The
Laser User

Issue 69

Spring 2013

Focus on laser cladding and hardening

Success at ILAS 2013

The AILU objectives

The principal objectives of AILU include:

- To foster co-operation and collaboration on non-competitive technical matters and provide a forum and mechanisms for sharing experience and expertise.
- To encourage the expansion of laser use into applications where they can add value and increase company competitiveness.
- To represent and promote the interests of industrial laser users.
- To disseminate professional and other information to members.
- To promote best practice in the commercial applications of lasers in materials processing and allied technologies.
- To support the maintenance and improvement of standards of laser safety and performance.

Benefits of membership

AILU membership is a valuable source of information concerning laser technology and applications. Benefits include:

- Subscription to The Laser User, the leading magazine on laser applications with news and views from the UK and world-wide.
- A 'hot-line' consultancy service provided by members for members.
- Free entries in the AILU Product and Services Directory on the web site.
- Regular meetings, including members-only meetings and open workshops e.g. where key areas of technology are open for discussion.
- Access to the members' area of the web site with lots of technical articles plus frequently asked questions, current laser safety and performance standards etc.
- Major discounts on registration fees for events organised by AILU and affiliated bodies.

the association of AILU laser users

Helping you make the most of laser technology

What does AILU membership mean to me?

I was first 'introduced' to AILU in 2006, and since then I've found the various activities of the association a key resource in developing my knowledge of the UK laser industry.

As a new-comer to laser materials processing in 2006, the workshops were a great opportunity to listen-to/present/discuss technical developments, as well as meet like-minded individuals. For the same reasons, I still attend AILU workshops now and enjoy catching up with people I've met previously. Similarly, I see the ILAS conference as a key event in my calendar - there are simply no other events in the UK where the laser processing community meets on as big a scale, and I think its scope and quality compare favourably with other conferences around the world. The Laser User magazine is another key output of the association, and I particularly like the fact its scope includes technical articles as well as news on recent events, business developments and product releases etc. I see both the events and the magazine as key dissemination channels for TWI's R&D activities.

A key AILU activity which I didn't fully appreciate at first, is the representation it gives the UK laser processing community when interacting with UK Government departments, agencies and public bodies. Based on the discussions in the Business Forum session at the recent ILAS conference, I'm sure this AILU activity will gain increasing focus over the next few years.

For the above reasons, I would recommend AILU membership to anyone interested or active in laser processing.

Jon Blackburn - TWI Ltd
jon.blackburn@twi.co.uk

Group subscription to the e-Magazine

For only £100 a year Corporate members can take out a group subscription so that everyone in their organisation can access the magazine at any time.

Contact *liz@ailu.org.uk* for further details

Courtesy Precitec

The cover photo shows a Precitec YC52 off axis laser cladding head in action at Tata Steel's Port Talbot Works

Joining AILU

We are a non-commercial non-profit-making organisation driven by a fascination for lasers and their potential in manufacturing, and by a desire to help members make the most of laser technology.

If you have an interest in laser technology and/or applications and are not already a member of AILU, then do consider joining the most active association of users and suppliers of laser-related equipment and services bar none.

The cost of membership is modest and the potential benefits huge.

Apply for membership on line by following the 'AILU membership' link at

www.ailu.org.uk

or simply contact the AILU office at

+44 (0)1235 539595

ASSOCIATION NEWS

ILAS 2013 a great success

With ninety papers over 2 days and three parallel sessions AILU's Industrial Laser Symposium (ILAS 2013) at the Nottingham Belfry Hotel on 12 & 13 March was a significant step up in every way from its predecessor in 2011: a good many more papers (up 50%), more sessions (up 50%) and most importantly a good many more delegates (up 20%).

ILAS Chair Martin Sharp welcoming delegates to ILAS

Mid morning refreshment break. An average of 166 delegates a day took advantage of networking opportunities

The core AILU office team (Liz, Trish, Mike B and Mike G) were very grateful to Al-Waidh of Liverpool John-Moores University and to the eight graduate students from Nottingham University who, sporting distinctive red ILAS t-shirts, providing support to ensure the smooth running of all the technical presentations.

Overviews of the technical sessions start on page 31. The AILU AGM also took place during ILAS and a brief review is provided on this page.

The Symposium dinner was enjoyed by 140 delegates. Entertainment was provided with John Powell on his classical guitar before the meal started and Mike Green put on a magic show in the bar at the end.

During the dinner the presentations of the AILU Award, the International Award and the Young Laser Engineer's Prize were made. The other prize presentation, to the best student extended abstract,

Delegates at the ILAS symposium dinner

was announced and made earlier in the day at the start of the first plenary session of the Symposium. The coverage of this and the other presentations is covered on page 2.

The post-symposium feedback questionnaire preserved the anonymity of respondents and encouraged critical comments. Overall the response was very positive, with over 96% of delegates keen to return for ILAS 2015 and recommending the event to their colleagues.

The ILAS exhibition: some of the 21 exhibitors

The two areas where improvements will be made next time are: (i) more exhibition space; and (ii) more introductory presentations for potential industrial users and more talks on industrial implementation of laser materials processing.

As the new AILU President's spells out in his message (see p 16), members can look forward to even greater efforts to attract industrial speakers and papers that are more industrially-oriented for ILAS 2015 (which will most likely be held in the Birmingham area) and indeed in all other AILU activities.

Finally, we owe a big thanks to Martin Sharp and the members of the Organising and Technical Programme committees for the successful culmination of many hours of planning over the last year and more.

WELCOME TO NEW CORPORATE MEMBERS

TEC Systems Limited

Acsys Lasertechnik UK Ltd

Powerlase Photonics Ltd

New faces on the AILU's committee

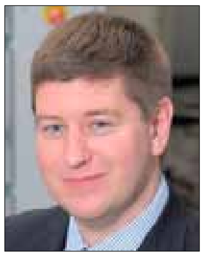
AILU's 19th Annual General Meeting took place on 12 March at the Nottingham Belfry Hotel, at the end of the technical presentations on the first day of ILAS 2013. The reports on the finances and activities over the last financial year and the minutes can be found in the 'committee documents' section of the members' area of the AILU web site.

The AGM signalled an important change in the AILU Officers. Martin Sharp, having served 1 year as Vice President and 2 years as President, handed over to Neil Main (see President's Message on p 16). Ric Allott, Business Development Manager for the UK Science and Technology Facilities Council (STFC) was appointed as AILU's new Vice President. A laser physicist turned businessman, Ric has held a number of positions. After a 3 year postdoc he worked at the Rutherford Laboratory then joined Exitech for 6 years before joining the UK Displays and Lighting Knowledge Transfer Network (KTN). He remained a KTN Director for 5 years before taking a position as CTO of Polyphotonics Ltd. He joined the STFC in September 2012.

AILU Vice President Ric Allott

Two relatively new AILU members joined the AILU steering committee: Adam Clare, a lecturer in Advanced Manufacturing at Nottingham University, and Jon Blackburn, Manager of the Laser and Sheet Process Section at TWI, Cambridge. In addition, Gerry Jones of Trumpf UK, previously co-opted onto the committee, formally rejoined. Matthew Gibson of Laser Optical Engineering Ltd and Andy Waterhouse of II-VI UK Ltd retired from the committee having each served a 3 year term.

Adam Clare



Jon Blackburn

As the AGM concluded, the new President thanked Martin Sharp for the massive effort he dedicated to supporting AILU over his two years as President.

Making a mark in the laser community

AILU Young Laser Engineer's Prize

This year's Young Laser Engineer's Prize was won by Sam Lester, for his work at Tata Steel on the application of laser cladding to critical components in the steel works. Nick Longfield, Sam's mentor at Tata, described how Sam's work led to outstanding lifetime improvements in severe operating conditions, work that subsequently resulted in the installation of a cladding system at Tata's Port Talbot works. *See article on p 23.*

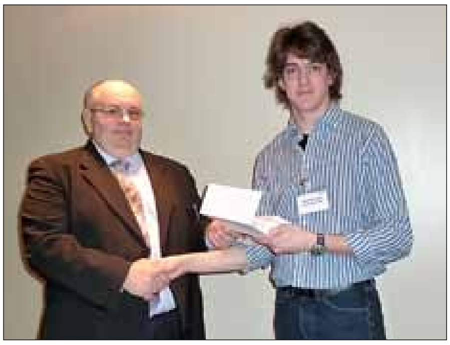
Sam Lester receiving the cheque and plaque from AILU President Neil Main. In the background is Nick Longfield, Sam's mentor at Tata.

(right) The AILU Young Laser Engineer's plaque, kindly engraved by Adrian Norton of thinklaser.

The Prize, a laser engraved plaque and a cash prize of £275 was presented by AILU President Neil Main.

ILAS 2013 Best student abstract

Members of the ILAS 2013 organising committee independently reviewed the extended abstracts submitted by students. The best of these, judged on its content and its relevance to industrial need, was 'Fume analysis techniques for laser processed CFRPs' submitted by Matthew Leach, a PhD student from Hull University (see abstract opposite). Matthew received the Prize, a cheque for £200, at the start of the first plenary session of the Symposium.



Hull University PhD student Matthew Leach receiving his cheque from ILAS 2013 Chair Martin Sharp.

ILAS 2013 Best Student Abstract

Fume analysis techniques for laser processed CFRPs

Matthew Leach[1], Howard Snelling[1], Andy Easey[2] & Adam Fryer[2]

1. Department of Physics & Mathematics, University of Hull, Hull, UK, HU6 7RX
2. Purex International Ltd, Rotherham, South Yorkshire, UK, S63 5DB

Laser processing of carbon fibre reinforced plastics (CFRP) is an area of increasing interest in industry and research due to its desirable properties and the complex nature of the process. Because of the complexity, the processing may have to be optimized for the specific task. In this paper we are analysing the fume from laser ablated CFRP.

To analyse the particulates in the plume, we have observed debris from the laser ablation of CFRPs using an optical microscope and a scanning electron microscope. Figure 1 is an SEM image which shows a fibre which has been ejected from a carbon fibre weave as a result of being processed with an RF CO_2 laser.

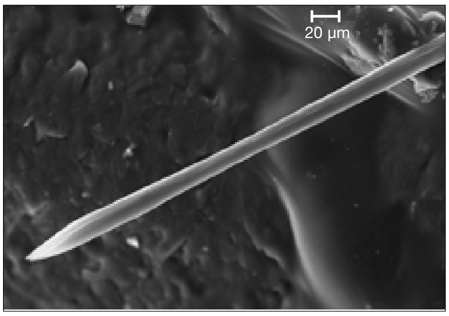


Figure 1. An SEM image of a captured carbon fibre, ejected from an RF CO_2 laser processed T300 carbon weave.

Fibres can also be observed as they leave the laser processed carbon fibre weave sample in a time resolved fashion using ultrafast shadowgraphy, see figure 2. Shadowgraphy involves directing a collimated 5ns pulse of visible light through the plume at a specific time during or after the interaction, then recording the shadow on a camera with a high magnification macro setup.

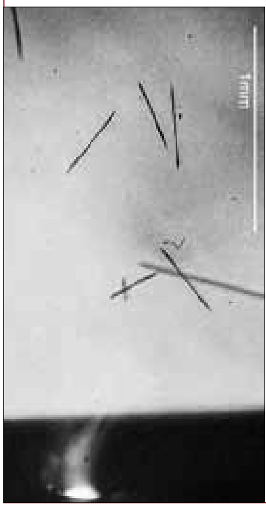


Figure 2. A shadowgraph taken 1372μs after the interaction between a 1ms RF CO_2 laser pulse and T300 carbon fibre weave had started (~372μs after the RF CO_2 laser pulse had ended). The image clearly shows sections of fibre being ejected from the surface.

