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LIA TODAY

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Focus:
MEDICAL

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LIA TODAY

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ABOUTLIA

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

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

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

CALENDAR OF EVENTS

Laser Safety Officer Training

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

Laser Safety Officer with Hazard Analysis*

Mar. 7-11, 2016	Los Angeles, CA
Jun. 13-17, 2016	Philadelphia, PA
Sept. 19-23, 2016	Las Vegas, NV
Oct. 17-21, 2016	San Diego, CA

*Certified Laser Safety Officer exam offered after the course.

Industrial Laser Safety Officer Training

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

Medical Laser Safety Officer Training*

Mar. 5-6, 2016	Los Angeles, CA
Jun. 11-12, 2016	Philadelphia, PA
Sept. 17-18, 2016	Las Vegas, NV
Oct. 15-16, 2016	San Diego, CA

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

Lasers for Manufacturing Summit

Apr. 25, 2016	Atlanta, GA

Lasers for Manufacturing Event® (LME®)

Apr. 26-27, 2016	Atlanta, GA

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

Oct. 16-20, 2016	San Diego, CA

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President's Message

I am greatly honored to serve as LIA President for 2016. Having been involved in LIA activities since 1986, I have witnessed the growth and changes of LIA over the last 30 years. ICALEO® has grown from traditional macro-processing to wider themes including micro and nano-fabrication, additive manufacturing and the introduction of peer-reviewed papers for publication in the LIA journal, *Journal of Laser Applications*® (*JLA*), which has seen a noteable improvement in quality, scientific impacts and citations over the last few years. The development of high power fiber lasers and ultra-fast lasers over the last decade has changed the entire laser processing industry.

I am grateful for the leadership and hard work by Past President Robert Thomas, LIA Executive Director Peter Baker, all the LIA past presidents, the LIA staff and our Board of Directors over the last few years to develop and drive LIA agendas to promote laser and photonics sciences, technologies, applications and the safe use of lasers for the benefit of mankind.

Laser materials processing is now a major manufacturing technology used in wide sectors of industry including aerospace, automotive, electronics, computers, mobile phones, displays, renewable energy, data storage, security and health care. It is our scientists, engineers and business entrepreneurs that have enabled the innovations and this wide spread growth in use of lasers for advanced manufacturing. LIA has provided a useful platform for the laser community to exchange ideas and develop collaborative relationships. The role of lasers and photonics in our everyday lives is becoming so important that 2015 was designated as the International Year of Light by the United Nations. The US government recently announced an investment of $600 million for a new national integrated photonic manufacturing hub (AIM Photonics) at Rochester with a government/industry joint venture.

During 2016, LIA will carry out a review of LIA membership and services, led by President-Elect Paul Denney, aiming to improve our services to the laser community. An area of growth will be seen in additive manufacturing and the wider use of ultrafast lasers within the industry. Asia, particularly China, will lead applications, while Europe and the US are expected to continue to lead innovations in the lasers, beam delivery and process monitoring, and control technologies. The job shop community in the US is a large community that LIA's service could improve. As the Vice President of the Association of Laser Users in the UK, I have witnessed the benefit of laser job shop workshops there. Good practice could be transferred across. LIA will develop a long-term vision and strategy plan in 2016 led by past president Reinhart Poprawe, who successfully transformed the JLA as its editor-in-chief. We will also carry out a review of LIA's finances and develop a financial plan to enable the healthy growth of the institute and its services to the laser community. Students and young people are our future. LIA will welcome students to join LIA and participate in LIA events to learn from experienced seniors and improve career opportunities. We need support from all of our members and the laser community to realize these goals and agendas.

Finally, I wish a happy, healthy and prosperous New Year to all the LIA members, officers, LIA staff and everyone in the laser community.

Lin Li, President
Laser Institute of America

Executive Director's Message

TRANSITIONS

Each year around this time I reflect on how blessed our society is by the quality of our officers and board (learn more about them on page 14). As our President, Officers and a third of our Board change each year, it is my sincere pleasure to thank all those who served last year and to welcome this year's leaders.

Bob Thomas, our 2015 President, has guided us quietly and wisely through the year, in which we made improvements to our conferences, our journal (*JLA*) and our training courses. In addition to his LIA duties, Bob chairs Accredited Standards Committee (ASC) Z136, which develops the ANSI Z136 series of laser safety standards for the safe use of lasers. My sincere thanks and appreciation to Bob for his contributions and leadership.

I am pleased to welcome 2016 President Lin Li, who brings a strong record of achievement together with energy and a flow of good ideas on how we can further improve and upgrade LIA. Lin is spearheading our fundraising initiative to raise the necessary funds for LIA to carry out our mission and vision even more effectively as we approach our second half century of service to the laser industry in 2018.

The coming year promises to be interesting and challenging.
We wish all of our readers a healthy and successful 2016!

