

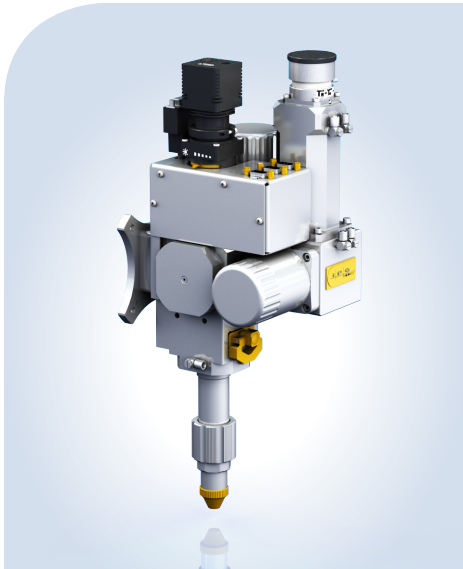
The Active Fiber

Winter 2018 Newsletter

The Active Fiber is an IPG Photonics' quarterly newsletter featuring company news, product updates, and notable applications. To subscribe to the Active Fiber or for more information on products and processes discussed in this issue, please contact sales.us@ipgphotonics.com.



Wobble Head: A Modern Approach to Laser Welding by Vijay Kancharla



Standard welding heads are designed to focus a collimated laser beam to a required spot size, keeping the beam path static through the beam delivery and a static spot at the focal plane. This standard configuration limits each set-up to a specific application.

IPG Photonics' Wobble Head, on the other hand, incorporates a standard weld head with scanning mirror technology to realize a movable beam inside the head that enables a variety of possibilities at the material surface. By moving the beam with internal mirrors, the focal spot dynamically adjusts as needed. This capability to wobble the focus spot offers new solutions for laser welding that could not be realized with traditional welding methods.

Welding with the wobble technique has shown tremendous potential in difficult-to-weld scenarios by improving weld solidification behavior of the melt pool, reducing the thermal gradient, decreasing sensitivity to weld hot cracking, and bridging gaps in poorly fit-up parts. Users may select various wobble modes, and program wobble frequency and wobble amplitude to suit their process. Users also have the option to turn off the

wobble mode to attain a static spot. A wobble head is typically configured for a smaller spot size than a conventional welding head. The smaller spot size achieves tremendous power density enabling a stable keyhole which widens process windows to suppress porosity and weld cracking.

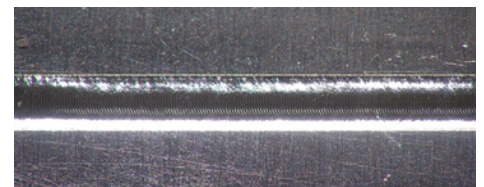
Laser welding of highly reflective materials shows great improvement in bond strength as compared to traditional welds, while broadening the process window for stable, spatter-free welds. Small spot welding with optimal wobble parameters overcomes many of the issues with high thermal conductivity and reflectivity associated with copper and aluminum, thus opening new possibilities for welding highly reflective metals for battery manufacturing applications, including



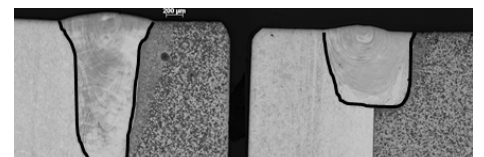
Stable and spatter-free welding of Copper contacts

welding dissimilar metals. IPG's latest software updates also enable the Wobble Head to oscillate at higher frequencies and double the wobble widths than previously achievable. Varying frequency and amplitude can be advantageous for improving the cosmetic appearance of the weld bead, bridge larger fit-up gaps, and evolve the weld cross-section from a high aspect ratio weld to conduction-mode low aspect ratio weld.

IPG's Wobble Head technology is designed to deliver up to 30 kW of laser power in a compact and cost-effective package.



1100 Aluminum weld at 3.5 kW with circle wobble mode



Varying weld cross sections by changing wobble settings in steel alloy

Optional features include integrated seam tracking to provide automated adjustments of weld location and a scan controller to customize weld shapes. A multitude of accessories include co-axial shield gas assist, off-axis shield gas fixturing, and a weld monitoring system.

