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FOCUS:
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Photo courtesy of Lightmotif.

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

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Laser Institute of America
Laser Applications and Safety

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DEPARTMENTS

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LIA TODAY

THE OFFICIAL NEWSLETTER OF THE LASER INSTITUTE OF AMERICA

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

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

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. 25-27, 2013	Indianapolis, IN
Dec. 3-5, 2013	Orlando, FL

Laser Safety Officer with Hazard Analysis*	
Jun. 10-14, 2013	Niagara Falls, NY
Oct. 7-11, 2013	Miami, FL
Nov. 4-8, 2013	Los Angeles, CA

*Certified Laser Safety Officer exam offered after the course.

Industrial Laser Safety Officer Training	
May 7-8, 2013	Orlando, FL

Laser Safety Officer Training for R&D	
Aug. 13-15, 2013	Orlando, FL

Medical Laser Safety Officer Training*	
Jun. 8-9, 2013	Atlanta, GA
Oct. 5-6, 2013	Miami, FL

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

International Congress on Applications of Lasers & Electro-Optics (ICALEO®)	
Oct. 6-10, 2013	Miami, FL

Lasers for Manufacturing Event (LME®)	
Sept. 11-12, 2013	Schaumburg, IL

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3RD ANNUAL

PRESIDENT'S MESSAGE

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

We are still experiencing a lot of uncertainty in the economic environment that has an impact on all of us. Just while I'm writing these notes, the US President had to announce the significant budget cuts for this year. This certainly has an impact on the proposed US initiative on photonics and lasers. On the other hand, Photonics West showed a lot of new developments on the advanced application side and hardware side as well. New possibilities will fuel the laser economy. In this issue of *LIA TODAY*, you can read the latest news on texturing with picosecond lasers. Surface modification, from texturing, engraving and alloying to laser additive manufacturing, will have a huge impact on the future engineering of products. While working on femto and atto second lasers, the laser industry is handing over industrial ready picosecond lasers to the product engineering community. This results in new designs on cell phones on one hand and more fuel efficient transportation due to reduction of friction by the texturing of bearing components. Our future task now is how to get the information about these new ways of manufacturing into the product engineering community and schools. The LIA Team has already successfully taken on this task. Just a few weeks ago, LIA hosted the Laser Additive Manufacturing (LAM®) Workshop, purely focused on applications. This issue will also give you an overview of what is happening in this application field.

Beside some smaller consolidation on the laser manufacturer side that happened the last few months, new players are entering the market. Several high tech laser companies from China are offering newly developed sources and systems, some of which even start reaching out to the US and Europe. With this in mind, LASER World of PHOTONICS CHINA which occurred in March, was another exciting event for our industry. Some of the major players used this show for world premieres rather than the traditional shows in America or Europe.

Whatever happens with the general economy, TEAM LIA, you as a member, and all the other laser people around the world, have a lot of new enabling technology available and we should look into the year positively.

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

Yours,

Klaus Löffler

Klaus Löffler, President
Laser Institute of America

EXECUTIVE DIRECTOR'S MESSAGE

Lasers in Advanced Manufacturing and LIA's Eternal Triangle

I designed my first laser in 1970 for use in the hybrid circuit manufacturing business, and subsequently sold these systems in Europe and North America. Since the customers were in the high technology field, there was no problem with them learning how to use the systems and designing the product to take advantage of the laser's features.

Then, in the late 1970s and early 1980s, I was involved with early work on laser marking with Quantrad Corporation. Since these systems were involved in general manufacturing, this is where I first encountered the fear and ignorance of lasers which slowed their adoption. I realized that the sphere of use of lasers is bounded on one side by knowledge and on the other side by ignorance and fear.

This boundary has apparently reached the White House and the President now wants to fund advanced manufacturing, presumably on the grounds that without a product you cannot have a gross domestic product worth much! So now there is a National Network for Manufacturing Innovation (NNMI), which will be funded with perhaps $1 billion and already the National Additive Manufacturing Innovation Institute (NAMII) has been funded to the tune of tens of millions of dollars.

Recently, the National Research Council published a report called *Optics and Photonics: Essential Technologies for Our Nation* which, amongst other things, recognizes the need for photonics in advanced manufacturing. LIA is working with the IEEE Photonics Society, OSA, SPIE and the Institute of Physics to nurture and promote this study in the hope of attracting funding. As part of our effort, LIA has formed and supported the Advanced Manufacturing Subcommittee which has produced a white paper on the obstacles and proposed solutions to manufacturing using lasers. This white paper appears on page 18. We welcome your comments and suggestions on this white paper which should be sent to pbaker@lia.org.

Meanwhile, the LIA continues to work on the underpinnings of this technology through ICALEO® and the *Journal of Laser Applications® (JLA)*. For five years now, we have hosted a workshop on Laser Additive Manufacturing (LAM®) and for two years the Lasers for Manufacturing Event (LME®). Now, to increase our efforts towards lifting the curtain of ignorance, we are making many of our courses and presentations at LAM, LME and ICALEO available online at "Laser U" to help people understand how to get started using lasers in manufacturing.

This, of course, is in keeping with the LIA logo, showing education, industry and government locked in an eternal triangle!

Peter Baker

Peter Baker, Executive Director
Laser Institute of America

ADVANCED LASER APPLICATIONS & SOURCES
A NATIONAL FOCUS

By Geoff Giordano

With photonics-driven manufacturing innovation becoming a hot topic in the nation's capital, advanced laser applications — particularly in aerospace, automobiles, agriculture and energy production — are getting a bigger share of the spotlight.

From gas and steam turbines to pipelines and passenger jets, even underwater welding in nuclear reactors (see LAM 2013 wrap up story on page 10), current and next-generation lasers will bear more of the brunt of manufacturing, protecting and repairing vital components of all types and functions.

When Fraunhofer ILT won Aviation Week's innovation award last year by producing an 80-blade BLISK (blade-integrated disk) in about two minutes per blade with laser additive manufacturing (AM), it provided a powerful example of potential manufacturing efficiencies.

"The difference in manufacturing time is a factor of roundabout 60: minutes instead of hours," explains ILT's Prof. Reinhart Poprawe, immediate past president of LIA. "An average-sized BLISK will take about 180 hours of milling. With laser additive manufacturing, we can make it in 180 minutes. Based on that, I am sure there are a lot of applications for complex components and products, which can be made more economically — and maybe more important, more ecologically — in the very near future."

AEROSPACE AND AVIATION

At LIA's second-annual Lasers for Manufacturing Event (LME®) in Schaumburg, IL, in October, past LIA President David Belforte provided a comprehensive survey of areas where lasers are going to influence manufacturing with their unique capabilities.

"There are 5,000 narrow-body jets being planned over the next 20 years to be built here in the United States," he noted. Furthermore, with Airbus announcing it will double its operation in Alabama from $24 billion up to $50 billion, he enthused that aviation "is a terrific sector" for the laser industry.

Lasers are used to craft components throughout contemporary aircraft, from brackets and door hinges up to turbine engine components and fuel swirlers. The increasingly intricate operations lasers can perform often allow for redesigned parts that can dramatically reduce weight — up to 50 percent or more — by using less material and hence boosting energy efficiency.

In terms of turbine engines, Belforte noted that each of those 5,000 new jets will require two engines. "Every one of those engines has millions of holes drilled in it," he said. "There are 1,100 companies in the United States involved in the aircraft turbine engine business; many are using industrial lasers."

IPG'S QCW 9 Kw FIBER LASER — COMBUSTOR DRILLING FOR AEROSPACE APPLICATIONS

To be precise, "the typical jet engine has upwards of 3 million (transpiration cooling) holes that are percussion drilled," noted Bill Shiner, vice president of industrial markets for IPG. "With fiber lasers, we're getting better hole quality and better consistency, and we're drilling up to 50 to 100 holes per second."

But lasers are not limited to the insides of the plane. As the innovative wings and fuselage of the Boeing 787 Dreamliner illustrate, lasers are being asked to drill more than metals. "I never thought we would be cutting composites with lasers, but the fiber laser is doing an interesting application" in that area, Belforte noted. "With more and more composite materials being used in aircraft, it looks like a good growth market."

Those composites can be cut "either by high-power multipass processing or by ultrashort laser pulses below the nanosecond regime," Prof. Poprawe explained. "Both approaches are feasible, depending on the cut geometry: round holes or lines with multipass processing, and arbitrary shapes with ultrashort pulses."

