LIA TODAY

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THE LASER INSTITUTE

LIA TODAY
The Laser Institute's
Bi-Monthly Newsletter

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LIA TODAY is a full-color digital newsletter, published six times per year. It includes articles on the latest industry news to keep members and other laser professions current on important issues impacting the laser community.

Distribution includes all subscribed users involved in laser technology - from end-users to system builders and nurses to laser physicists. LIA TODAY readers consist of production managers, supervisors, safety professionals, and researchers, end-users, laser physicians and nurses.

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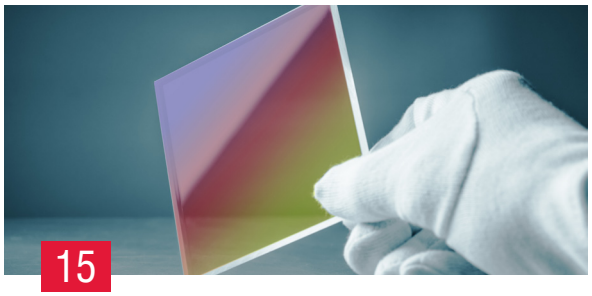
GENERATION 3 STEELS

By John Sutter

Generation 3 steels promise higher strength, lighter weight, and formability. These benefits are poised to change the automotive industry, but can they be welded together?



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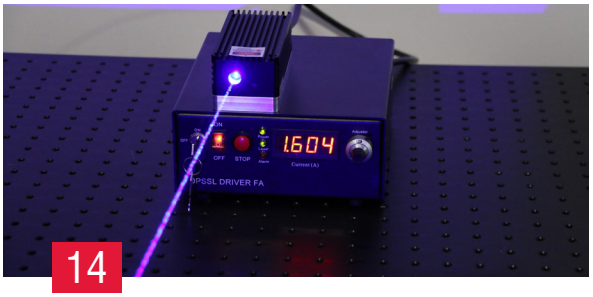
IMPROVING THE LASER-DAMAGE THRESHOLD OF LASER OPTICS WITH RANDOM ANTI-REFLECTION NANO-TEXTURE

Traditional thin-film anti-reflection coating is considered a performance-limiting factor in laser optics due to the damage caused to the deposited thin-film coating by sustained high-intensity lasers. A practical solution involves replacing these thin-film coatings with anti-reflection (AR) treatment consisting of randomly-distributed surface relief nanostructures.

LIA TODAY

THE OFFICIAL NEWSLETTER OF LIA

LIA TODAY is published bimonthly to educate and inform students and professionals of challenges and innovations in the field of photonic materials processing.



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ACHIEVING HIGH-QUALITY WELDING OF NON-FERROUS METALS VIA BLUE DIODE LASERS

The laser processes on non-ferrous metals are affected by the reflective nature of the material and are prone to welding defects like spatter formation. The use of blue laser light can mitigate these challenges as well as improve laser welding quality in the form of high-power diode lasers.

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LASER PAINT-STRIPPING ROBOTS FOR AIRCRAFTS

New laser technologies are revolutionizing every industry, including the aircraft industry. Aircraft must be stripped of paint and repainted every five to six years to avoid corrosion. XYREC, a company in the Netherlands, uses robots with lasers to strip the paint that is usually removed by people using chemicals. This method is much more time efficient and environmentally friendly.

FEATURES

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Course Highlight

MEDICAL LASER SAFETY OFFICER TRAINING
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MON, 01/25/2020 TO FRI, 01/26/2020

Are you an RN, OR supervisor, surgical tech or training coordinator who has been assigned the critical responsibility of LSO in a medical facility? Designed to meet the special needs of medical professionals, LIA's Medical Laser Safety Course will provide the training you need to build and maintain a successful laser safety program.

As an LSO at a medical facility, you have a unique set of responsibilities. Not only is laser safety a top priority to protect your staff, but it is critical to protecting your patients. Our MLSO training program addresses the specific laser safety protocols as they relate to medical and healthcare environments.

