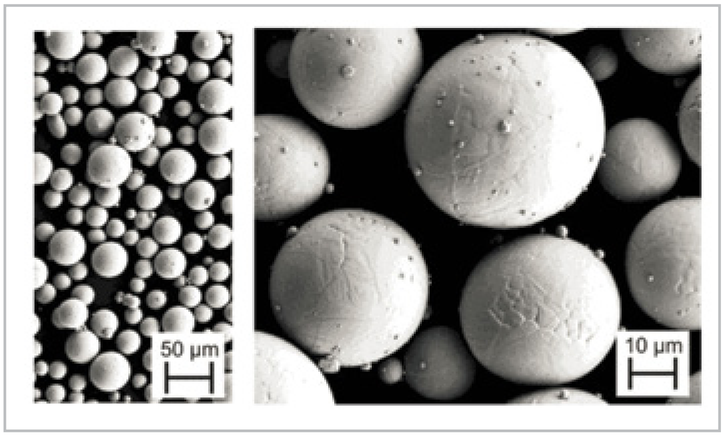

Figure 1c: SEM overview of IC-PA powder (left) and detail of morphology (right).

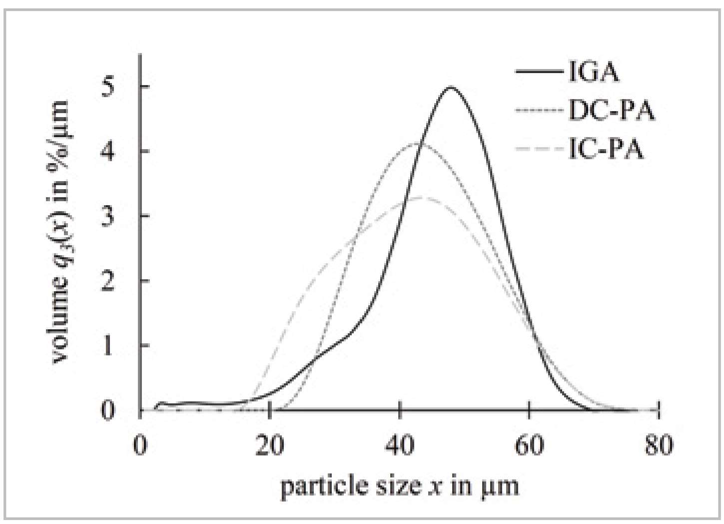

Figure 1d: Particle size distribution of the investigated powders.

The results of the chemical composition analysis are shown in Table 1. While all powders meet the specifications for the Ti-6Al-4V alloy, the substantially lower oxygen content in the IC-PA powder should be noted.

element \	IGA	DC-PA	IC-PA
Ti		balance	
Al	6.39	6.5	6.27
V	4.08	4.06	4.1
Fe	0.19	0.21	0.2
C	0.005	0.006	0.015
H	0.002	0.002	0.002
N	0.009	0.011	0.010
O	0.122	0.139	0.073

Table 1: Chemical composition of the three investigated powders (in wt%)

The flowability measurement methods do not yield completely conform results for the three powders, as shown in Table 2.

method \	IGA	DC-PA	IC-PA
Hall flow[a]	+	++	--
Angle of repose[a]	o	+	o
Avalanche angle[a]	o	+	-
Hausner ratio[b]	+	++	+
FT4 (dynamic)[a]	o	+	o
FT4 (aerated)[a]	o	+	+

[++] very high; [+] high; [o] fair; [-] low; [--] very low
[a] relative comparison; [b] acc. to [1]; [c] acc. to [2]

Table 2: Assessment of flowability by various methods

A detailed description of the methods and results regarding flowability may be accessed in [3].

Despite the differences noticed in flowability, all three powders have been successfully applied in LBM, and no anomalies have been observed by visual control of the powder deposition process. The relative density of the specimens is 99.74% (IGA), 99.69% (DC-PA) and 99.62% (IC-PA), yielding no clear correlation with the flowability results.

Regarding chemical composition, only slight variations from powder to part have been observed, cp. table 3. Again, all specimens meet the specifications for the alloy composition. However, the significantly lower oxygen content of the IC-PA powder persists to the final part. Oxygen is a major factor in increasing strength and reducing ductility [4].

(Continued on page 12)

element \	IGA	DC-PA	IC-PA
Ti	balance		
Al	6.36	6.22	6.35
V	4.17	4.04	4.17
Fe	0.19	0.21	0.2
C	0.009	0.009	0.018
H	0.003	0.003	0.002
N	0.021	0.021	0.021
O	0.131	0.156	0.083

Table 3: Chemical composition of samples (in wt%)

The influence of oxygen content can be clearly observed in the static strength properties of the specimens, cp. Figure 2. While the IGA and DC-PA powders produce specimens with comparable YS and UTS, the specimens from IC-PA powder show slightly lower strength values. The ductility of the IC-PA specimens is significantly higher.

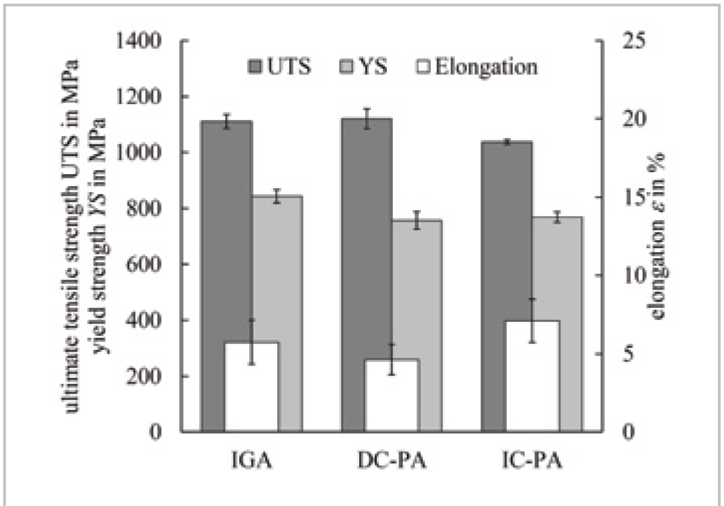

Figure 2: Yield strength, ultimate tensile strength and elongation at fracture of the as-built specimens.

Conclusions and Implications on Quality

Three Ti-6Al-4V-powders from different production routes were successfully used to build test samples in a commercial LBM system. While the powders showed distinct differences in morphology, chemical composition and flowability, no anomalies in the deposition process of the LBM system were observed.

Despite the differences in powder characteristics, a clear correlation with part properties was only observed for the oxygen content, which significantly influences static strength and ductility. It becomes clear that the oxygen content is by far the dominating influencing factor regarding part properties once titanium is applied in LBM.

As for the flowability assessment, it was found that no simple method exists that can easily predict the behavior of the powder under all conditions relevant for LBM. Since the powder supply from the container resembles a rather static condition while the deposition process is characterized by a rather dynamic condition, a suitable test method will probably need to take into account both cases.

In consequence, a potential way to assess the quality of a powder could consist of the following steps:

- Initial assessment of the flowability by a simple and efficient method such as Hall flow or Hausner ratio, which can be used to find anomalies in a powder batch compared to an existing reference
- Subsequent test of powder batches showing anomalies in the initial test by a more sophisticated method such as the FT4 powder rheometer, which may help to understand the exact behavior of the powder under various conditions
- Continuous and thorough analysis of the oxygen content of powder and production samples

Alternatively to the first two steps, direct application of a layer of the powder to the LBM system and visual inspection may be used. ■

Acknowledgements

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LAM 2018

LIA invites you to the 2018 Laser Additive Manufacturing Conference

BY RON D. SCHAEFFER, PH.D.

Laser Additive Manufacturing (LAM) is one of the most exciting potential growth areas for the laser industry. The market has been watched for a few years and every year there are gains in the revenue generated by this market segment, but so far the revenue curve has not started rising dramatically. This can be viewed as both good news and bad news. The "bad" news is that the market has not exploded…yet! According to Alan Nogee from Strategies Unlimited, the industry can be broken down as follows:

- Stereolithography – Reasonable growth but the industry depends on more non-laser solutions.
- Laser Sintering (DMLS/SLS) – This area is growing strongly. There are two main application areas – plastics and metals. Plastics suffer from the availability of a variety of materials and usually use CO_2 and Diode lasers, usually with under 300W of output power.
- High Speed Sintering (HSS) – This is a newer technology and is used primarily for plastics. This technique is 10 – 100 times faster than SLS and can manufacture many tens of thousands of units per day. At the time of this writing, metals are not yet there, but time may change that.