The shadowgraphy allows us to observe the expansion of the particulate plume and therefore its velocity due to the RF CO_2 laser ablation of CFRPs; however, it does not enable us to view low density gas phase ejecta. The setup can be modified to create a time resolved interferometer. This allows us to observe refractive index changes in the ablation plume, via a fringe shift. These can be caused by temperature changes or gases in the plume, produced by the laser ablation.

On the right of figure 3 an interferogram of a laser interaction with CFRP is shown. We can see either gas phase material, or heated air and how it behaves with respect to time. To follow this result up, CFRP was processed in a sealed chamber, through a NaCl window (the internal atmosphere was air). Using fourier transform infrared spectroscopy (FT-IR) we can get an absorbance spectrum for the gas in the cell.

From the absorbance spectrum for RF CO_2 laser processed CFRP, shown in figure 3, we can deduce which permanent gases are present from the absorption peaks. A large CO_2 absorption peak is visible; this could be due to atmospheric changes in the FT-IR, but it is also an expected ablation product. We can also see carbon monoxide peaks, and peaks which are likely to be hydrogen cyanide.

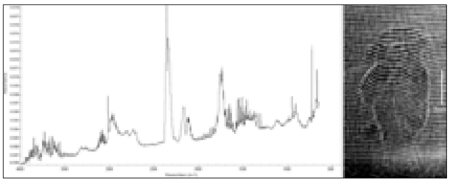


Figure 3. An FT-IR absorption spectrum of the gas produced from the RF CO_2 laser ablation of CFRP. A time resolved interferogram shows the gas dynamics of the ablation site.

We plan to expand on this work to get a comprehensive set of data for the fume dynamics of CFRP processed with an RF CO_2 laser. We also want to expand the work to compare the results with pulsed laser sources, such as TEA CO_2 and excimer lasers. Preliminary work with a femtosecond source is underway.

Corresponding Author: Matthew Leach

E: m.leach@hull.ac.uk

Presenter

Matthew Leach is a PhD student in the Department of Physics & Maths at the University of Hull, working on the fume dynamics of laser processed carbon fibre composites.

ASSOCIATION NEWS

First presentation of the international AILU Award

Dr Dirk Petring, Head of Macro Joining and Cutting at the Fraunhofer ILT in Aachen Germany, became the first person to be given the AILU International award in recognition of the great support he has given AILU over many years. Dirk is internationally recognised as a leading figure in laser cutting and welding and has been a regular contributor to the AILU magazine and speaker at AILU workshops. Gifted with a great sense of humour he gave an excellent speech after being presented with the Award by past president Martin Sharp.

The new AILU International Award presented to a member of the industrial laser community outside the UK in recognition of the outstanding support they have provided to AILU

Dirk Petring speaking at the Award presentation

AILU honors one of its longest standing job shop pioneers

The AILU Award is given in recognition of an outstanding lifetime contribution to the industrial use of lasers in the UK. Presented for the first time at the ILAS symposium dinner in the presence of a record 120 attendees, it was a particularly happy occasion for John Bishop and his wife Diana.

Back in 1979 Bishop helped build the UK's first moving optics laser profiler and established a spin-off company, Lasercut Products where he remained until 2003. He has been an evangelist in the laser job shop community and an active supporter of AILU and before that the Make It With Lasers programme. He retired from the AILU job shop committee only very recently.

In accepting the Award John recounted his first experience in laser cutting:

"Back in the late 1970s, my initial interest in what was a new cutting process was that it seemed to solve our problems in cutting thin section steel with any degree of accuracy or flatness. However, I soon discovered that no one was offering such equipment, at least not a laser cutting machine in a form that was suitable for my existing business.

AILU President Neil Main (left) presenting the AILU Award to John Bishop.
As always, we are most grateful to Micrometric for laser cutting and assembling the elaborate stand for the internally 3-D engraved glass block.

"After some discussions with Coherent (UK) in Cambridge, I was shown a computer-control machine that had been made for the SATRA (Shoe and Allied Trades Research Association) to water cut leather parts for shoes. As a result, we cobbled together what might have been the first moving optic machine in the world. I had no idea that we were 'pioneering' anything, I just wanted to get it producing parts for customers, which it did very well!

"Of course, in those days, we spoke of Watts of power, not kilowatts, and of cutting speeds in terms of millimetres per second, not metres, and on a good day we could cut 5 mm or even 6 mm thick sheet with the wind behind us!

"Some time later my accountant said to me, 'I'm going to give you some advice which I don't think you will take: draw two lines under this and move on.' My reply was 'You're right, I'm not giving in. I think I'm on to something here.'

"Little did I know just what!!!"

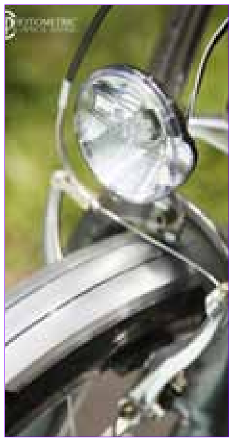
Partnering with EPIC
AILU is partnering with EPIC, the European Photonics Industry Consortium, to develop the largest database of companies active in Photonics in Europe, which includes laser manufacturers and integrators. Over 4000 companies will be referenced and the MS Excel database, the report and the interactive map will be shared with all the survey participants.

Make sure to be included. The survey takes only 5 minutes to fill online at:

https://www.surveymonkey.com/s/PhotonicsMapping

More information can be found on www.epic-assoc.com/database

The LED arms race



Cyclists, car drivers and pedestrians alike cannot fail to have noticed how bicycle lights have been getting brighter in recent years. The Sunday Times newspaper of 31st March 2013 reported that Photometric & Optical Testing Services LLP has uncovered an alleged arms race in the field of LED-based bicycle lights. As reported, Photometric Testing revealed that 80% of popular bicycle lights are more powerful than the legal limit for dipped beam headlamps of cars. One of the lamps tested exceeded the limit for a dipped beam headlamp by a factor of 13. Whilst ever brighter lights offset the vulnerability of cyclists causing dazzle to other road users can be counter-productive.

One can only wish those concerned with the "arms race" to produce ever brighter lights a greater success than the laser safety community has had in trying to kerb the sale of dangerous laser pointers.

Our thanks to Robert Yeo of Pro-Lite (www.pro-lite.uk.com) for sending this in. Ed.

Name change

On 1 April 2013 the functions of the Health Protection Agency were transferred to Public Health England. HPA email addresses and phone numbers change at the same time.

Further information on Public Health England can be found at: www.gov.uk/phe

BUSINESS

Company expansions

Lotus Laser now represented in USA

Designed, configured and tested in the UK, Lotus Laser Systems offer innovative, highly capable laser marking and cutting solutions at a purchase price and cost of ownership that is commonly lower than similar products from alternative providers.

“When selecting a distributor in the USA we looked for more than just a short term sales partner. High quality service and support is vital to the success of our brand,” said Lotus Laser Systems Group Director Dean Carpenter. "The commitment of MVTS Technologies to service and support aligns well with that profile,” he added.

Contact: Dean Carpenter
E: dean@laserite.com
W: www.lotuslaser.com

Raylase expands German HQ

Raylase AG, a leading manufacturer of high-precision components and submodules for laser beam deflection, modulation and control, announced that it has expanded its headquarters in Wessling, Germany. The new offices and extended production facilities, as well as a newly created application centre.

The extension adds about 2,500m^2 of new space. As well as additional offices and production facilities, Raylase has created a new application centre in which to show customers and partners its innovative products.

Contact: Harnesh Singh
E: h.singh@raylase.de
W: www.raylase.de

Trumpf's new development centre

Trumpf has erecting a new building

at the town of Schramberg-Sulgen to house both office space and laboratories dedicated to the development of solid-state lasers.

At the opening ceremonies Peter Leibinger, vice-chairman of the Trumpf Group Management Board, noted: “Schramberg is not only the cradle of the German laser industry. Today it is one of the world’s leaders in laser technology development and production.”

Contact: Heidi-Melanie Maier
E: Heidi.maier@de.trumpf.com
W: www.trumpf.com

Company acquisitions

Coherent acquires Innolight GmbH and MiDAZ Ltd

Coherent, Inc has acquired the businesses of Innolight Innovative Laser and Systemtechnik GmbH and MiDAZ Lasers Ltd, which together provide core technology building blocks for an emerging class of commercial, low cost, sub-nanosecond pulsed lasers for micro-electronics manufacturing.

Innolight is a leading manufacturer of low power, short pulse lasers for industrial applications like silicon processing, and ultra-stable continuous wave lasers used in atom trapping and other demanding scientific applications.

The patented MiDAZ technology enables simple amplifiers to be incorporated in a broad range of laser products delivering power scaling and long lasting performance in electrically efficient designs. The combination of Innolight’s semiconductor based architecture with MiDAZ amplifiers is anticipated to deliver a broad range of compact, low cost sub-nanosecond IR, Green and UV laser sources, offering best in class performance, value and footprint.

Contact: Roy Harris
E: sales.uk@coherent.com
W: www.coherent.com

Scanlab acquires Blackbird Robotersysteme

Scanlab AG, a leading manufacturer of scan systems for laser material processing and medical technology, has acquired all shares of Blackbird Robotersysteme GmbH, a Garching-based producer of innovative control solutions for robotic laser-welding equipment.

Both companies have been working together since 2009 and offer the currently most capable 3D scanning solution for remote laser welding: intelliWELD high-power scan heads controlled by the RobotsyncUnit. This merger enables even more rapid expansion of the portfolio of laser fabrication solutions for automakers and industrial producers.

This merger underscores Scanlab's aim to also be the remote-welding market's top provider of fast and precise beam positioning.

Scanlab AG is a worldwide leading and independent OEM manufacturer of scan solutions for deflecting and positioning laser beams in three dimensions. bio-medical and medical technology.

Contact: Erica Hornbogner
E: e.hornbogner@scanlab.de
W: www.scanlab.de

IPG acquires Mobius Photonics

IPG Photonics Corporation has acquired privately held Mobius Photonics to accelerate its entry into the UV laser market and deepen IPG's development team. Mobius provides high-power pulsed UV fibre lasers for micromachining, such as dicing and scribing of wafers, VIA drilling and solar hybrid panel processing.

"The acquisition of Mobius Photonics will augment our current development efforts in UV fibre lasers to quickly penetrate the UV laser market, which we believe could be a significant sales driver for IPG in the coming years. Mobius has deep expertise in UV lasers, a strong patent portfolio and proprietary techniques relating to UV lasers," said Valentin Gapontsev, IPG Photonics' CEO. "The market has been waiting for a cost-effective, reliable and stable UV fibre laser. Now that we can combine Mobius' UV laser expertise and experience with IPG's low-cost, proprietary fibre, pump diode and component technologies, we believe that we can effectively build a presence in the fine processing market."

Contact: Tim Mammen
E: sales.uk@ipgphotonics.com
W: www.ipgphotonics.com

Coherent acquires Lumera Laser

Coherent, Inc. has acquired Lumera Laser GmbH (Kaiserslautern, Germany) a recognized industry leader in ultra-fast lasers for Micro-Electronics, and Precision Materials Processing. The acquisition complements Coherent’s existing portfolio of industrial ultrafast lasers and broadens the company’s product capabilities in these rapidly developing markets. It is anticipated that Lumera will play a central role in the expansion of Coherent’s ultrafast product and market growth through its new capabilities and applications expertise.

Lumera has enjoyed significant success with its broad range of picosecond products in such applications as speciality marking & engraving, photovoltaic manufacturing, glass cutting and LED scribing. Mark Sobey, Executive Vice President of Coherent, said, “With a combined industrial picosecond installed base of >500 systems in 24/7 production, we intend to leverage our world-wide sales and service network and joint technology expertise so that these growing markets will benefit from the broadest selection of ultrafast laser solutions.”