Vijay Kancharla, IPG's Applications Lab Manager, can be reached at vkancharla@ipgphotonics.com



Surface Preparation with IPG Pulsed Lasers by Arthur Amidon

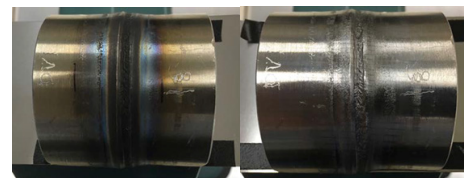
Laser surface preparation is a booming application for IPG pulsed lasers as customers continue to search for enhancements to manufacturing quality and efficiency. Laser surface preparation is an ablative process whereby laser energy is focused and absorbed by the surface to produce favorable modifications. Applications include the removal of paint, adhesives, oxides, oils, and mold release from metal, glass, and composite substrates. In addition to material removal, laser texturing of the surface plane is also used to improve the strength and reproducibility of adhesive bonding in applications ranging from painting to creating strong, reliable mechanical joints for automobiles or heavy industrial equipment. Lasers displace traditional processes like abrasive blasting, CO₂ dry ice blasting, wet chemical baths and manual grinding/sanding in the aerospace, automotive, and heavy manufacturing industries by improving cost and quality while offering an environmentally friendly process.

IPG offers a variety of **pulsed lasers** and beam delivery systems that can address an array of customer requirements. YLPN models up to 200 W are favored for fine or delicate applications with spot size in the 50 µm range. Higher power models reaching 4 kW provide much faster processing speeds. IPG's 2D and 3D mid and high power **scanner options** allow spot sizes from 400 µm - 2.5 mm. Other options include spot shape, pulse width, pulse repetition rate, spot-to-spot overlap, line-to-line overlap, and energy density. Let's look at a few techniques of surface

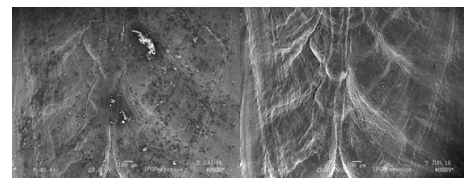
preparation using the YLPN family of 1 kW pulsed lasers.

Surface Cleaning

Surface cleaning is an easy application that is often served by a large spot, low pulse energy at high scan speed. If machine oils and incidental surface contamination are the targets, a large spot with minimal pulse and line overlaps can quickly clean lightly contaminated surfaces. This technique is especially helpful when cleaning incidental oils, grime commonly associated with metals received with a standard mill finish.



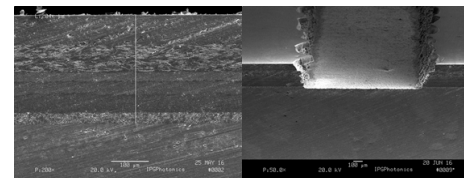
The figures above show stainless steel pipe sections welded together before and after cleaning. The weld process on uncleaned sections produces a heat affected zone, which in turn causes the discoloration (caused by the oxidation) over the surface adjacent to the laser weld (above left). The cosmetic appearance was improved via laser ablation (above right).



In addition to the visual observations, various analytical tools are used to measure surface contact angle or identify chemical characterization of the sample. The SEM/ EDS analysis of the weld above shows a large reduction in carbon and

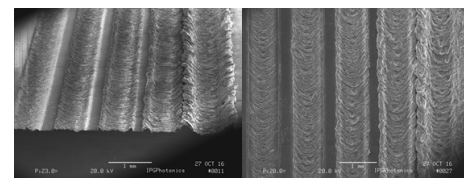
oxygen as a result of removing oxides and other surface contaminants. Minute traces of sodium, potassium, and chlorine disappeared after cleaning.

Paint Removal



Paint removal applications come in many different forms. The two SEM images (above) are cross sections of a painted aluminum alloy before and after laser paint removal. The left hand figure shows a 300 µm thick paint stack on an aluminum substrate of 75 µm clear coat, 75 µm blue coat, 100 µm white coat and 50 µm primer coat. The figure on the right shows the processed sample with all layers removed down to the aluminum.

Surface Texturing



Surface texturing can impart various characteristics to the treated metal. Texturing can be cosmetic or promote a subsequent process such as bonding and joining. The figures above show five textured areas on an aluminum 6061-T5 alloy. The laser texturing has the dual benefit of cleaning the surface while providing mechanical keying to enhance subsequent adhesive bonding.

Arthur Amidon, IPG's Applications Engineer, can be reached at aamidon@ipgphotonics.com.



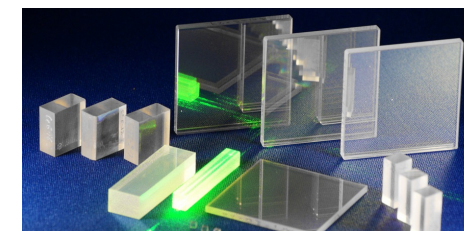
IPG Acquisitions by Trevor Ness

*“2017 was an exciting year for IPG Photonics with three companies acquired and joining the IPG family: **OptiGrate, Innovative Laser Technologies, Laser Depth Dynamics.***

What do these companies bring to IPG?