The good news is that the LAM market is set to really ramp up and could spike in the next couple of years. Therefore, it is a great time to investigate LAM (and thereby the LAM® Conference) to get in on the "ground floor" of the technology. While this conference has been around for 10 years, this year the venue has moved to Schaumburg, IL, for the first time and is co-located with the Lasers in Manufacturing Event® (LME®) with overlap on Wednesday, March 28th. The conference takes place at the Schaumburg Convention Center on March 27–28, 2018.

Why attend LAM?

- Interact with laser industry experts – the Program chairs in particular are a very recognizable and highly respected group.
- Find out if Laser Additive Manufacturing can help with your manufacturing problems.
- Network not only with the exhibitors but other attendees as well.
- As part of the registration fee for LAM, entry to the LME show is also included! Take advantage of both events and all of the associated benefits.
- Find a job in the photonics industry – or find laser experts to bring onto your team if you are thinking about ramping up laser processing.
- Increase the bottom line by increasing profits! In a manufacturing world this is what it is all about.

Program/Agenda

The LAM chairs will return to build on its successful program from last year. Milan Brandt of RMIT University will continue as the General Chair, with John Hunter of LPW Technology, Inc. and Minlin Zhong of Tsinghua University serving as Conference Co-chairs.

Day One

A representative from America Makes will give the first keynote address of the conference, titled "Smart Collaboration: A Public-Private Approach to Advancing the Additive Manufacturing Industry." America Makes strives in additive manufacturing (AM) and 3D printing (3DP) technology research, discovery, creation, and innovation to increase global manufacturing competitiveness.

Other presentations range in topics from laser cladding to laser welding. Prabu Balu of Coherent, Inc. will discuss recent advances in laser cladding. Balu is the senior application engineer at Coherent. His talk will provide a set of guidelines to successfully deposit highly reflective materials using powder-based laser cladding (LC), high deposition rate (up to 10 kg/hr) with minimal dilution (as low as 1%) using hot-wire based LC and thin coating thicknesses (varying from 25 μm to 500 μm) using ultra-high-speed LC process.

Paree Allu of Flow Science will give a presentation on "Computational Fluid Dynamics (CFD) Modelling for Additive Manufacturing and Laser Welding." Allu is a computational fluid dynamics engineer at Flow Science. Allu will explain how CFD modelling can help with the widespread use of AM technologies by providing a framework to better understand AM processes from the particle and melt pool scales.

Day One will wrap up with presentations on Process Monitoring, featuring John Lehman from the National Institute of Standards and Technology (NIST) and his talk on Laser-based Manufacturing; Novel Developments in Process Monitoring at NIST. Lehman is the leader of the Sources and Detectors research group at NIST and a fellow of the Alexander von Humboldt Foundation of Germany. The research group provides laser power and energy meter calibrations to the U.S. and much of the world.

Day Two

Keynote speaker Ehsan Toyserkani from the University of Waterloo will kick off Day Two with an overview of Canada's additive manufacturing initiatives. Toyserkani is the founder of and research director for the MSAM lab at the University of Waterloo, the university research chair for additive manufacturing, and a professor in the Department of Mechanical and Mechatronics Engineering. His presentation will cover the challenges and opportunities related to a research program on novel in- and off-line quality monitoring of selective laser melting along with assurance protocols.

The following session will feature Warwick Downing of Rapid Advanced Manufacturing Limited and his thoughts on how to grow the metal additive manufacturing industry. Downing is the chief executive of Rapid Advanced Manufacturing. He established Rapid Advanced Manufacturing Ltd (RAM3D) in 2013 with a group of like-minded shareholders to grow the commercial opportunities created by the growth of the metal 3D printing sector.

In the final session of the conference, Mohsen Seifi from the American Society for Testing and Materials (ASTM) International will discuss the standardization of additive manufacturing. Seifi is the director of Global Additive Manufacturing programs at ASTM International. Previously, he was a doctoral researcher in the Department of Materials Science and Engineering at Case Western Reserve University.

After the final session, there will be a reception on the show floor in conjunction with LME starting at 4 pm. Since LAM attendees are welcome to fully participate in LME, there are also many more talks, tutorials and classes available. Please see the information on LME for details. LIA will provide attendees with an enhanced experience by co-locating LAM and LME.

Sponsors

The premier LAM conference sponsor is Alabama Laser. Alabama Laser has been involved in laser materials processing for many years and is one of the pioneers of LAM in the U.S. Alabama Laser provides a range of advanced laser services, such as cladding, welding and heat treating, as well as process development, laser research, and custom laser systems. Working in conjunction with their affiliate company, Alabama Laser Technologies, they are also able to offer customers additional services such as laser cutting, punching, forming, welding, and precision machining services.

The other generous sponsors of LAM are Trumpf, LPW and Laserline. Trumpf is a German manufacturing company with not only a large laser division, but an even larger traditional machine tool presence, and they are making a big push for LAM as part of their strategic future planning. LPW Technology Inc. is a metal powder manufacturer that aims to improve additive manufacturing. Its quality powders are compatible with all additive manufacturing systems. The company also offers a PowderLife lifecycle management program for quality assurance. Safe-handling, storage, measurement, and testing solutions are available to ensure proper powder usage. Laserline is a company delivering high power diode lasers. Laserline is a longtime LIA supporter and has been in the LAM industry for many years. Laserline offers industry-appropriate laser solutions for laser materials processing – from beam generation to the work piece.

In addition to their sponsorship, all of the above companies are also exhibitors and will have experts at both LAM and LME ready to answer any technical or budget-related questions that may arise.

Registration is now open! For more information and to register, visit **www.lia.org/lam**. ■

Ron D. Schaeffer is a technical consultant to PhotoMachining.

FOR TIPS ON HOW TO MAKE THE MOST OF YOUR CONFERENCE VISIT, SEE PAGE 17.

LME 2018

Register Now for the 2018 Lasers for Manufacturing Event

BY RON D. SCHAEFFER, PH.D.

The laser market is booming! While the U.S. economy in general is on a tear with the stock markets at record highs, the laser industry in particular is showing better financial numbers than the overall economy. The total laser market was up approximately 20% in 2017 relative to 2016, making it one of the best years in the history of the laser industry, and it appears that 2018 could show just as much growth.

The laser market is growing due to manufacturers discovering the use of lasers to improve their processes. Don't be left behind by your competitors. Attend the Lasers for Manufacturing Event® (LME®) to learn more about laser applications for manufacturing.

LME was conceived seven years ago as a venue to introduce commercial laser applications to a wider audience. LME 2018 will take place on March 28–29 at the Schaumburg Convention Center in Schaumburg, Illinois. Two other two-day conferences, Laser Additive Manufacturing (LAM®) 2018 and DigiFab Con 2018, will be co-located with LME. Registration to either conference will include admittance to LME.

LME is small enough that attendees can have personal contact with laser industry decision makers, yet big enough to attract a number of reputable exhibitors and industry icons. In addition to the exhibitor booths on the show floor, there will be technical talks and classes intended to promote the laser industry and to educate.

Why attend LME?

- Interact with laser industry experts.
- Find out if lasers can help with your manufacturing problems.
- Network not only with the exhibitors but other attendees as well.
- Sign up for the local field trip to Trumpf's new Smart Manufacturing Facility. Opened in 2017, the facility features digitally connected production solutions for the sheet metal process chain.
- Find a job in the photonics industry – even though this is a manufacturing event, it serves as a good venue for recent graduates because it is inexpensive and gives a lot of bang for the buck.
- Increase the bottom line by increasing profits!

Program/Agenda

Keynote Speakers

One of the keynote addresses will be made by Dr. Geoff Shannon from Amada Miyachi discussing lasers for medical device manufacturing (Day Two from 2:15–2:45pm). Henrikki Pantsar from Trumpf Inc. will speak about lasers in heavy manufacturing (Day One at 2:00–2:30pm).

Tutorials

On Day One, I will be giving a tutorial on Current Trends in Laser Micromachining from 8:30 -10:00am. This course will present information on precision laser subtractive manufacturing using mostly UV and USP (Ultra Short Pulse) lasers. On Day Two, a tutorial will be given by David Havrilla from Trumpf on Laser Welding Techniques and Applications. Trumpf is an industry leader in the field of not only laser welding and material removal, but they also have a very large non-laser presence in the manufacturing industry. This course dovetails perfectly with the proposed visit to the local Trumpf facility. These tutorials are free to attendees.

Lasers 101 and 102

These talks provide basic information on many aspects of laser technology. They start at about 10:15am each day and go until the end of the day. The topics will cover laser sources, beam delivery systems, laser safety, laser marking, laser cleaning, laser cutting, laser welding, laser cladding and optics. These short presentations are given by many industry icons, and these presenters are generally available to not only answer questions but to meet informally afterward.