Contact: Roy Harris
E: Sales.uk@coherent.com
W: www.coherent.com

BUSINESS

Major sales

Spectrum secures significant laser wire marker contract in China

Spectrum Technologies, a UK-based laser wire processing system specialist, has won the bid to supply the new Labinal SAIFEI Joint Venture in China with top of the range UV laser wire marking equipment.

Spectrum will supply Labinal SAIFEI with a Nova 860, a high speed UV laser wire marking and processing system from the company's ground-breaking Nova series, which will be used in the production of aircraft electrical systems. The system is due to be delivered later in 2013 to SAIFEI's new facility, currently being established in the Pudong area of Shanghai.

Spectrum is already well established in the Asia region and especially in China. The company has an office in Shanghai as well as engineers based in Shenzhen and Beijing ensuring customers have access to local technical support, spare parts and general customer service.

On delivery of the SAIFEI system, Spectrum will have installed 24 UV laser wire marking systems in China, in addition to over 140 laser wire stripping products.

Spectrum counts the large Western aerospace manufacturers who now have facilities in China, as well as many of the country's indigenous wiring system producers such as Shenyang Aircraft Corporation, Changhe Aircraft Industries, Harbin Aircraft Manufacturing Corporation and Xi'an Aircraft Company among its customers.

Contact: Peter Dickinson
E: pdickinson@spectrumtech.com
W: www.sprectrumtech.com

Laserdyne announces sale for IPG's Russian application centre

Prima Power Laserdyne, a world leader in precision multi-axis laser machining systems, has sold a second Laserdyne 795 XS to IPG Photonics.

The new Laserdyne system will be installed at IPG'S NTO IRE-Polus application centre in Moscow. As with the first Laserdyne system delivered in 2008 to the Oxford MA, USA facility, this system will be configured to operate with a variety of IPG Photonics fibre lasers. However, the focus of the work in Russia will be to explore the use of IPG's line of QCW lasers for percussion and trepanning of aerospace quality holes. Identical development work is underway at Laserdyne's facility in Champlain, MN, USA.

Mark Barry, Vice President of Sales for Prima Power Laserdyne said, "We are excited about the work that has been accomplished to date utilizing a high power fibre laser at Laserdyne and the work performed at the IPG USA facility."

"This approach will no doubt yield further advances in cutting, drilling and welding with fibre lasers," Mr. Barry added. "Of interest to both companies is the entire area of aerospace laser processing where there is an opportunity to combine the motion and process control capability associated with Laserdyne products with the beam quality and control of fibre lasers.

Contact: Mark Barry
E: mark.barry@primapower.com
W: www.laserdyneprima.com

Information

Trumpf's new online magazine

Trumpf's new "Masters of Sheet Metal" online magazine aims to provide those working in or with the sheet metal industry (from job shop operators to high-volume manufacturers) with customers' success stories and information on technologies.

See: www.mastersofsheetmetal.com

Contact: Gerry Jones
E: g.jones@uk.trumpf.com
W: www.trumpf.com

New brochure on Convergent high-powered industrial CO_2 lasers

Prima Electro North America has released a new brochure that details the Convergent line of high powered industrial CO_2 lasers. The brochure includes photo examples, technical details and the operating specifications of each model.

Contact: Mark Barry
E: mark.barry@primapower.com
W: www.prima-na.com

People

Leibinger resigns as Chair of the Supervisory Board of TRUMPF Group

Professor Berthold Leibinger retired as Chairman of the Supervisory Board of the Trumpf Group at the end of 2012. He had a long and close association with the company, which he joined in 1950 as an apprentice mechanic. In 1978 he became President of Trumpf. He has received numerous honours and awards for his entrepreneurial as well as social commitment.

Contact: Heidi-Melanie Maier
E: heidi.maier@de.trumpf.com
W: www.trumpf.com

New Mitsubishi UK sales manager

Paul Jenkinson has joined World Machinery as the Mitsubishi UK Sales Manager.

Paul began his career in Leeds during the 1970s at a heavy fabrication company. In the early 1980s he joined a pipeline valve manufacturer before joining Pullmax in 1986. Originally selling non-laser tools, he moved to selling $C0_2$ flat bed laser systems from 1988.

"Selling in the fabrication and sheet metal industry as it has grown into CNC machine tools and automation has been a fascinating journey so far and I look forward to continuing the challenge with World Machinery,"said Paul.

Contact: Wayne Hipkiss
E: sales@worldmc.co.uk
W: www.worldmc.co.uk

Lee Bayliss is joining TLM

Lee Bayliss has joined TLM Laser, with responsibilities for TLM's applications facility and custom software applications.

"This will help us to get samples turned around in the fastest possible time, it will enable us to write custom interfaces and strengthen our ability to compete on a global basis," said Andy Toms, Director of TLM.

Lee comes to TLM with 15 years of laser experience and will be based at our Bromsgrove facility.

Contact: Andy Toms
E: andy@tlm-laser.com
W: www.tlm-laser.com

Ultrafast laser for high throughput materials processing

Coherent has expanded its family of industrial ultrafast lasers with the new Talisker 1000 series. This new series of high power picosecond lasers is designed for high-throughput, precision materials processing applications in the semiconductor, solar (photovoltaics), medical devices, consumer electronics and automotive industries.

The Talisker 1000 has three single wavelength versions, all at 1000 kHz and with average powers as high as 25 W: near IR (1064 nm) for scribing and engraving stainless steel and other metals; green (532 nm) for higher precision and perfect for several high value exotic metals; and UV (355 nm) for processing glass and other transparent or brittle materials.

Picosecond lasers enable precision materials process with superior spatial resolution and virtually no peripheral thermal effects.

Contact: Mark Thompson
E: mark.thompson@coherent.com
W: www.coherent.com

Fibre-coupled 1kW diode laser system

DILAS have launched a fibre-coupled system to meet the needs of volume production in industrial applications. The new DILAS SF1000/400 is capable of delivering up to 1 kW output from a 400 µm fibre at a single wavelength.

The SF1000/400 is ideal for applications including: soldering, heat treatment and thin metal welding plus scientific research applications such as fibre laser pumping. This fully integrated turnkey system includes a water-air-chiller, diode laser power supply, control unit enabling external interfaces plus chassis and metal-armoured fibre. The 1 kW system is designed with a user friendly interface for ease of integration within material processing workstations.

The full range of DILAS diode laser systems and accessories are available in the UK and Ireland from ES Technology.

Contact: Robert Church
E: r.church@estechnology.co.uk
W: www.estechnology.co.uk

New low-mode welding laser from SPI

SPI's new CW low-moded laser is specially designed for thin material spot welding. When welding thin materials or where the weld is not to be visible from the back then the new low-moded 200 W laser offers an excellent solution. SPI has tailored the beam ($M^2 \sim 4$) to suit the application with the right degree of intensity and mode stability delivering the perfect profile to avoid cratering or break throughs in the spot weld.

With CW or modulated (up to 100 kHz) and power output variation of <1% the laser provides a solution in micro-welding across a range of applications including smart phones, battery contacts, medical devices and fine connectors.

Stuart McCuloch, Medium Power Product Manager for SPI Lasers says “Beam tailoring has become a standard feature of SPI’s pulsed lasers for marking and micro-machining and now in 2013 SPI have moved onto the CW medium power product set. The capability to provide such specific moded lasers is enabled only by laser companies capable of designing and drawing their own fibre, of which SPI is one of the few world-wide”

Contact: Jack Gabzdyl
E: jack.gabzdyl@spilasers.com
W: www.spilasers.com

UV fibre laser for high precision

A new ultra-violet fibre laser from Coherent offers the precision processing capabilities of a short-pulse, picosecond laser, together with the high throughput speed characteristic of a Q-switched, diode-pumped, solid-state laser.

The Daytona™ 355-20 delivers over 20W of power at 355 nm in sub-nanosecond pulses at repetition rates of over 1 MHz. In addition, it produces a TEM_{00} (M^2 <1.3) output beam, making it ideal for precision micro-machining. Pulse width can be adjusted from <1 ns to 20 ns, while repetition rate can go from single shot to over 2 MHz.

Q-switched UV lasers typically deliver pulse widths >10 ns, creating an unacceptable HAZ in many applications. Daytona deliver the optimum combination of precision and average power for high throughput applications.

Contact: Victor David
E: victor.david@coherent.com
W: www.coherent.com

IPG's new kW fibre lasers

IPG have launched a new generation of kilowatt class low-mode Ytterbium fibre lasers offering lower cost per watt of laser power, operating expenses and service requirements. Leveraging its experience from delivering thousands of Kilowatt fibre lasers to commercial customers over the last decade, the improved 1060 nm laser from IPG offers customers exceptionally simple operation and extends the range of applications for fibre lasers.

"We used our newest internally developed component base to create these new laser products," said Valentin Gapontsev, CEO of IPG Photonics. "Our goal was to create products for a much broader range of applications than now, including ones currently served by non-laser technologies, thereby expanding the market for IPG lasers."

Designated as the YLS-xxx-Y13 series, the new lasers offer customers lower operating costs and service requirements over IPG's current best-in-class lasers. The main benefits include increased wall plug efficiency (up to 33% from 28-30%), up to two times average improvement in beam quality and an increase in the estimated mean time of uninterrupted laser operation. IPG offers this series an industry-leading three-year warranty.

Contact: Bill Shiner
E: bshiner@ipgphotonics.com
W: www.ipgphotonics.com

Purex solve laser fume issue for Avon

Purex International has just installed seven of their Alpha laser fume extractors onto coding lasers at the Avon manufacturing plant in the Philippiness, where plastic containers are laser marked with 3 lines of alphanumeric characters.

"Overall we have saved money by not having to install a costly vent to atmosphere system and our operators know their workplace and health is protected by the Purex Alpha 400's," said Raul Tortola - Production Supervisor at Avon.

Rotherham based Purex International manufacture a wide range of equipment to extract hazardous fumes and dust for varied applications including laser coding and engraving, printing, welding and many others.

Contact: Jon Young
E: jon.young@purexltd.co.uk
W: www.purexltd.co.uk

Versatile all metal mirrors

Laser Beam Products' all metal mirrors are ideal for scientific instruments and OEMs. Chemically polished to a surface smoothness normally only available on UV grade mirrors, they eliminate the need for mounts and all the problems and cost that mounts involve. An all metal mirror, like the one pictured above in aluminium, can have mounting holes, dowel pins, and in this case a through hole in the optical surface itself. O ring grooves can be machined into the mirror if needed, on the face and around the circumference.

LBP's plated coatings (e.g. electroless nickel and gold) cover all the mirror surfaces including the internal surface of holes, so chemical resistance is maintained. With sealed CO_2 lasers such plated coatings are specified as they prevent the pure laser gas from being denatured by exposure to copper.

A gallery of metal laser mirrors on the LBP web site illustrates what's possible.

Contact: Mark Wilkinson
E: sales@lbp.co.uk
W: www.lbp.co.uk

Hamamatsu new products

<u>New camera with 70 frames/s readout</u>

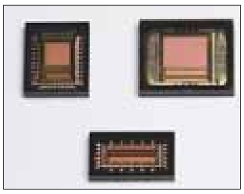
The ImagEM X2 is a new electron multiplying (EM) CCD camera with even higher speed than its predecessors. Completely redesigned, the camera features a back-thinned EM-CCD sensor, offering high speed and precision performance for low-light imaging.

The ImagEM X2 makes superfast exposures possible even in a photon-starved environment. It delivers 70 frames/s at the full resolution of 512 x 512 pixels with a high signal-to-noise ratio, enabling quantitative high-speed, low-light imaging.