Peter Baker, Executive Director
Laser Institute of America

Network with the Experts

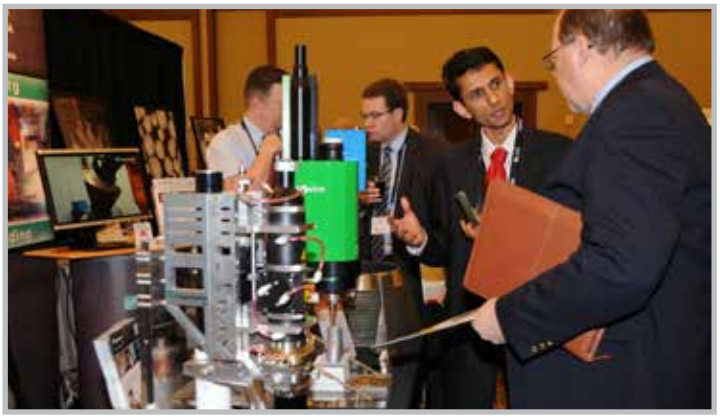
During LIA's Upcoming LAM Workshop

LAM®
LASER ADDITIVE MANUFACTURING
WORKSHOP

BY MICHELLE L. STOCK

Additive manufacturing has been creating buzz for some years, and is now on the threshold of becoming mainstream. According to a PricewaterhouseCoopers survey of more than 100 manufacturing companies in 2014, 11 percent had already moved to volume production of 3D printed parts or products. With interest only increasing based on maturing technologies and processes, there has never been a better time to learn the latest about laser additive manufacturing, meet and network with experts, and benchmark laser additive manufacturing against other technologies – and no better place than LIA's fast-approaching Laser Additive Manufacturing (LAM®) Workshop.

The two-day event, held on March 2-3 in Orlando, FL, will focus on the question "why lasers?" in the burgeoning field of additive manufacturing. Through its keynotes, sessions, exhibits and networking opportunities, the workshop will answer that question and many more. For people involved in manufacturing of complex, lightweight, metal and other structural materials, LAM is a must-attend event.



LAM provides great networking opportunities with experts in the AM industry during the Exhibitor Reception

Paul Denney (Lincoln Electric) General Chair of this year's LAM, along with his Co-Chairs Ingomar Kelbassa (Fraunhofer ILT) and Jim Sears (GE Global Research Center) have designed the program to look at how people are using additive manufacturing, and where, when and why lasers are the best solution when compared to other technologies. Denney commented, "We are hoping this year's workshop will help attendees better understand the pros and cons of laser-based additive manufacturing over other technologies. Hopefully it will also provide direction to those looking to improve on the status of the laser additive manufacturing and what technologies need to be developed and/or improved upon." Users from all industries that require structural materials, such as oil and gas, aerospace, agriculture automotive, defense, marine, medical device, transportation, power generation, construction, and tool and die, can benefit from the knowledge gained by attending LAM. Whether focused on relatively small parts like medical implants and special lightweight brackets for planes, or much larger parts being made directly or that are having their surfaces modified, the program will provide an overview on the different options that are out there today to create formed parts and why you would choose each.

This year's workshop kicks off with a keynote presentation by Professor Sudarsanam Suresh Babu of The University of Tennessee at Knoxville, presenting Recent Advances in Metal Additive Manufacturing at a Manufacturing Demonstration Facility: Role of in-situ Process Monitoring, Computational Modeling, and Advanced Characterization. Following the keynote, speakers from companies who are involved in alternative technologies to laser additive manufacturing will present, including companies using gas metal arc welding (GMAW), ultrasonic welding and electron beams. With that background in mind, the program will turn to how companies select the "best" additive manufacturing process(es). The program will continue with a session on the latest in additive equipment directly from major manufacturers, including Concept Laser and Optomec Design, followed by a session on new additive approaches from both academia and industry experts, such as wire-fed additive manufacturing that can produce features the size of a match-head. The first day will be capped by an excellent opportunity to network – the Exhibitor Happy Hour Reception.

The second day will address "bridging the gap" of laser additive manufacturing from research to application. Starting off, a keynote address by Professor David Bourell of The University of Texas at Austin, Director of the Laboratory for Freeform Fabrication, will discuss the current status of additive manufacturing. The morning sessions will provide insights from government, corporate and academic labs and how they are taking innovations from the lab to the factory floor. In the afternoon, the topics will shift to job shops and how they use additive manufacturing for their customers. This portion of the event will hold particular interest for those who wish to start developing prototypes and even production parts using additive manufacturing processes, but

do not know where to begin and are not ready to commit to purchasing equipment. The workshop will close with the latest in process monitoring and control, two very important aspects to developing robust manufacturing processes.

Peter Baker, LIA's executive director, is excited about this year's workshop, stating "Now in its 8th year, LAM has become a premier event in the additive manufacturing arena. We are grateful to the contributors and sponsors who create this valuable workshop."

Of special note to those involved in medical applications, LAM General Chair Denney adds, "While LAM 2016 does not specifically have a medical focus, those in this industry sector may find the workshop of interest. Technology in sessions on new processes, monitoring-control, research facilities and equipment advances may be of benefit to those in the health care arena. LAM 2016 also provides many networking opportunities to meet with professionals involved in the next generation of processes, equipment and controls that will be used in the medical services market."

Whether you want to learn more about laser-based powder-bed, powder-fed and wire-fed processing, what the latest materials are for use in these processes, or what the latest additive manufacturing trends are by job shops and industrial manufacturers, LAM 2016 is the conference you will want to attend this year. Visit the LIA website (**www.lia.org/lam**) for more information and to register today. ■

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"Welding" Nerve Cells

An Interview with Ellen Townes-Anderson

BY TALIA LANDMAN

Research in the field of biomedical laser applications was a new focus at the Laser Institute of America's (LIA's) 34th International Congress on Applications of Lasers & Electro-Optics (ICALEO®). A fascinating presentation given by Dr. Ellen Townes-Anderson of Rutgers University, titled "'Welding' Nerve Cells Together with Laser Tweezers," explored new research using optical tweezers and collaborated with the work of her late Nobel Prize-winning father and laser pioneer, Charles Townes.

Townes-Anderson's late father introduced the idea of "optical tweezers" to her in the 1990's. She felt that she might be able to use optical tweezers to test if cells can reconnect and the ones they prefer to be partnered with. The answer to this question is vital to circuit repair. It can optimize the possibility of choosing two partners that intrinsically want to be connected.

