LIA TODAY

THE OFFICIAL NEWSLETTER OF THE LASER INSTITUTE OF AMERICA

The international society dedicated to fostering lasers, laser applications and laser safety worldwide.

FOCUS: LASER ADDITIVE MANUFACTURING | VOLUME 20 NO. 1 | JANUARY / FEBRUARY 2012

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Laser Institute of America

Laser Applications and Safety

Photo courtesy of Fraunhofer Institute for Laser Technology ILT, Aachen, Germany / Volker Lannert

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THE OFFICIAL NEWSLETTER OF THE LASER INSTITUTE OF AMERICA

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

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

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CALENDAR OF EVENTS

Laser Safety Officer Training
Feb. 27-29, 2012 | Phoenix, AZ
June 26-28, 2012 | Chicago, IL
Dec. 4-6, 2012 | Orlando, FL

Laser Safety Officer with Hazard Analysis*
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Laser Additive Manufacturing (LAM) Workshop
Feb. 29-Mar. 1, 2012 | Houston, TX

International Congress on Applications of Lasers & Electro-Optics (ICALEO®)
Sept. 23-27, 2012 | Anaheim, CA

Laser Welding & Joining Workshop
Oct. 23-24, 2012 | Schaumburg, IL

Lasers for Manufacturing Event (LME)
Oct. 23-24, 2012 | Schaumburg, IL

Visit **www.lia.org** *for all course and event listings.*

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.

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PRESIDENT'S MESSAGE

Dear LIA members, friends, colleagues and readers,

On the occasion of Photonics West in San Francisco we had the opportunity to hold this year's first Executive Committee Meeting on Sunday, January 22. I have the pleasure to let you know that we are on a very good track out of the difficulties caused by last year's worldwide decline. Peter Baker and his staff did and do outstanding work and you may want to join me in recognizing the staff whenever you have a chance to do so!

New events are coming up – LAM looks like an all-time high this year in quality and number of attendees. If you have anything in mind with Laser Additive Manufacturing – and I cannot imagine anyone not – you or at least your organization should have a look. "3-D- Printing" using computer data to manufacture parts up to 10"x10"x10".The future of "Production 2.0" just begun and you can be part of it in Houston February 29 - March 1, 2012 (**http://www.lia.org/lam**).

Further on, plan now for your contribution to ICALEO® in September 2012, it will be very worthwhile! We shall increase the threshold for quality in the papers in order to make the conference even more effective for the attendees. Also, the events around the scientific and technical program shall be selected and planned on a top level for more fun and true relaxation during the "off-hours" of the conference. We are looking forward to a great event!

The international scene is very active. In Japan we expect a top-level photonics event on April 23-27, the OPIC2012 Optics & Photonics International Congress in Yokohama (**http://opicon.jp**), a meeting of scientific and strategic global relevance, especially for the Asian and Pacific strategies and markets. World class presentations and panel discussions with scientists, politicians and industrial representatives are scheduled.

LIA and your president wish you a great start into a promising 2012!

Sincerely yours,

Reinhart Poprawe
President, Laser Institute of America

EXECUTIVE DIRECTOR'S MESSAGE

Team LIA is blessed with great leadership from our conference chairs, to board members to our officers.

Today I want to thank our 2011 LIA President Stephen Capp. Steve led us through the evaluation of our Lasers for Manufacturing Event and then participated as a member of the charter group of exhibitors who steered us to a successful launch.

As president, Steve was my go-to guy for advice and counsel and he, like his predecessors, struck just the right balance between being there when needed yet trusting me and the LIA staff to know our jobs and do it without micro management.

Now we welcome our 2012 President Reinhart Poprawe, who as executive director of Fraunhofer ILT has been a friend and supporter of LIA for decades.

Reinhart, in addition to being president, has been hard at work as editor-in-chief of our *Journal of Laser Applications®* where he has installed an impressive team of editors covering an array of topics.

As you can see in the profile on page 10, he is committed to helping us to be No.1 with our Journal and ICALEO and we all look forward to working with him as our society continues to build momentum as the premier international society for laser applications and safety.

Welcome Reinhart!

Peter Baker, Executive Director
Laser Institute of America, pbaker@lia.org

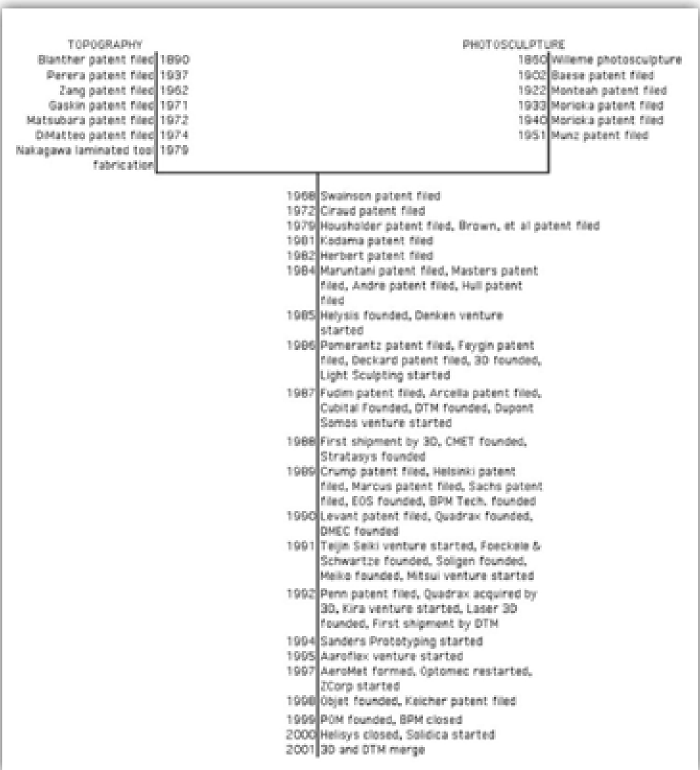
THE HISTORY OF LASER ADDITIVE MANUFACTURING

By David L. Bourell and Joseph J. Beaman, Jr.