The best part about the 101/102 talks is that they are given on the floor of the exhibition, so there is no need to leave the exhibit floor to attend these talks. In the past, most of these presentations have drawn a standing-room-only crowd.

Ask the Experts

Another extremely useful tool is the "Ask the Experts" booth, also located on the show floor. Spearheaded by industry veteran Neil Ball, this booth will be staffed by various laser experts and will be open for business throughout both days. The format is quite informal, and if the experts cannot answer your questions, they can usually direct you to someone in the hall who can.

Sponsors
It would be impossible to hold these conferences without the sponsorship of our corporate members. The generous sponsors of LME are IPG Photonics, Laser Mechanisms and Trumpf, all recognizable names in the laser industry.

IPG manufactures laser sources and a standard array of laser machining systems and has held to the proposition of driving laser costs continually lower by revenue growth, volume growth and vertical integration.

Laser Mechanisms provides beam delivery components to customers all over the world and is recognized as an innovator in the field of beam delivery.

Trumpf manufactures laser sources, as well as components and industrial machining systems, and has been active in the industry for many years promoting the cutting edge applications.

Exhibitors
At the time of this writing, there are almost 50 exhibitors registered. These exhibitors range from companies providing laser sources (Amplitude, Ekspla, Light Conversion, Lumentum and SPI, for example) to companies that provide a complete industrial laser system (Alabama Lasers, GF Machining Solutions, Haas Laser Technologies and Lasea). In addition, there are a number of optics and components companies to round out everything in between the laser source and the work piece. A number of companies involved in laser safety will be exhibiting, such as longtime LIA supporter Kentek. There will also be some exhibitors in the field of Laser Additive Manufacturing at LME, including companies like Trumpf, Alabama Laser, LPW Technology and Powder Alloy Corporation.

As with the sponsors, without the participation of these exhibitors, this exhibit would not be possible. There is not enough space to recognize each of these exhibitors in this article, but each and every one is a valuable contributor to the overall success of the event.

What's New in 2018?
Perhaps the most exciting new opportunity is the interaction of LAM and LME, which previously were completely separate conferences.

Digifab Con has also never before been held in conjunction with LME. Produced by Fab Lab Hub, this program will explore how digital fabrication – like 3D printing, laser cutting and CAD – is changing the world. Attendees will see exciting technologies like 3D printing, laser cutting, robotics and artificial intelligence and will have the opportunity to meet with visionaries, educators and innovators. Learn how anyone can use digital fabrication to bring new ideas to life and change the world!

Registration is now open! For more information and to register, visit **www.laserevent.org**. ■

Ron D. Schaeffer is a technical consultant to PhotoMachining.

INCREASE YOUR ODDS OF SUCCESS AT LAM AND LME 2018

10 YEARS LAM® LASER ADDITIVE MANUFACTURING CONFERENCE

LME® LASERS FOR MANUFACTURING EVENT®

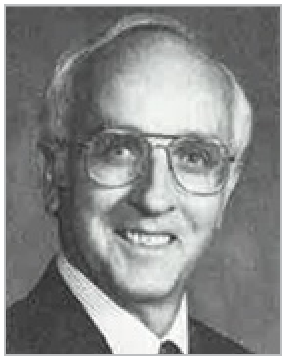
Here are a few tips that may help make your visit a success.

- If possible, come with specific questions prepared in advance. If the project is still new, that is fine too, as general knowledge is still very useful especially in the first stage of many planned projects.
- Take advantage of the Keynotes, courses, classes, talks, etc.
- Take time to talk to ALL of the interesting vendors, even if you have come to the conference for a specific visit or meeting. There is a lot of information available – be a sponge!
- Stay at the event hotel if possible as most of the laser vendors and sponsors will be staying there, and this is a perfect venue for less formal interactions – in other words you can grab someone in the hallways, restaurants or bar and get to know them. People do business with people!
- Meet the LIA staff and LIA's new Executive Director Nat Quick. These people are very smart and experienced and know a LOT of people, so they can connect you to the contacts you need. Plus, they are a bunch of good folks who you want to get to know regardless.
- Join the Laser Institute of America as a member and receive all of the member benefits. Also, if you really want to get into the technical detail, consider attending our flagship conference, ICALEO, in the Fall.

Celebrating LIA's 50th Anniversary

A lifetime with the LIA

BY DAVID BELFORTE



David Belforte in his early years, around 1980.

I joined LIA in 1971 at the urging of members Jim Smith (IBM), Dave Edmunds (Xerox) and Dave Sliney (U.S. Army Center for Health Promotion and Preventive Medicine). At the time, I was part of an intrapreneurship spin-off from the Research Division of American Optical Corporation (AO) with a charter to test a then-new concept, a commercial venture called Laser Products using the company's Nd:Glass laser technology. AO scientist Dr. Mason Cox, then president of LIA, introduced me to Smith, Edmunds and Sliney because of my interest in advancing the idea of laser welding with the AO technology.

LIA was incorporated in 1968. By 1971, LIA was undergoing a mission change as many of the founding members, mostly laser scientists and physicists like Dr. Arthur Schawlow and Dr. Theodore H. Maiman, were being superseded by laser engineers and managers from budding laser product companies. Laser eye safety was the connecting tissue as many of the members served in that function for the organizations for which they worked, such as Messer's Smith, Edmunds and Sliney along with Jim Rockwell (Rockwell Associates) and Sid Charschan (Western Electric).

In the early days, most LIA members were associated with other professional societies, many holding offices or chairing various committees or conferences. I, for example, belonged to the American Welding Society (AWS), American Society for Metals (now ASM International) and Society of Manufacturing Engineers (now SME), all of which were interested in this new technology—laser processing—as was I. LIA members had other society time commitments, however, being part of a society involved with the dynamic and seemingly limitless laser technology, with a mission to advance it, was too compelling. Plus LIA had a very compatible core of individuals sharing a common interest, who became members united with common interests in laser safety and materials processing. With them, the organization gathered the strength to consider expansion.

In 1972, incoming President Jim Smith asked me to become a member of the Board of Directors, a position I was to hold for many years. My first duty was to attend a board meeting held in conjunction with an Optical Society of America (OSA) annual conference and trade show in Washington, DC. When Smith called the meeting to order, it quickly became evident that only seven of us—three officers and four directors—would make up the quorum. Regardless, it was a good session with a lunch in between a full agenda of work. As we finished and prepared to leave, Jim sheepishly requested that we all chip in to cover the lunch tab.

So this was my introduction to the "new LIA"—it was essentially broke, had no staff, and had no headquarters. As I flew back home, I contemplated my other activities in the well-funded AWS, ASM and SME compared to the understaffed (everyone was a volunteer) and underfunded LIA. Deciding that great potential existed for building the organization and working with a great group of laser enthusiasts, many of whom went on to be life-long friends, was a challenge worth undertaking.

That same year, Jim Smith, Dave Edmunds, Jim Rockwell and I met with the publisher of a leading technology publication whose wisdom and support we sought to help us grow LIA and make it a factor in laser technology advances. We left this meeting depressed that he had very little regard for the organization and its future.

Sidney Charschan (center), Schawlow Award honoree, is flanked by outgoing LIA President Peter Baker (left) and Carl Nilsen, PRC Corporation (Award Endower) in 1987.

Past Presidents of the LIA in attendance, from left to right: Dave Whitehouse, Bob Goldstein, Dave Belforte, Milton Chang, Bill Tiffany, Jim Rockwell, and Dave Edmunds in 1986.

Some of his negative thoughts, however, became part of the goals we set for the "new" LIA—grow a membership by providing them with the services other societies did not, establish a professional management team, and position LIA as the driving force in specific laser technology sectors. Many years after, that publisher told me he had given us little chance of success but admitted he had misjudged our determination and energy. Shortly after that initial meeting, on April 26, 1973, LIA published the first ANSI standard—the American National Standard for Safe Use of Lasers (ANSI Z136.1).

Five years later, at the LIA's 1978 annual meeting in Anaheim, California, I, as president, presided over the first Honored Speaker Award to Dr. Leon Goldman (University of Cincinnati), which eventually became the Arthur Schawlow Award. This essentially initiated what was to become the published cosponsored history of *The Laser in America*. In 1981, I created and presided over the first (and only) Joint U.S./Japan International Conference on Laser Material Processing, which President David Whitehouse, in 1982, morphed into LIA's highly regarded International Congress on Applications of Lasers & Electro-Optics (ICALEO®).

In 1985, Accuratus Ceramic Corporation became LIA's first corporate member, leading to the expansion of LIA's membership services. LIA also added to its publishing repertoire in 1988, when the first LIA Today newsletter debuted.

In 1995, LIA honored me with the Schawlow Award for my contributions to the advancement of industrial laser material processing, which primarily were a consequence of my years in the organization.