"My research focus is in trying to repair the connections between nerve cells," explained Townes-Anderson. "All of our brain, eye and spinal cord functions depend on good communication between nerve cells."

Upon looking into the possibility of using the tweezers to repair cells, Townes-Anderson discovered they had been used to move molecules and bacteria. However, no one had yet tried to move vertebrate cells, or cells with a nucleus. Her idea peaked the interest of two companies, which provided Townes-Anderson and her team equipment for a testing site.

Townes-Anderson used cells from a tiger salamander because they have the largest cells in the vertebrate kingdom. She considered that the larger cells might be more difficult to move with the tweezers and it wasn't long before they encountered issues. When the team started to struggle with trying to move the cells, she realized what was wrong and came up with a new idea.

The laser tweezers work through changes in the index of refraction, which release torque, or power, onto the cells. Townes-Anderson determined that in order to successfully move the cells, she had to create a non-adhesive substrate to place onto the culture dish so that the cells did not stick.

"That's one of the first projects we had," Townes-Anderson explained. "[We had] to find something that the cells wouldn't stick to, so that the small piconewtons of the laser tweezers will be able to pick them up. We found a substance called polyHEMA which is the same stuff that they use for contact lenses. I think that makes sense because you don't want your contact lens to stick to your cornea. It's a very non-sticky substance and we started to coat the glass coverslip that we're going to put the cells on with this polyHEMA. When we did that and put the cells into the culture dish, we could, in fact, pick them up. Then we were able to move them. It was very exciting."

Townes-Anderson and her team at Rutgers were able to move the largest cells in the vertebrate kingdom with laser tweezers. They picked up photoreceptive cells, photosensitive cells and what they call "second order" and "third order" neurons. Small groups starting with two cells, three cells and more were created, and led to a fascinating discovery.

"We did discover that cells have intrinsic preferences. That a rod photoreceptor likes a different kind of cell than a cone photoreceptor, and that these preferences were not always what you would expect. In order words, they weren't the cells that they might normally be in contact with. That's the kind of information you need if you're going to be thinking about repair. So, when you're repairing something, it turns out that they like an unexpected partner. A novel partner."

More experiments with cells and laser tweezers included using tweezers to place cells onto micro-electro arrays (MEAs), which are electrodes connected to a box that can generate electricity and excite the cells. Neuro-scientists often use MEAs and randomly "drop" the cells onto the electrode. They don't know what electrodes the cells are going to pair with, or the number of cells going to an individual electrode. Townes-Anderson and her team experimented with using the tweezers to carefully place cells onto electrodes and controlling the cell types each electrode head.

"We were able to use some of these ideas of polyHEMA and moving [cells] with the tweezers; and indeed, we can place specific cells on top of specific electrodes, excite them, and watch them grow back together. That was another step for the use of laser tweezers with cells and we're still working on that." ■

Townes-Anderson is a professor in the Department of Neurology and Neurosciences at Rutgers New Jersey Medical School in Newark, NJ.

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2016 LIA Officers

Meet LIA's New President & Board of Directors

BY BETSY MARONE

LIA's 2016 President, Lin Li graduated from Dalian University with his B.Sc. in Automatic Control before earning his Ph.D. and DIC in Laser Engineering from London University's Imperial College in 1989. With a research focus in high power laser engineering, Prof. Li worked as a post-doctoral research associate at the University of Liverpool until 1994, when he became a lecturer at the University of Manchester Institute of Science and Technology (UMIST). In 2000, Prof. Li became a full-time professor at the University and founded UMIST's Laser Processing Research Center. An esteemed member of the faculty, Prof. Li – who remains the director of the Center – has also served both as Director of Research and as Deputy Head of the School of Mechanical, Aerospace and Civil Engineering, in addition to his work as the Head of the Manufacturing Research Group.

As the author or co-author of nearly 600 publications in laser processing and more than 340 publications related to laser materials processing and photonic sciences in peer-reviewed journals, Prof. Li is an experienced contributor to the laser industry. In addition to the 47 patents he holds, Prof. Li also serves on the editorial board of 12 international journals, including *Optics & Laser Technology*, *Lasers in Engineering*, and *CIRP Journal of Manufacturing Science and Technology*.

The field to which Prof. Li remains so dedicated has recognized him for his extensive work. In 2014 he received the Sir Frank Whittle Medal from the Royal Academy of Engineering, the Royal Society Wolfson Research Merit Award for his work in nanophotonics, and the University of Manchester's Researcher of the Year medal.

An elected Fellow of LIA since 2007 and of the Royal Academy of Engineering since 2013, Prof. Li has held several esteemed positions within organizations worldwide. He served as a member of LIA's Board of Directors from 2009-2013, LIA Secretary in 2014, President-elect in 2015, and as an annual ICALEO® presenter since 1986. Additionally, Prof. Li was elected to The International Academy for Production Engineering (CIRP), served as President of the International Academy of Photonics and Laser Engineering, and Vice President of the Association of Industrial Laser Users (AILU).

As President, Prof. Li plans to establish a strong, sound financial program to ensure a successful future for the organization. In addition to improving the LIA community as a whole – through increased membership and international renown – and the vital services LIA supplies the laser industry, he will also work with his fellow officers to develop a long-term vision and strategy for the organization and explore not only the laser job shop sector, but also the expanding Asian laser community. His focus as president will also extend to the continued success of LIA's conferences in 2016, including the 35th ICALEO Congress in San Diego, the Laser Additive Manufacturing (LAM®) Workshop in Orlando, and the Lasers for Manufacturing Event® (LME®) in Atlanta.