What technology and capabilities do they have that add value to our product portfolio? ”

These exciting acquisitions enable us to improve our technical differentiation and product range in a variety of ways. Let's take a deeper look:



In May, **IPG acquired OptiGrate Corporation**. Based in Florida, OptiGrate is the pioneer and leading manufacturer of the highest quality chirped volume-bragg grating technologies (VBG) in the world. Their VBG-based components enable dramatic performance improvement, miniaturization and cost reduction of ultrafast pulsed lasers for micro-materials processing, medical and other applications. The ultrafast laser market is a large-growth opportunity for IPG and OptiGrate components provide IPG with best-in-class technology that is integrated into IPG's ultrafast lasers.

Innovative Laser Technologies (ILT), a manufacturer of high-precision laser-based systems, was the second acquisition of the year. These turn-key systems provide best-in-class solutions to the medical device industry and other key end-user markets. ILT provides customers with customized machine engineering, laser application design, integration services and full post-integration support. ILT systems use a type of software which is qualified for medical device manufacturing (HMI-2000). This software enables seamless data collection and transfer between their customers manufacturing execution systems and their laser solutions.



ILT's automation and application expertise and best-in-class specialty software will allow IPG to deeply penetrate medical device applications and accelerate expansion into the many non-medical device applications requiring precision laser solutions. In addition, IPG's leading-edge fiber lasers, vertical manufacturing and international distribution and service capabilities can expand the addressable market for ILT's industry-leading systems.



Our third acquisition of the year took place in early December, when **IPG announced the acquisition of Laser Depth Dynamics (LDD)**; an innovative provider of in-process quality monitoring and control solutions for laser-based welding applications. Their proprietary technology 'inline coherent imaging' (ICI) enables real-time measurement of weld penetration depth. This weld depth monitoring is a powerful capability that enables companies to have accurate process control and ultimately higher yields in their manufacturing process. The technology integrates with IPG's own growing range of welding beam delivery products which are sold alongside our lasers. The acquisition allows IPG to provide end users with a total integrated solution for laser welding.

Trevor Ness is Sr. Vice President of Global Sales and Marketing. He can be reached at tness@ipgphotonics.com.



Drilling with Fiber Laser Technology by Bill Shiner

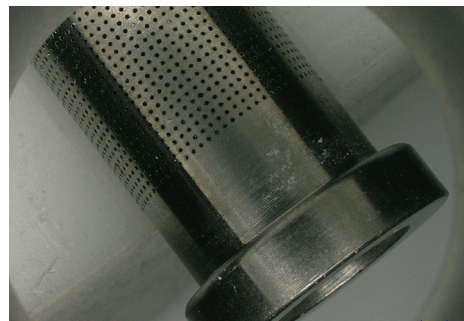


Fiber lasers have gained rapid acceptance as the choice for drilling a wide range of materials and material thicknesses due to their superior drilling rates combined with the wide range of hole diameters that can be processed. The fiber laser selection is application dependent. The predominant laser drilling techniques are percussion and trepanning. Both are usually processed with the laser operating in the pulsed mode to improve the hole metallurgy.

When **percussion drilling**, the laser is focused to the same diameter as the desired hole. Dependent upon the thickness and composition of the material, one or multiple pulses may be required to produce the final hole. Typically, percussion drilled holes are in the range of $<.002$ " - $.035$ " in diameter with thickness capability greater than 1".

IPG's QCW fiber laser is preferred for percussion drilling due to its very high peak power alongside moderate average power. For example, the QCW 2000/20000 fiber laser has a peak power of 20 kW and an average power of 2000 W. If a 20 J pulse is used, then 100 holes per second is possible in most materials. Smaller holes requiring less energy can be drilled substantially faster.

The QCW laser's high peak power pulses can also be used to trepan. When **trepanning**, the laser is focused to a smaller spot size. Larger diameter holes are produced to the accuracy of the spot size and the motion system accuracy. In both drilling modes, the fiber laser can achieve holes at 90° normal, or at an angle with minimum recast and heat affected zone. IPG produces a large range of QCW fiber Lasers with peak powers from 1.5 kW to 23 kW and average powers from 250 W to 2300 W with the selection dependent upon the thickness to be drilled and the required hole diameter.



For drilling thin materials, another choice is to utilize a high peak power q-switched fiber laser or shorter variable pulsed fiber laser. These lasers are available in a wide range of power levels and feature very high peak powers and repetition rates. When trepanning with minimum spot sizes of 20 μ m, precise holes can be formed rapidly.