Since then, LIA has introduced three more successful conferences: The International Laser Safety Conference (ILSC®) in 1997, the Laser Additive Manufacturing (LAM®) conference in 2007 and the Lasers in Manufacturing Event® (LME®) in 2011. Over the years, LIA has had almost 5,000 individual members and more than 500 corporate members. Of those, around 2,000 individual and 160 corporate members are active today.

LIA officers confir at headquarters building, 4100 Executive Park Drive, Cincinnati, Ohio. President R. James Rockwell, Jr. (at right) confirs with James Smith (center) Past-president and current chairman of the LIA Educational Committee and David Edmunds, President-elect, prior to LIA Board of Directors meeting held in Cincinnati, Ohio concurrent with the short courses co-sponsored by LIA in early August 1974.

Looking back on the 50 years of LIA from its current preeminence as a global leader in laser safety and advanced laser material processing, with a well-staffed headquarters in Orlando, Florida, fiscally sound and professionally managed, I recall all the opportunities LIA brought me, the wonderful people I met and worked with, and best of all, I never picked up the tab again. ■

David Belforte is Editor-in-Chief of Industrial Laser Solutions.

Meet LIA's New Officers
& 2018 Board of Directors

BY LINDSAY WEAVER BURT

LIA's 2018 President, Milan Brandt, has been involved with lasers and manufacturing technologies professionally for 34 years and is recognized nationally and internationally as the leading Australian researcher in the field. Prof. Brandt is a professor in Advanced Manufacturing in the School of Engineering, as well as the Technical Director of the Advanced Manufacturing Precinct, and the Director of RMIT Centre for Additive Manufacturing at RMIT University in Melbourne, Australia. He is the recipient of numerous awards and is the author of more than 200 publications, five book chapters, and a book on laser additive manufacturing.

After graduating from Macquarie University in Sydney, he joined the Department of Defence Materials Research Laboratory in Melbourne, where he was involved in the development of new visible lasers. In 1986, he joined the CSIRO Division of Manufacturing Technology in Sydney to conduct research on the interaction of laser radiation with materials and the application of this research to manufacturing processes such as laser welding, cutting, surfacing, and cladding of materials. This led to the development and commercialization of a number of new, laser-based products and processes. In 1990, he established the first Industrial Laser Centre in Australia to further promote laser technology to industry and develop new applications of significant commercial benefit. The Centre became the focus for industrial laser activities in Australia and attracted many industry collaborators.

In 1999, Prof. Brandt was invited to join Swinburne University and was offered a large grant to establish laser macromanufacturing research activities. He grew the activity into the largest research and development effort in Australia at the time. A major outcome of this research was the development of laser cladding technology for the repair of leading edge of low pressure turbine blades in-situ in collaboration with the CRC for Welded Structures and 11 power-generating utilities. The technology was commercialized through Hardwear, a company he helped establish with CRC for Welded Structures and at which he served as the technical director.

Since joining RMIT University in 2010, he has led activities in additive manufacturing based on selective laser-melting technology involving many industry and research partners. The Centre for Additive Manufacturing, which was established by Prof. Brandt, has about 25 academics, research fellows, and Ph.D. and masters students, and it receives AUS $1.5 M in external grants annually.

Prof. Brandt has had a 30-year association with LIA, including his involvement on the organizing committees for ICALEO and LAM for many years, as well as serving on the LIA Board of Directors. Prof. Brandt was the organizer and General Chair for PICALO 2004 and PICALO 2006, which promoted industrial lasers and applications in the region. He is also the Senior Editor of JLA in additive manufacturing.

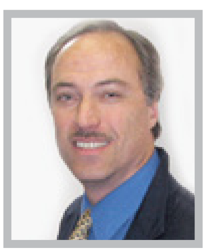
As this year's president, Prof. Brandt is committed to further increasing LIA's role and its membership locally and globally through new workshops and conferences on laser applications and laser safety. In particular, he will work with the CEO and Board to increase LIA's profile and influence locally.

We wish Prof. Brandt the best of luck in all of his endeavors as this year's LIA president.

President-Elect Minlin Zhong is a tenure-track professor at the School of Materials Science and Engineering of Tsinghua University and the Director of the Laser Materials Processing Research Center. He received his bachelor's degree in laser technology from Huazhong University of Science and Technology in 1983 and his Ph.D. in laser materials processing from Tsinghua University in 1997. From 1997 to 1998, he was a post-doc Fellow in the Laser Centre of French Welding Institute and a guest scientist in Hannover Laser Centre in Germany. He started his research on laser materials processing in 1983, with his research interests spanning laser micro-nano fabrication, laser surface engineering, and laser 3D printing. He has been the PI for 19 international cooperation projects, 20 domestic scientific projects, and 20 domestic industrious projects. In addition to publishing more than 300 papers in peer review journals and international conferences, he has 18 patents and four book chapters to his name. Dr. Zhong was elected a Fellow of Laser

Institute of America in 2010 and an LIA board member in 2005-2007, 2011-2013, and 2015-2017. Currently, he serves as a senior editor of the *Journal of Laser Applications*, as executive editor-in-chief of the *Journal of Chinese Lasers*, as an editorial member of *Light: Science & Applications* (Nature Publication Group), and as a reviewer for numerous international journals.

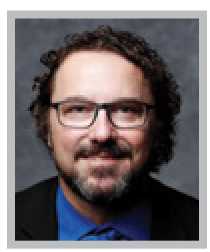
Secretary Henrikki Pantsar is Director of Applications and Services at Trumpf, Inc., Laser Technology Center in Plymouth, MI. In this position, he is responsible for micro, macro, marking, and additive manufacturing applications, as well as after-sales operations, including technical services and spare parts. Previously, he held the positions of Chief Technology Officer and Vice President of Research and Development at Cencorp Corporation/Valoe Corporation. He has also worked in the field of laser applications at Fraunhofer USA, VTT Technical Research Centre of Finland, and Lappeenranta University of Technology. Dr. Pantsar received his Doctor of Science in Technology degree from Lappeenranta University of Technology, and he also received the Henry Granjon Prize of International Institute of Welding for his work in laser-hardening research.



Treasurer Gilbert Haas has worked with industrial lasers for the past 35 years. Though he holds a B.S. degree in Electrical Engineering from the University of Wisconsin and an A.S. degree in Laser Technology from North Central Technical College, he has further advanced his formal education by completing several additional classes in the fields of Mechanical Engineering and Metallurgy. Throughout his career, Mr. Haas has taught, lectured, and published several papers. He also holds several national and international patents in the field of industrial laser applications. Mr. Haas started his career by gaining practical and hands-on experience as a Laser Field Service Engineer and a Technical Support Engineer. As he advanced into his career as a Senior Applications Engineer, he worked on developing the industry's first commercially produced Nd:YAG 1KW SLAB Laser. Since Mr. Haas always saw a need for new and innovative laser beam delivery technology throughout his career with lasers, he founded Haas Laser Technologies, Inc. in 1992. Recognized as an innovator and technology leader, his company provides one of the largest selections worldwide of laser beam delivery components and sophisticated beam diagnostic equipment for industrial applications. Mr. Haas additionally purchased and repurposed an industrial building that now operates under Flanders-Ironia, LLC as a successful industrial building complex, housing several local and international tenants.

Immediate Past President Paul Denney recently joined IPG Photonics, where he is the Director of Advanced Process Development with the task of forecasting process and hardware needs for future industry applications. Since earning his B.S. in Material Science and Engineering and his M.S. in Metallurgy at the Massachusetts Institute of Technology, Mr. Denney has gained many years of materials research experience, holding positions in the Research Department of C.F.&I. Steel Corporation, U.S. Naval Research Laboratory (NRL), Westinghouse R&D Center, Applied Research Laboratory at Penn State, EWI, Director of the Laser Applications Laboratory at CCAT, and until December of 2017, he was the Senior Laser Applications Engineer at Lincoln Electric. Throughout his career, Mr. Denney has been involved in multiple societies and is currently a member of the American Society for Metals and the American Welding Society, where he serves on the C7, C7C and C7D committees. He holds 36 U.S. patents, received two ARL Penn State Technical Contribution Awards, and was bestowed an R&D Top 100 Award in 1997.