CUTTING PROCESS OF FIBER-REINFORCED PLASTICS

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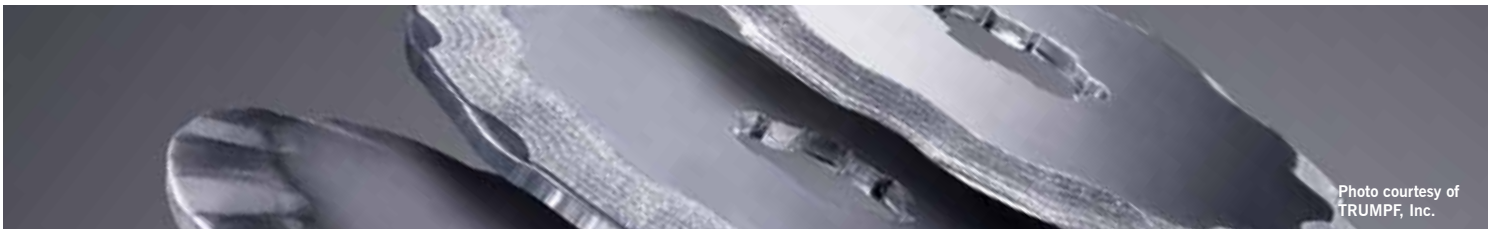


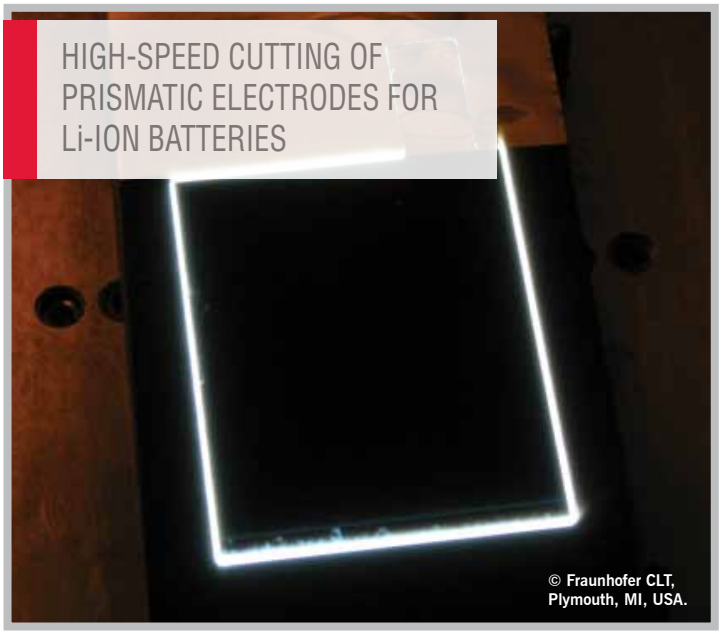
Photo courtesy of TRUMPF, Inc.

POWERING THE ENERGY INDUSTRY

"A lot happens in energy applications," Prof. Poprawe asserted. "Practically all components and laser processes — drilling, cutting, welding, ablation and surface functionalization — are to be considered." In battery production, for instance, high-speed cutting of multicoated electrodes is a promising application.

Lasers' compactness, mobility and reliability are significant factors in their growing applicability. "We're drilling down in oil wells up to 16 kilometers," Shiner noted. "We have some of our lasers on vessels in the Gulf of Mexico welding components."

More drilling rigs are going into operation every month, Belforte said. "Downhole drilling is a terrific opportunity, especially when you turn that angle and go 90 degrees to do that fracking operation. Many of those downhole operations use lasers one way or another, some of them to help fracture the rock."


HIGH-SPEED CUTTING OF PRISMATIC ELECTRODES FOR Li-ION BATTERIES

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Laser metal deposition (LMD) has become indispensable to the oil and gas industry. "In the offshore area we have drilling components coated via laser metal deposition, especially oil drilling components," said Juergen Metzger of TRUMPF. For example, "the tubes that are going down (and) connecting the driller with the base station. Then we have the so-called stabilizers that stabilize the tubes in the drilling hole, and they have really high requirements on wear resistance. They are made with laser cladding, with hard-facing coatings."

Gas and steam turbines are another area where lasers can prove highly beneficial. The former "are expected to generate a quarter of all the power in the United States in the next five years," Belforte said. "If you look at that engine… every one of those turbine blades, every one of those compressor sections, has got laser processing in it."

"For the turbine business, about 90 percent is titanium-based alloys or nickel-based alloys," Metzger said. "When we bring down material and build up a compressor blade by 2 or 3 millimeters, it's very important that we are not bringing double the material that is needed. (We want) only about 20 percent more of what is needed on the sides" to reduce post-processing needs.

Today's refined processes are a far cry from those about 20 years ago, recalled Rene Karel, president of Laser Welding Solutions (LWS) in Houston. "I came out of a conventional industry with conventional cladding techniques. We started noticing more of the laser-applied coating back in 1995, but it was very limited; it was mostly CO_2 lasers. It's come quite a way." In the energy field, "there are constant innovations. Today you're seeing all kinds of different (component) sizes, different geometries and different base materials.

"It's constantly growing; it becomes a huge effort for most small companies to keep up with the different demands. You have to have an ongoing R&D project. It's one of the things that allows you to enter other markets and market areas when you can develop something that is unique to that particular industry and it becomes a standard for a period of time until something else comes around that is a little better."

For LWS, "we managed to get into the ID cladding better than most when we first started," Karel said. But trial and error plays a significant role in adopting new laser applications. "Some of the components that were already out that were being developed by institutes. We looked at all of those and tested some of them, and none of them were that good. These things are designed basically in a laboratory: If they work, they're deemed successful. But if you are in a manufacturing environment where it's ongoing, 24/7, then flaws in the design will show up pretty fast. They become unreliable, they require a lot of maintenance — they require a lot of "tampering" to keep them going. We were able to come up with a design that was fairly robust and saved on excess powder. We hardly had to touch it very much at all; (the process) became a workhorse for us."

Meanwhile, solar cells — requiring laser scribing of thin films and flexible substrates as well as the drilling of holes to improve energy conversion — are expected to undergo a resurgence this year, Belforte predicted. And, with 9,000 miles of pipeline out of a planned 20,000 miles under construction in the United States, hybrid laser arc welding will likely see increased usage. "A lot of those (projects) are considering or may even be using high-power lasers to weld the pipe together," Belforte said.


Photo courtesy of TRUMPF, Inc.

GROWING BUSINESS IN AGRICULTURE

The agriculture industry was at once "spectacular" but a bit of a letdown for the laser industry last year, Belforte asserted. The heavy earth-moving and harvesting equipment at the core of food production requires "a lot of lasers for cutting, welding and cladding applications."

"In earth-moving machinery, heavy-duty yet lightweight structures as well as surface-enhanced tools are applied," Prof. Poprawe explained. "For the purpose of welding the structures, high-power and high beam quality lasers are needed. These include 10 to 40 kilowatt lasers with output close to the diffraction limit. Fiber lasers, disk lasers and CO_2 lasers in that class are used. For cladding of components with wear-resistant coatings, metal layers or thick films, diode lasers are suited because the applications do not demand high beam quality. Thus, less costly lasers are used."

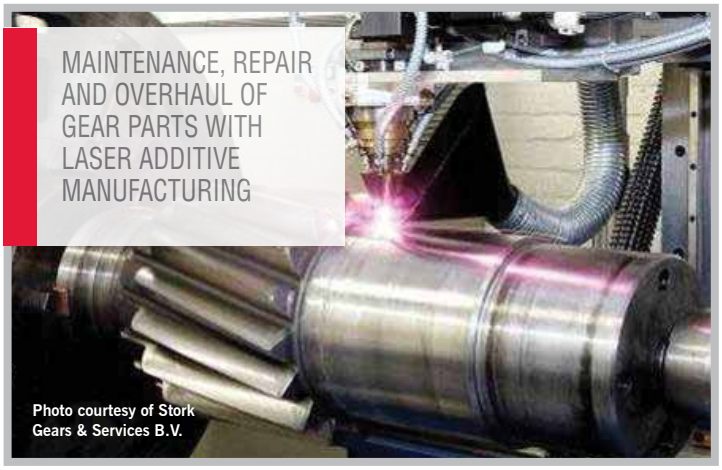
MAINTENANCE, REPAIR AND OVERHAUL OF GEAR PARTS WITH LASER ADDITIVE MANUFACTURING

Photo courtesy of Stork Gears & Services B.V.

Such cladding can double the life of particularly high-wear components, Metzger noted. Whereas more routine digging components can still be made with traditional methods, "we have a lot of parts that have to keep their geometry, like inside parts where other knives and blades are." For example, he said, a shear bar produced with laser cladding "has to be quite straight (because) another knife blade is shearing along it." Lasers' low heat input is ideal for the necessary near net shape production.

While lasers are reducing the time required for post-processing, "more important is the reduction of the material needed," Metzger said. "When you bring down material with a powder process, that has an efficiency of about 50 percent to 80 percent; we lose the powder. But with machining we also lose the very expensive material. That is why we try to be as close to net shape as possible. It's less about the time reduced for machining than not losing so much material by bringing away material that is not needed."

Marketwise, TRUMPF has seen growth in Europe, Russia and the US, Metzger said, but no clear picture has emerged in China yet.

WHAT'S NEXT

Ultimately, "Precision and quality are the decisive factors for future products, where economical and ecological efficiency and lot-size independence are the main concerns," Prof. Poprawe advised. "High-power ablation and additive manufacturing with high-power, ultrashort-pulse lasers and high beam quality diode lasers will make the difference over the next decades."

He sees prices for these systems coming down "considerably," particularly as the high-power diode lasers that directly or indirectly pump other lasers decline in cost.

In terms of increasing deposition rates, Metzger has a more conservative view in light of research indicating output approaching 20 to 30 kilograms an hour. At the moment, we can do about 3 to 4 kilograms an hour," he said. "We are working on increasing the deposition rate per hour for rotary parts, but this is not anything that will explode. We will try to double it, maybe, but we will not try to make it 10 times higher."

"I think the industry is narrowing it down to what works the best as far as cladding," Karel said. "Deposition is a little bit of an issue when you get to really large parts and you want to try to do those as quickly as you can. Metallurgical data prevents you from going too far with that. There are limits."

Wherever considerable material is milled from semi-finished products, "additive manufacturing will be the choice of the future," Prof. Poprawe asserts, being less expensive, less time-consuming and using less material. Whether it will be preferable for a job shop to provide or treat parts, or for the end user to install its own equipment, will depend on the application. "We have exactly the same situation today in laser cutting, where the industry operates at a balanced point of job shops running 24/7 at minimum cost vs. proprietary processes at the end user." ■

LIA's industry-leading conferences and workshops — ICALEO®, the Laser Additive Manufacturing (LAM®) Workshop and the Lasers for Manufacturing Event (LME®) — keep users up to date on cutting-edge research and applications. To register to attend, visit **www.lia.org/conferences**.