Bill Shiner is Sr Marketing Advisor to the CEO. He can be reached at bshiner@ipgphotonics.com.



Applications

IPG Photonics offers complimentary sample processing, evaluation and laser product recommendations. Whether the processing method is cutting, welding, marking, or surface modification, IPG has comprehensive application knowledge and expertise in materials, process development, system set-ups for clean environment requirements, and metallurgical and surface analysis. Each evaluation includes an applications report and follow-up. [Contact IPG](#) to arrange your initial evaluation.

Visit www.ipgphotonics.com for more information on IPG lasers and systems.



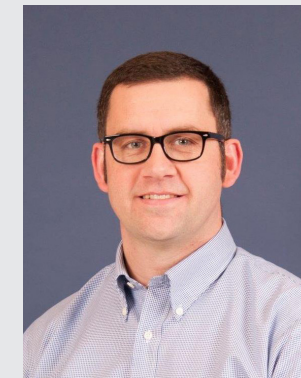
Employee Spotlight



David Barta joined IPG Photonics as Director of System Sales in June 2017. In his new role, David is particularly excited about the potential of IPG Photonics products and the diverse industries that IPG serves.

He studied Electrical Engineering at the University of Wisconsin at Madison. While attending school, he began a 33-year career with Midwest Products and Engineering in Milwaukee. During his tenure at MPE, he was responsible for Business development and grew into the VP role for the company and was part owner at the time. Mr Barta left in 2013 after the sale of MPE to a private equity company. He subsequently became involved with Generation Growth Capital, a Milwaukee-based private equity firm, who had just acquired ILT, Innovative Laser Technologies in Minneapolis. David's role with ILT began as a member of the board of directors and evolved to a full time role leading the company's Business Development activities. Dave was promoted to President and CEO in 2016. During his free time, David and his family enjoy skiing, fishing, sailing, cooking and travel. Dave can be contacted at dbarta@ipgphotonics.com.

Steffen Mueller joined IPG Photonics in May 2017 as an Applications Manager for Research and Development of Laser applications for the Novi facility. Steffen has over 15 years' experience working in laser application research and development focusing in laser welding, laser cladding and laser additive manufacturing. Prior to joining IPG Photonics, Steffen worked for Fraunhofer both in Germany and USA. Steffen can be contacted at (734) 545-5835 and stmueller@ipgphotonics.com.



Laser Remote Welding Made Simple!

Experience the Future of Manufacturing

- Complete Toolset for Integrators
- Improved Process Quality and Reliability
- Unmatched Value



Did you know...?



...that IPG's GLPN-500 laser was the force behind Walt Disney World's screen debut of "Star Wars: Rogue One" as Spaceship Earth transformed into the Death Star?



...that IPG 's 50W 1550 nm laser was used in a Gates Foundation funded research project to develop solutions for mosquito eradication?



...that IPG launched a new veterinary system that enables veterinarians to perform soft tissue surgery and pain therapy from a single device?

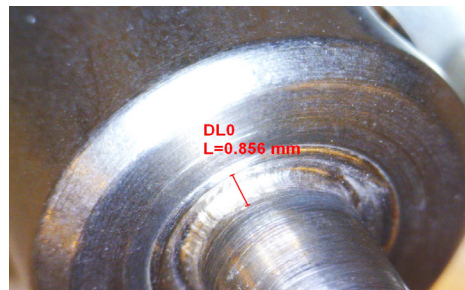


Have You Considered Changing from a Traditional Welding Process such as MIG or TIG to Fiber?

by Bill Shiner

IPG can help, we not only provide lasers but also optical beam delivery as well as complete turnkey systems solutions.

IPG fiber lasers for micro welding, spot welding and thick-section welding are rapidly replacing conventional welding systems on the production line. These robust, low maintenance, highly efficient **CW fiber lasers** are available from a few hundred watts of continuous power to the **multi-kilowatt level** with the selection dependent on the weld thickness and weld speed. IPG's **QCW lasers** offer pulsed welding capabilities operated at high peak powers for spot welding or switched to continuous power for seam welding applications.



IPG offers a complete line of **welding heads and beam accessories** designed to insure reliable, trouble-free welding in a production environment. In addition to the wobble welding technology, the integrated beam switch allows the fiber laser to be rapidly diverted to multiple work stations from a single fiber laser.

There are many advantages to processing with a fiber laser and the main one being the tremendous speed advantage over conventional TIG and MIG welding operations. This results in a much smaller heat affected zone while eliminating the annealing of the surrounding material. The fiber laser has become the choice technology for welding heat-sensitive components. The non-contact feature of laser welding also eliminates distortion prevalent with conventional welding while providing a finished weld of excellent quality and appearance.