2018-2020
Board of Directors



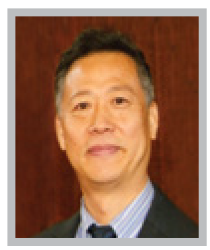
Neil Ball is the president of Directed Light Inc., a laser technology company based in San Jose, California, that serves the industrial, medical, and scientific laser communities worldwide since 1983. Mr. Ball has devoted his adult working life to the industrial laser industry. He began his career 32 years ago as an application technician in the job shop manufacturing sector at LaserFab, Inc. in California. After developing his laser knowledge, he moved to Systron Donner Inertial and became involved in the production of inertial guidance packages, accelerometer, gyroscopes and inclinometers. Mr. Ball joined Directed Light Inc. in 1993 to assist in applications development, system design, and component/service support. In 1998, he became general manager of the components and job shop divisions. He is still active in systems and applications development. Mr. Ball has led the marketing and developing sales plans for both national and international arenas and is the resident methodologist, working on projection of future industry trends. He is a member and a fellow of the Laser Institute of America.

Robert Braunschweig is the managing director of LASEA, Inc. (U.S. operation of LASEA, a leading manufacturer of industrial laser machines and laser solutions), a position he was appointed to in August 2016 after his company B-Lasers had great success distributing LASEA products. Mr. Braunschweig received his M.S. in 1997 from the School for Advanced Processes in Electronics and Optics in Orleans, France, majoring in Lasers and Photonics. For the past 20 years, he has held engineering and development positions at Continuum, Quantel, Dicon FiberOptics and Opotek, where he contributed his skills in solid-state lasers, tunable lasers, and fiberoptic components. Through his broad range of experience in R&D, Product Development, Manufacturing, Technical Support, Sales, and Business Development, he has emerged as an expert in his field, bridging research with industry.

Stephen Capp is currently CEO at LTC Holdings, Inc. Mr. Capp previously held the position of CEO of Laserage Technology Corporation, in addition to positions such as Plant Manager and Vice President of Operations. He graduated from Milwaukee School of Engineering in 1978 with degrees in Electrical Power Engineering Technology and Industrial Management and has worked in the laser industry for more than 25 years. He has been a member of LIA since 1992 and has previously served as president. He has also served three previous terms as the national treasurer and member of the Executive Council of the International Microelectronics and Packaging Society.

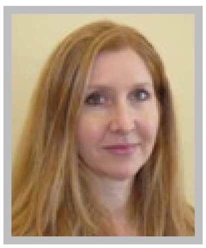
Bo Gu is the founder and president of BOS Photonics, located in Boston, MA. Prior to that, he was the managing director of IPG Asia and General Manager of IPG China, responsible for developing fiber laser markets, especially in China. Before becoming a corporate executive in the laser industry, Dr. Gu was a scientist in the laser and photonics field. He has authored more than 100 publications and presented papers (13 plenary, 54 invited). He is the inventor of 56 issued patents and 60 pending patent applications and has developed 31 commercial products of lasers and laser systems for industrial markets. Dr. Gu is a fellow of OSA and SPIE. He is also the Vice Secretary General of Chinese Optical Society and the vice president of the Laser Processing Committee.

Dr. Marshall G. Jones joined GE Global Research (GR) in 1974 as a mechanical engineer after receiving his M.S. and Ph.D. from the University of Massachusetts. He received his B.S. in the same field from the University of Michigan. He worked for four years as a development engineer in high energy physics at Brookhaven National Laboratory after his undergraduate studies. Dr. Jones, a Principal Engineer, has performed research and development work for most all the industrial business segments of GE. He has spent most of his GE career addressing laser materials processing, laser device development, and fiber optics, which has afforded him 55 U.S. patents, 57 foreign patents, and more than 50 publications. Dr. Jones is a GE-GR Coolidge Fellow, a member of the National Academy of Engineering (NAE), and a fellow of the American Society of Mechanical Engineering (ASME) and of LIA.

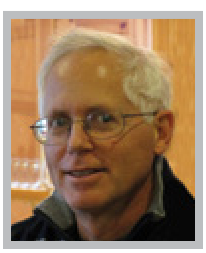


Professor Lin Li started laser-processing research in 1985 at Imperial College, UK, with Professor Bill Steen. After obtaining a Ph.D. in laser cladding in 1989, he worked as a researcher at Liverpool University for six years on laser welding, concrete processing and in-process monitoring. In 1994, he took up the faculty post at the University of Manchester Institute of Science and Technology, UK. In 2000, he was promoted to a full professor and became the Director of the Laser Processing Research Centre. In 2009, he was appointed as Director of Research and Deputy Head of the School of Mechanical, Aerospace and Civil Engineering at the University of Manchester, UK, and he was elected as a member of Senate of the university. In 2015, he was appointed Associate Dean for Business Engagement and Innovation in the Faculty of Science and Engineering. Professor Li is the author and co-author of more than 600 publications in laser processing, including 47 patents and more than 350 publications in peer-reviewed journals. His research has led to practical applications in the aerospace, automotive, medical, and security industries. He also co-founded five laser-based high-tech companies in the UK.

Klaus Löffler has exhibited a wide range of experience throughout his career, from engineering and application to sales and implementation after graduating from the University of Stuttgart, Germany, with his master's in mechanical engineering. In 1991, he joined TRUMPF Laser Technik as a CO_2 development engineer. He ventured to the U.S. in 1995 and started the TRUMPF North American laser operation. During his career, Mr. Löffler has been responsible for the implantation of many TRUMPF lasers worldwide, as well as the creation of the TRUMPF Laser Technology Center in Plymouth, MI. In 2002, he moved back to Germany and took on the task as head of joining at the Volkswagen AG. In this position, he was responsible for implementing 400 high-power lasers into production. Since 2007, he has been serving in different sales responsibilities, and since 2014, he has been a member of the management board of the TRUMPF business field laser. Mr. Löffler served as a member of the LIA Board of Directors from 1997 to 2002 and again since 2007. He has fulfilled many valuable roles in the organization, including president in 2013. In addition to his active presence within LIA, Mr. Löffler serves on the advisory board of the Fraunhofer IWU, Bavarian Laser Center, School of Advanced Optical Technology, and more.



Michelle L. Stock, Ph.D., recently became the Director of Product Line Management at MACOM. Dr. Stock obtained her Ph.D. in 1994 from the Center for Ultrafast Optical Science at the University of Michigan. After graduating, she joined ultrafast fiber laser specialist IMRA America as an engineer and product manager, commercializing pioneering femtosecond lasers. In 2007, she co-founded Arbor Photonics to introduce proprietary specialty optical fibers to improve lasers for precision material processing, acquired by nLight in 2012. Besides being a board member of LIA since 2015, Dr. Stock is the first chairperson of Mi-Light (the Michigan Photonics Industry Cluster) and has been involved in the U.S.-based National Photonics Initiative (NPI). Until the end of 2017, she was the President of mlstock consulting. Stock is also a member of OSA and a Fellow of SPIE.



Michael Woods is the Laser Safety Officer at the Department of Energy's SLAC National Accelerator Laboratory. He is an Engineering Physicist, with a B.S. in Engineering Physics from Queen's University in Kingston, Ontario, Canada, and a Ph.D. in High Energy Physics from the University of Chicago. He has been at SLAC for 29 years, including 20 years as an engineer/researcher in accelerator physics and experimental particle physics. He spent 15 years utilizing high-power laser systems for photo-injectors, Compton polarimeters, and electron beam diagnostics. He became SLAC LSO in 2008 and completed his CLSO certification the same year. Dr. Woods is a member of ANSI ASC Z136, ADCOM, SSC-1, SSC-8, TSC-4, and TSC-5 committees, and he is secretary for TSC-4.

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TRUMPF

Taking Manufacturing Technology to the Next Level

BY LINDSAY WEAVER BURT

With a mission to take manufacturing technology to the next level, TRUMPF, Inc. is the leading manufacturer of laser technology for industrial applications in North America. The company manufactures products that can be found in every industrial sector and used for a variety of fabrication processes such as additive manufacturing, cutting, welding, marking, and surface treatment. Based out of Farmington, CT, TRUMPF Inc. employs more than 1,000 workers in North America and operates facilities in California, Connecticut, Illinois, Michigan, New Jersey, Mexico, and Canada.

TRUMPF, Inc. comprises two divisions—Machine Tools and Laser Technology—and is the largest subsidiary of the German-based TRUMPF Group. It was founded in Connecticut in 1969 and has invested heavily in facilities and personnel across North America to bring development, production, and support of advanced fabricating technologies closer to North American manufacturers.

TRUMPF, Inc. began the production of tools for computer numerical control (CNC) punching machines in 1974 and then manufactured the first combination punching and laser-cutting machine built in the U.S. in 1980. In 1988, the company began to manufacture flatbed laser-cutting machines in Farmington. This particular facility has since expanded to include the production of several models of punching and laser-cutting machines, material handling automation, and laser resonators.

Most recently, TRUMPF launched the TruPrint 3000, a 3D-printing machine that uses laser metal fusion technology and enables the industrial-scale production of complex metal parts layer by layer in a powder bed. The laser system covers all aspects of the additive manufacturing process chain, beginning with inputting data for the 3D design and ending with downstream tasks like unpacking and cleaning the newly minted parts.