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LAM 2013 PRESENTS GROUND BREAKING APPLICATIONS IN AM

By Geoff Giordano

If additive manufacturing is becoming the next big thing as some experts and companies believe, the Laser Institute of America's fifth-annual Laser Additive Manufacturing (LAM®) Workshop helped pave the way by providing more information on the road map leading to an AM revolution.

Situated in its largest venue yet, LAM 2013 featured more than 20 presentations covering everything from nuts-and-bolts cladding and repair to sky's-the-limit projections of the growing impact of additive processes. While US government initiatives trumpet innovation in photonics and manufacturing, LIA continues to lead the charge in advocating greater profitability through advanced laser-based AM applications.

More than a third of LAM 2013's nearly 200 attendees came from outside the US; most were primarily focused on metals, a few on plastics. Sessions remained packed throughout the two days of the workshop as the program ran the gamut from the latest AM methods in the energy, aerospace and defense industries, to more esoteric usages in health care and customizable personal products.

As President Barack Obama praised the nation's first manufacturing innovation institute in his State of the Union address on Feb. 12, LAM 2013 opened with a keynote by renowned AM consultant Terry Wohlers of Fort Collins, CO. Speaking at his second consecutive LAM, Wohlers noted the significant uptick in corporate inquiries into AM technologies. Large companies like Wal-Mart, Staples and Germany's SAP are among the firms that have approached Wohlers seeking advice on how to get into the 3D printing/AM game.

By the time LAM General Chair Paul Denney of Lincoln Electric wrapped up the proceedings with a highly detailed assessment of the bottom-line repair-or-replace decisions confronting various industries, attendees had been treated to a workshop rich in detail, organized in eight segments.

COMPREHENSIVE PROGRAM

LAM 2013 showcased new methods, new workflows, new facilities and new possibilities in sessions spotlighting process chains, digital manufacturing, surface tailoring, powders and an overview of the National Additive Manufacturing Innovation Institute (NAMII) — the pilot facility under the National Network for Manufacturing Innovation.

In addition to NAMII in Youngstown, OH, LAM educated attendees about Penn State's Center for Innovative Materials Processing via Direct Digital Deposition. CIMP-3D, a major metals lab for NAMII, serves as an "honest broker" of additive-enabling technologies, explained Richard Martukanitz. It now features a new 8,000 square foot Additive Manufacturing Demonstration Facility that aggregates the university's AM and prototyping technology under one roof.

Similarly, Ryan Dehoff of the Oak Ridge National Laboratory explained ORNL efforts to facilitate AM research by allowing partners to use its resources. In the past 14 months, ORNL's manufacturing demonstration facility has entertained more than 1,000 visitors, Dehoff said. In partnership with Carpenter Powder Products, ORNL has produced iron-based nanocomposite powders in industrial quantities — more than 12 tons to date — to clad ship decks for skid resistance and the inside of nuclear fuel containers.

ORNL is "helping industry understand additive manufacturing a little bit better," Dehoff explained. "With all the emphasis and hype out there, it's a little confusing. If you just get the sales pitch with additive manufacturing, you don't get a true picture of additive manufacturing. We try and help companies work through those challenges and give them direction and work with them to solve their problems."

Meanwhile, Christian Hinke, managing director of Fraunhofer ILT's just-launched photonic production research campus in Aachen, Germany says the new facility will explore femto and nano photonic production during its 15-year funding window.

"We have a seen a huge increase in process efficiency for laser-based manufacturing technologies," asserted Hinke. This enables innovative business models and extraordinary levels of customization, such as with the printing of consumer-uploaded designs for iPhone covers. In a first, Nokia has released a 3D development kit to its customers so they can print custom covers for their Lumia 820 phones. EOS has even released a jewelry-specific laser-sintering machine, he said.

These are just a few of the many indicators of an active year for AM. "There has never been so much excitement in this industry," Wohlers enthused. "It is absolutely off the charts, through the roof. Interest is at an all-time high."

A vital part of any use of AM is a well-designed process chain. Workshop Co-Chair Ingomar Kelbassa presided over a three-presentation segment emphasizing the all-important computer-assisted framework that helps realize the "complexity for free and individualization for free" at the core of the most futuristic AM.

A vital part of any use of AM is a well-designed process chain. Kristian Arntz of Fraunhofer IPT urged a holistic approach to

creating specialized CAM modules that facilitate everything from repair of turbine components to laser machining of complex geometries to improving part life up to 80 percent. Considerations like tool-path planning and collision avoidance during processing are critical. "Laser alloying and wire deposition welding are examples where complex process conditions have to be brought on free-formed parts," he explained.

In a more academic approach, Gerald Bruck of Siemens Power Generation shared results of a study of the effect of angle of beam incidence on ytterbium fiber laser cladding of alloy 625. By using a six-space "shish kebob" allowing assessment of beam-substrate interaction at 15, 30, 45, 60, 75 and 90 degrees, he and his fellow researchers simulated instances, particularly in the energy industry, where components are generally flat or horizontal but with a bevel introduced in the same feature. They found that, with decreasing angle of beam incidence and constant power density, about 80 percent of melt width can be maintained without powder feeding. About 25 percent of the powder is scattered, and dilution rapidly increases, while capture efficiency decreases from about 60 percent to 35 percent. Furthermore, with angle of beam incidence, the bead profile leans and slumps downhill until gravitational effects are overcome by reduced deposit and surface tension.

GROUND-BREAKING APPLICATIONS

Ted Reutzel of the Applied Research Lab at Penn State University updated attendees on successes and lessons learned during the in-situ laser cladding repair of Naval vertical launch system tubes. Using a portable laser-safe enclosure to enable restoration of the nickel-based substrate, the system is an alternative to less-durable brush electroplating.

Another Penn State effort involves repair of seawater valves in various parts of ships at multiple orientations and made from different materials. The laser-driven system must be deployable within the ship. Researchers developed a wire-based laser head that clads at 45 degrees and tested it against gas tungsten arc welding. As a result, the design of that head has been transferred royalty-free to five small US businesses, Reutzel said.

In an even bolder project, Ryan Bucurel of Westinghouse detailed a dry underwater laser beam welding process that uses constantly flowing inert gas to remove water from the weld area. In single-pass and multiple-pass tests, negligible amounts of crack-producing hydrogen entered the weld. The process is intended for repairing spent-fuel pool liners or cracked Stellite 6 radial guide clevises in nuclear reactor vessels.

Speaking of processing hard-to-reach places, Aravind Jonnalagadda of Fraunhofer CCL announced the imminent release of the third version of its interior cladding device, which will deliver up to 3 kilowatts of laser power out to 39.4 inches of reach in a minimum tube diameter of 3 inches.

THE FUTURE OF AM

Low-cost systems like personal 3D printers and high-end parts production will continue to drive the adoption of AM, Wohlers asserted. He and Professor Bill O'Neill of the University of Cambridge stressed that relatively inexpensive digital systems can foster children's creativity and could become a fixture in many homes.

On the high-value end, aviation and aerospace are poised to continue making great strides in AM. Boeing is creating structural parts on a satellite using Ti-6Al-4V on a powder-bed fusion system. Airbus parent EADS has 40 employees studying, among other things, how to consolidate many parts into one and how to reduce part weight with lattice structures and topology optimization. Honeywell Aerospace has been flying an Inconel 718 part for certification for almost three years, and GE Aviation "has been very vocal with their interest in this area," particularly during development of the LEAP engine. GE has converted a 20-part fuel-injection system produced with brazing into a single CAD-driven component printed layer by layer that is slated to gradually reach full production by 2016.

In terms of national developments, the US is investing $70 million in NAMII, the first of 15 manufacturing innovation institutes to cost about $1 billion. Martukanitz noted that within a year of its inception, NAMII is set to award about $8 million in project funds for research at Technology Readiness Levels 4 to 7 and will issue a call for a second project in June.

Meanwhile, China has announced an RMB 1.5 billion multiyear investment in AM, Wohlers said, and Australia has completed three projects focused on AM. In late November, Germany's, SLM Solutions unveiled a 1 million euro, 2.8 kilowatt metal system using multiple lasers. At the same time, another German firm, Concept Laser, showed a 1 kilowatt variable-focus laser costing 1.4 million euros developed in a partnership with Fraunhofer ILT. Daimler, the partnership's initial customer, will use it to build automobile parts, including full-scale engine blocks, he said.

"Aerospace and medical will drive additive manufacturing over the next three to five years," Wohlers concluded. "Whenever the volumes are relatively low and the part value is high, and the parts are relatively small, you can begin to make a business case to at least consider using this technology for manufacturing." He is seeing "waves of certifications" that promise a bright future for AM.

LAM 2013 SESSIONS COVERED EVERYTHING FROM POWDERS, PROCESS CHAINS AND DIGITAL MANUFACTURING TO NAMII

COMPANIES DISPLAY THEIR LATEST AM TECHNOLOGY AT THE LAM EXHIBITOR RECEPTION

PLENARY SPEAKER TERRY WOHLERS PRESENTED LAM CHANGES OVER THE LAST YEAR

WORKSHOP GENERAL CHAIR PAUL DENNEY (LEFT) WELCOMES LAM ATTENDEES

LIA EXECUTIVE DIRECTOR PETER BAKER (LEFT) WITH LAM WORKSHOP CO-CHAIR INGOMAR KELBASSA (RIGHT)

"We have a heavy push from aerospace," agreed ORNL's Dehoff. "We also see a lot of defense agencies. Most people we interact with have a pretty good business case for additive somewhere in their product line. It may not be making product — it may be making a tool or die for their product line. But they say, 'Oh, I didn't know I could do that.' That's one of the things we're really trying to do: Get people to understand what you can and can't do — what are the limitations of the different technologies."