This course meets all LSO training requirements as outlined by the ANSI Z136.3 Safe Use of Lasers in Health Care standard, OSHA, and The Joint Commission. In addition to the working knowledge you will gain, you will earn 12 Contact Hours, 1.5 BLS CM Points by the Board of Laser Safety, 12 CECs by the AAHP and eligible for ABIH CM points.

EXECUTIVE DIRECTOR'S MESSAGE

The year is coming to a close, and with 2019 nearly behind us, we look ahead and move forward with our experiences from the past year providing important guidance. Much of our attention has been on improving ICALEO 2020 and we plan to pay more attention to safety and education in the New Year.

ICALEO Update:

First, I would like to acknowledge the hard work of the volunteers who are really the driving force behind ICALEO 2020. The members of the International Advisory Board, the members of the Exhibitor's Steering Committee, the conference chairs and track chairs, and also you, the LIA members and ICALEO attendees who took the time to provide feedback on the ICALEO 2019 survey. Because of this input, this will truly be your ICALEO, and we are confident about the relevance of the program that is being developed.

This winter brings a change in season for us, as we are now back on track with a three-year conference-planning model. We are in the process of securing conference meeting space for 2021 and 2022, which will allow us to share information sooner that better helps you plan your travel arrangements. We are also back to a more comfortable timeline of announcements – the 2020 ICALEO call for papers and posters is already being reviewed by the International Advisory Board and you can expect to see the announcement by the end of this month.

Of the changes coming, is a return to the basics, with a single-day, four-hour Exhibitor Reception after the day's technical sessions have concluded. This, among other changes, has been warmly welcomed, and although we are still in the early stages of planning, we have received multiple verbal commitments from sponsors and exhibitors for next year. The sponsor/exhibitor guide is now available for review here - https://assets.lia.org/s3fs-public/pdf/conferences/ICALEO%202020%20Brochure_0.pdf.

In addition to ICALEO, we are also looking at the feasibility of offering one or two workshops next year in conjunction with other events. Potential topics will be discussed with our Board.

Safety Update:

As with catching up on ICALEO, we are working toward earlier planning for the International Safety Conference (ILSC) meeting space. More information will be available soon for the 2021 conference.

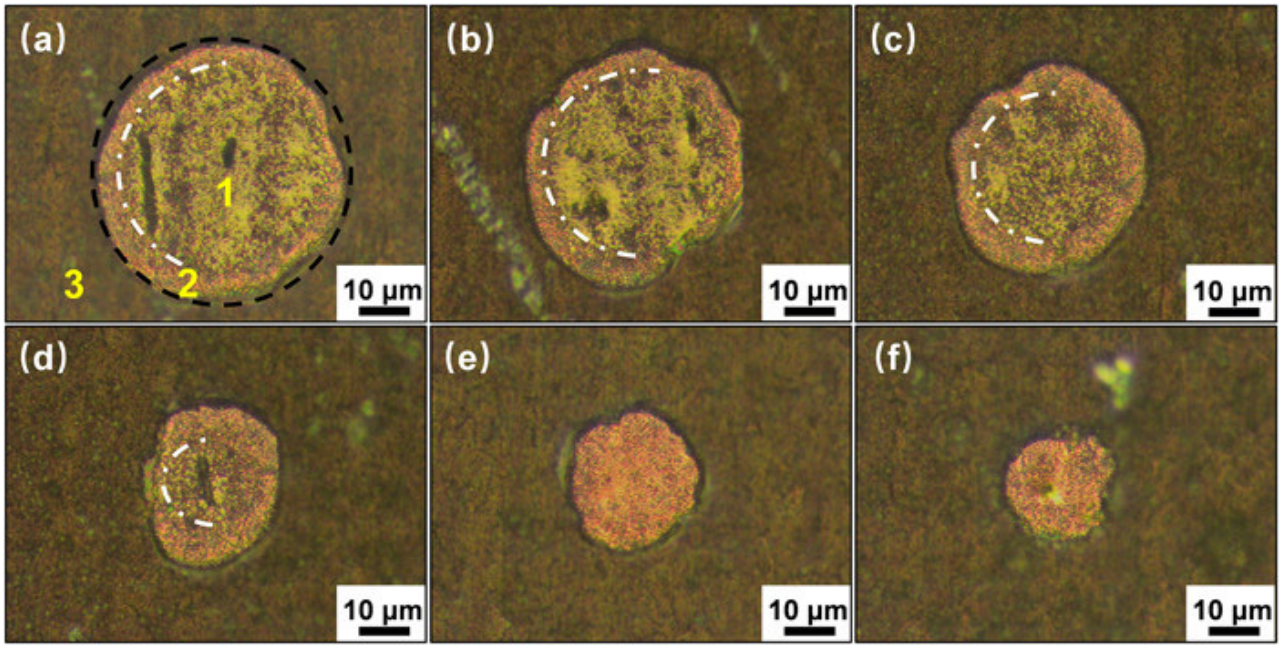
The ANSI Z136.5 and Z136.7 laser safety standards were approved at the Main Committee level and we hope to see them both published early next year. The ANSI Z136.8 is in the final balloting stages and may potentially be published next year as well.