<u>ORCA-Flash4.0 V2 sCMOS camera</u>

The new ORCA-Flash4.0 V2 is a 4-megapixel scientific CMOS camera that offers unrivalled flexibility across a wide range of microscopy applications. The ORCA-Flash4.0 V2 has many new features such as two scan speeds, a readout mode for light sheet microscopy, and USB 3.0 and Camera Link interfaces. It is an excellent camera for super-resolution microscopy, TIRF microscopy, ratio imaging, light sheet microscopy, FRET, high-speed calcium ion imaging, real-time confocal microscopy, and other imaging applications.

<u>Image sensors for high-precision, real-time distance measurement systems</u>

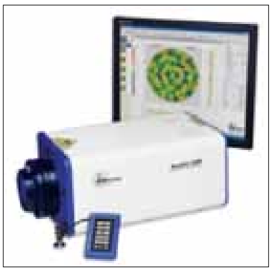


Three new image sensors feature high-speed charge transfer structure to enable high-precision TOF (time-of-flight) distance measurements. The S11961-01CR is the industry's first linear image sensor for TOF distance measurement, and the S11962-01CR and S11963-01CR are area image sensors for 3D distance-measuring cameras.

The new image sensors have been designed for use in a wide variety of applications including object detection in semiconductor wafer transfer systems, shape detection by industrial robots, and intruder detection by security systems.

Contact: Maria Fetta
E: maria.fetta@hamamatsu.co.uk
W: www.hamamatsu.com

New infrared interferometer



4D Technology have released the new AccuFizâ LWIR laser interferometer. The LWIR enables the measurement of aspherical optics without the need for a holographic element. It is ideal for measuring concave, convex and afocal IR components, as well as IR telescopes and lens systems.

The interferometer operates at a wavelength of 10.6mm for an accurate measurement of polished and rough glass as well as metal. The IR wavelength enables measurement of rough-ground optics prior to the final polish.

Available from Laser Physics UK the AccuFizâ LWIR laser interferometer can also be supplied with an optional, vibration-insensitive dynamic mode to enable measurements under almost any environmental condition without vibration isolation or turbulence control.

Contact: Siwan Smith
E: Siwan@laserphysics.co.uk
W: www.laserphysics.co.uk

New products from Aerotech

Rotary stage enhanced performance

Aerotech's AGR series motorized rotary stages provide significant improvements in speed, load capacity and long-term positioning performance over previous generations of worm-gear-drive stages. They provide general purpose positioning in laboratory and industrial uses, in a robust and economical package.

The AGR series performance specifications include an accuracy to 20 arc seconds with 8 arc seconds bi-directional repeatability, 30 rpm maximum speed, and 360° continuous or optional limited travels. Tilt error motion is 10 arc seconds, axial error motion is 5 µm, radial error motion is 10 µm and maximum axial load is to 425 kg. Fabricated from aluminium alloy for weight saving, high structural stiffness and long-term stability, the addition of a larger clear aperture is a key enhancement. Apertures are available from 50 to 200 mm diameter.

Easy lab automation with Ensemble LAB

Aerotech's new Ensemble® LAB control platform makes it easier than ever to automate laboratory and light industrial manufacturing applications. A full-color touch-screen display enables quick access to all the core functionality while providing deep contrast and exceptional readability, while the intuitive tabbed interface provides single press access to all setup and operation screens. An integral rubberized front-panel interface provides immediate tactile feedback for jogging and manual positioning operations. A front-panel USB port is available for connection of a keyboard and other peripherals to assist in the creation of complex program sequences. It is ideal where ease of operation is desired without sacrificing overall system capability.

Contact: Simon Smith
E: ssmith@aerotech.co.uk
W: www.aerotech.com

Automatic high-precision alignment for laser processing: SCANalign

Users of the Scanlab SCANalign vision system can realize high-precision laser processing in low-precision environments: the system automatically recognizes and locates fiducial markers or other features on workpieces, from which a laser beam can be very precisely positioned. The result is laser processing that is more precise than any part or mechanical fixture in the machine itself. In addition, the vision system allows calibrating the working field and checking the result of the laser process. Users can follow the processing online, or on a PC or remote terminal. In simple terms, SCANalign provides self-aligned laser processing. It is perfectly suited for micromachining, high-volume engraving of small parts and many other applications. It will also be available for high-power remote welding in the automotive and other industries.

Contact: Erica Hornbogner
E: e.hornbogner@scanlab.de
W: www.scanlab.de

Rofins' performance laser enhances craftsman skills in jewellery repair

As the use of lasers for jewellery manufacturing and repair continues to grow, jewellers are rusing this precision technology to undertake welding and joining processes that cannot be performed using traditional methods, without risking damage to the precious metals or stones.

Deacon & Son (Swindon) Ltd, was founded as a jewellers by George Deacon in 1848 and today still remains a family run business. Deacons purchased a Rofin StarWeld Performance some 5 years ago and the laser, although not totally replacing the traditional flame for soldering has become the mainstay for their jewellery repair.

"The ability to be able to precisely focus the beam and therefore produce only localized heat is a real benefit when working on intricate fretwork or in the close vicinity of delicate stones," said Steve Davison. "Using the laser also means that we save significant amounts of time as we do not have to remove and then re-set stones when making repairs."

The transition to Laser is really quite straightforward says Steve Davison, "The Laser does not replace the crafts-

man skills which are essential in this industry, but actually enhances them through the precision and control available from the process. This in turn boosts confidence when undertaking some work which would be extremely difficult with the more traditional processes."

The laser here has clearly established itself as an integral part of this business and looks set to feature as a significant milestone in the company's illustrious history.

StarWeld Performance users benefit from a process of continuous improvement, which is based upon extensive customer feedback. The result is a system that inspires innovation and enhances the skills of the jeweller through precise control of the joining process.

Contact: Dave MacLellan
E: sales@rofin-baasel.co.uk
W: www.rofin.co.uk

Laser cladding in ship and other offshore applications

Cladding has long been used in a variety of industries for improving the surface and near-surface properties (e.g. wear, corrosion or heat resistance) of a new part, or to resurface a high-value, worn component, allowing it to then be machined back to original physical tolerances.

Examples of cladding used in ship and offshore applications include hydraulic cylinders and pump shafts, bearing surfaces for both propeller shafts and ship-board pumps, and tensioner shafts for oil rigs. For new parts, lower-cost materials, such as steel with low carbon content or some stainless steels, are often used to create the basic part, which is then clad with a tailored layer of a corrosion-resistant and/or wear-resistant material, to provide specific properties in critical areas. This includes tungsten carbides (often in a NiCrBSi matrix) for wear resistance, and Inconel 625 for areas exposed to drilling mud or seawater. In the case of corroded and/ or worn parts the outer surface is first undercut to expose a pristine metallic substrate. This is clad or rebuilt with the original substrate material, or one that is mechanically or environmentally superior. This step may be repeated to achieve thicker overlays. The final step is usually a fine grind to restore the part to its original design specifications.

There are numerous traditional techniques used for cladding, including various forms of arc welding and thermal spraying. Recently, laser cladding has emerged as a viable alternative to these techniques. In laser cladding, the laser acts as a precisely controllable power source that is used to create the optimum weld pool into which is fed feedstock in either wire or powder form, thereby forming the clad layer.

Laser cladding has proved competitive or superior in some applications, because it delivers key benefits including minimized dilution (contamination of the cladding alloy across the base material-clad deposit interface), much lower heat input and hence minimized part distortion, precision deposition resulting in excellent dimensional control, high throughput, and efficient use of the cladding powder or wire. An additional and very important benefit for marine applications is that the clad layer forms a true metallurgical bond with the base material.

High-throughput laser cladding in action. The photo shows the output of a 4 kW direct diode laser system applying a Tungsten Carbide blend on a seal area to provide a highly wear resistant surface. Image courtesy of F.W. Gartner Thermal Spraying Ltd.

F.W. Gartner Thermal Spraying Ltd. (www.fwgts.com) a business unit of Curtiss-Wright Technologies, is a leading contractor supplying both laser and traditional thermal cladding services to marine and other demanding applications, including cladding of new parts and reclamation of worn parts. Michael Breitsameter, Director of Sales & Marketing at FWGTS, explains, “Thermal spraying is a low-cost method of reclaiming the original dimensions for a part, but this should not be confused with restoring original mechanical integrity. The bond between the coating and substrate is a mechanical bond only, so the coating is less robust, potentially compromising any use involving impact or point loading. In contrast, the laser process melts both the cladding material and the very outer surface of the substrate resulting in a true metallic bond. This integrity delivers excellent physical properties, in some cases superior to those of the original bulk material.”

Earlier laser sources for cladding, such as carbon dioxide (CO_2) and solid state lasers, were not ideal for some applications in terms of their optical characteristics, cost of ownership and physical size. To better meet the needs of laser cladding, Coherent developed the Highlight™ series of direct-diode laser systems. Two primary advantages of direct diode lasers are their inherent electrical efficiency and physically compact size. Furthermore, their near infrared output is efficiently absorbed by all cladding materials, and their large “effective” clad width (up to 30 mm) is geometrically well matched to most cladding applications for the off-shore industry. (Without profile modification, other laser types typically produce a narrow beam and hence small spot size on the work surface). All this translates into low cost of ownership, and the ability to clad at deposition rates that are competitive and in many cases superior to traditional overlay technologies, as illustrated in the figure above.

Breitsameter notes that, “A direct-diode laser is an industrially mature tool that is truly optimized for everyday use in terms of reliability, repeatability and operational simplicity. The rapid development of this technology has significantly expanded the range of applications for laser cladding.” To clarify which marine applications are best suited to laser processing, Breitsameter explains, “At FWGTS we use both laser and traditional cladding methods. The laser method is always a first choice for point loading applications, where thermally sprayed claddings might suffer from early failure. It’s also best for applications where thicker (e.g., several millimeters) coatings or reclamation are required, where thermal spraying coatings become impractical due to internal stresses.”

Heiko Riedelsberger Coherent Inc
E: heiko.riedelsberger@coherent.com
W: www.coherent.com

News from Concept Laser

Adding complex geometries

The flexibility of the LaserCUSING® process allows Hybrid components to be manufactured in which complex geometries are built upon relatively simple base components, saving time and cost. ES Technology Limited, UK and Ireland distributors for the range of Concept Laser LaserCUSING® machines have a demonstration unit at their Daventry facility. In a recent example, an intricate Bronze Lattice was built upon stainless steel washers, super glued to a base plate. It illustrates the potential for adding a fine filter mesh to components such as pump housings. This is done in a few simple steps and without the need for sophisticated component fixtures.

Using the Hybrid build capabilities of the process, together with the options of different materials, provides a highly flexible and cost effective method of producing a wide range of components. The Hybrid process also offers opportunities for the repair of damaged parts.

LaserCUSING goes large with Daimler

With a primary focus on aluminium alloys, which provide the basis for lightweight automobile construction, Daimler AG has collaborated with the Fraunhofer Institute for Laser Technology (ILT) and Concept Laser, to develop a new super laser melting machine, the X line 1000R, with a build chamber size that surpasses anything seen previously.

The 1000R is being developed for toolless manufacturing of large functional components and technical prototypes. At its heart lies a laser in the kilowatt range. Daimler's aim is to replace costly sand-casting and die-casting applications, used in the early phases of development; also, in future, for manufacturing lightweight structures with a high level of rigidity.

Requirements in auto construction

Daimler's demands were: a significant increase in the build-up rates, an improvement in the quality of the surface finish, reproducibility and reliability of the machine as a result of appropriate process monitoring, as well as the qualification of further aluminium series alloys for a range of applications.