But while enthusiasm builds for 3D printing, selective laser melting, laser metal deposition and sintering, attendees were encouraged to continue embracing bread-and-butter approaches.

"Before we believe this technology is a panacea, we always have to keep in mind that there is a direct inverse relationship between the deposition rates that can be achieved vs. the feature qualities," Martukanitz said. "I believe the ability to alter these curves either through build rates, end definition or feature quality is the next generation of emphasis." In fact, "when you look at what we're accomplishing (at CIMP-3D), it's joining technology, and we believe that we can learn a lot from the welding and joining community."

Workshop Co-Chair Jim Sears of GE Global Research Center concurred, noting that "as you find where (AM) fits, it's not a replacement technology; it's an additional technology that takes you to a new place. That's where design innovation will be a necessary asset. (AM is) just another thing in the box; you still have to post-process (a part), you have to be able to inspect it, you've got to be able to finish it. (AM) does give you some enabling capabilities, but you can't leave everything else behind."

ECONOMICS OF CLADDING

While opportunities in advanced AM continue to bubble up, business in the 2D realm continues to be a benefit for the laser industry. "There are about as many different types of wear as there are different types of cancer," said Denney, who noted that Lincoln Electric took on laser technology within about the past two years and purchased two laser systems integrators within the past year.

As Denney explained, the annual cost of friction and wear is 6 percent of global Gross Domestic Product: $4.14 trillion out of $69 trillion. Meanwhile, corrosion costs about 3.1 percent of the GDP for the US — about $1 trillion in 2012. Earlier, ORNL's Dehoff noted that the cost of steel wear to the US economy is estimated at $65 billion a year.

In addition to the costs of wear and tear are costs in labor, he stresses: a $5,000 part in a ship, for instance, might cost $50,000 to remove and repair.

Efforts continue to get laser processes closer to arc cladding deposition rates. For instance, Denney noted, Fraunhofer IWS has achieved rates up to 30 pounds an hour by pairing an 8 kilowatt laser with 12 kilowatts of induction heating in the area of the process. Lincoln Electric has been able to use resistance heating of the wire to decrease the laser power required to deposit clad material, he said. That means for the same laser power, the deposition rate is greater than what is possible with powder alone.

The ability to maximize the heating of the wire without causing an arc is possible by using a solid-state power supply that monitors and stops an arc before it starts. "This allows us to double or triple deposition rates," Denney explained. For nickel alloys, "we can put down one layer for about $70 a square foot vs. $280 for arc." Even if the hot wire process needed to deposit two layers to equal the performance of the arc clads, the hot wire laser process should still be about half the operating cost. At 5,000 square feet a year, that equates to $700,000 to $1 million in savings, including labor and utility costs. That is about the cost of a laser hot wire cladding system, he noted.

THE FINAL WORD

All in all, "I thought the workshop and content were good," said Wayne Penn, president of platinum sponsor Alabama Laser. Sears concurred. "I was happy with the presentations," he concluded. While LAM 2013 devoted ample time to US AM initiatives, Sears emphasized that "what's happened in industry is probably more interesting, with acquisitions and forward movement of technology."

Dehoff, a first-time LAM attendee who fielded many inquiries after his presentation, said: "I'm impressed with the international presence. I like the cladding aspect and the other aspects of lasers that aren't necessarily there in the additive community."

To stay in touch with the latest trends and cutting-edge applications in AM, plan to attend LAM 2014; additionally visit **www.lia.org/lam** for updates on the location, dates and program. In the meantime, select presentations from LAM 2013 will be available online at **www.lia.org/laseru**. ■

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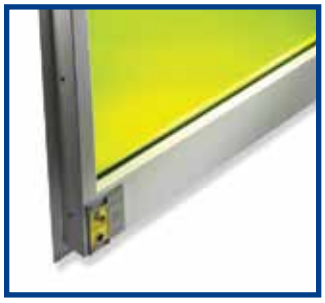

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3D SURFACE TEXTURING TECHNOLOGY USING ULTRASHORT PULSED LASERS

By Max Groenendijk

Ultrashort pulsed lasers have proven to be excellent tools to fabricate micro and nanotextured surfaces. These surfaces have a high potential for several applications where the tiny surface textures can improve or add a specific functional property. It was at ICALEO® 2006 that we first demonstrated a super hydrophobic surface obtained by texturing using a femtosecond pulsed laser. However, the capabilities were limited to small and flat surfaces. In order to be able to introduce this technology in industrial applications Lightmotif developed a 3D capable machine. At ICALEO 2012 results obtained on real 3D curved parts were presented, bringing this innovative technology closer to the market.

Functional surfaces are a hot topic. A lot of research has addressed the fabrication of super hydrophobic surfaces for example. Such surfaces exhibit textures on micro and nanoscale combined with a water repelling, low surface tension material. The textures "amplify" the water repelling property, leading to a partial contact of the liquid that only touches the texture's peaks. The liquid is very mobile and rolls off the surface leaving it completely dry and clean.

A completely different example are textures that can largely improve lubrication in a sliding motion by introducing dimples in one of the surfaces. The lubricant will start a circular motion inside the dimple that builds up a hydrodynamic pressure. The dimple serves as a lubricant reservoir and a trap of wear particles. By this combination, the friction coefficient and surface wear can be considerably reduced.

For dry contact, a different kind of surface texture is needed to reduce the friction coefficient. A very interesting application is the reduction of skin friction by a surface covered with tiny pillars. The contact area is largely reduced and a silky smooth touch is the result.

Optical effects that can be achieved range from diffraction gratings to surfaces with highly reduced glare. In biomedical applications surface textures can be used to improve cell adhesion, for example on implants.

However, the speed of the texturing process is a concern in most applications. Industry can only use this technology when an economic process can be realized. In most cases, direct texturing of surfaces by ultrashort pulsed lasers would add too much cost. A very attractive solution to this challenge is to texture a master surface that can be replicated in a cheap mass production process. The approach in our case is to use injection molds that have been laser textured. In the injection molding process, the textures are transferred to the polymer product surface. This technology is especially suited for producing surfaces with improved (skin) friction, super hydrophobic surfaces or products with anti-glare properties.

Notwithstanding, a big challenge is the fabrication of textures on 3D curved parts. Especially for texturing of injection molds this capability is needed, as the majority of potential polymer products have a curved surface. This challenge was targeted by Lightmotif, a company that started five years ago as spin-off from the University of Twente. A machine is now realized that uses a picosecond pulsed laser in combination with a five axis

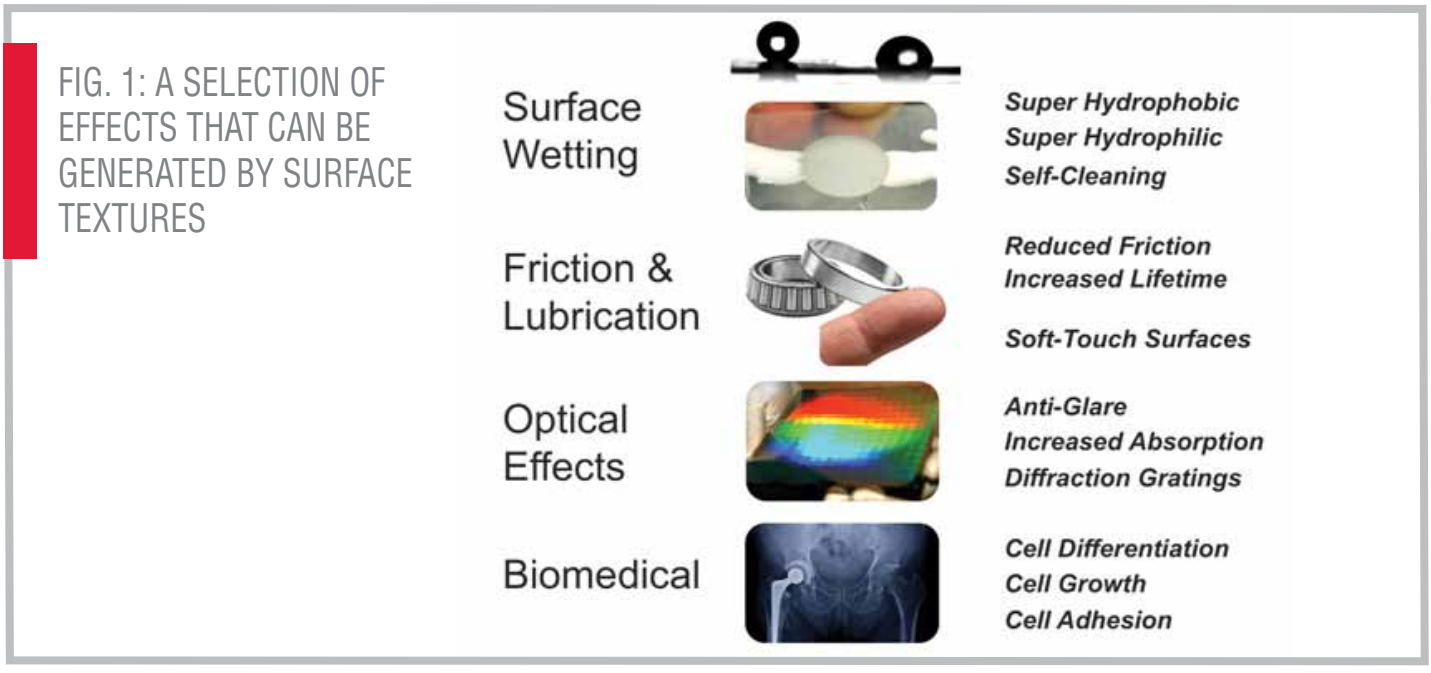

FIG. 1: A SELECTION OF EFFECTS THAT CAN BE GENERATED BY SURFACE TEXTURES

motion platform. The development of this machine was partly conducted in the collaborative project "Nanoclean," financed by the European Commission. This project had the goal to upscale the technology of super-hydrophobic surfaces for the automotive market. This market is interested in using such surfaces for generating self-cleaning properties.