We would like to work more closely with other conferences to offer laser safety training and reach a broader audience. We encourage any groups with interest to reach out to us. We would also like to expand our in-house training offerings – a quote for in-house training can be requested on our website - https://www.lia.org/training/non-medical/on-site-in-service-training/request-a-quote.

Wishing you all happy holidays and a bright New Year,

Nat Quick
Executive Director

JLA | EDITOR'S PICK



Images of "opening holes" created with a single shot at laser fluences of (a) 10.23, (b) 4.72, (c) 1.97, (d) 0.71, (e) 0.53, and (f) 0.4 J/cm2.

PICOSECOND LASER LIFT-OFF METHOD FOR FRACTURE AND DEBONDING OF COPPER OXIDE LAYER GROWN ON COPPER SUBSTRATE

By: Huazhong Zhu, Hongchao Zhang, Xiaowu Ni, Zhonghua Shen, and Jian Lu

Abstract: The objective of this work is to investigate the ablative removal behavior of copper oxide under the picosecond laser (pulse duration 12 ps and wavelength 1064 nm) irradiation. For this purpose, a thin CuO layer with a thickness of about 750 nm is synthesized on a pure copper substrate by the dipping method to serve as the target samples for experimental tests. It is shown that, unlike the pure ablation behavior, the removal process of the CuO layer is mainly based on the nonthermal lift-off effect, by which the stripping of the whole piece of oxide films from the substrate can be achieved with a single pulse shot. A minimum fluence required for peeling off the layer is determined to be about 0.11 J/cm2. Further analyses demonstrate that the entire pop-off of the CuO layer caused by the confined ablation at the interface occurs only if the laser fluences are applied below 0.62 J/cm2. However, when it comes to the cases at higher fluences, a thin residual layer can be observed remaining on the substrate. To explain this phenomenon, a plausible interpretation with respect to the ablation induced by nonlinear absorption and impact ionization is proposed, which declares that it is the combination of direct ablation and the interface lift-off that ultimately causes such special removal features. In addition, the influence of the oxide film thickness on the debonding threshold and the removal behavior are additionally assessed.