Additive manufacturing is a collection of computer-controlled processes that create parts in a layerwise fashion without part-specific tooling. Applications share the common characteristics of part production with complex geometry in relatively small production runs. Historically, applications were limited to production of prototypes and casting inserts, since part mechanical properties and surface finish were inadequate for actual structural applications. More recently, coupled with post processing, additive manufacturing has been used to produce a variety of production tooling, short-run structural parts, customized bio-engineered parts, mass-customized parts, architectural designs, parts for automotive and aerospace applications, archaeological replicas and artwork[1]. The demand for products and services from additive manufacturing technology has been strong over its 23-year history (1988-2010). The compound annual growth rate of revenues produced by all products and services over this period is an impressive 25.1%[2]. This article describes a historical context of additive manufacturing technology based largely on U.S. patent literature.

ADDITIVE MANUFACTURING TIMELINE

The figure displays an early chronological timeline of additive manufacturing. This chronology should not be considered complete; it indicates some but not all of the major time events in this field up to about 2002. Two early roots of additive manufacturing are topography and photosculpture. In the late 1960s, "proto-additive manufacturing" technologies



Early chronology of additive manufacturing processes based on U.S. patent filings.

appeared which ushered in actual additive manufacturing process development in the mid-1980s, concurrent with the advent of low-cost, desktop computing.

As early as 1890, Blanther[3] suggested a layered method for making a mold for topographical relief maps. The method consisted of impressing topographical contour lines on a series of wax plates and cutting these wax plates on these lines. After stacking and smoothing these wax sections, both a positive and negative three-dimensional surface was generated that corresponded to the terrain indicated by the contour lines. After suitable backing of these surfaces, a paper map was then pressed between the positive and negative forms to create a raised relief map.

In 1974, DiMatteo[4] recognized that stacking techniques could be used to produce surfaces that were particularly difficult to fabricate by standard machining operations. In one embodiment, a milling cutter contoured metallic sheets, and these sheets were then joined in layered fashion by adhesion, bolts or tapered rods. In 1979, Professor Nakagawa of Tokyo University used lamination techniques to produce actual tools such as blanking tools[5], press forming tools[6] and injection molding tools[7]. This is a precursor to all "cut-and-stack" additive manufacturing technologies, including laminated object manufacturing.

Photosculpture arose in the 19th Century as an attempt to create exact three-dimensional replicas of any object, including human forms[8]. One somewhat successful realization of this technology was developed by François Willème in Paris in 1860. A subject or object was placed in a circular room and simultaneously photographed by 24 cameras placed equally about the circumference of the room. An artisan then carved a 1/24th cylindrical portion of the figure using a silhouette of each photograph, and these were later assembled.

In 1951, Munz[9] proposed a system that has features of present day stereolithography techniques. He disclosed a system for selectively exposing a transparent photo emulsion in a layerwise fashion where each layer comes from a cross section of a scanned object. Lowering a piston in a cylinder and adding appropriate amounts of photo emulsion and fixing agent created these layers. After exposing and fixing, the resulting solid transparent cylinder contained an image of the object. Subsequently this object could be manually carved or photochemically etched out to create a three-dimensional object.

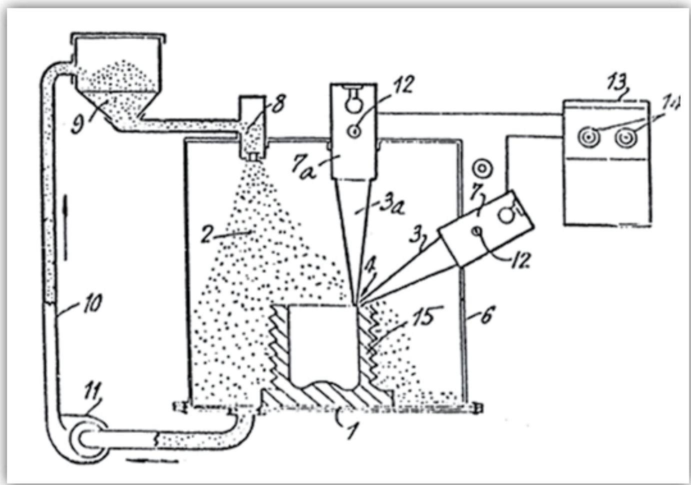
In 1971, Ciraud proposed a powder process that has the features of modern powder-based direct deposition additive manufacturing techniques[10]. This disclosure described a process for the manufacture of objects from a variety of materials that were at least partially able to melt. To produce an object, small particles were applied to a matrix, and a laser, electron beam or plasma beam then heated the particles locally. As a consequence of this heating, the particles adhered to each other to form a continuous layer. Brown, Breinan and Kear at United Technologies Corporation in 1982 patented a similar powder-based technique for building up material in a near net shape fashion to produce rotors for the aerospace industry[11].

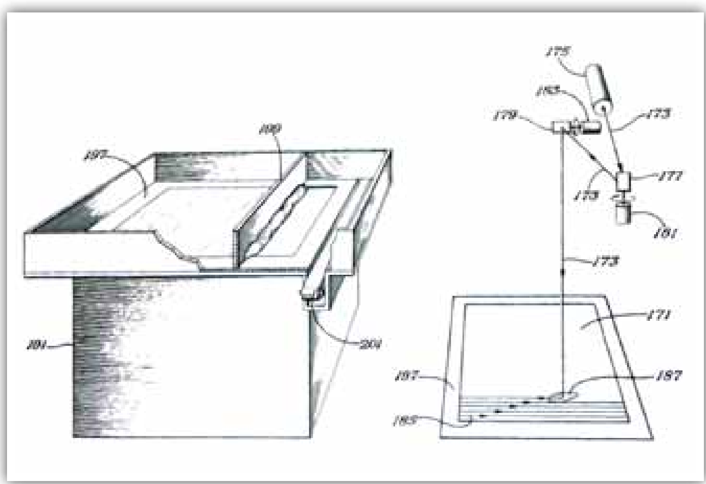
In 1979, Housholder[12] presented the earliest description of a powder laser sintering process in a patent. He discussed sequentially depositing planar layers and solidifying a portion of each layer selectively. The solidification can be achieved by using heat and a selected mask or by using a controlled heat scanning process.

Hideo Kodama of Nagoya Municipal Industrial Research Institute was the first to publish an account of a functional photopolymer rapid prototyping system in 1981[13]. In his method, a solid model was fabricated by building up a part in layers where exposed areas corresponded to a cross-section in the model. He studied three different methods for achieving this using both a mask and an x-y plotter with an optical fiber.