The high and flexible availability of such a machine opens up entirely new possibilities for Daimler AG in the further optimisation of their product development.

Building titanium components

Concept Laser's Mlab cusing has already firmly established itself as a successful additive manufacturing platform, for the production of parts in a wide range of materials including Cobalt Chrome, Stainless Steel and precious metals such as Gold and Silver. The latest version of the system, Mlab cusing R, now offers the capability to produce components in Titanium. To accommodate its reactive nature the Mlab cusing R has been designed to meet the stringent ATEX directives for safe processing such materials in a safe manner.

Contact: Colin Cater
E: c.cater@estechnology.co.uk
W: www.estechnology.co.uk

Mitsubishi ex laser proves unexpectedly versatile for vehicle parts maker

A new eX3015 4.5kW laser cutting machine from Mitsubishi Electric, supplied by laser cutting specialist, World Machinery, has significantly improved manufacturing flexibility and capacity at PSS Ltd, a Norfolk based manufacturer of power steering components and other equipment for the commercial vehicle, construction and agricultural equipment markets.

The catalyst for the purchase of the new machine was the acquisition by PSS of George Moate Ltd, a manufacturer of specialist agricultural equipment, including the Tillerstar, an innovative tilling, de-stoning and bed preparation machine for the potato and root vegetable industry. “We were already considering adding a laser cutting capability to our range of state-of-the-art CNC manufacturing equipment,” explains PSS managing director Richard Pratt, “But it was the Tillerstar, which makes extensive use of sheet materials in its construction, that finally tipped the balance.”

The Mitsubishi laser machine has quickly become an integral part of PSS’ manufacturing operations and the company is currently using it to process up to three tonnes of material a day, including steel, stainless and plastic in thicknesses ranging from 1.5mm to 25mm.

“We chose the eX machine based on its speed of cutting and simplicity of programming,” explains Richard Pratt. “For production work, we download CAD files directly from our design office, but operators also make use of the on-board CNC controller for prototypes and short runs.”

The speed and flexibility of the new machine has allowed PSS to extend its use to a wide variety of other jobs. “We are increasingly using the machine to rough out parts such as washers, items might previously have cut from bar on a CNC lathe," says Richard Pratt. We also produce various sheet components that we would previously have outsourced, which helps us to cut the number of parts we need to keep in stock, and reduces our input costs.”

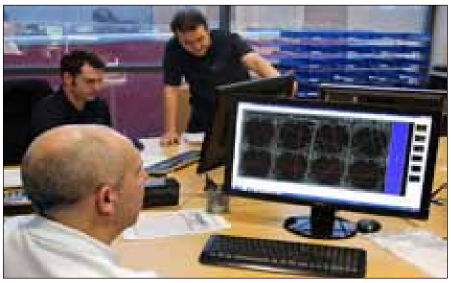
The addition of laser cutting to the range of CNC machining capabilities already installed at PSS also allows it to extend its offering to customers. “One of the key reasons companies come to us is our ability to be extremely flexible in the volumes of the products we produce,” notes Richard Pratt. “We are able to manufacture anything from ten parts or less to many hundreds, which is very valuable for customers in supporting older products or niche models. The flexibility of the Mitsubishi machine allows us to extend that service into new categories of component, while maintaining the same rigorous quality and delivery performance our customers rely on.” PSS is also considering taking on subcontract laser cutting work for other manufacturers, the first time it has made use of one of its machines for such work.

Part of the reason the new machine has proved so productive so quickly, is thanks to the “seamless” delivery and commissioning service from its supplier, World Machinery, according to Richard Pratt. “The guys at World Machinery worked with us right from the start of the purchase process,” he says. “They came in and measured the site, installed the machine and provided training for our operators. They are still helping us now with the manufacture of some particularly complex components.”

PSS has plans to further develop the capabilities of its Mitsubishi eX laser cutter, with the future addition of a 4th axis for the machine. “We are 90 percent certain we’ll go ahead with that modification,” says Richard Pratt, “But we wanted to make sure we were comfortable operating the basic machine before adding the extra axis.”

Contact: Wayne Hipkiss
E: sales@worldmc.co.uk
W: www.worldmc.co.uk

Success from reliable laser cutting



Plant reliability is vital for any manufacturing enterprise, but particularly for a subcontractor starting out with a single machine tool. This was the position Danny Fantom found himself in at the start of 2012 when he formed FC Laser Ltd to provide subcontract laser cutting and forming services.

He purchased a Bystronic 4.4 kW Bysprint Pro flatbed laser cutting machine. Ever since its commissioning in June 2012 it has operated faultlessly in FC Laser's 9,000 sq ft sheet metalworking facility in Ilkeston, Derbyshire.

Mr Fantom commented, "The machine has not missed a beat during more than 3,000 hours of operation and we have not had to call out a service engineer once.

"The Bysprint Pro has been instrumental in expanding our customer base, from a single firm to >100 clients now. New enquiries are coming in each week across many different industries. Correspondingly, FC Laser has grown from six staff at the outset to 12 currently, including two apprentices on day-release.

Highlights of the company's service are quotation within an hour of receiving an enquiry, rapid turnaround of orders supported by 24/7 working when required, and next-day delivery anywhere in the UK, whether to a small business or a multinational company.

Competitive prices are offered, partly as a result of having the confidence to over-run the Bysprint Pro lights-out after the 6.00 am to 10.00 pm manned shifts. Thicker materials are normally processed during the night to take maximum advantage of the extra capacity. A sheet on each of the two beds can provide five hours' unattended production.

"We have been so pleased with the first machine that we have ordered a second 4.4 kW Bysprint Pro, this time opting for a larger cutting surface of 4 x 2 metres. It has the added advantage of automatic nozzle centring, which will further reduce machine downtime.

Contact: David Larcombe
E: david.larcombe@bystronic.com
W: www.bystronic.co.uk

Amada laser cutting at BAE Systems

Amada UK has installed a FO3015 MkII 4 kW laser with rotary index tube cutter at the HM Naval Base (HMNB) in Portsmouth, a facility controlled and operated by the Royal Navy in co-operation with BAE Systems. The machine is processing ship components so efficiently that other parts of the business are now eyeing the investment with growing interest.

“Our existing large-bed laser cutters don’t handle work optimally with light plate (between 1 and 20 mm thick)," said Trevor Parsons, Production Engineer.

BAE Systems wanted a machine that processed both flat sheet and plate, and offered integrated tube/section cutting. The major reason for selecting the Amada FO3015 was the option to add a rotary index tube cutter, which in combination with Amada software Dr ABE Blank and Dr ABE Tube makes this a unique offer in the marketplace.

“Amada were the only supplier that could offer an integrated solution for bar cutting that was well matched to our light plate shop requirements,” he says. “It gives us the flexibility we need to quickly go from flat sheet cutting to box/angle/section and pipe cutting. We can also cut angle section and channel with non-uniform wall thickness, a common challenge on our parts.”

Installed in February 2012, the Amada FO3015 runs all day between 06:30 and 16:00, when the light fabrication hall is manned, following which the machine will typically run two programs “lights-out”, with each job running for 2-3 hours facilitated by automated Amada pallet change technology.

“The Amada FO3015 is perfectly suited to the smaller size of our light plate parts, making it a very efficient solution,” says Mr Parsons. “For instance, using our larger laser cutters, the off-cuts produced were previously consigned to waste streams, whereas now they are ideal for making parts on the new Amada.”

Contact: Gary Belfort
E: gary.belfort@amada.co.uk
W: www.amada.co.uk

LaserQuote makes it easy for laser cutters

Idronic has an exciting new add-on to LaserQuote that gives its customers the ability to generate their own instant quotes automatically and seamlessly.

Customers simply log into the system, start a new quote and interactively import their drawings. A quotation is automatically generated and sent to the customer, based on the costing preferences that the LaserQuote user had configured.

This ground breaking feature has been possible via Idronic’s partnership with Aptia Solutions, UK based nesting specialists and makers of QuoteFab.

For a limited time this add-on is free for unlimited use for all licensed users of the LaserQuote and RanFab solutions.

Contact: Codrin Mitin
E: codrin@idronic.com
W: www.idronic.com

Barrett Steel's credit checking service

The Barrett Steel Group has teamed up with Experian, a UK credit reference agency, to offer an exclusive credit checking service to its customers. The pay-as-you-go facility offers instant and concise information to evaluate companies' credit worthiness.

Barrett Steel has an introductory offer of 30% off the first order. Customers can also sign up for ongoing monitoring, with alerts sent via text or email.

Contact: chris Lamb
E: chris.lamb@barrettsteel.com
W: www.barrettsteel.com

LVD's new 19” touch screen user interface for Sirius laser cutting systems

LVD's latest 19” touch screen GUI, Touch-L, provides users of its Sirius Series of CO_2 laser cutting systems the ease of touch technology for both routine and complex applications to be completed with minimal operator input.

A screen features intuitive graphical icons and visual indicators to display functions such as lens and nozzle selection, cutting head position, parts nesting etc. It also incorporates a part programming and nesting feature

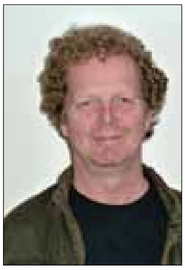
Contact: Chris Philips
E: c.phillips@lvduk.com
W: www.lvdpullmax.co.uk

JOB SHOP CORNER

Chairman's report

Job Shop Spring

Notes from Captain John



What Ho Pirates! I've been chairman of the jobshop group for three years now – and as I step off the podium I'd like to thank my manager, my agent, my mum and all the little people – or the jobshop committee as they prefer to be known.

As outgoing chief pirate I will be handing on the Holy Cutlass of Antioch to my friend Dean Cockayne of Midtherm laser Ltd in Dudley. With the cutlass goes the responsibility of declaring, once a year, that the recession will be over by your birthday. I don't know when Dean's birthday is – but I hope its soon…

My own birthday (6th of march – send presents directly to the AILU office) passed without much of an upturn in the economic situation or the weather – but thankfully things are less grim now than they were when I first ascended the jobshop throne in 2010 – and I for one would like to take all the credit for that. Those of you who doubt the reliability of this claim might like to have a close look at the Powell family motto; 'Beer got me into this mess – and, as god is my witness, beer will get me out of it.'

In a couple of weeks the jobshop committee will be congealing to oversee the handing over of the Cutlass – and, possibly more importantly, we will be sorting out the date, venue and speakers for the annual Jobshop meeting in October. If any of you have suggestions for topics please email mike at the AILU office. I hope to see you all at the meeting after the long, hot, barbeque summer, which I herewith confidently predict...

Cheers

John Powell
E: jpowell@laserexp.co.uk

Most dynamic subcontractor 2013

Mark and Richard Hutchinson receiving their award

AILU members Hutchinson Engineering of Coleraine, Northern Ireland were the 2013 winners in the 'Most Dynamic Subcontractor' category at the annual MTA awards held in the ICC Birmingham on 28th March.

"We strive to be the best at what we do and to receive this prestigious UK wide award is fantastic," said Mark Hutchinson. "We would like to thank all those who voted for us and especially thank all our employees who have worked hard in order to help achieve this recognition."

Contact: Mark Hutchinson
E: mark@hutchinson-engineering.co.uk
W: www.hutchinson-engineering.co.uk

Ever improving service

Bystronic UK is keen to optimise its service operation. Half of all its employees are service-centric, comprising 33 external service technicians to attend to the company's laser, waterjet and press brake machines, and 10 internal service employees to help man the company's hot line and service desk.

All Bystronic field service engineers are equipped with PDAs, furnishing them with details such as customer address, machine's serial number and service history; and after the service call, the customer signs the PDA to indicate completion and has the option to complete a short questionnaire that helps the service department analyse performance and drive improvement.