Journal of Laser Applications 31, 042015 (2019); https://doi.org/10.2351/1.5121339

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JLA Journal of Laser Applications

TRENDING IN THE NEWS:
LIA'S TOP 4 ARTICLE PICKS

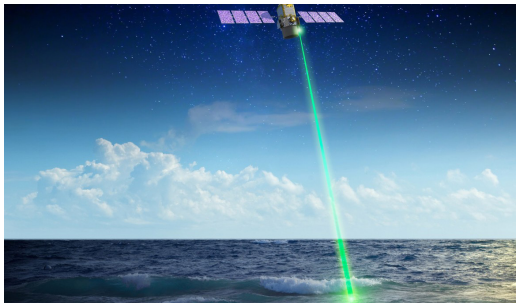
1

SCIENTISTS INVENT A WAY TO SEE ATTOSECOND ELECTRON MOTIONS WITH AN X-RAY LASER

An attosecond is an incredibly short period of time—two are to a second as one second is to the age of the universe. Using X-ray laser bursts of just 280 attoseconds, researchers at SLAC National Accelerator Laboratory have found a way to observe the movements of electrons.

Read more

2

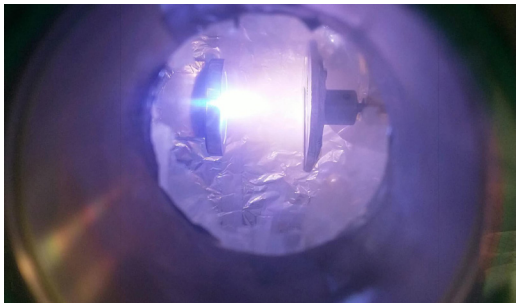


SPACE-BASED LASERS TRACK EARTH'S LARGEST ANIMAL MIGRATION IN UNPRECEDENTED GLOBAL STUDY

A joint study by NASA and the French space agency, Centre National d'Etudes Spatiales (CNES), has used space-based lasers to produce the first global study of the great migration of tiny marine animals that takes place twice every day.

Read more

3



SCIENTISTS MAKE BENDABLE GLASS USING ALUMINUM AND LASERS

Working towards a future where drinking glasses don't break and phone screens don't crack when dropped, scientists are attempting to overcome the brittleness of glass. In this new work, scientists used crystalline aluminum oxide instead of sand to make some tiny glass samples.

Read more

4

NEW PRINTER CREATES EXTREMELY REALISTIC COLORFUL HOLOGRAMS USING LASERS

Researchers have developed a new printer that produces digital 3D holograms with an unprecedented level of detail and realistic color. This offers high-speed, high-quality printing that could be useful for architecture models, fine art, exhibits, and other applications.

Read more

Figure 1:
Production laser door welding utilizing integrated seam tracking

Generation 3 Steels

By:
John Sutter; Abicor Binzel USA

This article is intended to provide a general knowledge and understanding of what "Gen 3 steels" are, how they are being used, and the reasons they are being used.

Over the years automotive manufacturers have continually sought out new means of making their vehicles more desirable, more consistent, more profitable, and more fuel efficient. There are many ways to achieve these, but one of the ways they have been able to hit many of these targets with one shot has been the use of advanced materials like high strength steels. These steels can be made to exacting standards with application-specific qualities.

For example, a manufacturer might need an extremely strong steel in a difficult shape to stamp, like a bumper. This presents a need for a steel that can be stretched a great deal, but once assembled, has the strength needed to prevent injury to the vehicle occupants in the event of a collision. Steels in today's vehicles are often times tailored per specific application. Some steels get incredibly strong after they are heated up or stamped (or a combination of these things). These steels have some incredible benefits in weight savings, ability to style the shape of the vehicle, and increased safety -which all translate to desirability of the buyers of these vehicles. But there are also some incredible challenges being served up along with these benefits.

One of the most glaring challenges is how to assemble the vehicle. Traditional methods of welding these vehicles need to be re-thought in many cases. Some of these steels have extremely high carbon content, which makes them sensitive to phase changes when the heat from the welding processes is applied. This in turn often leads to welds that break within minutes or even seconds after the process is complete.