The roots of modern additive manufacturing trace back about 50 years, although preceding topographic and photosculpture methods share much in common with additive manufacturing and are over 100 years old. The prehistory of additive manufacturing provides a rich backdrop for current and future developments. One such articulation of the future was a research roadmap exercise for additive manufacturing organized by one of the authors[14]. In addition to technical targets, educational needs and a national testbed center were highlighted. ■

David L. Bourell and Joseph J. Beaman, Jr. are with the Laboratory for Freeform Fabrication, Mechanical Engineering Department at The University of Texas at Austin.





Early additive manufacturing laser-based powder processes of Ciraud[10] and Housholder[12].

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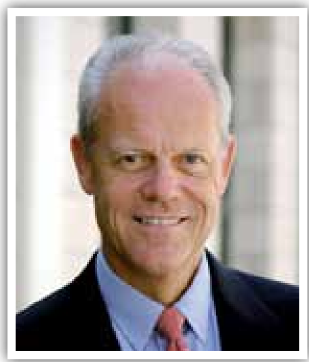
MEET LIA'S 2012 PRESIDENT AND BOARD OF DIRECTORS

Reinhart Poprawe, LIA's 2012 president, has worked in the laser industry and its related organizations for over 30 years. He received an M.A. in physics from California State University in Fresno in 1977. After completion of his Ph.D. in physics (Darmstadt, 1984) he joined the Fraunhofer Institute for Laser Technology in Aachen, Germany where he worked as head of a department for laser-oriented process development.



In 1988 Poprawe started Thyssen Laser Technik GMBH and was the company's CEO. Since 1996 he has been managing director of the Fraunhofer Institute for Laser Technology and holds the University Chair for Laser Technology at the RWTH Aachen. In 2004 he served as vice rector of Aachen University and currently is a member of several boards in the scientific and industrial organizations, e.g. the AKL Arbeitskreis Lasertechnik e. V. Aachen. He also chairs the RWTH International Board and is the Rectors delegate for China.

Poprawe's main areas of expertise are laser applications, laser additive manufacturing, rapid prototyping, micro technology and photonics in life science. He also has vast experience in laser development and with plasma technology in the realms of process analysis, sensors for laser processes, laser induced plasmas, EUV sources for lithography and microscopy, XUV-sources and laser induced breakdown spectroscopy.

ILT is the leading laser center in Europe. The aim of ILT activities is the economical application of lasers in the industry. The services offered by ILT include strategic research, applied research on products and processes, prototype development, quality management, consultancy and training programs. ILT has spun out 30 companies with a total of about 1,000 employees in the past with the annual rate being a little over one company per year.

DURING HIS TERM

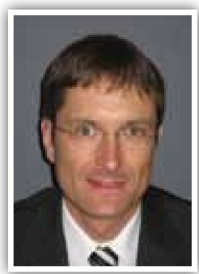
Poprawe has been an LIA board member since 2001, editor-in-chief of the *Journal of Laser Applications®* (JLA) since 2010 and was the 2011 president-elect. In 2006 he became a fellow of the LIA. During his term as LIA president, Poprawe would like to accomplish the following goals: see more attendees at all of LIA's conferences, courses and workshops, which shall help increase the society's bottom line and see LIA's reputation and message of laser safety gain momentum in the form of more members. Additionally, he will be working to make LIA's 30-year-old International Congress on Applications of Lasers & Electro-Optics (ICALEO®) the number one global laser conference with top quality invited speakers, first class and relevant presentations and top notch infrastructure and events. Emphasis will also be put on making JLA the top global journal in laser applications.

Poprawe will be kept busier than most LIA presidents as during 2012 another topical workshop shall be implemented similar to the LAM (Laser Additive Manufacturing) Workshop, which is the Laser Welding & Joining Workshop being held in October. Also, a workshop on ultrafast processing is in the works for 2013.

On a personal note, Poprawe is married to Anette and they have four children. He loves sailing (has all the papers you need for doing it all on your own), snowboarding, philosophy, lyrics, plays golf once in a while and has a great passion for art (does some painting) and music. Convinced of the relevance of high quality and cultivated comprehensive language, he founded an initiative for the local theatre in Aachen, where he serves as a member of the board. Here's wishing Reinhart Poprawe a successful year as LIA president!

Poprawe having fun in the lab and out of it.

EXECUTIVE COMMITTEE

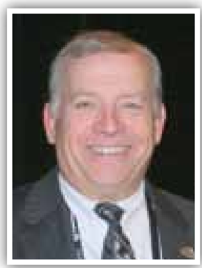


President Elect Klaus Löffler graduated from the University of Stuttgart with a master's in mechanical engineering. Since 2009 he is responsible for the strategic industry development for the TRUMPF Laser und Systemtechnik. In 2004 he founded the Automotive Laser Conference in Wolfsburg, Germany, which together with ALAW and JALAW builds a global conference partnership. In 2006 he took over international sales at TRUMPF Lasers and Systems and in 2007 became an LIA board member. Besides LIA, he serves on the board of the SLT conference and other events with the goal to ensure the global growth of laser technology.

Treasurer Yongfeng Lu is currently the Lott Chair Professor of Engineering at the University of Nebraska Lincoln. Lu received his BEng degree from Tsinghua University (China), M.Sc. and Ph.D. degrees from Osaka University (Japan) in 1984, 1988 and 1991 respectively. Besides the fundamental research work that led to a large number of publications and a number of national and international awards, he also has successfully developed a number of laser-based material processing technologies and commercialized them in industries. In the past few years, he received around $10 million of research funding from DoD, NSF, DOE, NRI, private foundations and industry, including a MURI grant from ONR. He served as the general chair for ICALEO in 2007 and 2008.

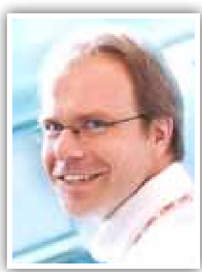
Secretary Robert Thomas received his B.S. degree in physics from Pittsburg State University, Pittsburg, KS in 1989 and his Ph.D. in physics from the University of Missouri–Columbia in 1994. He has worked in the areas of experimental and theoretical biomedical optics with the USAF Research Laboratory at Brooks City-Base, Texas. From 1996 to 2002 he served as a research physicist with TASC and Northrop-Grumman Corporation. In 2002 he joined the USAF Research Laboratory where he holds the title of principal research physicist. He has authored and co-authored more than 25 peer-reviewed papers and more than 50 contributed papers. In 2007 Thomas was named a fellow of the LIA.