After extensive research and development, TRUMPF TruDisk Pulse 421, which is a pulsed, high-power laser that enables the welding of highly reflective materials like copper, is now available. Its high absorption rate and high peak pulse power of 4 kW at repetition rates in the millisecond range allow for fast, efficient, and smooth processes like spot welding and bonding electronic components. It now has a 50 percent smaller footprint than the previous generation TruDisk, as well as a 20 percent improvement rate in wall-plug efficiency. This advanced laser source is easily integrated into the Industry 4.0 connected production line due to its integrated control and its communications and sensor systems.

Another popular TRUMPF laser product is the TruMicro 5370, which sets a new standard for the quick and cost-effective UV micromachining of various polymers and brittle materials. With 30-Watt average power and 75 μJ pulse energy, these picosecond pulse width lasers impress with their exceptional beam quality, stability, and reliability.

Another model, the TruMicro 7380 nanosecond UV thin-disk laser, has the ability to deliver an impressive 400 Watts of short pulse 343 nm output with high-pulse energies, even at high frequencies. It is specifically optimized for line generator use in organic light-emitting diode (OLED) laser lift-off, photo bleaching, and semiconductor production applications.

In keeping up with continued growth in the industry, TRUMPF has recently built a complete Smart Factory that digitally connects the entire sheet metal fabrication process chain to serve as a technology consultation center for companies looking to introduce digitally connected production techniques into their own manufacturing locations.

In the last five years, TRUMPF has noticed significant growth within additive manufacturing, specifically with technologies that can perform 3D printing of metal components. The automotive industry is finding new applications for lasers, such as developing more lightweight parts and the laser cutting of press-hardened steel components that are critical for crash performance. E-mobility is emerging as well and is expected to grow quickly within the next several years. TRUMPF is the only manufacturer in the world to offer both laser metal fusion (LMF) and laser metal deposition (LMD), the two relevant laser technologies for additive manufacturing.

TRUMPF joined the Laser Institute of America (LIA) in 2013 and believes that LIA offers a unique platform for professionals within the laser community to exchange ideas, share philosophies, and learn about new technologies. In turn, this helps members to develop new skills and also drives growth within the laser industry. ■

For more information, visit **www.trumpf.com/en_US**.


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Member Innovations

Photonics Industries Raises Pulse Energy of DSH-355-40 UV ns Laser

Photonics Industries' DSH-355-40 UV ns laser now has the highest pulse energy of >1 mJ. This improvement has been made to meet the demand for higher speeds in the manufacturing of mobile devices and flat panel displays.

The laser is lightweight, compact, and now more efficient and cost-effective. It is housed in a single box that does not require a separate controller, power supply box or umbilical cable. This reduces the footprint and power consumption.

Users in the industrial micromachining industry can increase their manufacturing throughput yields by two-times or more in various applications. The >1mJ pulse energy level has also opened up new possibilities for applications.

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

FANUC Introduces Two New Robots

On November 29, 2017, FANUC debuted their new SR-3*i*A and SR-6*i*A SCARA robots at the International Robot Exhibition (iREX) in Tokyo, Japan. The latest robots from the major robotics supplier are fast, compact, precise, flexible, and user-friendly. The two models are ideal for assembling, testing, inspection, packaging, and handling in the consumer electronics, auto plastics, food and beverage, lab automation, appliances and medical device manufacturing industries.

The SR-3*i*A model features 3kg payload, 400mm reach, and 200mm stroke, while the SR-6*i*A offers a 6kg payload, 650mm reach and 210mm stroke. The robots feature optional bottom cable exits to protect the cables and save floor space, integral air lines, 24VDC power and I/O signal cables and optional solenoid valves to simplify system integration and reduce costs, a brake release switch on the robot's arm to allow for easy error recovery, high inertia capacities and new high-performance R-30*i*B Compact Plus controllers.

Both models offer the same software options as all other FANUC robots, including Integrated Vision, force sensing, conveyor tracking, fieldbus connectivity, and integrated safety.

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

Members In Motion

IPG Photonics Acquires Laser Depth Dynamics

On December 4, 2017, IPG Photonics announced its acquisition of Laser Depth Dynamics (LDD), which provides in-process quality monitoring and control solutions for laser welding. LDD has pioneered inline coherent imaging technology for direct, precise weld penetration depth measurement. LDD also offers seam tracking, height following, and 3D volume imaging technology. These tools ensure consistency and monitor weld quality in real time.

Of the acquisition, Felix Stukalin, the senior vice president of IPG's North American Operations, said: "We believe this technology, when combined with IPG's expanding portfolio of welding solutions, will help drive adoption of laser-based welding within the automotive, medical, consumer products and aerospace industries."

LDD's Kingston, Ontario, headquarters will be developed into IPG's new center of product development for weld monitoring solutions.

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

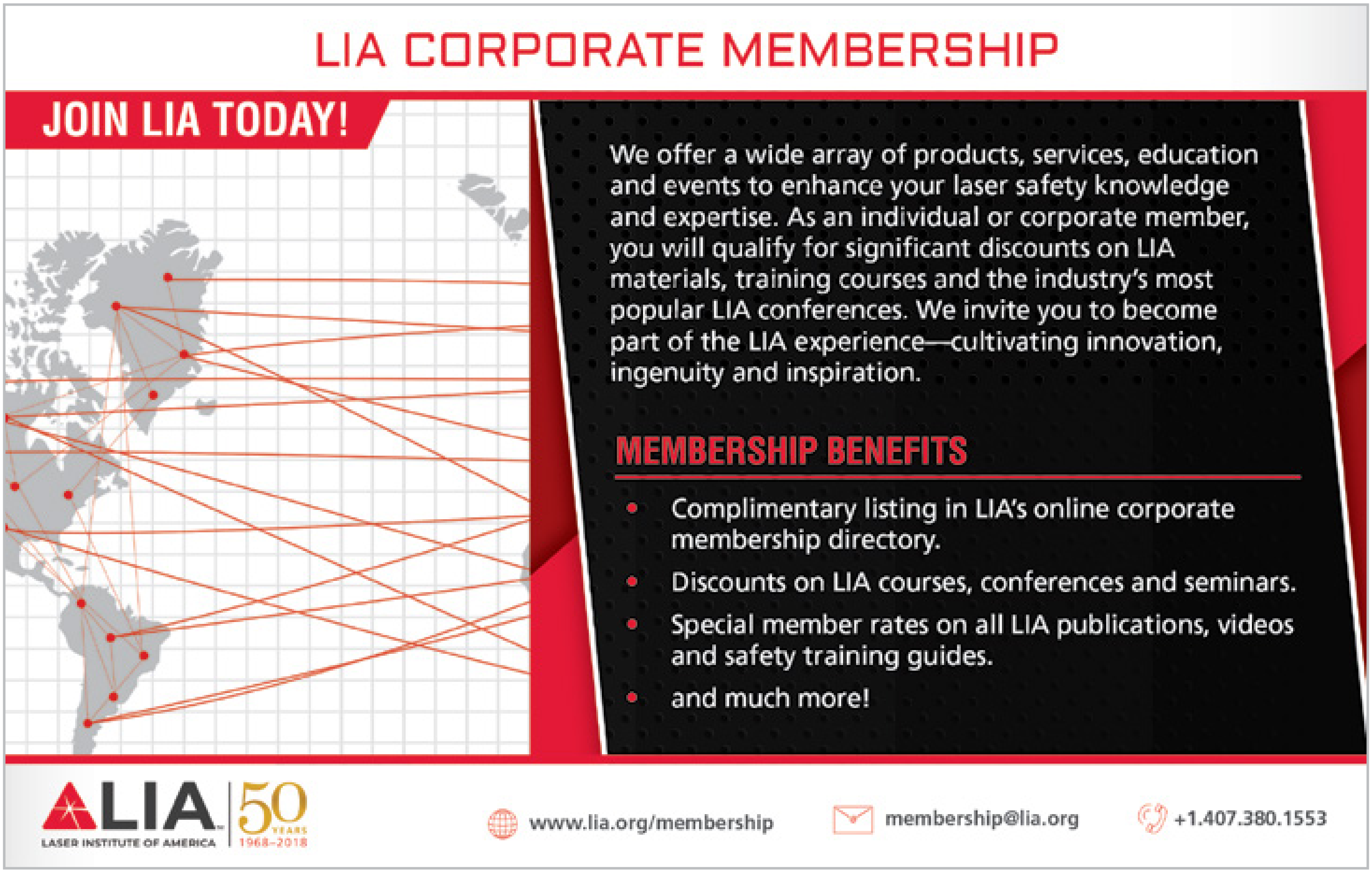
2017 A Record-Breaking Year for Boeing

2017 saw Boeing deliver a record-breaking 763 airplanes, send the new 737 MAX 9 and 787-10 Dreamliner on their first flights, and start the production of the 737 MAX 7 and the new 777X. It was the sixth year in a row in which the company's commercial airplane deliveries surpassed those of any other manufacturer. Due to high demand for the single and twin aisle planes, the company saw a total of 912 net orders in 2017.