A proud resident of Manchester, UK – the home of industry-changing scientific discoveries – Prof. Li spends his free time with his wife and his 13-year-old daughter. Outside of work, Prof. Li has won Taichi tournaments and pursues his passion for music as a Dizi and Erhu player in a Chinese music band, Oriental Breeze. We wish Lin Li success in his 2016 presidential term!

President-Elect Paul Denney has been a staple in laser materials processing for more than 33 years. Over the span of his career, Denney has served in numerous high-ranking positions in his field. While he now holds the office of Senior Laser Applications Engineer at Lincoln Electric in Cleveland, OH, Denney previously worked as the Director of the Laser Applications Laboratory at the Connecticut Center for Advanced Technology (CCAT), the Laser Technology Team Leader at the Edison Welding Institute (EWI), the Head of the High Energy Processing Department at ARL Penn State, a research engineer at the Westinghouse Electric Research & Development Center in Pittsburgh, PA, a metallurgist at the Naval Research Laboratory (NRL) in

Washington, DC, and a product metallurgist at C.F. & I Steel Corp. in Pueblo, CO. In addition to his extensive career, Denney holds 28 US patents and is a member of ASM and AWS, where he contributes to C7, C7C and C7D committees on high power density processes. Denney is a dedicated member and elected Fellow of LIA. In addition to his roles as LAM General Chair and the Laser Materials Processing Chairperson at numerous ICALEO conferences, Denney served as the organization's Secretary in 2015.

Treasurer Stephen Capp is well-known for his laser industry work, which has spanned more than 25 years. A graduate of Milwaukee School of Engineering, Capp earned degrees in Electrical Power Engineering Technology and Industrial Management in 1978. Capp has spent the majority of his career at Laserage Technology Corporation, where he originally held positions as Plant Manager and Vice President of Operations before becoming CEO of the company – a major international supplier of laser-processed materials – in 1994. A member of LIA since 1992, Capp previously served the organization as President. In addition to his work with LIA, Capp has been involved in the International Microelectronics and Packaging Society, where he served three terms as the National Treasurer and a member of the Executive Council.

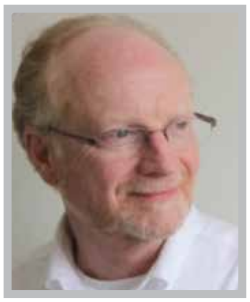
Secretary Milan Brandt is renowned as an expert in his field, becoming a leader in the researching of micromachining with lasers. A Professor in Advanced Manufacturing at RMIT University's School of Aerospace, Mechanical and Manufacturing Engineering, Professor Brandt also holds positions as the Technical Director of the Advanced Manufacturing Precinct and the Director of the RMIT Centre for Additive Manufacturing at the University in Melbourne, Australia. His research currently focuses on additive manufacturing with the use of selective laser melting technology. With experience in laser cladding, cutting, drilling and welding, Professor Brandt's numerous technological achievements, research papers, patents and commercial products have earned him both international and national recognition in scientific and industrial circles. Additionally, Professor Brandt has commercialized his research results, including his most recent work on laser cladding technology for the in-situ repair of steam turbines. Professor Brandt is a Fellow of LIA who has previously served on the Board of Directors and on the organizing committees for both ICALEO and LAM. While Professor Brandt also acted as Organizer and General Chair for PICALO 2004 and PICALO 2006, he was an editor of LIA's *Journal of Laser Applications*® (*JLA*).

Immediate Past President Robert Thomas is a prominent figure in the laser industry, recognized for his research and publication contributions to the field. After earning his B.S. from Pittsburgh State University in 1989, he attended the University of Missouri, where he received his Ph.D. in Physics in 1994 for his work in spectroscopy and numerical simulations for strained-layer semiconductor heterostructures. Since joining the Air Force Research Laboratory in San Antonio, TX in 1994, Dr. Thomas has become a national leader in the research of experimental and theoretical biomedical optics. He has authored and co-authored over 40 peer-reviewed papers and more than 50 other contributed papers in areas ranging from laser-tissue interactions and tissue optics to computer simulation and laser safety exposure limit definitions. A member of SPIE, the American Physical Society (APS), the Directed Energy Professional Society (DEPS), and the Institute of Electrical and Electronics Engineers (IEEE), Dr. Thomas was named Chairman of ASC Z136 in 2010 for the research he completed for the development of the ANSI Z136 series of standards. Elected as a Fellow of LIA in 2007, Dr. Thomas has held numerous leadership positions within the organization, including President in 2015.

(Continued on page 16)

2016-2018
Board of Directors

Clive Grafton-Reed is an awarded contributor to the laser industry. He began his career in the defense industry before receiving a Fellowship in Manufacturing Management from the Cranfield Institute and joining Lumonics Lasers in 1987. As the Global Process Owner of Laser Processes at Rolls-Royce since 2008, Reed is responsible for the technical direction of laser technology throughout the group, the approval of capital investments in laser systems, and the development of company policies and standards. In this position, he frequently advises global suppliers on laser applicability and has made significant changes in manufacturing, such as extending the use of lasers from classical 1064 nm to deep UV. The company awarded Reed the Rolls-Royce Engineering & Technology Prize for Creativity in 2012 for the contribution of his patent application for a miniaturized laser beam control device responsible for processing inside an aero-engine. In addition to his numerous patents for laser systems and applications, Reed is a member of the Technical Advisory Board for Fraunhofer UK.