"From data collected since the system commenced in April 2012 99% of the 281 completing the questionnaire stated they were happy with Bystronic's speed of response," said MD Dave Larcombe.

Contact: Dave Larcombe
E: david.larcombe@bystronic.com
W: www.bystronic.com

Laser marking and engraving

Kettering-based Carrs Welding Technologies Ltd has invested in a Trumpf TruMark Station 5000 laser marker to complement its laser welding service.

Carrs most frequently uses marking for traceability of parts but is keen to explore a much wider range of applications, including as a weapon against counterfeiting parts.

"The laser treatment gives the product a signature which is exceedingly difficult to reproduce faithfully," said MD Phil Carr.

"The beauty of laser marking is that it can be applied equally to a flat or curved surface and the process can impart no thermal or mechanical damage to the product. This is especially important with delicate or electronic components," Phil added.

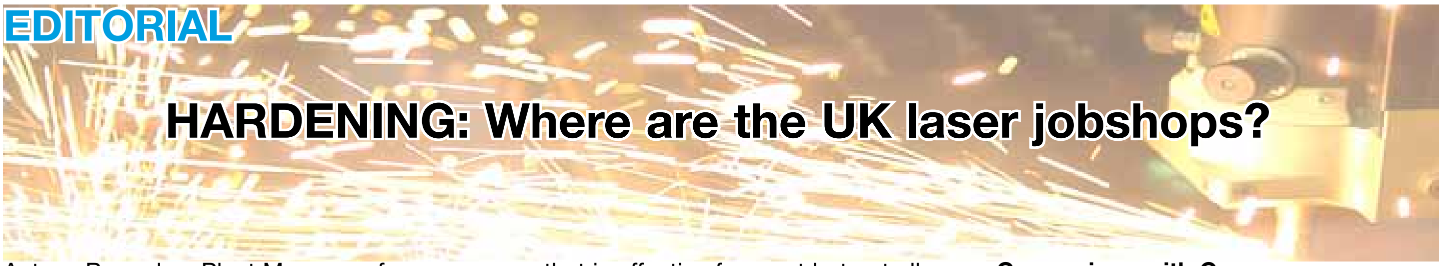
New laser welder

Carrs has also recently invested in a Trumpf TruDisk 4002, a solid state laser welding system. The laser allows the company to weld material above 5 mm thick, as well as aluminium workpieces.

"We have nine systems installed for welding all nature of jobs; small, medium and large," says Managing Director, Phil Carr. "Most of our production work is carried out on our four Trumpf solid-state laser systems – the first was installed in 2003 – with prototype and repair work assigned to other equipment."

"Our next move will likely be a 6 kW system, which will take us to yet another level of capability."

Contact: Phil Carr
E: phil@carrswelding.co.uk
W: www.carrswelding.co.uk



HARDENING: Where are the UK laser jobshops?

Antony Bransden, Plant Manager of Ionbond Lasertechnik, a small (five employee) laser surface hardening job shop based in Nürnberg, Germany, can't understand why there is so little job shop activity in laser hardening in the UK. "There is typically a laser hardening job shop in every big city," he told me at ILAS 2013. "As well as the home market we have customers from The Netherlands, Italy, Austria, France and the UK. "

There may well be in-house laser surface hardening going on somewhere in the UK, probably within the revitalised automotive sector. What is almost certainly the case is that there are no subcontract engineering companies currently offering the service.

In this issue of the magazine there is a summary of Tony's laser hardening presentation at ILAS 2013 on p15 and an article by Roland Dierken of ERLAS Lasertechnik in Erlangen, on state-of-the-art industrial laser cladding and hardening systems, starting on page 21.

Why use a laser for hardening?

To put hardening into context, Table 1 summarises a range of beneficial laser surface treatments [1]. The hardening process we are considering here is Martensitic transformation, a process that is effective for most but not all steel alloys. As described in [2], there are three phases to the process: heating a surface layer to the austenitising temperature (heating phase); holding this temperature for a short time (soaking phase) to allow temperature diffusion to the required depth; then rapid self quenching (cooling phase).

Process	Surface	Depth (μm)	Application
Annealing	Doped Si	0.1-1	Removal of implantation damage
Splat quenching	Amorphous	1-10	Modification of properties
LCVD	Au, Ag, Ni, Cu	<10	Electronics
Sputtering	Au, Ag, Ni, Cu	<10	Electronics
Melting	Ledeburite Amorphous	<50	Corrosion, wear
Shock hardening	Twinned microstructure	<500	Fatigue
Texturing	Steel, ceramic	<500	Improvement of properties
Transformation Hardening	Martensite	≤ 3000	Wear, fatigue
Alloying	Metal alloys, Carbides, Nitrides	≤ 2000	Wear, corrosion
Dispersion	Metal alloys, Carbides, Nitrides	≤ 2000	Wear
Cladding	Metal alloys, Carbides	≤ 5000	Wear, corrosion

Table 1. Laser surface treatments of metals

Comparing the laser beam to that of a flame, its main competitor for surface hardening, we can make the following points:

- The laser beam provides heat only to a well defined surface area, so removal of the beam results in self-quenching; making for a fast one step process. Fast local cooling is not possible with flame heating.
- The highly responsive control of laser power in conjunction with a pyrometer ensures that the surface temperature can be held within tight tolerances during the soaking phase [3] (Note in [3] that the surface temperature is measured and the laser power adjusted accordingly at ~ 200 Hz). Such control is just not available for flame heating.
- The remote delivery of power allows the laser beam to reach into corners and other areas that are hard-to access for a flame.
- Local heating by laser means that hardening can be localised, opening up new design opportunities and avoiding potential deleterious heating effects on other parts of the workpiece.
- Only the laser route offers the combination of controlled application of heat, maintenance of the optimum magnitude and duration of temperature, and rapid self quenching. As such it is a reliable, highly controlled process that meets modern manufacturing requirements. So it is that car manufacturer Volkswagen have decreed that 'All press tools should be laser hardened'

Application areas

Laser hardening job shops deal with a wide range of components weighing from 10 gm up to 5t and more [5]. The main industrial applications areas are in enhancing the performance of moulds and folding and forming tools used by the sheet metal industry but as with all jobshop work, there are many lucrative areas waiting to be found.

Comparison with Germany

Estimates of the number of German laser jobshops offering different laser process services shown in column '1' in Table 2 was provided by Antony Bransden [1]. AILU estimates of the number of jobshops offering laser cutting in the UK is about 45% of the 898 claimed for Germany (whose manufacturing output is ~3 times the UK's). However, a comparison of columns '2' and '3' shows that relative to the number of cutting jobshops in the two countries, the numbers undertaking welding and engraving are similar, in the UK drilling is relatively twice as active as in Germany, but cladding and especially hardening is very weak in the UK. In this simplistic comparison we would expect ~12 UK organisations providing hardening and ~42 providing cladding.

Process	1	2	3
Hardening	28	0.03	0
Welding	377	0.42	0.39
Cladding	95	0.11	0.02
Cutting	898	1	1
Engraving	379	0.42	0.33
Drilling	73	0.08	0.19
Alloying	4	0.004	N/A
Soldering	11	0.01	N/A

Table 2: Comparison of laser job shops by process. 1- number of German laser jobshops offering the service; 2- numbers in '1' normalised to laser cutting value; 3- normalised number of UK AILU member job shops for each process. (NB: Alloying and Soldering are not in the AILU classification scheme for jobshops)

Conclusion

There should be an excellent market for subcontract laser hardening and cladding in the UK. It is clear that the laser source and process technology is mature and offers great benefits over conventional processes, and its success in Germany is proof that the commercial case is sound.

References

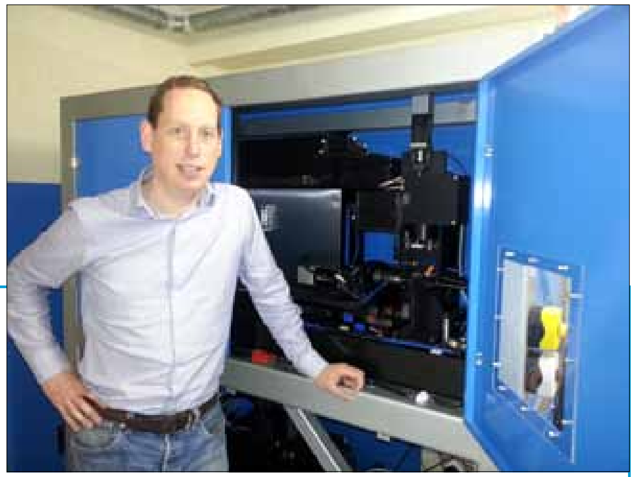
1. Material provided courtesy of Anthony Bransden, Ionbond Lasertechnik
2. 'An introduction to laser hardening and its industrial applications' Antony Bransden. TLU 69, p 17
3. 'Laser assisted processes for tool manufacturing' P Hoffmann, R Dierken, T Heinze. TLU 69, p 21
4. Private conversation with Roland Dierken of ERLAS Lasertechnik in Erlangen
5. Private conversation with Anthony Bransden, Ionbond Lasertechnik

Mike Green AILU Secretary
E: mike@ailu.org.uk

See Observations p 29

The laser micro-machining business

*Interview with **David Gillen***
Managing Director of Blueacre Technology Ltd



How do your business activities divide between the delivery of turnkey laser systems and your subcontract R&D work; and how have your activities and resources in these two aspects of your business evolved with time?

The company currently has a 60:40 split between laser systems and subcontract work, which has grown from 100% subcontract work 4 years ago. Our customer base is approximately 90% medical device or life science orientated. This was not planned but as the company grew, we noticed that there was a gap in that market, particularly in Ireland and the UK. The machine sales has grown into the life science sector, although we build for other markets as well.

It seems that most UK companies providing laser systems typically have to export over 80% of their product because their home market is so weak. How does this compare to your experience?

We have always been an export orientated company, which I don't think is a reflection on the Irish market. In fact I would say that the Irish market for laser related products is disproportionately large when compared to the overall economy. The large medical device base utilizes a significant portion of laser technology, which is brought in from all around the globe.

The medical sector is well established in Ireland and stent cutting seems to be of significant interest to Blueacre. What challenges have you faced in breaking into the medical equipment and component sector?

The stent market, although lucrative for medical device manufacturers is not a particularly large market for equipment suppliers. If you do the math, the total number of system required to machine all the stents produced globally is surprisingly small. However the ability to process tubes, other than stents, is key to the production of a wide range of medical devices.

The main challenges in breaking into the medical sector are as much about brand awareness as about capability. Ireland being a small country makes networking much more important, but opening the door only presents the next level issues, such as quality, ability to deliver, financial stability. For a small company to get an order from a large multinational requires a senior engineer to put their neck on the line. The saying 'no one ever got fired for buying IBM' is applicable in every market and I think it is sometimes simpler for local companies to look overseas when sourcing suppliers. To get buy in from the Irish based multinationals requires you to be technically better than the competition, which can only be obtained by investing significantly in R&D. Therefore Blueacre Technology has spent a lot of money and effort on the ancillary side of laser equipment manufacturing, such as vision system integration and seemingly simple things like ensuring our machines are compatible with databases. This has paid off in the long term but such a level of development is hard for a SME to sustain.

Is being based in Ireland an advantage to your business at the preset time?

The market we work in is always going to be global, and being based in Ireland will not give us any benefits over a company in another part of Europe. That said, if Britain decides to leave the EU it may work more in our favour, given the knock-on effects it would have for Britain's competitiveness.

Have you considered setting up a subsidiary elsewhere in the world, for example in China or the USA?