FIG. 2: THE FIVE AXIS MANIPULATOR, TEXTURING AN INJECTION MOLD

The Lightmotif machine is constructed on a solid granite base with a weight of 9,000 kg and a travel of 1m x 1.5m x 0.4m. A kinematic model of this machine is fully integrated into the 3D capable software. Methods for generating the texture description on 3D curved surfaces have been developed in order to accurately place the functional textures on the surface. The surface is divided into tiles that are textured one after the other. The manipulator steps to a tile and a galvo-scanner applies the texture within the boundaries of this tile. Different methods can be used to arrange the textures inside a tile. This can have an effect on the functional performance and also determines the optical properties. When a regular texture distribution is chosen, the reflective properties of the individual tiles are different resulting in a kind of 'carbon fiber' look, as can be seen on the textured steel ball depicted on the cover of this issue.

In the Nanoclean project a demonstrator mold for a mirror cup was textured, as depicted in Figure 2 and Figure 3. Injection molding using this mold has resulted in super hydrophobic behavior.

The 3D texturing technology is an important milestone for using functional surfaces on a variety of products. Applications using injection molding are just one example. Other applications that can benefit from this development include texturing of implants to improve cell adhesion or biocompatibility. Forging tools or sheet metal forming tools could be equipped with surfaces reducing friction and wear.

FIG. 3: THIS INJECTION MOLD FOR A MIRROR CUP WAS TEXTURED AS THE DEMONSTRATOR IN THE NANOCLEAN PROJECT

Lightmotif concentrates on the development of the laser machine technology and is not the specialist in all the different application areas. The needed development towards applications is conducted in collaboration with industry and institutes. Lightmotif now offers the 3D texturing machine for application development and hopes that this can boost the development of new applications. ■

Max Groenendijk is Managing Director of Lightmotif.

LIA AIDS NPI IN REVOLUTIONIZING US MANUFACTURING WITH LASER TECHNOLOGY

By Geoff Giordano

With the US government running a full-court press to foster manufacturing innovation, the Laser Institute of America made the case for laser-based advanced manufacturing processes during a special presentation in the nation's capital.

LIA representatives advocating laser-driven manufacturing joined four other subcommittees discussing the growing usage of lasers in health, defense, energy and communications during a daylong National Academies event Feb. 28. While the work of these five subcommittees was triggered by the National Research Council's updated report *Optics & Photonics: Essential Technologies for Our Nation*, LIA's efforts answer key goals of the Obama administration's National Network for Manufacturing Innovation (NNMI).

The *Optics & Photonics* report issued a series of "grand challenges" to the laser community. In a multipoint presentation, Laser Mechanisms President Mark Taggart detailed highlights of an LIA-driven white paper drafted by the Advanced Manufacturing subcommittee he chairs.

MARK TAGGART, LASER MECHANISMS, INC.

"I'm honored to have been selected by my peers to go to Washington, DC, and explain the unique challenges facing the US laser industry and the steps we need to take to maintain our global leadership in photonics," Taggart said. "I need to thank the members of Advanced Manufacturing Subcommittee and the Laser Institute of America for all their hard work in preparing this white paper."

LIA Executive Director Peter Baker initiated the subcommittee quickly after the *Optics & Photonics* report was issued last year. The urgings of the report, first issued in 1998, are being promoted through the National Photonics Initiative (NPI).

"We will use LIA's promotional resources to promote the NPI widely," Baker asserted. "LIA will take a leadership role in areas where we have played a major role for many years, namely laser materials processing and particularly manufacturing including additive manufacturing. With respect to educating the manufacturing workforce, LIA has developed a significant and relevant suite of courses for our attendees, who are manufacturing people seeking to understand how lasers can improve their processes."

First among LIA's initiatives is a new series of online courses derived from its industry-leading conferences and workshops: ICALEO®, the Laser Additive Manufacturing (LAM®) Workshop and the Lasers for Manufacturing Event (LME®).

"The educational components of LAM and LME support the key recommendations" of the *Optics & Photonics* report, Baker explained. "Furthermore, LIA has led the way in the research underpinning laser materials processing and additive manufacturing at ICALEO and in our *Journal of Laser Applications®.*"

MAGDI AZER, GE GLOBAL RESEARCH

The initial draft of LIA's white paper notes that photonics and optics advances in Europe and Asia are greatly streamlining and accelerating manufacturing and that "laser processes allow for reduction in total energy consumption versus traditional methods, making it 'greener.'" The paper goes on to explain that "advanced manufacturing makes it possible to machine materials that are otherwise very difficult to process with conventional methods. The trend toward customization can be achieved with novel processes enabled by the inherent flexibility of the laser tool."

As the NPI progresses, LIA will explore funding guidelines for realizing various laser-based manufacturing initiatives. Possible solutions for reaching NPI goals include fostering more advanced education and degrees in design and laser materials processing, creation of new standards and research to "prove out" processes, innovative financing for laser equipment purchases, and public outreach to inform the public about the benefits of lasers.

"The government can assist in removing the obstacles in employing advanced manufacturing techniques by investing wisely" in such solutions, LIA advises.

Any solutions to meet federal manufacturing goals "need to be industry-driven," Baker says. "LIA looks forward to leverage our decades of experience and wealth of resources toward advancing NPI's goals and helping US manufacturers harness the power — and profits — lasers offer." ■

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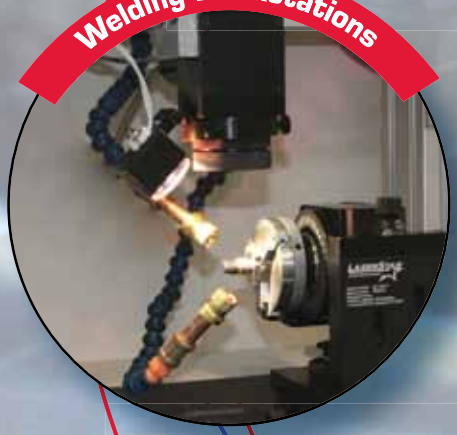

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LASER WORLD OF PHOTONICS CHINA 2013

LASER WORLD OF PHOTONICS CHINA 2013 INDICATES THE GREAT IMPORTANCE OF THE CHINESE PHOTONICS MARKET

Asia's leading laser, optics and photonics industry event, LASER World of PHOTONICS CHINA 2013, closed its doors at Shanghai New International Expo Center on March 21 after having attracted a total of 539 exhibitors from 18 countries on a record exhibition area of 28,750 m^2, a 25 percent increase over last year. The three-day trade show was attended by 36,042 trade visitors and buyers, increasing by five percent with another historical high. The PHOTONICS CONGRESS CHINA and other accompanying programs featured discussions on advanced lasers, automatic laser processing, laser macro-processing, laser micro-processing, optics, IR technology, laser safety and other topics. 1,810 experts and researchers took part in the congress and discussed innovations and developments in other laser and optics technologies.

INNOVATIONS AND APPLICATIONS HERALD THE INDUSTRY'S FUTURE

As one of the first industry events in the year, LASER World of PHOTONICS CHINA has always been regarded as the industry's foretaste for the coming year. The innovations and applications presented at the trade show herald a bright future for the Chinese market. Weiguo Fan, General Manager of the Laser Technology Dept, Shenyang SIASUN Robot & Automation Co., Ltd., spoke highly of the show: "Compared with other trade shows, LASER World of PHOTONICS CHINA is larger and covers a wider range of topics from micro-processing to macro-laser processing. In view of the number of trade visitors and their needs, we can say that the laser processing market still harbors great potential."

This year, the trade show continued to focus on "innovations and applications in laser and photonics technology," and featured products and solutions in four areas: Laser Systems for Production Engineering, Lasers and Optoelectronics, Optics and Manufacturing Technology for Optics, Imaging and Optical Metrology. At the trade show, products from all over the world attracted the attention of a large number of visitors who discovered numerous creative applications. Leading companies from China and abroad showcased the indispensable role which laser and photonics technology plays for visitor industries such as metal processing, automobile manufacturing, ship building, aerospace, semiconductors and electronics, as well as education and research, life science, medicine and health.

"This is a very successful trade show both in terms of the number and expertise of visitors. The visitors came from the following industries: aerospace, automobile manufacturing, metal processing, solar energy, electronics, medical treatment and others. Apart from customers from Shanghai, there were also visitors from Southeast Asia, for example Japan and Korea," said John Peng, Managing Director of Rofin-Baasel China Co., Ltd.

Cutting-edge processing technology, an unparalleled exhibitor profile and active discussions in the exhibition halls made everyone confident about the laser and photonics industry. Chenghan Lu, an engineer from Foxconn, visited the show for the first time. "I found many laser applications at the show. I am interested in laser cutting and welding, and I was greatly impressed by the products for automotive welding and parts cutting."

NEW TECHNOLOGY HIGHLIGHTS AND REQUIREMENTS

As an enhancement of traditional laser processing technology, the new technology combining automatic control, machine vision and robot technologies proved to be a topic of discussion for a large number of visitors. Leading enterprises like ABB, REIS, Staubli, SIASUN, TRUMPF, Rofin, Han's Laser, HuaGong, Penta Chutian, DNE and TAYOR exhibited their new products and solutions that will reshape the future of laser processing.