This isn't the first time the auto industry has faced these kinds of challenges. The change from frame construction to unibody. The addition of Rust inhibiting coatings. The change from mild steel to high strength steel. The change to advanced high strength steels. These have all happened over the last 50 years of auto manufacturing and were all met with answers robust enough to change the way vehicles are assembled forever. While Gen 3 steels were developed in the early 2010's, it has taken several years for manufacturers to understand how to implement them in their vehicles. Some of

the newest changes to vehicles are the increased use of aluminum, carbon fiber, and Generation 3 Advanced High Strength Steels.

So what are Gen 3 steels and why do they break the traditional rules for joining? The answer begins in understanding the needs of the industry: formability and high strength. It would seem these characteristics are diametrically opposed. As the industry regulations for fuel efficiency and competition for styling and safety ratings yearn to attract buyers of each manufacturer's vehicles, the raw material suppliers answered with High Strength steels. Steels that, through chemistry and an understanding of mechanical properties and phase changes, under certain conditions would be able to meet both the needs of formability AND high strength at certain times throughout the manufacturing cycle.

From Mild steels and Interstitial Free (IF) steels to Martensitic steels and Transformation Induced Plasticity (TRIP) steels, the menu of steels that carmakers have to pick from is growing. This menu can be charted out by plotting elongation percentages for a given material against its tensile strength. As more and more recipes are tried, there have been some serious advancements in what is possible in the world of steel. Some of these advancements led to TWIP (Twinning Induced Plasticity), which have extremely high percentages of Manganese in their recipe, and Austenitic Stainless Steels, which left a very large gap in the formability to strength chart from traditional steels and strength steels.

Generation 3 steels are designed to fill in that gap. Some examples of current Gen 3 steels are DP (Dual Phase) 980, and several variants of that. Also SHF 1180, TBF980 (both Trip Aided Bianitic Ferrite steels), and PHS 1300 and 1500 (a conversion delayed Boron Steel designed to be hot stamped around 900°C). Much attention is given to these steels that exist in the range of 1200MPa Ultimate Tensile Strength and 30% elongation ductility. A primary goal for Gen 3 steels was to achieve the tensile strength of Martensitic Steels with the ductility closer to Mild steels. This translates to targeting the development of these steels to be able to stamp parts that are deeper without the stamping splitting or cracking. Some of the automotive components appropriate for these steels are bumpers, frames, door impact bars, b-pillar reinforcements, roof reinforcements, load beam reinforcements, and floor cross members. The payoff for manufacturers to use these steels instead of older high strength steels is the continued weight reduction.

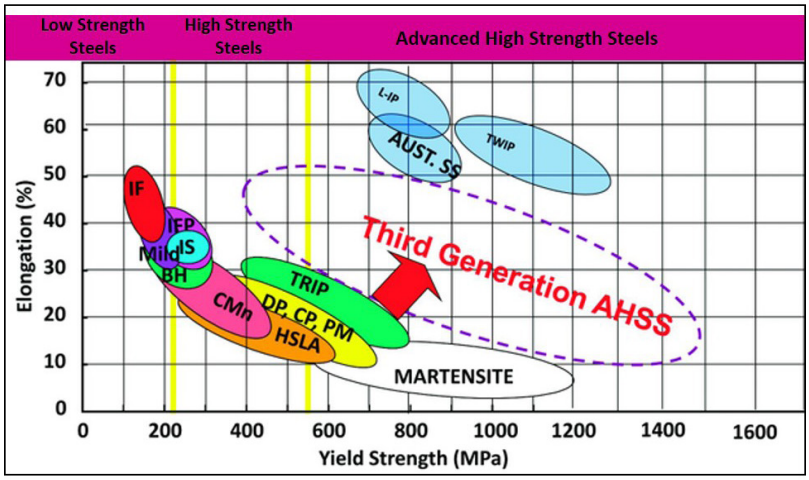


Figure 2:
Formability is critical to stamping manufacturers while high yield strength paramount for lighter and stiffer vehicles

A primary goal for Gen 3 steels was to achieve the tensile strength of Martensitic Steels with the ductility closer to Mild steels.