Not to date. We have managed to sell into Asia and USA without any need for a dedicated subsidiary. However, we have had discussion with distributors in Asia, and will most likely set up an agreement in that region.

How local is your customer base for your subcontract R&D work?

The subcontract work is again 90% export, going mainly to the UK and the USA. Interestingly, the biggest local market is probably for marking, which is becoming a requirement for traceability of tooling in many sectors.

Are you surprised that there aren't more laser micro-machining job shops in the Ireland and the UK?

Two things are always going to be a barrier to entry for laser micro-machining. Firstly micro-machining is still a bit of a 'craft' and experience in a range of disciplines is necessary to get good results. Secondly, the cost of entry is high with motion control, optics and laser systems all to be purchased before you can get into business. With this in mind it is not surprising that there are so few companies providing laser micro-machining services.

How do you see the future for micro-processing laser job shops in Ireland?

I think the answer to the question is is the same for micro-processing job shops everywhere. Companies are always going to need laser processing, whether it be macro or micro. For micro machining it is more an issue that the supplier has the correct technical experience as well as the suitable laser i.e. picosecond or Excimer, rather than being geographically close. Therefore if you have the right equipment, then I think the future for laser micro machining is bright wherever you are based.

How easy is it for you to find people with the right education and skills for your business? Do you have strong links with universities?

Finding staff is always hard, particularly as there is no specific laser based courses for under-graduates. Therefore the best you can hope for is a well-educated graduate that can learn on the job.

Do you think that the case for using lasers in manufacturing (i.e. technology transfer in laser materials processing) is still to be made in Ireland?

There are a host of areas, especially in the more traditional Irish industries of Food and Beverage, where laser processing has yet to make any significant in-road. A lot is down to lack of education on the varied uses of laser and the cost benefits that can accrue. This will not change overnight but I can see the use of lasers increasing, especially as their cost comes down.

How has the present downturn in the world economy affected Blueacre? Are you seeing signs of an upturn?

Luckily we have had the strongest three years of growth since the downturn commenced. This is in part down to the nature of the sector, with medical devices always being a steady market and also due to the limited number of companies who can do the work.

Where do you envisage Blueacre will be, in terms of its size and capabilities, in 5 years time?

The plan is to grow both sides of the business. On the contract side we continue to see polymer processing of medical devices as a growing market. Therefore investing in polymer capable lasers is a key priority at the moment. On the machine building side we have tended to be a manufacturer of bespoke systems, customised for particular customer requirements. In parallel to this work we have been developing our own machines, with a tube cutter being the first Blueacre Technology ‘product’. The plan is to continue with this and roll out a new product every 12 months.

David Gillen
E: dgillen@blueacretechnology.com

Laser Materials Processing in the Medical Technology Sector

In December last year the Health Technology and Medicines KTN undertook what is referred to as a “deep dive” roadmapping exercise on High Value Manufacturing (HVM) in The Medical Technology Sector. The exercise highlighted lots of priority topics that require innovation and R&D in many areas (e,g, physics and materials) but, considering the emphasis on HVM, the initial report did not have as much content on R&D in manufacturing as I was expecting.

As expected, the one manufacturing process that came through strongly was Additive Manufacture (AM): It is still developing but already offers innovative solutions for product development and rapid manufacture. However, it is not the only process with great potential in the medical technology sector. High volume nano-scale manufacturing and manufacturing technologies for surface functionalisation were surprisingly not selected for further investigation; indeed, the key technologies of much medical sector manufacturing are concentrated in milli and micro manufacturing: scales at which LMP already dominates. One thinks for example of the laser-based manufacture of stents, micro welding of metals and polymers, precision drilling of cannulae and needles, marking and engraving of identification codes; surface functionalisation to aid implant integration, reduce healing times and control stem cell differentiation.

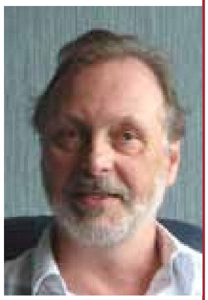
When it comes to laser technology the UK is particularly strong in micromachining and related processes, with several world leading laser manufacturers and system builders, developing and exporting 80%+ of their product, and with significant R&D being undertaken in both universities and RTO’s.

It is therefore of some concern that the current emphasis of the HVM Catapult leans towards macro-scale applications, particularly in the aerospace, automotive and nuclear sectors. As a HVM tool, the laser should be a key enabler for driving the manufacturing requirements in the medical technology sector, and this should be provided for in the ongoing development of Catapults; one can only hope that that the Technology Strategy Board will not lose sight of this.

I discussed the initial draft report of the meeting with Sue Dunkerton, Co-Director of the Health KTN, and we agreed that the exercise needed to give more attention to manufacturing, and a majority of the feedback I provided has been incorporated into the current report, a version of which is available for further comment. It can be found by going to the Health Technology and Medicines KTN section of the TSB '_Connect' web portal.

Martin Sharp
E: m.sharp@ljmu.ac.uk

PRESIDENT'S MESSAGE



ILAS 2013 has come and gone and a great success is was too. A very great number of people gave their time to make it work so well. My thanks, and I am sure the thanks of every AILU member, go to all those who organised, planned, operated, spoke or attended the event.

The feedback from delegates was discussed recently in a wash-up session with the members of the ILAS2013 organising and technical programme committees, which effectively became a first planning meeting for ILAS2015. It seems we got lots of things right but there is scope for making the next ILAS even better than the last. In particular, we will work to increase the number of industrial application presentations in the programme and we will choose a venue that can offer better facilities for exhibitors and a larger exhibition area so that the refreshments and lunch can be served within it, in order to encourage delegates to spend more time looking at the stands.

Meanwhile, post ILAS, the work of AILU continues. One of Martin Sharp's projects as President was to make AILU more visible to those using lasers in manufacturing and this will continue.

We do have good visibility among academics; our representatives from laser suppliers do a sterling job; there is a strong base of laser job shops that strongly support us. But we do very badly with the industrial user sector. In particular, there are many companies out there who use lasers every day who either do not know of the Association or who find us irrelevant.

From my many years of experience in the engineering subcontract sector I know that improving this situation will not be easy; however, we must strive to be relevant to industrial users of lasers if we are to be true to the objectives of AILU. (These are set out on the back of the magazine front cover.) I see this as essential to the future well being of the Association and it is something that I will make a priority during my two years as AILU President.

Neil Main
E: neilmain@micrometric.co.uk

An introduction to laser hardening and its industrial applications

Antony Bransden

The field of laser surface heat treatment is large and covers all materials such as plastics, glass, ceramics and metals. The depth of treatments areas range from microns (e.g. etching, micro-machining, marking) through to millimetres (e.g. transformation hardening, alloying, surface cladding).

In a typical arrangement for laser transformation hardening the heat source, the beam of a high power laser, is optically formed to match the size of area requiring to be hardened; see figure 1.

Careful selection of process parameters (e.g. laser power, heating pattern and treatment speed) brings a surface layer up to the austenitising temperature (the heating phase). The austenitising temperature is held for a short holding time (the soaking phase) to allow temperature diffusion to the required depth

Due to the rapid nature of heating, a steep temperature gradient is created which results in a fast cooling (self quenching) by conduction of heat into the components bulk (the cooling phase). With appropriate steels, a transformation to martensite (a saturated solution of carbon in iron) occurs on removal of the beam, with an associated increase in hardness.

In general, martensitic transformation causes an expansion of the materials lattice structure resulting in a beneficial compressive stress in the hardened area. The principle requirement is the improvement of wear resistance. Abrasive wear is reduced due to laser hardened surfaces exhibiting higher hardness than the abrasive medium, while adhesive wear can also be influenced due to a reduction in the coefficient of friction. Laser hardening can also improve the fatigue characteristics of surfaces.

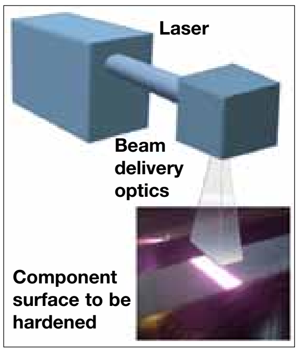


Figure 1: Schematic of laser hardening technique
Typical hardened dimensions are:
width: 2 - 30 mm;
depth: 0.5 - 3 mm

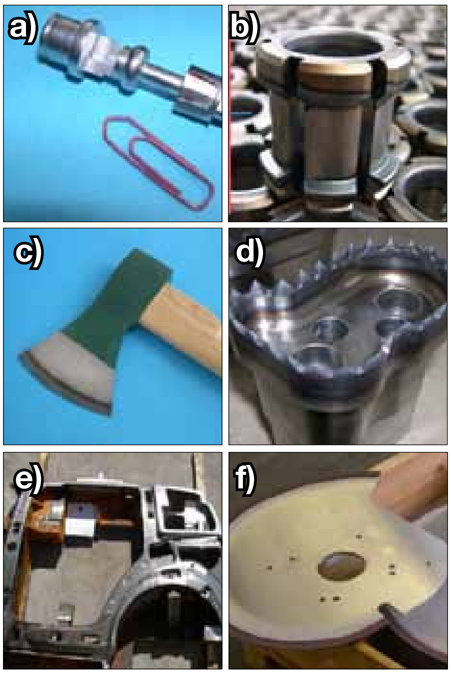


Figure 2: A selection of laser hardened components: (a) lock parts; (b) collet chuck; (c-e) cutting/ stamping tools; (f) rotary knife.

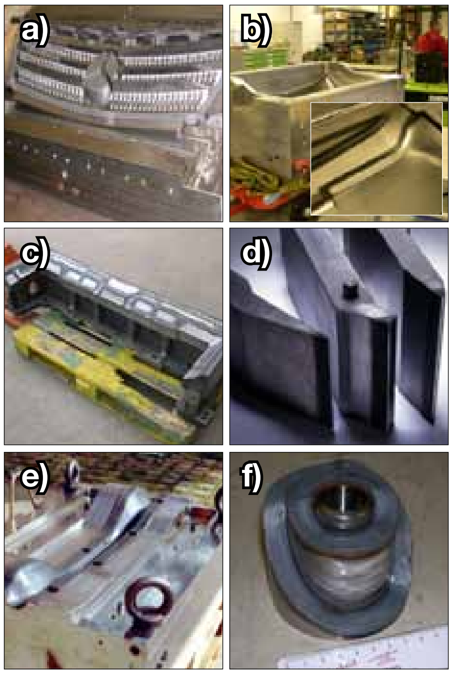


Figure 3: A selection of laser hardened components. (a,b) plastic injection molds; (c-e) forming tools; (f) control cam.

Applications

The applications of laser surface hardening are many and widespread e.g. in the tool, automotive and power generation industries. Examples are found such as press and cutting tools, collet chucks, drive shafts, pump and gear parts. Examples are shown in figures 2 and 3

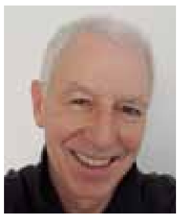
A classic application is the hardening of the sealing edges on plastic injection moulds. During service, the high injection pressures can result in high wear particularly when the plastic contains abrasive media e.g. glass fibre. Wear of these regions results in parts with burrs and this often requires tedious removal by hand. The requirement for an ever increasing service life demands a hardening of these edges. Many suppliers employ flame although this does not always bring the desired results and for difficult geometries is limited. Laser beam hardening results in a uniform heating and good temperature control, as well as a flexible and rapid processing of complex geometries.

Folding tools are another good example. All contact surfaces with the sheet materials can suffer from wear due to high contact pressures and sliding. Laser hardening is ideally suited to the hardening of these surfaces where the precise application and fast treatment times lead to a minimum heat input reducing distortion. The flexibility of laser hardening allows a wide variety of tool shape to be hardened.