Fiber lasers are the ideal choice for welding extremely thin materials as well as thick sections beyond 1" and is a function of the power of the fiber laser. When selecting the laser power for the maximum speed and thickness, the laser can be reduced in power to process thinner materials at very high speeds. This makes the fiber laser very versatile for companies welding a wide range of thicknesses. With fiber laser welding, unlike TIG and MIG, the skill of the operator becomes a non-issue resulting in consistent, predictable and reliable welds reducing the scrap rate in many instances. Fiber lasers with their fiber delivery are easily integrated to many types of motion systems and robots with many driving multiple work stations from a single source, ideal for remote welding applications.

Bill Shiner is Sr Marketing Advisor to the CEO. He can be reached at bshiner@ipgphotonics.com.



Contact

Contact sales.us@ipgphotonics.com to arrange complimentary sample processing, evaluation and in-depth introduction to IPG laser and system products. Visit us at www.ipgphotonics.com for more information on IPG lasers and systems.



Upcoming Events

- Jan 27 - Feb 1** **Photonics West**
San Francisco, CA
- Feb 6 - 8** **MDM West**
Anaheim, CA
- March 28 - 29** **LME & LAM**
Schaumburg, IL
- Apr 30 - May 3** **OTC 2018**
Houston, TX
- May 15 - 17** **CLEO:EXPO**
San Jose, CA
- May 23 - 24** **ALAC 2018**
Livonia, MI
- June 12 - 14** **MDM East**
New York, NY
- Sept 10 - 15** **IMTS**
Chicago, IL
- Sept 20 - 21** **IABC**
Dearborn, MI
- Oct 14 - 18** **ICALEO**
Orlando, FL
- Oct 31 - Nov 1** **MDM Minneapolis**
Minneapolis, MI
- Nov 6 - 8** **FABTECH**
Atlanta, GA

In addition to these upcoming events, IPG also offers regional seminars and in-house events. Please contact sales.us@ipgphotonics.com to find out more.



Photonics West and MD&M by Lorraine Martinez



IPG Photonics showcased its growing laser product portfolio at the 2018 SPIE Photonics West exhibition in San Francisco, California. A record-setting 23,000 registered attendees joined the 1,300 exhibiting companies at the largest annual meeting of industry, academia, and SPIE members in the photonics community. IPG featured its broad range of laser products and accessories including:

- ▶ Latest additions in short picosecond and femtosecond **ultrafast lasers**
- ▶ **Medical lasers** for use in veterinary surgery and pain therapy
- ▶ **New beam delivery** options, including LDD process monitoring for welding
- ▶ **Thulium** and **hybrid Mid-IR lasers** for scientific and medical applications

Industry representatives from medical device and consumer electronics as well as university researchers visited the IPG booth requesting information about our latest product releases and novel laser application capabilities. The three-day exhibition provided excellent networking opportunities for colleagues and customers alike.

IPG Photonics' laser systems were also well represented at the annual Medical Device and Manufacturing conference in Anaheim, California. This exhibition featured our flagship **Multi-Axis platform** in the table top footprint as well as newly acquired Innovative Laser Technologies' **cutting and welding systems**. Live tube cutting and welding demonstrations allowed customers from medical device, aerospace, and consumer electronics industries to view IPG's system capabilities and application processes.

Lorraine Martinez, IPG's Sales & Marketing Manager, can be reached at lmartinez@ipgphotonics.com.



Benefits to Fiber Laser Welding

- ▶ Lower Manufacturing Costs
- ▶ High Speed
- ▶ Low Thermal Distortion
- ▶ No Filler Wire Required (Typically)
- ▶ Non-contact Process
- ▶ Reliable – Consistent – High Yield
- ▶ Process Feedback Capability for Quality Control
- ▶ More Stable Process, Less Scrap and Rework

We have detailed welding capability calculators that can help you to evaluate the introduction of a new welding process, contact us to speak to representative.

One Stop Shopping from IPG Photonics, the Market Leader in Fiber Lasers



PICK YOUR LASER

- Multi-kW
- QCW
- Pulsed
- Sub-kW

PICK YOUR ROBOT

- ABB
- FANUC
- KUKA
- Other

PICK YOUR APPLICATION

- Cutting
- Welding
- Cladding
- Cleaning
- Sintering

PICK YOUR PROCESSING HEAD

- Cutting
- Scanner
- Powder Feed
- Welding
- Wobble Weld

PICK YOUR WORKSTATION

- Rotary
- Auto Feed
- X,Y
- Multi-axis

ADD TO BASKET