Immediate Past President Stephen Capp is CEO of Laserage Technology Corporation. He previously held positions as plant manager and president of operations. Laserage is an international supplier of laser-processed materials growing to one of the largest laser job shops in the U.S. 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 30 years. He has been a member of the LIA since 1992.

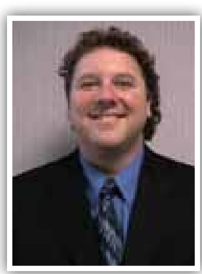


2012-14 BOARD OF DIRECTORS

Lutz Aschke, Ph.D., has been managing director and CTO of LIMO Lissotschenko Mikrooptik GmbH in Germany since 2006. From 2004 until 2006 he served as technical director at the executive board of LIMO. Additionally, since 2007 he is a member of the board of IVAM, the international association of companies and institutes in the field of microtechnology, nanotechnology and advanced materials. Since 2011 he has been a member of the board of stakeholders of the European Photonics21 initiative. His scientific background is in plasma physics, especially DUV optics, EUV light sources and laser fusion.

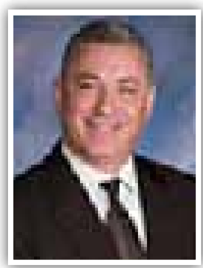


Neil Ball is the president of Directed Light Inc, San Jose, CA, a laser technology company serving the industrial, medical and scientific laser communities worldwide since 1983. Ball has devoted his adult working life to the industrial laser industry. He began his career 26 years ago as an application technician in the contract manufacturing sector at LaserFab, Inc. in California. He moved to Systron Donner Inertial and became involved in the production of inertial guidance packages, accelerometer, gyroscopes and inclinometers. Ball joined Directed Light in 1993 to assist in applications development, system design and component/service support. He 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.

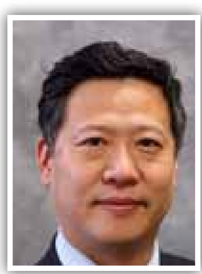


Milan Brandt is a professor in advanced manufacturing in the School of Aerospace, Mechanical and Manufacturing Engineering, RMIT University, Melbourne Australia, focused in the area of additive manufacture using selective laser melting technology. The school is a leading provider of teaching and research locally and internationally in these disciplines. Brandt is the leading Australian researcher in the area of macro machining with lasers. This has resulted in technological achievements, patents, research papers and commercial products that have been recognized internationally and nationally. He was involved in setting up the company Hardwear to commercialize this technology. He has also actively promoted the benefits of laser technology to the Australian industry through invited presentations, conference papers and industry seminars. Professor Brandt is a fellow of LIA and was on the organizing committee for ICALEO, serving on the board of LIA and being the organizer and general chair for PICALO 2004 and 2006, which promoted industrial lasers and applications in the region.

Michael Francoeur began his welding career in 1977 as an entry-level employee at an electron beam welding job shop. In 1985 he formed his first company, Dynamic Electron Beam Corp. and in 1992 opened Energy Beam Labs, Inc. in Cheshire, CT. Francoeur had changed the original business model used at Dynamic such that Energy Beam's charter would be to provide research/development and engineering services to a variety of industries in need of precision welding. In 1995, Francoeur went through the entrepreneurship education curricula at Harvard Business School and MIT, which lead to the next reinvention of his business and in 1998 launched Joining Technologies. The new vision targeted laser welding as the principle offering with electron beam as a supporting technology. Joining Technologies has nurtured several strategic alliances, most notably with Fraunhofer ILT in Aachen, Germany.



Lin Li is director of the Laser Processing Research Centre at The University of Manchester; he started laser-processing research in 1985 at Imperial College, London University, with Professor Bill Steen. After obtaining a Ph.D. in laser processing, he worked for six years in the Laser Group, Liverpool University. In 1994, he took up a lectureship (assistant professor) at the University of Manchester Institute of Science and Technology. Li is the author and



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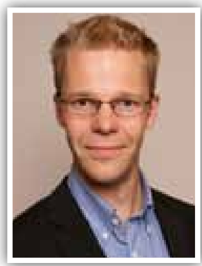
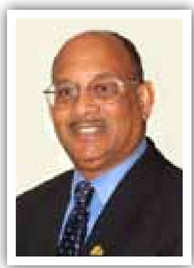
co-author of over 500 publications in laser processing including 45 patents and over 250 publications in peer-reviewed journals. He was awarded a fellow at the Institute of Engineering and Technology, International Academy of Production Engineering (CIRP), LIA and the International Society of Nanomanufacturing. He serves on the editorial boards of nine international journals and co-chaired the Laser Materials Processing Conference at PICALO 2008 and 2010.

Bill O'Neill is a reader in laser engineering within the Cambridge University Engineering Department and director of the Centre of Industrial Photonics. He has written and researched widely on the subjects of laser-matter interactions, optical engineering, laser based manufacturing technologies and micro/nano fabrication techniques. He is a fellow of LIA and the Institute of Physics and an industry and governmental advisor on a number of laser-based manufacturing technologies. He has established a number of university spin-out companies.



Henrikki Pantsar is director of research and development of Cencorp Corporation. He has more than 10 years experience in developing industrial laser applications and systems for various industries. Before joining Cencorp in 2010, he worked in the laser processing research groups Fraunhofer USA, Inc. in Michigan and VTT Technical Research Centre of Finland. He received his Doctor of Science degree from Lappeenranta University of Technology. He has authored more than 40 publications for international conferences and scientific journals. He received the Henry Granjon Prize of the International Institute of Welding in 2006. Henrikki is a regular presenter, program committee member and chairman at ICALEO conferences, and was the LMF conference chair at ICALEO 2011.



Nathaniel Quick is a past president, past secretary, a current executive committee member and fellow of LIA, president and chief technical officer of AppliCote Associates, LLC, Lake Mary, FL, a technology development and licensing company and CTO of !nflect, LC, a technology licensing firm. AppliCote Associates collaborates with academic institutes, including the University of Central Florida/CREOL. Quick has a Ph.D. from Cornell University in materials science and engineering and is a UCF Florida Photonics Center of Excellence advisory board member, UCF Industrial Advisory Committee member, a fellow of the African Scientific Institute, a past guest researcher at NIST and past member of the Army Science Board. He currently holds 39 U.S. patents and has over 60 publications.