John Hunter has been an integral member of the laser industry for 38 years. With a BBA from the University of Notre Dame and an MBA from Loyola University of Chicago, Hunter originally held the position of Commercial Director at Powder Products, Inc., where he was responsible for product development, sales and global marketing. As the General Manager and Treasurer of LPW Technology, Inc. (LPW) since 2014, Hunter successfully established this USA company – a wholly-owned subsidiary of LPW Technology, Ltd. in the UK. Throughout his career in the laser industry, Hunter has continuously contributed innovative products, ranging from metal powders for additive manufacturing to extruded activated carbon structures. Additionally, Hunter became a member of LIA in 2010 and, the following year, became a member of the LAM Workshop Program Committee.

Stefan Kaierle's successful career began when he earned his Ph.D. in Mechanical Engineering from RWTH Aachen University in Germany. As the Department Head for System Technology Fraunhofer ILT, Prof. Kaierle has concentrated his research not only on laser system technology, laser materials processing,

laser process control, and optics, but also the related fields of eco-efficiency, automation and laser engineering. After completing guest professorships at Changchun University in 2005 and Beijing University of Technology in 2007, Prof. Kaierle joined Laser Zentrum Hannover (LZH) as Head of the Department of Materials and Processes in 2012. Throughout his career, Prof. Kaierle has published 200 scientific papers – both in journals and conferences – and holds over 10 patents. He is also an active member of organizations across the globe, including the European Laser Institute (ELI), where he is a Fellow and served as President from 2003-2013. After becoming a member of LIA in 2013, Prof. Kaierle ultimately was elected a Fellow. In addition, he is a member of the Board of Stakeholders of the European Technology Platform Photonics21, the Co-Executive Editor-in-Chief of the NATURE journal *Light: Science & Applications*, and has acted as both chairman and a board member for many international conferences.

Yongfeng Lu is a familiar face at LIA, where he has served in a variety of positions. A graduate of Japan's Osaka University, he earned his M.Sc. in electrical engineering in 1988 and his Ph.D. in the same field in 1991. Prof. Lu began his career as a faculty member in the ECE Department at the National University of Singapore before moving to the Department of Electrical Engineering at the University of Nebraska-Lincoln (UNL). Now the Lott Distinguished Professor of Engineering at UNL, Prof. Lu has more than 20 years of experience in the processing and characterization of micro- and nanostructured materials. The research projects he conducts with his group have garnered financial support not only from numerous organizations – including NSF, AFOSR, ONR, DTRA, DOE, DOT, NCESR and NRI – but also from private companies and foundations in Japan. Prof. Lu has authored and co-authored over 300 journal papers and 350 conference papers and is a respected Fellow of SPIE, OSA and LIA. He served as LIA's president in 2014 and as the Congress General Chair for ICALEO in 2007 and 2008. Prof. Lu – who has been both Chair and General Chair for major international conferences – continues his work with these events, holding the position of General Co-Chair for LASE at Photonics West in 2014 and 2015.

Eric Mottay has proven himself an integral member of France's laser industry. A graduate of École supérieure d'optique – the most prominent institution for Optical Engineering in

France – he developed fiber delivery systems for Nd:YAG laser welding while working at Commissariat à l'Energie Atomique before joining B.M. Industries in 1986. As the Technical Director of the laser manufacturing company, his specialty was the development and manufacturing of solid-state lasers. In this position, he brought numerous groundbreaking products to the market, including high energy Q-switched Nd:YAG lasers, advanced parametric oscillators, and Ti:Sapphire-based ultrafast laser systems. In 1997, he moved to the United States and began state-side operations for B.M. Industries, ultimately making the project a success within one year of its inception. Mottay's work continued in 2001 when he founded Amplitude Systemes, now a leading manufacturer of industrial ultrafast lasers.

Robert Mueller is a staple in the laser industry with over 30 years of experience working with a variety of lasers and over 20 years of experience with industrial laser applications and systems. Mueller earned his M.Sc. in Laser Physics from the University of Toronto and later received his Ph.D. from York University, where he wrote a thesis on laser welding dynamics. Over the course of his career, he has gained areas of expertise that range from process development and system design for laser welding and laser cutting systems to in-process quality monitoring and control. Early in his career, Dr. Mueller worked for Powerlasers and NuTech Engineering, Inc. Today, Mueller – a Certified Laser Safety Officer (CLSO) since 2003 – is the Senior Laser Applications Specialist at Massiv Automated Systems in Brampton, Ontario, Canada. In this role, he is responsible for the specification, design and process development for all laser systems and applications, as well as laser safety at the company, including system design, laser system certification, and laser safety training.

Andreas Ostendorf is a renowned contributor to the German laser industry. After studying Electrical Engineering at the University of Hannover, he earned his Ph.D. there in 2001. Prof. Ostendorf joined Ruhr-University Bochum in 2008 as a full-time professor and the Chair of Laser Applications Technology (LAT). Prior to this position, Prof. Ostendorf had a storied career at Laser Zentrum Hannover (LZH). Beginning with the company as a scientist focusing on micro-machining using UV and ultrafast lasers, Prof. Ostendorf later became a member of the Board of Directors and CEO of the company in 2001. Throughout his career as a scientist working on laser micro- and nanostructuring, Prof. Ostendorf has been involved with the German Collaborative Research Centers, as well as numerous national and international research programs. Prof. Ostendorf has been an important member of LIA since 2002. Since then, he has been both Co-Chair and General Chair of ICALEO, a member of both the Board of Directors and the Executive Committee of LIA, a Fellow of LIA and SPIE, and LIA's 2008 President. In addition, Prof. Ostendorf is a member of the WLT German Scientific Laser Society, which cooperates internationally with LIA.