Steven Wang, Deputy Manager of ABB Robotics Welding Application Center, ABB Engineering (Shanghai) Ltd., commented: "This is the first time that ABB participated in LASER World of PHOTONICS CHINA. This is a very professional and wide-ranging trade show. Since ABB also promotes its robot application in the laser industry, we took part without hesitation."

END USERS' GET-TOGETHER FOR PERFECT PROCUREMENT PLATFORM

At LASER World of PHOTONICS CHINA 2013, every booth was always full of visitors and lively discussions were held. Exhibitors and visitors alike expressed their satisfaction with the overall

results. Sunny Deng, Director of Han's Laser Technology Co., Ltd., showed great appreciation. "LASER World of PHOTONICS CHINA has become an exhibition for high-speed, advanced and high-performance technologies. We met numerous target customers and received several orders. The trade show far exceeded our expectations."

PHOTONICS CONGRESS CHINA WIDELY ACCREDITED

The PHOTONICS CONGRESS CHINA was again held concurrently with the trade show. The 8th International Conference on Laser Processes and Components (LPC 2013), which formed part of the Congress, addressed the new topic of laser 3D printing technology (laser additive manufacturing). Professor Wang Huaming from the Faculty of Materials Science and Engineering at Beihang University said "A large number of world-famous experts described the latest research findings and developments in laser processing technology at LPC 2013. It is a great idea to link scientific studies with industrial applications. This combination helps researchers to find out about the latest information and requirements in the industry, and makes a major contribution towards promoting industrial technology and the manufacturing industry."

The PHOTONICS CONGRESS CHINA also included the 8th National Conference on Laser Technology and Optoelectronics and Release of 2012 China Optics Outstanding Achievements, OSA Short Courses, and a workshop on Laser Safety Protection Certification. The workshop on laser safety protection certification showed the increasingly more important role which laser safety plays in production. The Machine Vision Technology & Application Conference was also held at the same time and combined scientific discussions, application examples and products. It was well received by the audience.

The next LASER World of PHOTONICS CHINA will be held at the Shanghai New International Expo Center from March 18-20, 2014. ■

CORPORATE MEMBER PROFILE
FRAUNHOFER IWS

The Fraunhofer Institute of Material and Beam Technology (IWS), part of the Fraunhofer-Gesellschaft organization, is an innovative source for applied research and development of laser and surface technology. Dedicated to pioneering and promoting up-and-coming technologies, IWS is renowned for its contributions to the field of laser-based processes for joining and cutting as well as distinctive surface and coating technologies. As part of an overarching effort to instill new practices into the marketplace, IWS delivers valuable tools and services applicable to private and public customers worldwide.

A non-profit organization formed in 1949, Fraunhofer-Gesellschaft is now the largest organization for applied research in Europe. With a total of 66 separate institutes and research units, the organization emphasizes the importance of application-oriented research and the development of innovative technologies. While enabling the creation of novel solutions with global benefits, the Fraunhofer Institutes also bolster the competitive strength of economies in local markets as well as throughout Europe.

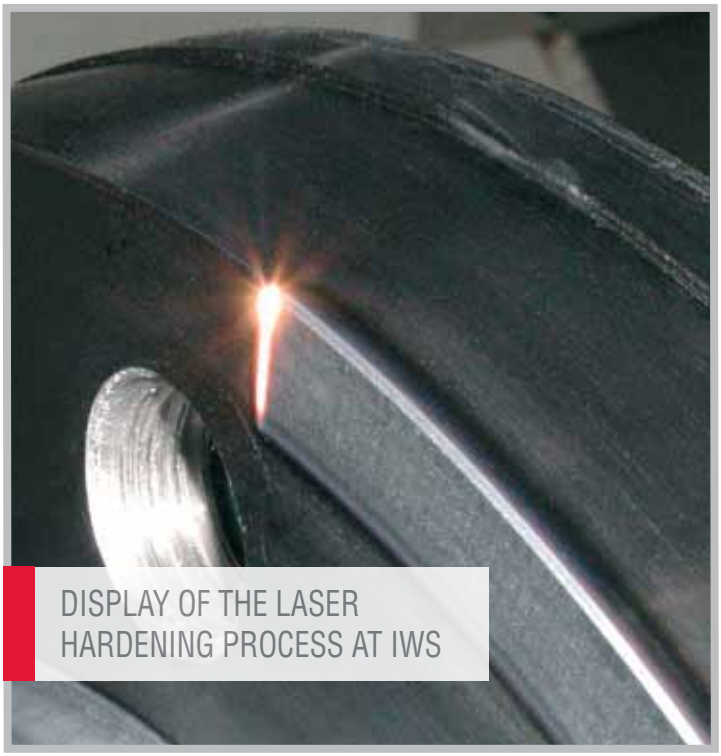
Achieving independence in 1990, the Institute for Material and Beam Technology (IWS) began as a spinoff from the Central Institute for Solid State Physics and Materials Research (ZFW). The IWS initially concentrated its research on laser processing technologies such as the laser hardening of turbine blades and pulsed laser deposition procedures. Based in Dresden, the IWS has another German branch in Dortmund, in addition to locations in Wroclaw, Poland, and East Lansing, MI. Together, the IWS employs over 268 scientists, engineers, technical staff and more.

Fraunhofer IWS provides a range of laser-based services including ablation, cutting, joining, surface treatment and cladding. The Institute is also a leading innovator in coating systems through physical vapor deposition (PVD) and nanotechnology, which are designed to apply to difficult materials. IWS attributes their success in the production of new strategies and systems to their unique research capabilities and expert staff.

"Our special feature is the expertise of our scientists in combining the profound know-how in materials engineering with extensive experience in developing system technologies. Every year, numerous solution systems have been developed and have found their way into industrial applications," said Deputy Director Dr. Anja Techel.

One of the new solutions in development will allow the IWS to circumvent problems with standard melt-based welding processes. Because such systems are unequipped to efficiently join modern functional materials such as aluminum alloys and copper, the IWS has engineered multiple workarounds.

"To address these challenges Fraunhofer IWS engineers are working on welding processes that purposely avoid the melting of the materials. The primary focus is on technologies such as friction stir welding, laser beam soldering, laser induction roll plating and electromagnetic pulse joining. We offer process development, prototype welding and system technology developments," Techel explained.



DISPLAY OF THE LASER HARDENING PROCESS AT IWS

As a result of these and similar advancements, Fraunhofer IWS has been able to witness industry growth firsthand. "In 2012, our largest growth was in the area of laser hardening, laser cladding and additive manufacturing, as well as in Laser Arc technology, a special PVD technology. Various applications in these fields have been transferred into the industry. Generally speaking, we see strong growth in all of our business units... laser and surface technologies are so modern and exciting, we are happy to work in these fields," said Techel.

Committed to staying ahead of a growing industry, Fraunhofer IWS continues to pursue new fields of research and development. As more advanced technologies are used in industrial markets, scientists from IWS have chosen to concentrate on energy efficient systems.

Fraunhofer IWS

"Projects focus on battery research, friction reduction and the optimization of electrical steel... the development and industrial implementations of modern technologies in the areas [of] energy conversion, storage and efficiency are of substantial importance at IWS. Furthermore the research into electro mobility and energy storage systems became a main focus to our scientists and engineers," noted Techel.

A member of LIA since 1996, Fraunhofer IWS views the Laser Institute of America as an essential means of networking. "Since 1997, Fraunhofer IWS Dresden has been concentrating its USA activities within the Fraunhofer Center for Coatings and Laser Applications (CCL) in Michigan. The US market is one of the most important international benchmarks and innovation driving forces for applied research and development. In our opinion, networking is a very important factor of success," concluded Techel. ■

For more information, visit **www.iws.fraunhofer.de/en.html.**

ASC Z136 UPDATE

This year's annual meeting of ASC Z136 was held in Orlando, FL on Sunday, March 17 just prior to the International Laser Safety Conference (ILSC®). Some committee members viewed the meeting as the kick-off event to ILSC, while others were only able to attend ASC Z136 and related ancillary meetings.

LIA Executive Director Peter Baker's opening remarks acknowledged with sadness the passing of Emeritus Members Dave Edmunds and Sid Charschan. He noted with great appreciation their sustained and substantial contributions to the work of the committee. A resolution honoring their service was made and approved en masse. Baker went on to announce the reappointment of Ben Edwards as ASC Z136 Secretary and recommendations of reappointment of Robert Thomas and Sheldon Zimmerman as Chair and Vice Chair, respectively. Both were approved by the committee unanimously.

After a brief overview of the organizational structure of ASC Z136, the results of the pre-meeting confirmations ballot were shared with the membership. All previous standards and technical subcommittee chairs, as well as appeals pool members, were approved for reappointment. The committee welcomed two new organizational members, the Federal Aviation Administration (FAA) with Ricky Chitwood as its representative and KLA-Tencor with Karl Umstadter as its representative. Including these additions, ASC Z136 is now comprised of 83 total members, seven of which are alternates and two Emeritus, netting a maximum of 74 eligible votes for the committee.

Following the ADCOM's administrative reporting, Fred Seeber led a discussion on the merits of reconvening standards subcommittee 5, responsible for the development of the Z136.5 standard for *Safe Use of Lasers in Educational Institutions*. He recommended finding a new chair and beginning the revision process. After further dialogue, a motion was made to reaffirm the Z136.5 document and reconstitute SSC-5 with Seeber serving as interim chair until another candidate is found. The motion carried with no objections and one abstention.