While conventional steels have simple structures and generally have a yield strength less than 550MPa, Advanced High Strength steels are characterized by complex or dual phase structures and specific microstructural features. A lot goes into the chemistry or recipe for these materials in order to manipulate the physical properties to a specific need or application. Many of these steels have been developed with a specific part in mind from the start, and many of these steels have multi-phase microstructures in order to improve ductility while meeting specific strength requirements.

One of the challenges alluded to earlier is the weldability of these new steels. With high carbon content and susceptibility to experiencing phase changes with heat, limiting the heat input in many of the welding processes becomes far more important than it ever has been. This is pushing the envelope of the industry's welding knowledge. While some research facilities and labs might understand how to get good welds with these materials, not every production line or repair welder in the shop necessarily has a handle on the importance of these factors.

A re-education is happening in both the shop floor and the process engineering worlds for the automotive industry. While welding has always

A re-education is happening in both the shop floor and the process engineering worlds for the automotive industry.

been a skilled trade, there is a marked deficit of welders with the skills for many of these new materials in the industry. Processing engineers too are looking to systems they may not have used before, like riveting and laser welding. Both of these processes have some significant costs associated with them, but they offer serious advantages to the manufacturer when they can successfully join the metals that give them the weight reductions they are seeking.

The industry is continually learning. The steel companies tried with their 2nd generation of Advanced High Strength steels to achieve some of the same things they've done with the Gen 3 steels, but most of these attempts were rejected because manufacturers were not able to find efficient ways to join these steels. Now with the Gen 3 steels, steel producers have modified their chemistries to improve weldability and have the same formability and high strength properties they were seeking. And in this industry, success is measured by acceptance. As these materials are being implemented right now on almost every vehicle platform hitting the market, the Gen 3 steels are here to stay.

U.S. Department of Labor Promotes Worker Safety And Pay During the Holiday Season

WASHINGTON, DC – The U.S. Department of Labor's Occupational Safety and Health Administration (OSHA) and Wage and Hour Division (WHD) remind employers to protect worker safety and pay during the upcoming holiday season. "During the busy holiday season, employers must focus on protecting their workers by anticipating and preventing potential hazards in the workplace," said Principal Deputy Assistant Secretary of Labor for Occupational Safety and Health Loren Sweatt. "All workers deserve a safe workplace whether they are stocking shelves, packing boxes, delivering products or selling merchandise."

OSHA offers holiday workplace safety resources on warehousing, tractor trailer drivers, forklift safety, winter weather and crowd management. General safety guides are also available, providing information on workers' rights, the protection of temporary and seasonal workers, as well as safety for young workers.

Temporary or seasonal employees hired to provide additional help have the right to a safe and healthful workplace, and to be paid for the work performed. As hiring spikes, employees not familiar with seasonal employment, and employers unaccustomed to hiring part-time and/or seasonal employees may not be fully aware of the rules that surround such work.

"Retail employees work hard during the holiday season to serve shoppers and keep the economy thriving, and they have bills to pay. We need to make sure they are able to do so by ensuring workers are paid their rightful wages," said Wage and Hour Division Administrator Cheryl Stanton. "The holiday shopping season increases the numbers of temporary and part-time workers, so it's important that we inform these workers and their employers about rules concerning work hours, wages and employment conditions."

WHD enforces federal minimum wage, overtime pay, recordkeeping and child labor requirements of the Fair Labor Standards Act (FLSA). Common holiday season labor violations include failing to pay salespeople and cashiers for time spent prepping or closing out a register; requiring stock room and warehouse personnel to work through breaks without compensation; and not providing overtime pay to employees working more than 40 hours in a workweek.

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

The mission of the Department of Labor is to foster, promote, and develop the welfare of the wage earners, job seekers, and retirees of the United States; improve working conditions; advance opportunities for profitable employment; and assure work-related benefits and rights.