Koji Sugioka is a senior research scientist at RIKEN – Advanced Science Institute and a guest professor at Tokyo University of Science and Tokyo Denki University. He received B.E., M.E. and Ph.D. degrees in electronics from Waseda University in 1984, 1986 and 1993, respectively, and joined RIKEN in 1986 where he has worked on doping, etching and deposition of semiconductors and surface modification of metals using excimer lasers. Sugioka has received seven awards for his research, inventions and contributions in the area of laser microprocessing. He has published more than 130 articles, has given more than 80 invited talks at international conferences and about 90 invited talks domestically, has 30 patents or pending patents and served as a conference chair, co-chair and committee member for numerous international conferences. He is also editor-in-chief of *Laser Micro/Nanoengineering*.

Kunihiko Washio is founder and president of Paradigm Laser Research Ltd., Tokyo, Japan, since 2003. He received his M.S. degree in physics from the University of Tokyo in 1968 and Ph.D. degree in engineering from Tohoku University in 1980. He joined NEC Corporation in 1968 and engaged in R&D of various solid-state lasers and their applications for about 35 years. After retiring from NEC in 2003, he has been serving industries in consulting on development of lasers and their applications to materials processing. He has served as a program committee member for the International Symposium on Laser Precision Microfabrication since 2000 and a conference chair for ICALEO's Laser Microprocessing (LMF) Conference for two years. He was the ICALEO 2011 Congress General Chair. ■

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LASER GENERATED AIRBORNE CONTAMINANTS

By Richard Riffner

LASERS AND VENTILATION

Lasers are commonly used to mark, etch, cut and weld a wide variety of materials in automotive plants, packaging lines, medical procedures, aerospace manufacture and many other applications. It seems that there is a new use for lasers every day. Lasers can offer an alternative to traditional processing methods. If coupled with the right general and local exhaust ventilation (LEV) systems, lasers deliver excellent results in terms of precision, machining time, flexibility and performance. To comply with international health and safety regulations, LEVs are required or recommended for use with most laser operations in order to protect personnel and to enhance the performance of the laser system itself.

WHAT HAPPENS IN LASER PROCESSING?

When a laser beam is applied to the surface of a material, several conditions can occur. High temperatures that are generated cause the air near to the contact point to expand, generally back in the direction of the lens. The laser beam causes incineration, vaporization, melting and softening of the target substrate. Rapidly expanding gases pick up and carry the removable particles and droplets at relatively high velocities away from the substrate. The contaminants released consist of a wide variety of gases, in some cases noxious, e.g. benzene, phosgene. They also consist of the products of complete and partial combustion including possible oxides of the base material. Stainless steel, for example, releases chromium and nickel, which can cause chronic toxicological effects such as liver/kidney disease and cancer.

It is critically important that you are aware of the emissions produced during your specific application as many laser processes produce extremely harmful and even toxic fumes. The included list of laser generated airborne contaminants (LGACs) is provided by Purex, who manufactures digital and analog fume extraction solutions for laser applications.

Laser Generated Airborne Contaminants

Material	Emissions
Kevlar	Cyanide, Benzene, Nitrogen Oxide, PAH's
Polycarbonate (PC)	Phenol, Benzene, Cresol
Polyamide (PA)	Methanal, Butadiene, PAH's, Propenal, Benzene
Polypropylene (PP)	Butadiene, Propenal, Benzene
Polyethylene (PE)	Butadiene, Propenal, Benzene
Poly (Vinyl Chloride) (PVC)	Benzene, Methanal, PAH's, Phosgene, HCL
Rubber (SBR-man made)	Styrene, PAHs, Propenal, Benzene, Butadiene
Polyester (PET)	Benzene, Toluene, Ethylbenzene
Polystyrene (PS)	Benzene, Toluene, PAH's, Styrene
Mild Steel	Iron Oxide, Nitrogen Oxide, CO
Stainless Steel	Chromium, Nickel
Galvanised Steel	Zinc Oxide
Tool Steel / Hastelloy	Vanadium, Cobalt
Nimonics	Cobalt, Chromium, Nickel
Polyurethane (PU)	Benzene, Toluene

Emission	Effects on Personnel
Butadiene	Carcinogen, Kidney Damage
Cresol	Damage to Liver/Kidneys, Dermatitis, Cancer
Nitrogen Oxide	Asphyxia
Phenol	Damage to Liver/Kidneys, Digestive Disorders
Phosgene	Pulmonary Edema
Benzene	Carcinogen - Leukemia
Cyanide/HCN	Respiratory Failure
Chromium	Lung Cancer, Damage to Liver and Kidneys
Methanal	Severe Skin and Eye Irritant
PAH/Polycyclic Aromatic Hydrocarbon	Lung Cancer, Birth Defects
Styrene	Poisonous, Irritant of Respiratory Tract

PUREX
FUME EXTRACTION SYSTEMS

COMMON SUBSTRATES AND LGACS

There are a number of important items to take into consideration when evaluating LEVs for your application. Use these as a baseline when evaluating solutions.

Flow Control – Over time, filters become saturated and blocked from captured particulate. As blockage occurs, flow rates may drop and if not manually monitored, gases/particulate will not be captured and eliminated. LEVs with intelligent Flow Control automatically monitor airflow and adjust motor speed to keep the extraction rates at the required speed throughout the life of the filter. This ensures proper air quality while preventing downtime and expensive damage to equipment caused by loose particulate.

Air Monitoring – How do you know that your system is capturing what it should? Consider a solution that provides feedback and insures that the air returning to your workplace is safe.

Filter Status – It is important to change filters when needed or you risk having an LEV that no longer operates at the optimum level. On the flip side, changing them too soon can be expensive. Look for a system that provides feedback regarding filter status which produces a safe work place while reducing filter costs.

OSHA citations have now been issued relative to lasers using the authority vested under the "general duty clause" of Public Law 91-596; the Occupational Safety and Health Act of 1970. Once you pinpoint the emissions produced in your process and integrate an ample LEV, you can help insure the safety of your workplace, while extending the life and up-time of your laser systems. ■

Richard Riffner is the Sales Manager Americas for Purex International Ltd.

REVISED ANSI Z136.3 IMPROVES USER AND PATIENT SAFETY

By Geoff Giordano

With more therapeutic procedures moving into private medical offices and homes, the standard regulating the safe use of lasers in health care has undergone a much-needed update to ensure users, as well as patients, are protected.