Rajesh S. Patel is a practiced member of the laser material processing field, with over 20 years of experience. Earning his Ph.D. in Mechanical Engineering from the University of Illinois at Urbana-Champaign in 1989, Dr. Patel went on to work at his own consulting company and, later, at IBM, Aradigm and IMRA America. Today, Dr. Patel is a manager at Spectra Physics – a division of Newport Corporation – where he manages the Laser Processing Applications Lab and new laser product development projects. With professional interests ranging from laser development and optics to mask technology and laser material processing and equipment design, he is the author of 22 US patents related to the areas of laser processing, optics and the mask technology fields. In addition to publishing and presenting over 40 technical papers, Dr. Patel is an active member of both SPIE and LIA. He has served on LIA's Executive Committee, co-chaired ICALEO in 1997, 1998, 1999 and 2002, and held the position of General Chair of ICALEO in 2004.

Silke Pflueger has 25 years of experience in the field of industrial lasers and their applications. After earning her Ph.D. in Mechanical Engineering from the Technical University in Aachen, Dr. Pflueger began her career in lasers at the Fraunhofer Institute for Laser Technology in Aachen, Germany, working on laser development and applications projects. The position brought her to the Fraunhofer Resource Center in Michigan, where she served as project manager and proved integral to successfully establishing the young group as a center of excellence. Dr. Pflueger went on to be the Director of Sales and Marketing at Laserline Inc., as well as the Director of Sales for North America at SPI Lasers. Before accepting her current position at DirectPhotonics America, she also held engineering and marketing positions at SDL/JDSU, where she worked with high power laser diodes and fiber lasers.

(Continued on page 18)

Koji Sugioka is internationally renowned for his wide-ranging research focuses. A graduate of Japan's Waseda University, Prof. Sugioka earned his B.S., M.S. Eng. and Prof. Eng. in electronics at the institution. Beginning his career with RIKEN in 1986, Prof. Sugioka is currently a Unit Leader of the RIKEN-SIOM Joint Research Unit at the RIKEN Center for Advanced Photonics. Additionally, Prof. Sugioka has been a guest professor at Tokyo Denki University since 2004 and the Tokyo University of Science since 2006. While his current research interest lies in ultrafast laser processing for microfluidic, optofluidic, microelectronic and optoelectronic applications, his past research fields have varied from laser doping, laser etching and laser surface modification to laser-induced selective metallization, VUV laser processing, microfabrication of transparent materials, and more. The recipient of 11 awards for his research, inventions and contributions to the field of laser microprocessing, Prof. Sugioka also holds 16 licensed patents, has written more than 160 peer-reviewed journal articles, and has presented more than 130 invited talks at international conferences. In addition to his work as a member of the Board of Directors at the Japanese Laser Processing Society (JLPS) and as a Fellow of SPIE, Prof. Sugioka is editor-in-chief of the online *Journal of Laser Micro/Nanoengineering* (*JLMN*), is one of the founders of the International Symposium on Laser Precision Microfabrication (LPM) and has served as a Conference Chair, co-chair and committee member at international conferences. ■

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PhotoMachining, Inc.

Creating Solutions for Specific Micromachining Needs

BY BETSY MARONE

PhotoMachining, Inc. is a world leader in high precision, micromachining applications, specializing in the use of UV and ultrafast or Ultra Short Pulse (USP) – Picosecond (PS) and Femtosecond (FS) – lasers. A company known for its wide range of available micromachining lasers – which come in a variety of wavelengths to meet specific needs – PhotoMachining, Inc. provides the laser industry with laser micromachining, contract manufacturing and laser micro machining systems for industrial applications. The company's services meet the needs of numerous markets, ranging from medical devices and microelectronics to semiconductors and aerospace and defense.

Founded in 1997 by John O'Connell and Ronald Schaeffer, PhotoMachining, Inc. is located in Pelham, NH, where it is currently owned by the founders and two private investors. With over 20 employees – roughly 20 percent of whom hold Ph.Ds. in Physics or Physical Chemistry – the company consists of two divisions: the Systems Division and the Job Shop Division. Though they consider themselves primarily a job shop, PhotoMachining, Inc. uniquely combines this business with a systems division, which specializes in custom, innovative systems. The systems the company offers – generated in the job shop – are manufactured by working closely with customers, understanding their unique needs in order to create a solution that will meet their individual requirements.

While continuously providing customers with these integral services, PhotoMachining, Inc. has adapted to the industry's changes throughout its 19 years in business, evidenced by its constant use of the latest technology. This was first seen at the time of the company's inception, when 355 nm UV DPSS lasers became commercially available. This allowed the company to make the shift from larger excimer lasers to the smaller and more cost-efficient DPSS, UV and USP lasers for the majority of its UV applications. Though PhotoMachining, Inc. offers an array of fiber, Nd:YAG and CO_2 lasers, the company is most known for their work with the newer UV and USP lasers for high precision applications.

Among the company's many contributions to the industry, its UV laser processing ranks among the highest due to its wide selection of laser sources available with a variety of pulse lengths. Constantly adapting to the unique needs of customers and utilizing the latest technology available, PhotoMachining, Inc. continuously aims to expand its line of products and services. The company will do this once again in the spring, with the addition of a new, high power three-wavelength PS laser, which boasts 50 W in the fundamental stage. Also, the company plans to acquire a high power FS laser, over 100 W. In addition to the new options available in UV and short pulse lasers, the decreasing price of new lasers and the company's continued work with customers on new laser types will allow PhotoMachining, Inc. to continue offering the integral services for which it is known in the laser industry.