This achievement was due in part to high production rates for both the 737 and 787 Dreamliner lines of airplanes. Production for the 737 program increased to 47 airplanes per month last year.

The company's backlog has now grown to a total of 5,864 airplane orders, which will take an estimated seven years to fulfill. However, Boeing's President and CEO, Kevin McAllister, indicated that may be an overestimate: "Our planned production increases over the coming years are designed to satisfy this robust demand."

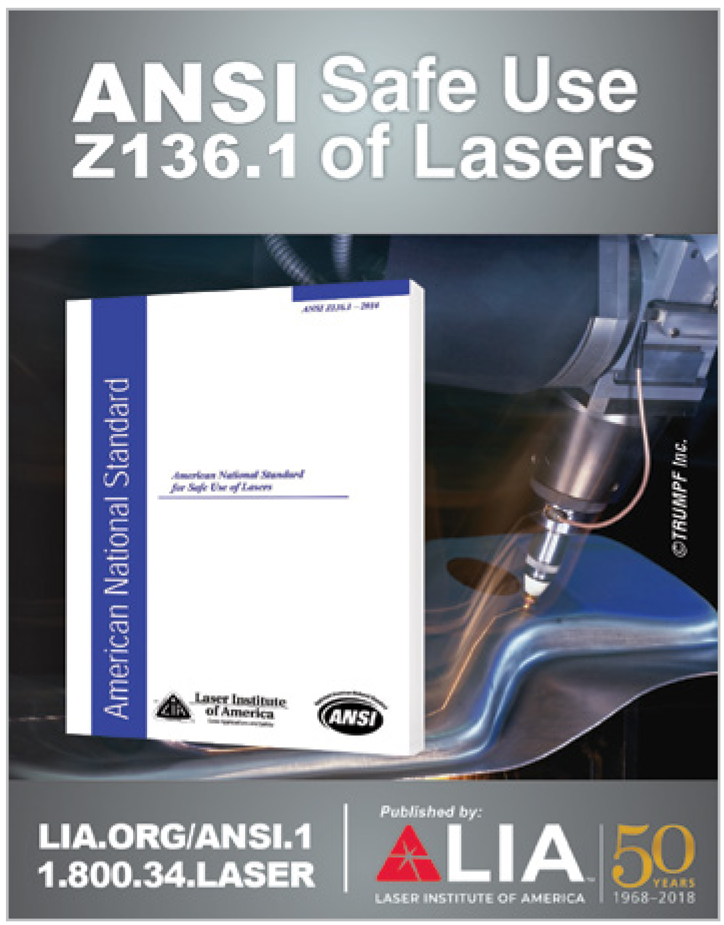
For more information, visit **www.boeing.com**.



WELCOME NEW CORPORATE MEMBERS

Lincoln Electric Company
Cleveland, OH

For a complete list of corporate members,
visit our corporate directory at **www.lia.org/membership**.



ASC Z136 | Update

Often overheard in our community, a reference used for our laser safety standards as well as our committee is "ANSI" – from "read your ANSI standard" to "I participate on the ANSI committee."

This, however, is not the proper use of the term "ANSI". A lesson to take to heart as this was the only operational finding of our recent audit.

The American National Standards Institute (ANSI) coordinates the development of U.S. national voluntary consensus standards by providing the structure within which these standards can be developed and consensus can be achieved. ANSI is the body that approves standards as American National Standards. ANSI approval of these standards is intended to verify that the principles of openness and due process have been followed in the document approval procedure and that a consensus of those directly and materially affected by the standards has been realized.

ASC Z136 is accredited by ANSI; it is the accredited standards committee responsible for the development of the Z136 series of standards for the safe use of lasers. Comprised of subject matter experts from technical societies, professional groups, government agencies, consumer organizations and trade associations, this volunteer group develops and maintains the Z136 laser safety standards.

Our standards are ANSI approved standards, each with its own designated identifier. The first American National Standard for Safe Use of Lasers, ANSI Z136.1 was published in 1973, with the objective of providing reasonable and adequate guidance for the safe use of lasers and laser systems. Fast-forward to today, the Z136.1-2014 is the most current version of this document. Referred to as the parent document in the series, it is the cornerstone of a viable laser safety program.

The series has grown to include guidance for application areas such as research and development in the lab (Z136.8), on the manufacturing floor (Z136.9), or within a medical facility (Z136.3). For the complete list of Z136 standards, please visit the LIA online store at www.lia.org/store.

To participate on ASC Z136, please visit the committee website at **www.z136.org** or contact Barbara Sams at **+1.407.380.1553** or **bsams@lia.org**.

A vital part of becoming certified is to retain an active certification status. To ensure CLSOs and CMLSOs maintain their knowledge, skills and abilities in the field, proof of continuing education is required every three years. This certification cycle begins on January 1 following the year in which an individual passes an exam and concludes on December 31 of the third year.

As we start the new year, many of our CLSOs and CMLSOs are starting a new certification cycle. Having a plan in place to accrue certification maintenance (CM) points upfront will relieve the eleventh hour stress of figuring out which activities can be claimed for how many points and whether enough points have been earned for renewal. A minimum of ten CM points are required to renew.

BLS CM points differ from CEUs and CEs in the way they are computed. The time specific breakdown below is the basis of how many CM points an approved activity may be worth.

Point Breakdown:

- < 2 hours = ¼ CM point
- 2 hours to 4 hours = ½ CM point
- 4 hours to 6 hours = ¾ CM point
- > 6 hours to 1 day = 1 CM point

The BLS allows for CM points to be claimed and awarded in a variety of ways. Most CLSOs and CMLSOs can earn 60% of their points simply by working in laser safety, i.e., job experience, and maintaining a membership in an approved organization. These categories, along with participating on a laser safety committee external of the workplace, are worth one CM point per year.

Another way to earn points is to attend a laser safety or applications professional conference or meeting. Conferences that are "all laser" such as ICALEO, ILSC, DOE LSO Workshop, ASLMS, or LASE are awarded one CM point per full day of attendance. For conferences and meetings that cover a broader spectrum of topics, e.g., AORN Congress or the Health Physics Society Meetings, credit is awarded only on the laser-related sessions. Add to those points by presenting a paper or poster.

It should go without saying that laser safety or applications education, from in-service training to an advance LSO course, attendance or teaching (external of job responsibilities), accumulates CM points.

Whether at the start of a three-year cycle or two years in, review the options for achieving CM points now and plan ahead to protect and keep that hard-earned certification.

OSHA | Update

LIA is committed to keeping the workplace safe from hazards associated with lasers. LIA formed an Alliance with the Occupational Safety and Health Administration (OSHA) to help achieve these goals. Learn more at **www.lia.org/oshaalliance**.

OSHA and Ironworkers Partner to Provide Outreach and Protect Construction Employees on Jobsites

The U.S. Department of Labor's Occupational Safety and Health Administration (OSHA) signed a two-year alliance with North Central States District Council of Ironworkers, the Ironworkers District Council of St. Louis and Vicinity, and Iowa OSHA to reduce electrical, fall, struck-by, crushing and welding hazards. The alliance members will also contribute information to OSHA campaigns, such as the National Safety Stand-Down to Prevent Falls in Construction, and the Safe + Sound Campaign for Safety and Health Programs.

OSHA uses its Alliance Program to partner with organizations concerned with the health and safety of employees to work toward preventing workplace fatalities, injuries, and illnesses.

Under the Occupational Safety and Health Act of 1970, employers are responsible for providing safe and healthful workplaces for their employees. OSHA's role is to ensure these conditions for America's working men and women by setting and enforcing standards, and providing training, education, and assistance.

U.S. Department of Labor Cites Pallet Manufacturer After Employee Injured by Machine

The U.S. Department of Labor's Occupational Safety and Health Administration (OSHA) cited Supplyside USA, a New Lenox-based pallet manufacturer, for machine safety violations after an employee was injured while conducting maintenance on equipment. This is not the first offense. The company faces $91,832 in proposed penalties for a total of 11 violations.

OSHA inspectors found that the manufacturer, which operates as Prime Woodcraft Inc., failed to install adequate machine guards, implement energy control procedures to prevent equipment from unintentional operation, and train workers about noise hazards. Furthermore, the manufactuer allowed combustible dust to accumulate on surfaces.