The revised "ANSI Z136.3 Safe Use of Lasers in Health Care" publication defines the parameters of proper laser use outside the tightly regulated hospital environment. Formerly titled the "American National Standard for Safe Use of Lasers in Health Care Facilities," the revision released in January includes new guidelines and information on:

- Wavelengths employed in medical environments. While some lasers are no longer listed, at least four new wavelengths have been added.
- The duties of laser safety officers involved with rented or borrowed laser equipment.
- Audit requirements and procedures.
- Clinically relevant terminology.

The comprehensive Z136.3 standard, reformatted to be more reader-friendly, addresses everything from laser systems hazard classification, to protective equipment, to non-beam hazards and room design. One of six ANSI Z136 laser safety standards in use, the revised Z136.3 standard serves to "acknowledge the diversity of laser therapy applications and practice setting locations," according to Peter Baker, LIA's executive director.

"The change is quite significant in that previous versions looked at the location in which a laser was used," notes Barbara Sams, director of Standards Development. "This change, instead of looking to the specific location, is looking at the application being administered by people for any type of health-care related purpose."

"In this revision, more consideration is given to the people using the laser," she continues. "The patient comes first, of course. However, when a patient is being operated on, they could be under anesthesia, they should have the proper protection over their eyes; they're protected. A greater focus has been placed on the people who are actually in the room using the laser - the surgeons, nurses, technicians, anesthesiologists, extending to veterinarians, laser hair removal facilities and even home use."

The new standard "is a must-read for every LSO and facility providing laser-based therapy," says Sue Terry, ANSI Z136.3 subcommittee member and LIA medical course instructor. "It is a pleasure to see that sample forms and documentation records remain a part of the appendix. These examples have long proven to be beneficial when establishing or revising a laser safety program."

Fellow committee member Patti Owens, also a registered nurse and certified medical laser safety officer, is equally excited about the revision. "As an experienced LSO in a hospital, dermatology practice and recently as an aesthetic/medical consultant, I am looking forward to … the new ANSI Z136.3 standard," she enthuses. "My clinics are already being advised of the upcoming changes and will begin the implementation phase."

Even so, the new standard is serving its vital purpose across a broader range of therapeutic uses. For example, the Association of Surgical Technologists will review the new guidelines to inform the update of the AST's "Recommended Standards of Practice for Laser Safety," says Kevin Frey, director of continuing education for the organization.

In the meantime, veterinary medicine has finally seen its laser-use needs addressed.

"There was a seven-year effort to have veterinary medicine included in the .3 document as well as included as an appendix," says Kenneth Bartels, who serves as the American Veterinary Medical Association's liaison to ASC Z136. "These inclusions were considered a priority since in some medical circles, laser use in veterinary medicine was considered totally different (from other uses). Laser manufacturers that market to veterinarians have for the most part provided excellent outlines for the safe use of their devices in veterinary medicine in the respective operator manuals. With the new .3 guidelines, for some manufacturers those efforts may be intensified."

LIA, the recognized industry leader in laser advocacy and safety education since 1968, serves as secretariat of the Z136 series of laser safety standards, administering the process and providing clerical support to the committee. To order the .3 revision ($130 for LIA members, $150 for non-members), visit **www.lia.org**/ANSI.3 or call LIA at 1.800.34.LASER. ■

CORPORATE MEMBER PROFILE

AEROTECH, INC.

LIA Corporate Member Aerotech, Inc., Pittsburgh, PA, manufactures the highest performance motion control components and systems for customers in industry, government, science and research institutions around the world.

Founded in 1970 by Stephen J. Botos and today a privately-held company, Aerotech's commitment to consistently advancing its product and value-added service capabilities is summed up in their motto, "Dedicated to the Science of Motion."

In the 1970s, Aerotech introduced the first ball-screw-based positioning systems with advanced linear servo drives. This represented a revolutionary advancement in system throughput — five times better than lead screw and stepper motor technology. By 2009 and many patents and introductions later, Aerotech introduced an entire line of nanopositioning products with nanometer or better resolution, repeatability, accuracy and in-position stability. Today, Aerotech operates full sales and service facilities in the U.K., Germany, Japan, Taiwan and China and maintains a growing number of direct field sales and engineering offices throughout the U.S.

TODAY'S LINEUP

The company's precision motion control products provide the critical performance for demanding applications in markets including laser processing and laser micromachining, medical device and life sciences, semiconductor and flat panel, photonics, automotive, data storage, military/aerospace, electronic manufacturing and test, assembly, research and development and others requiring high precision, high-throughput motion solutions. The performance of Aerotech's products is complemented by the depth and breadth of the company's product line, providing customers with a "one-stop" supplier for a quick and efficient solution for their application.

From Aerotech's award-winning Automation 3200 32-axis motion, vision, PLC, robotics and I/O network, to their Soloist series single axis and Ensemble series multi-axis stand-alone motion controllers, Aerotech provides a controller solution to fit almost any need. Aerotech also manufactures a large selection of high-performance brushless linear and rotary motors and PWM and linear drives.

Aerotech developments in the areas of mechanics, controls, software and laser control provide customers with laser cutting, welding, etching and marking systems.

Aerotech believes that building superior motion control systems starts with designing and manufacturing technically superior components. An Aerotech system begins with Aerotech motion components that are already best-in-class and specifically designed and optimized for the highest performance and lowest cost of ownership available.

COMING SOON

Soon to be available from Aerotech is the Nmark CLS/AGV that provides advanced control for laser marking. The all new Sensor Fusion will allow collection of position and sensor data at precisely the same time – i.e., sensor I/O is precisely aligned with encoder positions. All results can be retrieved through one easy-to-use software interface. Lastly, the A3200 MotionPAC is a software-based Programmable Logic Controller (PLC) that is completely integrated with the A3200 motion controller. MotionPAC complies with IEC61131-3 and PLCopen. The MotionPAC's tight integration with the A3200 motion controller allows users to command asynchronous, coordinated, blended, geared or cammed motion directly from ladder diagrams, function block diagrams or structured text.

"Use of fiber lasers has increased dramatically over the past five years. Aerotech sees this as a positive trend as it allows more flexible integration of the laser and beam delivery into the motion control platform. This ultimately yields a more capable system for the end user," said Scott Schmidt, product manager, Laser Processing and Micromachining Group at Aerotech.