Robert Thomas then reported on changes made to ASC Z136 procedures, proposed to resolve findings of the ANSI June 2012 audit. The initial ballot for revising the procedures closed just days earlier (March 12) with one negative vote. The negative balloter's comments were summarized and Thomas opened the floor for discussion. Ensuing conversation focused on the amount of flexibility the committee has opposed to what ANSI directs through its *Essential Requirements*, with respect to several of the outstanding issues. The deadline for submission of the revised procedures to ANSI is April 15.

Status reports from each of the subcommittees, along with new business items

- Proposed Development of Risk Assessment Tools
- Graphics in Z136 Standards
- Observations from a 1st Time Vice Chair

rounded out the afternoon. The meeting adjourned with plenty of time for members to join in the festivities of the ILSC Welcome Reception.

Want to learn more? Interested in joining ASC Z136 or any of its subcommittees? Contact Barbara Sams at +1.407.380.1553 or bsams@lia.org.

ASC Z136
Safe Use of Lasers
Accredited Standards Committee

BLS UPDATE

Board of Laser Safety

BLS APPRECIATION RECEPTION AT ILSC!

On Monday, March 18, the Board of Laser Safety held an Appreciation Reception for all certified laser safety officers (CLSOs and CMLSOs) in attendance at the 2013 International Laser Safety Conference (ILSC®).

A networking opportunity extraordinaire for BLS certified laser safety officers, LIA Executive Director Peter Baker made this an event to remember for those CLSOs and CMLSOs who contributed to the *CLSOs' Best Practices in Laser Safety* or *CMLSOs' Best Practices in Medical Laser Safety* by presenting each with a plaque thanking them for their work on the publications.

Comments received from our honorees (more will be featured in the BLS News & Review, May issue):

"It was very considerate for the Board of Laser Safety (BLS) to host the wonderful Appreciation Reception during the 2013 International Laser Safety Conference in Orlando. I was honored to be recognized as a co-author of the *CLSOs' Best Practices in Laser Safety* at the reception. It was truly a pleasant surprise to receive the magnificent plaque from Peter Baker. The book was an integral effort by many dedicated Certified Laser Safety Officers (CLSOs). It was a great privilege and pleasure to collaborate with such a committed, devoted and knowledgeable group. Numerous co-authors also became good friends of mine. I will certainly treasure this plaque and look forward to contributing myself for future revision of the *CLSOs' Best Practices in Laser Safety*." *—Wei-Hsung Wang*

"Thank you very much BLS for the reception and for the plaque recognizing my work for the *CLSOs' Best Practices in Laser Safety*. My colleague Hoa Ly (also recognized at the BLS reception) posted my picture on Facebook, so I got congratulations from around the world. I will definitely want to work on the next version of the book." *—Sandu Sonoc*

"It was an honor to be recognized at the BLS Appreciation Reception. The plaque was unexpected, and greatly appreciated! Thanks to all the LIA and BLS staff who worked so hard to make this reception and all the events at the 2013 ILSC such a success." *—Alice Sobczak*

FROM LEFT TO RIGHT - JUDI BIGGUS, CHRIS DISSINGER, SURENDRA DUA AND WIFE

BLS BOARD COMMISSIONER, DON HAES

VANGIE DENNIS (RIGHT)

RAY BEAUREGARD (RIGHT)

FROM LEFT TO RIGHT - SANDU SONOC, HOA LY, WEI-HSUNG WANG, ALICE SOBCZAK

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. View complete articles of the abstracts below online under the Featured Category.

FEATURED ABSTRACTS

ELECTROMAGNETIC CONTROL OF THE WELD POOL DYNAMICS IN WELDING OF ALUMINIUM ALLOYS

By Vjaceslav Avilov, André Schneider, Marco Lammers, Andrey Gumenyuk, Michael Rethmeier

A well-known problem of partial penetration laser beam welding is keyhole-tip instability representing the main source of porosity – gas bubbles leave the keyhole near its tip. The second important problem of keyhole mode laser welding is very intensive thermocapillary (Marangoni) convection in the upper part of the weld pool. In the present work an oscillating (AC) magnetic field was used to suppress porosity formation and to stabilize the weld pool surface in bead-on-plate partial penetration up to 4.4 kW Nd:YAG laser beam welding of AW-5754 plates in PA position.

NOVEL FUSION WELDING TECHNOLOGY OF SILICON/GLASS

By I. Miyamoto, Y. Okamoto, A. Hansen, T. Amberla, J. Vihinen, J. Kangastupa

Silicon/glass is one of the most widely used material combinations for sensing and actuating microsystems and micro electronic technologies.The authors have developed a novel fusion welding technique of Si/glass with high spatial resolution down to approximately 10μm at high throughput using ultrashort laser pulses (USLP) of high pulse-repetition rates without pre- and post-heating. Our results indicate that the mechanical strength of the weld joint and process throughput are at least competitive with anodic bonding, showing USLP has brought a new wave not only in welding of glass/glass but in dissimilar materials like Si/glass.

THE DIFFERENCE BETWEEN FIBER LASERS AND FIBER DELIVERED LASERS

By Tony Hoult

Nobody would disagree that real change is occurring in the laser industry. In the broadest context, what is happening is a shift from the conventional technique of assembling lasers using free space optical components to a technique based on splicing together fiber based components. It is now very widely accepted that this brings a range of benefits, not least of which are dramatic improvements in reliability, stability and ease of use.

JLA UPDATE

The Laser Institute of America's official refereed publication, the *Journal of Laser Applications® (JLA)*, an online-only journal, is complete with new features for a broader audience. *JLA* is hosted on AIP Publishing's robust Scitation online platform, providing the journal with great functionality and the ability to leverage a wide range of valuable discoverability features. JLA features nine topic sections, a faster peer-review process and a more functional website (**jla.aip.org**) 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.

RESERACH HIGHLIGHT

REVIEW ON LASER DRILLING I. FUNDAMENTALS, MODELING AND SIMULATION

By Wolfgang Schulz, Urs Eppelt, Reinhart Poprawe

High peak power lasers have been used for years for ablating matter. The most relevant application of this process is laser marking. Marking meets the demands of applications although the quality of ablation has potential to be further improved. However, the qualitative results of the ablation process especially for highly efficient removal of matter in the liquid phase like drilling have not met the standards of alternative processes—the latter is only the case in niches. On the other hand, the ablation by ultrafast lasers in the pulse regime of ps or below, which might meet the quality demands in terms of geometric precision, was too slow for economically feasible application because of the lack of average power. In fact, both process domains have been developed substantially and thus lead to a technological level, which make them ready for industrial innovations.

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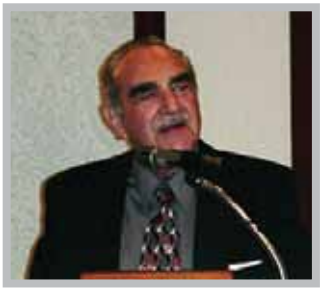
JLA
Journal of Laser Applications

SID CHARSCHAN REMEMBERED



Sid Charschan, a former president of the LIA and a recipient of the prestigious Wilkening and Schawlow Awards, passed away on February 22, 2013.

An early supporter of the LIA, Sidney was the first secretary of the Z136 and later served, for many years, as the chairman of that committee. He was a pioneer in the field of industrial laser applications and was a trailblazer in laser safety through his various roles with the Z136 Committee.

After serving with the US Army in the European Theater during World War II, Sidney received a degree in Mechanical Engineering from Columbia University. However, his technical accomplishments ranged well beyond that narrow discipline. He was a visionary, who possessed great imagination and creativity as attested by numerous patents, awards and technical papers and presentations.

Laser technology was in its infancy when Sid joined the Engineering Research Center (ERC) of Western Electric (later to become part of Bell Labs) in Princeton NJ. But even in those early days, Sid had the vision of utilizing lasers in novel industrial applications. He headed a team that developed diamond die drilling, the first ever industrial application of lasers. That application was so revolutionary and significant, that the equipment was later enshrined for display at the Smithsonian Institution in Washington DC.

Over the following years, Sid led a group of scientists and engineers in developing many industrial applications that later became standards in numerous industries. Chief among these were developments in semiconductor processing, laser metrology, as well as scribing, cutting and drilling of different materials.

Sid was endowed with superb personal and managerial skills that enabled him to build and lead teams that pursued technical challenges with determination and perseverance. He managed to instill devotion and loyalty in the people who worked for him, and earned the respect of those that came into contact with him in the course of business interaction. He was undaunted by difficult challenges, and refused to take "no" as an answer. He had great leadership qualities, inspiring those working for him and with him, and everyone who dealt with him walked away with a positive experience.

While leading technical teams at the ERC, Sid realized the proliferation of industrial laser applications would require the development and acceptance of national laser safety standards. So he devoted a great deal of time and effort to the development of laser safety standards through his leadership roles with the Z136. He steered a few of the original standards through the approval process, while navigating in unchartered waters. His managerial skills proved invaluable in those days.