Prime Woodcraft has 15 business days from receipt of its citations and penalties to comply, request an informal conference with OSHA's area director, or contest the findings before the independent Occupational Safety and Health Review Commission.

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

Validation of a Computer Model to Predict Laser-Induced Retinal Injury Thresholds

BY MATHIEU JEAN AND KARL SCHULMEISTER

A computer model has been developed to calculate the median dose of laser radiation exposure needed to produce a minimum visible lesion (MVL) on the retina of a rhesus macaque primate, which closely resembles that of a human.

The model is comprised of a schematic eye that represents an unprotected eye, an optical model of the retinal layers, a thermal model, and a damage model.

Using the proposed model, 253 experimental median dose values obtained from the primate study were simulated. Each damage threshold obtained using the model was compared with its experimental counterpart in terms of total intraocular energy. This model is the first to be validated for exposures for the eye's macular and para-macular regions and for the full range of wavelengths, retinal spot sizes, and exposure durations applicable for retinal thermal injury, with the exception of pulse durations shorter than 100μs. The validation shows that lesion thresholds can be predicted with relatively small uncertainty ranges for exposures in which no experimental data are available. However, the injury threshold obtained with a 1.5 milliradian (mrad) laser beam can be up to five times lower on the human eye than in the rhesus monkey computer model due to the fact that the color of human retinas are lighter than a monkey's, and the ocular transmission of human eyes is lower.

For risk analysis, only the macular exposure data should be used, because it yielded lower thresholds than the para-macular. This takes the lower threshold levels for humans into account.

Subscription Information

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

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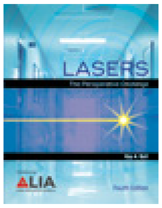
LIA | Announces



Coming Soon: Dr. Kay Ball's Revision of *Lasers - The Perioperative Challenge*

The fourth edition of Dr. Kay Ball's laser technology manual for healthcare professionals is expected to be released this March through LIA. This is the third revision of the book, as the use of lasers in medical settings has expanded greatly since the publication of the first edition in 1990.

The updated beginner's guide to laser technology for the operating room and other medical applications covers the latest research, the foundational physics of lasers, and safety practices.

"*Lasers: The Perioperative Challenge* takes a complex technology and simplifies it for ready access by nurses, physicians, risk managers, and other healthcare providers. It offers valuable information on how to apply current standards and guidelines for a laser-safe environment," said Dr. Ball. "I updated the book because there's such a lack of comprehensive books on the market that address all aspects of laser technology in healthcare."

The text even offers sample laser safety policies to provide templates for writing policies and procedures for the clinical environment, and it features more than 300 useful illustrations and graphics.

The book will be available for purchase on the LIA website for $80 for members and $90 for non-members.

Visit **www.lia.org/store** for updates on this book release.

AORN

Visit Our Booth at the AORN Global Surgical Conference & Expo

LIA will be exhibiting at the 2018 Association of periOperative Registered Nurses (AORN) Global Surgical Conference & Expo March 25-27 in New Orleans, LA. The event is an excellent opportunity for those in the field to connect with employers, discover new products, receive training and earn contact hours. Visit our booth (#2312) to learn more about our classes and products and get your copy of *Lasers - The Perioperative Challenge*, signed by the author Dr. Kay Ball.

The conference will be held at the Ernest N. Morial Convention Center. You can register online at **www.aorn.org/surgicalexpo**.

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ICALEO 2018 Abstract Submission Deadline is March 1

If you are interested in presenting your research in the field of laser material interaction at the International Congress on Applications of Lasers and Electro-Optics (ICALEO®), the deadline to submit your research is **Thursday, March 1, 2018**.

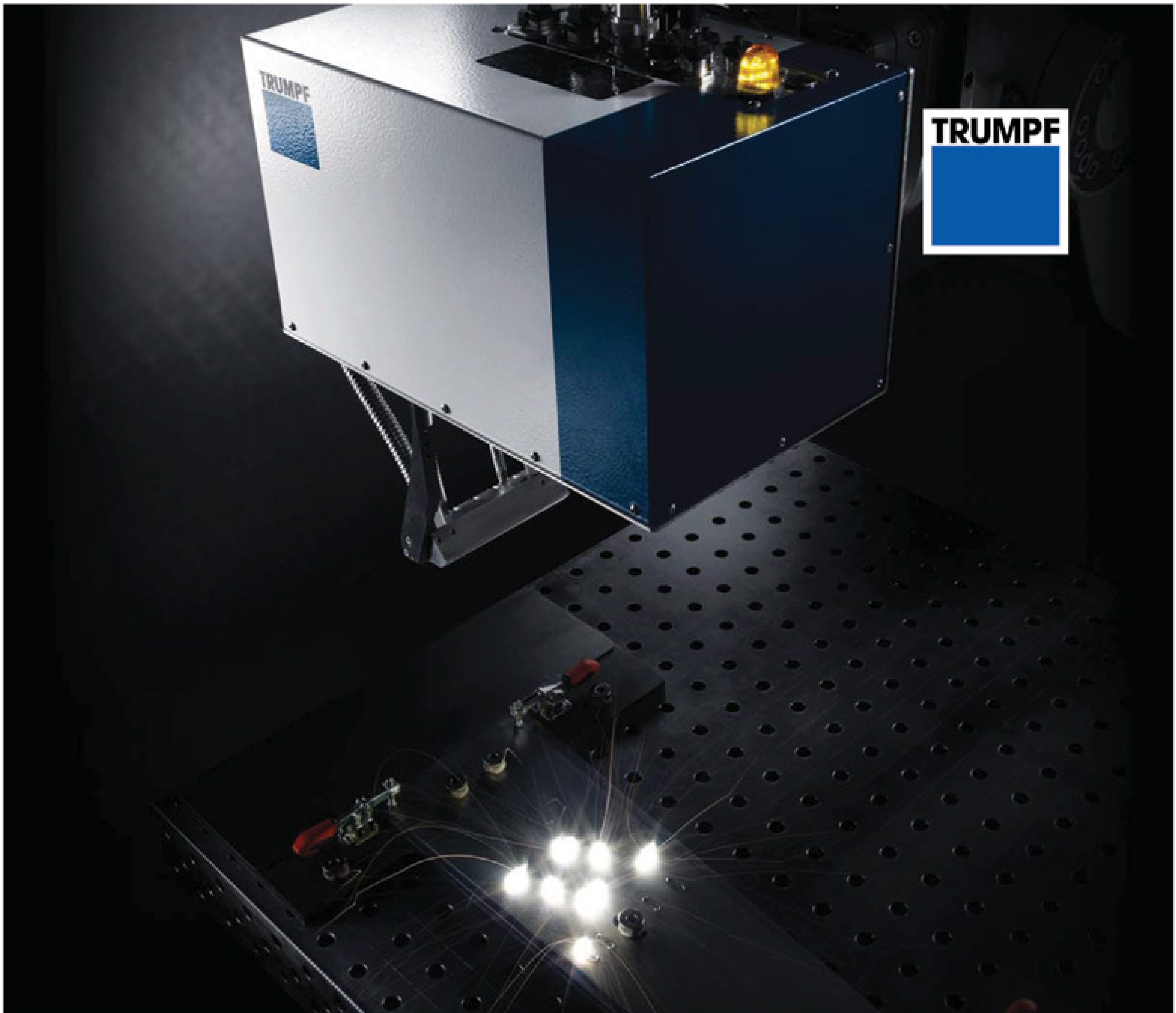
Submitted abstracts should be 200 words at minimum and 400 words at maximum and should contain original, recent, unpublished results of applications research, development, or implementation. Authors are encouraged to indicate the current phase of their work. Commercial papers will not be accepted.

Participants may opt to have their paper peer-reviewed. If chosen by the panel, elected papers will be identified as such in the ICALEO® 2018 Congress Proceedings and published in the *Journal of Laser Applications (JLA).*

Student Paper Award – Full-time university students are invited to submit papers on their research in the field of laser applications and electro-optics to our Student Paper Award contest. Submitted papers will be reviewed by conference chairs and slotted into appropriate sessions. Awards will be presented to 1st, 2nd and 3rd place winners and will be announced during the Closing Plenary Session of ICALEO® on Thursday, October 17. In addition to monetary rewards, winning peer-reviewed papers will be submitted to LIA's *Journal of Laser Applications (JLA)*, and the authors will be mentioned in an *LIA TODAY* newsletter article on ICALEO.

ICALEO 2018 will be held on October 14–18 at the Rosen Centre Hotel in Orlando, Florida.

Abstracts for papers or posters can be submitted online at **www.icaleo.org**.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