Aerotech is responding to industry trends in several ways. "Feature sizes on many devices across numerous markets are getting smaller year-by-year. This causes motion control providers such as Aerotech to not only develop more precise staging capable of accomplishing smaller motion with higher fidelity, but also has spurred us to add new features to our motion controllers such as laser triggering (PSO) directly from galvo encoder feedback and marrying galvo and servo systems together (our Infinite Field-of-View feature) to achieve large fields of view with very small spot sizes," he said.

An LIA Corporate Member since 2004, Schmidt sees membership in the LIA as providing a great resource of accumulated knowledge that is easily accessible for those in the laser processing industry. "From the wealth of technical knowledge they database and disseminate, to the personal interaction of LIA members, LIA plays a central role in tying the laser processing community together," he said. For more information, visit **www.aerotech.com**. ■

LASER INSIGHTS

Laser Insights is a feature to give insight into the very latest developments in laser safety and the possible applications of laser materials processing. These overviews are designed to give you insight into the content and applications of the papers presented at our conferences and workshops.
Visit ***www.lia.org/laserinsights*** *to begin your search.*

NEW STAINLESS STEEL POWDERS FOR LASER CLADDING

by Ingrid Hauer

New investments into laser cladding as well as wear and corrosion testing equipment have lead to the expanded use of stainless steels. Latest developments show these lower cost alloys are able to yield comparable physical properties to many of the traditional Ni-based and Co-based alloys commonly used today.

LASER ADDITIVE MANUFACTURING FOR AEROSPACE PROTOTYPING

by Agnes Klucha

Aerospace prototyping is a way to realize the vision of freeform fabricated metal additive manufactured parts on aerospace production engines, gain acceptance for additive manufacturing and change perceptions of what is possible. The freeform fabrication of laser additive manufactured metal parts is of prime interest in aerospace prototyping since a functional prototype can be delivered quickly to demonstrate and validate concept designs.

LASER ADDITIVE MANUFACTURING OF TURBINE COMPONENTS, PRECISELY & REPEATABLE

by Anja Techel

Laser additive manufacturing with diode, fibre or disc lasers offers outstanding possibilities for applications in aircraft manufacturing or maintenance. High-precision laser additive manufacturing requires precise tolerances of all the components like laser beam, machine configuration, powder delivery, media supply as well as process parameters and control. Only the right interaction of all components leads to precise structures. ■

View complete articles at www.lia.org/laserinsights under the Featured Category.

JLA UPDATE

The JLA is published four times a year by the LIA in February, May, August and November. It is available electronically to LIA members as a member benefit. To view the journal online, please make sure your membership is current.

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

For non-members of LIA, call the American Institute of Physics at 1.800.344.6902 for subscription information. To receive your JLA table of content e-mail alerts, sign up at http://lia.aip.org/alerting_services/toc_alerts.

Research Highlights

Laser Texturization to Improve Absorption and Weld Penetration of Aluminum Alloys

In the present work, laser texturization treatments have been performed for the first time on aluminum alloys to increase their absorption and weld penetration. Adjusting the experimental conditions, laser texturization increases the roughness and decreases the diffuse and specular reflectance of surfaces. The textured samples were subsequently subjected to bead-on-plate laser weld treatments with a high power diode laser. Taking the weld beads of sandblasted samples as reference, depth improvements percentages around 20% are reached in some textured samples. Laser texturization has demonstrated to increase the weld penetration ability of aluminum alloys, constituting a potential tool to reduce the energetic requirements of the laser welding process.

View complete articles at jla.aip.org.

MEMBER INNOVATIONS

NEWPORT INTRODUCES OPTOFLASH

Newport Corporation, Irvine, CA, has introduced the OptoFlash™, a miniature, multi-channel, spectrometer engine for applications requiring the detection of light energy at multiple wavelengths. This new, demultiplexing optical engine is easy to customize and configure with as many as 10 wavelength channels, selected from 24 standard wavelength options ranging from 200-900 nm. It is also available in 16 standard configurations that are commonly used in immunodiagnostic instrumentation. Originally developed for clinical chemical analyzers, the OptoFlash provides high speed and high linearity with minimal stray light. It provides simultaneous optical transmission information for each wavelength channel, making it an ideal solution for OEM applications that require a small (51 x 16 x 25 mm), and lightweight (only 30 grams), single-package device. For more information, visit **www.newport.com/OptoFlash-PR11**.

GALVANOMETER AND SCANNING MIRRORS

Cambridge Technology, Inc., Lexington, MA and San Francisco, CA, has released another product innovation for large aperture scanning applications. The 6250H, the latest addition to the CTI 62xxH product line of moving magnet galvanometers, is optimized to provide maximum performance for 30 mm - 50 mm apertures. Based on Cambridge Technology's highly successful 62xxH actuator and position detector innovations, the 6250H brings a price/performance breakthrough to large aperture applications. For more information, visit **www.camtech.com**.

FIRST ANDROID APP FOR DATA

Ophir Photonics, San Francisco, CA, a Newport Corporation brand, has introduced the Quasar App, the first mobile application that displays laser meter data on Android devices. The Quasar App connects to Ophir's Quasar device via Bluetooth. Once connected, the app displays power readings from the laser measurement sensor that is connected to the Quasar device within a range of 10 meters. The Quasar device broadcasts to your Android smartphone or tablet. Quasar offers a rechargeable NiMH battery that provides more than 20 hours of use. Ophir's StarLab PC software is included with each interface and converts any PC into a comprehensive laser power/energy meter. For more information, visit **www.ophiropt.com/photonics**.

MILLENNIA EDGE GREEN LASER

Spectra-Physics®, Santa Clara, CA, a Newport Corporation brand, has launched the Millennia® Edge™ single-frequency, continuous-wave (CW) green laser. The Millenia Edge 532 nm laser features low optical noise with exceptional beam quality and pointing stability in the most compact package available on the market. Millennia Edge is ideal for pumping Ti:Sapphire and other lasers, including carrier-envelope-phase stabilized systems, as well as holography and interferometry applications. For more information, visit **www.newport.com/ultrafast**. ■

MEMBERS IN MOTION

CREOL@25

CREOL, The College of Optics and Photonics, Orlando, FL, will be celebrating its 25th anniversary Mar. 15-16, 2012 with the event "CREOL@25" that will include presentations by Nobel Laureates, an awards banquet and presentations, industrial affiliate members' displays and lab tours of the CREOL research activities. The CREOL@25 symposium replaces the usual annual Industrial Affiliates Day of the College of Optics and Photonics that typically draws 200-300 people from all parts of the optics/photonics community. For more information, visit **www.creol.ucf.edu/Partnerships/Affiliates/AffiliatesDay2012**.