Original Release: November 27, 2019

Source: https://content.govdelivery.com/accounts/USDOL/bulletins/26e99a1

Achieving High-Quality Welding of Non-Ferrous Metals via Blue Diode Lasers

The laser processes on non-ferrous metals are affected by the reflective nature of the material and are prone to welding defects like spatter formation. The use of blue laser light can mitigate these challenges as well as improve laser welding quality in the form of high-power diode lasers.

Non-Ferrous Metals and their Welding Challenges

Laser welding of non-ferrous metals like copper and gold is influenced by the material's highly-reflective nature at a solid-state. Due to the low laser light absorption rate of these metals, more light is reflected during the welding process which necessitates higher energy input. It can be surmised that the high reflection rate of these metals not only reduces welding efficiency but also increases the chances of spatter formation due to the increase in the laser power used.

Spatter, or molten metal droplets that fly out of the weld site, is a type of defect that decreases the yield of parts that can be sold. This affects the bottom-line results of companies that work with these non-ferrous metals, like manufacturers of batteries and electronics, as well as aerospace industry participants. To overcome this obstacle, an improvement of the laser light that is being commonly used must be provided.

Blue Diode Lasers Reduce Reflectivity and Spatter Formation

A working substitute to the standard infrared lasers that are used in non-ferrous metal welding is the blue diode laser with continuous-wave output power, says Oleg Raykis of Laserline Inc. He explains that since the blue light spectrum is more readily absorbed by metals like copper and gold, its use will reduce the amount of back-reflected laser light during welding.

A novel approach in the industry, blue laser light is capable of producing controlled heat conduction for welding on highly-reflective metal and hence, improving the efficiency of the laser process. In addition, this optimization will assist in reducing spatter formation and create smoother weld seams. Furthermore, blue laser light eliminates the need for reinforcement material around the seam area that is traditionally used to reduce the reflectiveness of the non-ferrous metal.

A cost-saving welding method that provides improved aesthetics of the weld area, blue diode lasers offer an output power of up to 1.5kW at 450nm wavelength. This means that competent management by personnel is paramount, advises Raykis. He recommends well-regulated training for staff members as well as strict adherence to maintenance instructions. The rewards, however, will be a more robust welding operation with high-quality results and improved aesthetics.

Improving the Laser-Damage Threshold of Laser Optics with Random Anti-Reflection Nano-Texture

Traditional thin-film anti-reflection coating is considered a performance-limiting factor in laser optics due to the damage caused to the deposited thin-film coating by sustained high-intensity lasers. A practical solution involves replacing these thin-film coatings with anti-reflection (AR) treatment consisting of randomly-distributed surface relief nanostructures.

High Laser Power Levels and Optical Coating Damage

The increase in the power level that's used in today's laser systems is seen either in the form of pulses made for high peak power, or continuous waves for constant output power. Both mechanisms cause similar damage to the optical coating due to the high power output of the lasers. One of these most commonly-observed types of damage occurs during the absorption of the laser energy by the thin-film coating, which leads to localized heat generation and stress fracture or melting.

In addition, the absorbed heat also changes the shape of the laser's lens and causes a phenomenon called thermal lensing effect. Thermal lensing involves the deformation of the lens due to a temperature gradient and requires that the laser is refocused mid-operation. The operational hurdles listed here ultimately lead to reduced power handling capability within operations involving industrial lasers, medical lasers, lasers being developed for defense, and more.

Random Anti-Reflection (RAR) Nano-Texture as a Solution

James Nole, Director of Business at TelAztec, recommends the substitution of the traditional thin-film anti-reflection coating with a designed anti-reflection nano-texture that will be etched directly onto the optical material. A technology development and transfer company that focuses on the design and fabrication of nanometer-scale microstructures with unique optical functionality, Nole's team used their specialization in anti-reflection texture to create an enhanced alternative that addresses the challenge of high-intensity lasers.