A corporate member of LIA since 2005, PhotoMachining, Inc. values its work with the organization. Active participants at ICALEO® and LME®, PhotoMachining, Inc. connects with both current and prospective customers through LIA's work. "LIA is a great place to meet others involved in the laser industry, as well," says Chief Executive Officer, Ronald Schaeffer. ■

Member Innovations

Cymer Delivers Second Generation Solution for Reduction of Neon Consumption on ArF Light Sources

Cymer, an industry leader in developing lithography light sources used by chipmakers to pattern advanced semiconductor chips, announced the availability of its second generation solution to reduce the consumption of neon gas in ArF light sources. Neon is used in the routine operation of semiconductor light sources, and has recently been subject to supply limitations. Cymer's latest gas control technology is expected to deliver up to 75 percent reduction in neon consumption, further reducing the impact on chipmakers from neon shortages and price fluctuations

This is the result of the comprehensive Neon Reduction Program started by Cymer earlier this year that led to a solution to reduce neon consumption by approximately 50 percent for ArF and 30 percent for KrF released in September which was adopted widely by customers.

"Neon supply continuity and price variability have strongly impacted our customers," said David Knowles, Vice President of Cymer Light Source. "This latest release is part of our commitment to reduce the dependence on neon by collaborating with our customers to quickly release new solutions."

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

LPW Launches New Product Line - POWDERFLOW™

LPW Technology, a market leader in the development and supply of a Total Powder Management solution into the Additive Manufacturing (AM) industry, has launched a new product line called **POWDER**FLOW™.

POWDERFLOW™ is a comprehensive powder flow measurement kit, which allows you to quickly and fully characterize the powder flow to known ASTM standards. With their extensive experience, LPW knows that some may confuse machine problems with powder problems and vice versa, resulting in significant time and cost being wasted before a fault is found, therefore **POWDER**FLOW™ has been developed to combat such issues and thus reducing overall down time.

POWDERFLOW™ is delivered in a robust case and allows you to determine the following: Apparent Density ASTM B212, Angle of Repose, Hall Flow ASTM B213 and Carney Flow ASTM B964.

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

Members In Motion

GEOMATEC Laser Scanning Optics Now Available in North America

Precision Laser Scanning announces that GEOMATEC, a leading optics manufacturer in Japan, is now making its laser scanning optics available to the North American market. GEOMATEC makes high precision F-Theta lenses and beam expanders to rival the best in the world. The company has more than 50 years of experience in the optics industry but is virtually unknown outside of Japan.

GEOMATEC F-Theta lenses are diffraction limited across the scan field, have low wave front error and are very stable in high power applications. Telecentric lenses have telecentricity of < 1.5 degrees across the scan area. These qualities are important in high precision material processing applications.

Their fixed and zoom beam expanders have extremely low beam shape distortion. This is important in applications where beam shape is critical. They are easy to adjust for divergence. Common body size allows interchanging of different magnification to accommodate different sources.

Visit **www.precisionlaserscanning.com** *for more information.*

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

BLS Update

All CLSOs and CMLSOs with certification maintenance (CM) cycles that ended December 31, 2015 who have not recertified – *Contact the BLS office today to avoid losing your active status.*

In accordance with the CLSO and CMLSO Policies & Procedures manuals, CM worksheets with supporting documentation and recertification fees must have been postmarked by January 31 following the end of the 3-year certification cycle. The consequence of not recertifying by this date is "Inactive Status," which is loss of the use of designation.

To restore status, CM worksheets accompanied with appropriate recertification and late fees will be accepted up to and including May 31. After that time, it will be necessary to retake the exam to become active again.

For many CMLSOs in particular, coming up with CM points seems a daunting task as oftentimes laser safety is only a fraction of the job. To add to the confusion, one CEU does not equal one CM point; maintaining licensure is not equivalent to renewing laser safety certification. In essence, documenting professional development activities, e.g., continuing education is the goal of the CM point renewal process.

A breakdown of CM worksheet categories may benefit those trying to submit. Remember the requirement is a minimum of 10 CM points over the 3-year cycle:

- Job experience, 1 point per year = 3 points total
- Membership in a professional society, 1 point per year of membership = 3 points total, e.g., LIA, AORN, ASLMS, see the BLS website for approved organizations
- Attendance at a laser safety or applications conference, 1 point per 6-8 hour day e.g., attendance at the International Laser Safety Conference (ILSC®) = 1 point per day. Full conference attendance, i.e., Monday-Thursday = 4 points total

Attendance at AORN does not equal one point per day; only sessions related to laser safety can be counted toward BLS certification maintenance, points are determined based on session duration.

- Refresher training or in-service training, point values are time-dependent, i.e., how long did the training last?
- Publication of peer-reviewed articles = 1 point per article
- Magazine or newsletter publications (print or online) = ½ point per article
- Participation on a laser safety related committee outside of daily job responsibilities, 1 point per year = 3 points total
- Presentations at laser safety professional conferences, workshops or meetings = ½ point per presentation

For questions related to certification maintenance or assistance in completing the CM worksheet, please contact the BLS at +1.407.985.3810 or email **bls@lasersafety.org**.

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

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

Departments of Labor and Justice Launch Initiative to Cooperate on Investigation and Prosecution of Workplace Safety Violation

The Department of Labor and the Department of Justice have established a new initiative to prevent and deter crimes that jeopardize the lives and health of workers. The initiative strengthens the ability of the two departments to investigate and prosecute employers who fail to provide a safe workplace for their employees. Deputy Secretary of Labor Chris Lu joined Deputy Attorney General Sally Yates in signing the agreement during a ceremony at the Dept. of Justice on Dec. 17.