ARTIFICIAL TISSUE PROJECT

The generation of artificial tissue for implants has long been the focus of medical research. This task is now being tackled by a consortium of 16 European partners from industry and the research community under the leadership of the Fraunhofer Institute for Laser Technology ILT, Aachen, Germany.

The project, ArtiVasc 3D, will receive 7.8 million euros of funding from the European Commission. Over the next four years, the consortium will combine different technologies from the fields of additive manufacturing and biofunctionalization to develop a process capable of engineering blood vessels in an artificial scaffold system – ultimately, artificial skin. For more information, visit **www.ilt.fraunhofer.de**.

WELCOME NEW CORPORATE MEMBERS

AdlOptica Optical Systems GmbH
Berlin, Germany

HIGHYAG Lasertechnologie GmbH
Stahnsdorf, Germany

Photonics Industries International, Inc.
Bohemia, NY

Rofin-Sinar Inc.
Plymouth, MI

Silsbee Family Medicine, PA
Silsbee, TX

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

LME 2012 IN OCTOBER

LME 2012 will be held in Schaumburg, IL, Oct. 23-24 and will be the place to see the latest in laser technology, network with the industry's elite and find solutions to current and future manufacturing needs. The mission of LIA's Lasers for Manufacturing Event (LME) is to provide a one-stop event for companies interested in integrating laser technology into their production. Attendees will learn about laser choices, beam delivery, automation equipment, safety considerations, applications development and meet exhibitors that supply these products and services.

There is still time to sign your company up as an exhibitor or sponsor of this one-of-a-kind event. A variety of levels are available. Visit **www.laserevent.org** for more information or contact Jim Naugle at jnaugle@lia.org, 1.800.34.LASER.

LASER WELDING & JOINING WORKSHOP IN 2012

Join us in Schaumburg, IL, Oct. 23-24 at LIA's Laser Welding & Joining Workshop 2012 to learn from industry specialists from around the world about applying laser materials joining technologies to today's manufacturing challenges and opportunities. This workshop will offer quality technical sessions and networking opportunities to discuss equipment and applications with top laser industry leaders. Those that will be attending are manufacturing engineers and managers, product designers, process/R&D engineers, applications engineers, business developers and entrepreneurs, plant supervisors and anyone interested in laser materials joining technology (welding, joining or brazing).

There are sponsorship opportunities available for companies looking for that special niche market that this workshop represents. For more information, visit **www.lia.org/laserwelding/sponsors**, or call 1.800.34.LASER. You can choose the level that best matches your company's promotional goals and boosts your brand visibility.

ICALEO 2012 – CALL FOR PAPERS

A call for papers has been announced for the International Congress on Applications of Lasers & Electro-Optics (ICALEO®), which has a 30-year history as the conference where researchers and end-users meet to review the state-of-the-art in laser materials processing, laser microprocessing and nanomanufacturing, as well as predict where the future will lead. From its inception, ICALEO, which will be held Sept. 23-27, 2012 in Anaheim, CA, has been devoted to the field of laser materials processing at macro, micro and nanoscales and is viewed as the premier source of technical information in the field. Each year ICALEO features areas of topical interest. This year's featured sessions include diode lasers for processing and pumping, laser process monitoring and control, laser processing of biological materials, lasers in nanotechnology and environmental technology, laser hybrid processing, laser manufacturing for alternative energy sources and laser business development.

The deadline for abstract submission is Mar. 6. For more information, visit **www.lia.org/conferences/icaleo/call_for_papers**.

INTRODUCING CMLSOs' BEST PRACTICES PUBLICATION

Medical personnel in charge of the safe use of lasers for therapeutic procedures have a valuable new tool to help prevent harm to patients and health-care professionals. The Laser Institute of America has assembled the expert knowledge of leading certified medical laser safety officers in a new book, *CMLSOs' Best Practices in Medical Laser Safety*. The book compiles the latest knowledge about establishing a medical laser safety program, including laser safety regulations, how to control and evaluate such programs and the duties of MLSOs (medical laser safety officers).

"Laser technology has an enormous value and keeps making a positive difference in our health care arena," says Editor Vangie Dennis. "The growing prominence of lasers in medicine is rapidly approaching the point where no physician's education will be considered complete until their training has included some experience with basic laser physics and applications."

The 11-chapter book focuses on topics such as initial MLSO duties and responsibilities, beam and non-beam hazards and factors that determine laser-tissue interaction. The book's contributors also address the importance of safety audits once a laser safety program has been established. Packed with useful figures and tables, the book includes samples of a medical laser safety inspection checklist, a laser inventory sheet, a laser procedure record and laser safety audit forms.

LIA offers its CMLSO book as part of a full array of cutting-edge print, multimedia, online and classroom training resources. The book's publication coincides with the release of the just-revised *ANSI Z136.3 Safe Use of Lasers in Health Care* standard, which defines the parameters of safe laser use in any area where a health care laser system is being used. Both are available through LIA by visiting **www.lia.org/store**.

LASER PROCESSES AND COMPONENTS CONFERENCE

The 7th International Conference on Laser Processes and Components (LPC2012) will be held Mar. 20-21 in Shanghai, China in conjunction with LASER World of PHOTONICS CHINA 2012. The Peoples Republic of China is one of the biggest export target markets for photonics products. Since its induction in 2006, LASER World of PHOTONICS CHINA has become the leading laser and photonics trade fair in China. It is expected to have about 450 exhibitors and over 30,000 visitors. For more information, visit **www.photonics-congress-chinacn/lpc_en.htm**. ■

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ANSI Z136.3

2011 SAFE USE OF LASERS IN HEALTH CARE

REVISED DOCUMENT ADDRESSES:

- New Wavelengths
- Audit Requirements & Procedures
- Management Model for Diverse Use
- Safety Concepts/Personnel Responsibilities
- Lasers for Home Use
- LSO's Role in Rental Services
- Sample Forms

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