Random anti-reflection (RAR) nano-texture will improve the optic's laser-induced damage threshold (LiDT), also known as the beam intensity at which damage occurs at the lens surface. Utilizing RAR nano-texture are shown to increase the LiDT of the optics as compared to those with thin-film coating, as it reduces the rate of surface absorption of laser energy. Similarly, thermal lensing may be reduced and the optic's lifetime extended.

A novel approach to equipping laser optics with anti-reflection features, RAR nano-texture is compatible with both pulsed and continuous-wave lasers. Furthermore, despite being etched directly onto the optic's surface, the textured surface remains durable and easily cleaned with standard surface-cleaning methods.

The commercialization potential of RAR nano-texture has already been achieved by TelAztec with fused silica laser optics, with future development in the works for yttrium aluminum garnet (YAG) and non-linear crystal materials. The nano-texture's prospects in the industry remains bright with new research, while its current capacity as a viable replacement for thin-film coating helps to sidestep performance-limiting factors associated with high heat and power.

Laser Paint-Stripping Robots for Aircrafts

Stripping old paint off of aircrafts is now revolutionized with automation and lasers.

As technology continues to revolutionize, transportation evolves right along with it. Cars are obviously an important form of travel, but another staple is the aircraft. Airplanes were first commercialized as a form of travel in 1914. Since then, they have become a crucial part of how our world operates today, not only in terms of transportation but also for things like carrying cargo or participating in warfare.

As planes continue to be modified and improved, it's only natural that the maintenance of planes does as well. Most people don't realize quite how much maintenance a plane needs to keep it running properly. There are many parts to an aircraft that have to work just right in order for it to be functioning and safe to use. Just one of the things that need to happen to keep an aircraft in good condition is having it regularly repainted to avoid the possibility of corrosion. Peter Boeijink, the CEO of XYREC in The Netherlands and a plenary speaker in this year's ICALEO conference (2019), gave a presentation on this very topic and how his company's technology plays a role. "We see the issue with aircraft stripping of paint, which is important for an aircraft to avoid corrosion. Every five to six years paint has to be removed," he explained during an interview with us at the conference.

"Every day a large aircraft is in a hangar it's a $50,000 depreciation cost."

To repaint an aircraft, it must first be stripped of the coat of paint it already has. The first problem with this is, that stripping paint is not only a relatively frequent process but also a time-consuming one. Boeijink tells us that the current process for stripping of an average aircraft takes about four to nine days. This may not seem like a terribly long time, but it has its costs. "Every day a large aircraft in a hangar is $50,000 depreciation cost," he says. That can quickly add up to be expensive. The reason for the process being so slow is that it is

done manually by people coming in and using harsh chemicals to strip the paint. This can be a long process, especially considering how large aircraft can be. Another problem actually arises from the chemicals being used. They are paint solvers which are, as one would imagine, bad for the environment and the people using them.

XYREC's solution to these issues is by using robots; laser-wielding, paint-stripping robots. This is a perfect example of how, once again, we see how versatile lasers are and how there is innovation with them in new industries. Boeijink says it took about 11 years to work through the developing process for these robots, but now they are revolutionizing the industry. An important part of designing the robot was deciding what kind of laser to implement. This was especially challenging because, for this type of job, a laser is needed that will successfully strip the paint, but not damage the aircraft in any way. "In 2011 the conclusion was we need a CO2 laser, due to the CO2 wavelength being the best way to absorb the laser energy in paint," Boeijink explains. "We are the first company in the world able to control and monitor the laser beam while transporting the beam through the robot." This is certainly something to be proud of. However, he also goes on to tell us that

the work they do is possible because of the companies that supply the different parts that they need to put it all together. XYREC works with a lot of companies from all over the world to put their product together. “We are a real global player,” he says. Although XYREC’s primary market is aerospace, Boeijink is not opposed to looking at other markets. “Everything which is large and needs paint, [our system] can remove paint,” he says. This could lead to many possibilities in the future for many different industries.

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