But above all, Sid will be remembered as a decent guy, a nice person with utmost integrity who was willing to step in and help individuals and organizations in need. He was a real mensch. *–Ami Kestenbaum, Chief Technology Officer, Chestnut Consulting*

I first became aware of Sid and the activities of his group through conversations with some of the folks in the group in which I worked at Bell Labs in Murray Hill, NJ, in the late '60s. The group at Murray Hill invented and built crude working models of the YAG and a number other lasers. Sid's group would take these models and turn them into practical and useful systems. One example is the YAG laser system used for drilling diamond for the wire drawing dies used by Western Electric. I first met Sid in the mid '70s, about the time he took over as Z136 chairman when George Wilkening stepped down. In spite of the rapid growth of the committee in the '80s and '90s, Sid maintained his knack for moving standards along and remaining focused in a job sometimes akin to herding cats. Ami Kestenbaum was secretary. When important points were made (during meetings), Sid would turn to Ami and say, 'Ya got that, Ami?' He would just smile and nod. *–Ron Petersen, Consultant, RC Petersen Associates*

Of Sid's many accomplishments, three in particular were instrumental to the growth and current status of LIA. One of the first things he did was bring us the secretariat of the Accredited Standards Committee (ASC) Z136. That is the source of all our standards work and has served to strengthen our training program. Next, he launched the *Journal of Laser Applications® (JLA)* and served as its original editor-in-chief. He also steered the effort to have LIA take over and manage the International Laser Safety Conference (ILSC®). All told, he was a kind, thoughtful and constructive gentleman who had an indispensable hand in creating the fabric of what we do. *–Peter Baker, Executive Director, Laser Institute of America*

MEMBER INNOVATIONS

BUFFALO FILTER LAUNCHES VISICLEAR™ SURGICAL SMOKE PLUME EVACUATOR

Buffalo Filter is pleased to announce the VisiClear™ Surgical Smoke Plume Evacuator. VisiClear™ offers the latest in technology, resulting in a quiet, safe and intuitive smoke plume evacuator unlike any other on the market. VisiClear sets a benchmark for surgical smoke plume evacuation with its innovative design. Understanding the needs of the operating environment, the technologically advanced sound design of Whisper Technology™ provides quiet, non-disruptive operation. In addition, SafePort Techonlogy™ delivers powerful protection against cross contamination using sliding ports. Keeping up with the latest technologies, VisiClear stands clear from its competitors by utilizing an intuitive color touch screen to increase productivity and accuracy. For more information, visit **www.buffalofilter.com**.

OPHIR-SPIRICON'S NEW PYROELECTRIC LASER BEAM PROFILING CAMERA FEATURES LARGER ARRAY AND GIGE INTERFACE

Ophir Photonics, global leader in precision laser measurement equipment and a Newport Corporation brand, today announced the Pyrocam IV at Photonics West. The Pyrocam IV is the company's latest beam profiling camera. It features a larger, 320 x 320 pixel pyroelectric array that can profile beams up to 25 mm without the need for reduction optics. The new electronics control design includes an interface to GigE (Gigabit Ethernet) cameras for high-speed applications. The Pyrocam IV measures both pulsed and CW (continuous wave) lasers, from 13 to 355 nm and 1.06 to >3000 μm; an integral focal plane chopper is included for CW beams and thermal imaging. The camera is housed in a new, compact case that provides easy access to the array and chopper. For more information, visit **www.ophiropt.com/photonics**.

ROFIN OFFERS NEXT GENERATION ULTRASHORT PULSED LASERS

Rofin's new ultrashort pulse lasers StarFemto FX and StarPico deliver outstanding precision and quality as never reached before in laser material processing: cutting, ablating or drilling of almost all kinds of materials with minimal or no post-processing and without thermal damage. Ultrashort pulse lasers (USP lasers) which provide sufficient output power for industrial applications offer pulse lengths in the range from some 10 picoseconds to some 100 femtoseconds. They can be used for laser cutting, drilling, laser marking or surface treatment applications. Ultrashort pulses are shorter than the time needed for most energy diffusion processes within the atomic lattice. Therefore no heat is transferred to surrounding material which eliminates any unwanted material change. This is the reason why the method is referred to as 'cold'. For more information, visit **www.rofin.com**.

MEMBERS IN MOTION

NEW DEVELOPMENT CENTER SUPPORTS INNOVATIVE EFFORTS AT TRUMPF LASER GMBH + CO. KG

TRUMPF, the world's largest manufacturer of lasers for industrial use, has expanded its primary solid-state laser development facility by erecting a new building at the town of Schramberg-Sulgen. Thus TRUMPF Laser GmbH + Co. KG has augmented this corporate site with a structure offering 6,200 square meters of floor space. With about 250 guests in attendance, the official opening took place on March 6. The two floors in the Development Center house both office space and laboratories dedicated to the development of solid-state lasers. For more information, visit **www.trumpf.com**.

WELCOME NEW CORPORATE MEMBERS

Electro Optics Technology, Inc.
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New York University – Abu Dhabi
Abu Dhabi, UAE

Optometrics Corporation
Ayer, MA

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

LIA ANNOUNCES

NEW! ANSI Z136.2 HAS BEEN RELEASED

With the exponential growth of fiber-optic telecommunications comes the need for well-trained installation and service personnel. Guiding those employees will be the new ANSI Z136.2 laser safety standard, available from the Laser Institute of America. The standard provides guidance for the safe use, maintenance, service and installation of optical communications systems utilizing laser diodes or LEDs operating at wavelengths between 0.6 microns and 1 mm. Optical communication systems include end-to-end optical fiber-based links, fixed terrestrial point-to-point free-space links or a combination of both. This standard is intended to be used by those who assemble the end-to-end system and by service, maintenance and other personnel who may come in contact with such systems where access is in uncontrolled, controlled and restricted locations. It provides detailed safety information for systems where optical energy may be accessible and where source parameters are uncertain or not under the control of the user. Control measures commensurate with the specific hazard level (optical fiber links) and access level (free-space links) are provided. Most evaluations can be carried out analytically. A number of representative examples of hazard evaluation are provided in the appendices. To order the ANSI Z136.2 standard ($130 for LIA members, $150 for non-members), visit **www.lia.org/ansi** or call 1.800.34.LASER.

LME 2013 – THE EVENT OF THE YEAR

LIA's third annual Lasers for Manufacturing Event (LME®) is going to be held September 11-12, 2013 in Schaumburg, IL – in the backyard of the United States' manufacturing industry. LME 2013 will provide a one stop event for companies interested in integrating laser technology into their production. Visit the show floor theater for keynote presentations on the overall impact of lasers in general manufacturing, plastics manufacturing and the laser requirements for aerospace and automotive manufacturing. Attend the expanded free educational sessions covering the main laser types, economic justification for laser systems, design consideration for industrial laser systems and laser safety for industrial laser systems. Learn from world famous authorities, understand how laser technology is the future of manufacturing and how it is applied, and connect with the suppliers who can help you to benefit from using lasers in your manufacturing. Now is the time to sign up to exhibit at this one-of-a-kind event. Or highlight your company further, and choose from one of the prominent sponsorship opportunities that LME has to offer. For more information on attending, exhibiting at or sponsoring LME 2013, visit **www.laserevent.org** or call 1.800.34.LASER.

40% OFF ANSI Z136.1 – WHILE SUPPLIES LAST

The parent document and cornerstone of the Z136 series of laser safety standards, the ANSI Z136.1 (2007) provides guidance for the safe use of lasers and laser systems by defining control measures for each of the four laser classes. As a result of advances in laser devices and applications, it is recommended that this standard be obtained by all laser end users and is a must for users of class 3B and 4 lasers. Since the ANSI Z136.1 standard is the foundation of laser safety programs for industrial, military, medical and educational applications nationwide, this standard can and will affect the training and practice of laser safety in these environments. This standard includes laser hazard classification definitions, requirements for refresher training and updates to medical surveillance requirements. The ANSI Z136.1 standard provides an updated and thorough set of guidelines for implementing a safe laser program.

In addition, the standard covers laser safety program provisions including the duties and responsibilities of the LSO, non-beam hazards, administrative/engineering control measures, definitions, optical density, nominal hazard zone (NHZ), MPEs, accessible emission limit (AEL), bioeffects, standard operating procedures (SOPs) and example calculations. To order your copy today call 1.800.34.LASER or visit **www.lia.org/ansi.**

ICALEO 2013 – IN MIAMI THIS OCTOBER

Come and be part of LIA's 32nd International Congress on Applications of Lasers & Electro-Optics (ICALEO®) October 6-10, 2013 in Miami, FL, where researchers and end-users meet to review the state-of-the art in laser materials processing and predict where the future will lead. ICALEO has always been devoted to the field of laser materials processing and is viewed as the premier source of technical information in the field. Topics will include laser process monitoring and control, laser processing of biological materials, laser hybrid processing, laser manufacturing for alternative energy sources and laser business development. Don't miss the opportunity for your company to participate, sign up as and ICALEO 2013 Sponsor or Vendor today! For more information on attending ICALEO, or for sponsorship and vendor opportunities, visit **www.icaleo.org** or call 1.800.34.LASER.

FOR A LIMITED TIME ONLY: $200 OFF FOCAL POINTS

Laser technology has revolutionized the world of medicine. The use of lasers has made possible many treatments and procedures that no one dreamed of before lasers came along. Given the wide variety of laser applications and their increasing role in health care, it is essential that health care professionals understand fundamental information regarding lasers and their safe use. Plus, the ANSI Z136.3 *Safe Use of Lasers in Health Care* standard, as well as the Joint Commission and Occupational Safety and Health Administration (OSHA), require training for personnel as a component of any laser safety program. So for a limited time only, we are taking $200 off of *FOCAL POINTS – Interactive Training for Medical Laser Safety*. This user-friendly training program is the perfect tool for MLSOs to use to effectively train their staff. Go to **www.lia.org/store** for more information, including a video preview, and order your copy today!

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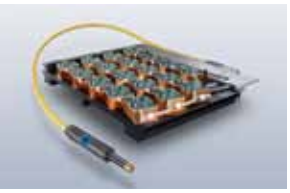

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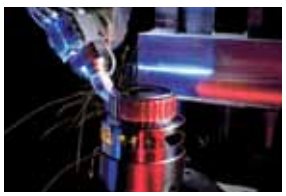

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