The Memorandum of Understanding calls for the Justice Department's Environment and Natural Resources Division and the US Attorney's Offices to work with the Department of Labor's Occupational Safety and Health Administration, Mine Safety and Health Administration, and Wage and Hour Division to investigate and prosecute worker endangerment violations. The worker safety statutes generally provide for only misdemeanor penalties, and the new initiative will encourage them to use the federal criminal and penal code and environmental offenses, which often occur in conjunction with worker safety crimes, to enhance penalties and increase deterrence.

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

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

Identifying Residual Stresses in Laser Welds by Fatigue Crack Growth Acceleration Measurement

BY JESPER SUNDQVIST, ALEXANDER F. H. KAPLAN, JAN GRANSTRÖM, KARL-GUSTAF SUNDIN, MARKKU KESKITALO, KARI MÄNTYJÄRVI AND XIAOBO REN

During laser welding, residual stresses are thermally induced. They can have strong impact on the fatigue behavior and fatigue life. A standardized measurement method for the fatigue crack growth rate was expanded to identify residual stress along the cracking path. The second derivative of the measured crack opening and in turn the crack acceleration corresponded well with distinct acceleration maxima and minima and accordingly with tensile and compressive stress, as was basically proven by numerical simulation. The method is simple and extendable. It provides valuable information, as was demonstrated for various situations.

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** to receive your *JLA* table of contents email alerts.

Introducing LIA's New Desktop Evaluator Software
You asked and LIA responded! After the inception of the web-based Laser Safety Hazard Analysis System, The Evaluator in 2010, LIA created an alternative platform of the product – the Desktop Evaluator – to further meet the specific needs of Laser Safety Officers (LSOs) in the field.

Unlike the web-based Evaluator, the Desktop Evaluator will be available for purchase on a USB drive, from which users can download the software to their computer. Once it is stored on users' PCs, LSOs will be able to perform a number of repeated calculations based on the ANSI Z136.1 *American National Standard for Safe Use of Lasers* – including maximum permissible exposure (MPE), optical density (OD), nominal ocular hazard distance (NOHD), nominal hazard zone (NHZ) and laser hazard classification – without worrying about being connected to the Internet. This feature will be especially beneficial for military users whose firewalls often restrict continuous access to online content.

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

LASER World of PHOTONICS CHINA 2016
LASER World of PHOTONICS CHINA 2016 will take place at the Shanghai New International Expo Center March 15-17. As Asia's largest tradeshow for lasers, optics and photonics, it covers all aspects of optical technologies — from components to applications. LASER World of PHOTONICS CHINA 2016 will showcase an entire spectrum for the five categories: Lasers and Optoelectronics, Optics and Manufacturing Technology for Optics, Lasers and Laser Systems for Production Engineering, Imaging, Machine Vision, Optical Metrology and Quality Assurance.

Since it was founded in 2006, LASER World of PHOTONICS CHINA has become the leading photonics exhibition in China. The fair's growing numbers year after year demonstrate the leading role of LASER World of PHOTONICS CHINA as well as the market's strong belief in this industry. Leading international experts pass on industry know-how at top level technical conferences such as the International Laser Processing, Systems and Application Conference LPC.

For more information, visit **www.world-of-photonics-china.com**.

Register to Attend FREE Education Courses at LME & Its Manufacturing Summit
LIA's Lasers for Manufacturing Event® (LME®) taking place April 26-27 in Atlanta, GA, is the place to see the latest in laser technology, network with the industry's elite and find solutions to current and future manufacturing needs. Attendees of LME can visit the show floor theater for keynote presentations on trending topics in the laser industry, attend expanded free educational sessions to understand why laser technology is the future of manufacturing, where and how it is applied, and connect with suppliers who can help you to benefit from using lasers in your manufacturing.

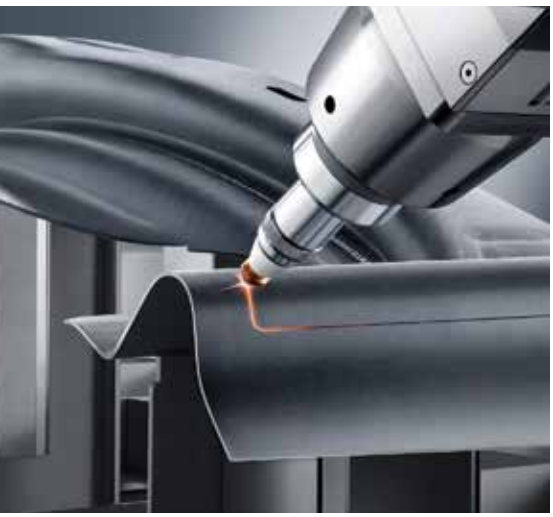
Held in conjunction with LME, don't miss out on the Lasers for Manufacturing Summit to be held on April 25. The Summit brings together C-suite and other top executives and will provide a comprehensive market perspective that is unobtainable elsewhere, with market data segmented by applications and laser technology from the laser industry's leading resources.

Visit **www.laserevent.org** for more information or to register today.

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

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

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



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It’s easy to see why thousands of manufacturers have made the switch to laser processing. Laser welding makes joining of dissimilar and lightweight materials possible, allows material thicknesses to be reduced, and even enables flangeless designs. Laser cutting is the only process that allows cutting of hot formed components. TRUMPF machines are also able to cut a wide variety of lightweight materials, including CFRP. Whatever the application, TRUMPF’s broad laser portfolio and applications expertise provide the perfect solution in the pursuit of making vehicles lighter, stronger and safer.

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