Major press tool manufacturers are now offering laser hardened tools as standard items. For smaller tool suppliers, the purchase of laser hardening equipment is uneconomic and the use of a contract heat treater provides a cost-effective alternative to in-house hardening.

Tony Bransden is with Ionbond Lasertechnik, part of Ionbond Germany GmbH, Allersbergerstrasse 185, 90461 Nürnberg, Germany

Contact: Antony Bransden
E: antony.bransden@ionbond.com



Antony Bransden is Plant Manager at Ionbond. He has a PhD in Material Science. He has worked with laser applications since 1974 including at Culham Laboratory and the University of Erlangen.

See Observations p 29

A comparison of fibre laser and CO_2 laser cutting

John Powell and Alexander Kaplan

Since the advent of commercial Fibre and Disk laser cutting machines there has been a lot of controversy about the performance of these devices – particularly in comparison to their more established CO_2 counterparts. In the early days the sales staff promoting fibre technology would often declare that the new lasers would very quickly replace CO_2 lasers – but this has not happened. Even taking into account the entrenched position of the older technology, Fibre and Disk lasers have not been as widely accepted as was predicted, although they have been proven to out-perform CO_2 lasers in certain important areas.

Here we present a direct comparison of Fibre laser and CO_2 laser cutting machines from a 'what laser should you buy next?' point of view. Both types of machine have their drawbacks and advantages, and a direct comparison needs to compare costs, cutting speeds, cut quality and several other factors including maintenance and safety considerations. A quantitative comparison of the two machines is surprisingly difficult – having given several talks on the subject the best analogy we can give is that it's like comparing a sports car with a family car.

Terminology
Fibre lasers have been the subject of a lot of jobshop interest for a few of years now – but what are they and what's the big deal? – and what, for that matter, is a fibre delivered disk laser? In some ways it's a bit like being back in the 80's when CO_2 laser sales folk were full of high-tech jargon and the jobshop owners had to sift through all the sales talk nonsense to work out what M^2 meant, and whether or not it was important.

In fact, as far as a jobshop manager is concerned there is no real difference between a fibre laser and a fibre delivered disk laser. The differences between them are similar to the differences between the technologies of the various batteries you can get for your torch. As long as the torch helps you to avoid stepping in the dish of cat food during a power cut, what do you care if it runs on Lead Zinc batteries or Star Trek diLithium crystals?

So – for the remainder of this article we will use the term 'fibre laser' to mean both fibre and disk lasers (the technical term for both is 'high brightness 1 micron lasers').

Background information
CO_2 laser cutting machines have been the main workhorse of the laser cutting world since the 1970's. A typical high power CO_2 jobshop machine has a power of 4 or 5 kW and is used to cut Stainless steel up to 15 mm thick, aluminium up to 8 mm thick, and mild steel (with oxygen assist) up to 20 mm thick and wood or plastics up to 40 mm. (These are commercially typical figures – higher power machines are available and these are not the maximum thicknesses which can be cut at 5 kW).

Fibre and Disk laser technologies are a direct extension of Nd:YAG lasers – which have enjoyed a niche in the laser cutting world since the 1980's. Originally Nd;YAG lasers were used either where fine detail (eg Clock hands) needed to be cut, or where the application demanded that the laser be fed to the workpiece by an optical fibre (e.g. on an automotive production line where space is at a premium). Fibre and Disk lasers are the more efficient, more powerful big brothers of the early Nd:YAG machines. Multi-kilowatt powers are available and these machines can cut thinner section (3 mm or less) metals considerably faster than CO_2 lasers of the same power. The choice between the two types of machine from a jobshop point of view is not straight forward – both machines have advantages and disadvantages.

In a meeting in the UK in 2012, the world's leading laser cutting expert – Dr. Dirk Petring - summed up the Fibre laser situation by saying that, 'If you compare the CO_2 and fibre laser performance for thin section metal cutting, the CO_2 laser is dead'. Within hours I heard a fibre laser cutting salesman misquoting this as 'The CO_2 laser is dead as far as cutting is concerned – Dirk Petring says so'. But two of the most important words in Dirk's original statement are 'thin section'.

Fibre lasers do a great job cutting metals thinner than 3mm – they are faster than their CO_2 counterparts and the edge quality is just as good. If you are a manufacturer of metal cabinets, air ducting components or point of sale display racks, where metal thicknesses are well within this region, the Fibre laser will do the job faster – and will probably be a better choice than a CO_2 machine.

For a jobshop the choice is less obvious. "My own firm uses four big CO_2 machines working 24 hours a day. If some new government initiative came along that paid for me to replace all my laser machines for free (I wish), I would not choose to get four Fibre lasers. I would get three CO_2 lasers and one fibre." (John Powell) So – why is this?

The Choice
First of all we need to establish a level playing field – and the most obvious leveller is purchase price. A 5 kW CO_2 laser cutting machine costs about the same as a 3 kW Fibre one, so we will investigate a comparison between these two types.

There are enough interlinked criteria involved in the direct choice of the two types of machine to drive anyone crazy. Fortunately the big laser cutting machine manufacturers have begun to generate genuine comparative information rather than useless 'fastest speed' data and I am grateful for the information supplied to me by both Trumpf and Bystronic in the preparation of this paper.

Although the detailed data can be confusing, there are only two basic considerations for the laser user:

1. How expensive will it be to produce my parts?
2. Is the cut quality good enough?

If we are comparing two machines which require similar capital investment, the expense of the parts is highly dependent on the time it takes to make them – and the costs per hour of running the machine.

Figure 1. Typical jobshop components.
Scale: the squares on the paper are 5mm.

Cutting speed
At first glance the production time must be related to the cutting speed – and, in the past, the sales people have concentrated on a comparison of the highest speed at which the laser can cut any given material. But this figure isn't that useful in a general engineering context – for the same reasons that the top speed of your car has very little impact on how fast you can drive from one side of town to the other.

A 3 kW fibre laser can cut 1 mm thick stainless steel at about 30 m/min and a 5 kW CO_2 machine will only achieve about one third of this speed. However, if you are cutting typical jobshop components (like the ones in figure 1) the speed advantage of the fibre laser might only result in a 25% - 50% increase in productivity rather than the hoped for 300%. This is because the machines spend most of their time accelerating, decelerating and stopping to pierce the material. Videos are now available from Trumpf and Bystronic which demonstrate this point very clearly and show that the speed differential gets progressively smaller as the complexity of the cut part increases. Other work by Bystronic also makes the point that machine acceleration rates are just as important as laser type if you need the fastest production times. This is particularly true when cutting thin section materials: a high acceleration (but more expensive) cutting machine attached to a CO_2 laser can beat a fibre laser attached to a lower acceleration machine.

So: fibre lasers are considerably faster than their CO_2 counterparts when cutting thin section material in large simple shapes – like refrigerator doors for example. When assessing the purchase of a machine for this type of job it is important to remember that the overall job time includes the changeover time from sheet to sheet. If you are cutting a full sheet of steel into two refrigerator doors in 3 minutes, the speed of the sheet changeover mechanism might have a considerable effect on production costs.

For material thicknesses of 4 mm and beyond the cutting speeds of the 5 kW CO_2 laser and the 3 kW Fibre laser start to converge and, because they are cutting slower, the maximum cutting speed is reached more often. At above about 8 mm thick the CO_2 laser is the faster technology – and in this regime, a comparison of highest cutting speeds starts to be useful because the laser cutting process is rate determining rather than the acceleration characteristics of the machine.

One other point to be made here is that piercing times have been much improved by the better manufacturers (like Bystronic and Trumpf) over the past few years. So a new machine will outperform an older machine in terms of acceleration and piercing times irrespective of the laser type it is attached to.

In summary – the fibre laser cuts metal faster at thicknesses below about 4 mm but these speed differences are most advantageous when cutting large, simple shapes.

Running Costs
For a realistic comparison, the running costs of our two machines should be compared per item rather than per hour. If machine 'A' costs 10% more to run than machine 'B' but produces 20% more products an hour, then it's part production running costs are lower, not higher than B.

However, to work out the actual costs we need to start from running costs per hour. Running costs can be divided into several different categories, including:

- Elvectricity
- Laser gas and cutting gas
- Operator salary
- Maintenance costs.

As a general comparison the following points are true:

- Electricity costs of a 3 kW Fibre laser cutting machine are between 25% and 50% that of a 5kW CO_2 machine.
- Fibre lasers don't use laser gas. However, Fibre laser machines generally use bigger nozzles and therefore more cutting gas than their CO_2 counterparts.

The most important of these considerations is electricity costs. Although the exact figures vary from model to model we can assume that a 3 kW fibre laser cutting machine (including dust extraction etc) consumes approximately 20 kW whereas a 5 kW CO_2 machine consumes about three times this much. In the UK electricity costs approximately £0.10 per kilowatt – so the CO_2 laser will cost approximately £4.00 more per hour to run.

If you are trying to reduce costs above all else then you might find that a fibre laser attached to a cheaper (lower acceleration) machine can produce parts more cheaply because the purchase and running costs are minimised. This point has been proved on typical parts by a number of trials carried out by Bystronic. Part production costs will be low even though your rate of production will also be low. This point is more probably appropriate to a manufacturer rather than a jobshop. In a jobshop situation there should (hopefully) be plenty of work waiting to go on the laser, so high productivity is very important and each cut product has a profit associated with it. A manufacturer might only need the laser to produce goods for a certain part of the week, in which case a cheaper to run (Fibre), less expensive (lower acceleration) machine might be the optimum purchase.

On a day-to-day basis, Fibre lasers cost less than CO_2 lasers to maintain. However, whereas the maintenance costs of a CO_2 laser over ten years (including large item failures) are well known, Fibre lasers are not yet old enough for large item replacement costs to be known. A typical large item failure on a CO_2 laser would be a turbo/blower, at a cost of about £12,000. The large items on a fibre laser could involve con

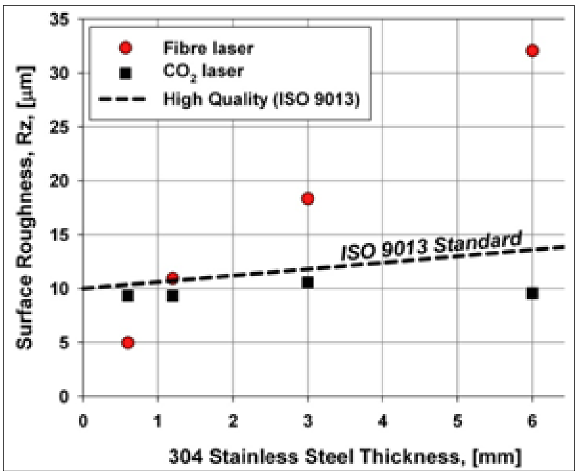


Figure 2. Cut edge roughness results for Fibre and CO_2 Laser cutting (Courtesy of TWI Ltd)

siderably higher costs but we don't have enough data on long term usage yet.

Cut Quality

In the early days of Fibre laser cutting machines the cut quality achievable above a thickness of about 6 mm was demonstrably poorer than that of CO_2 machines. However, the various R & D departments of the laser machine manufacturers have improved this situation and the cut quality differences between the two technologies are now less dramatic. Figure 2 shows a comparison of cut edge roughness between the two types of laser from work carried out at TWI Ltd.

Over the range of thickness shown here the CO_2 laser cut edge retains its low roughness, but the Fibre laser cut edge experiences a steady increase of edge roughness with material thickness – particularly towards the bottom of the cut edge.

From a general engineering point of view, below 4 mm the cut edges are similar for both types of laser for fusion cutting and we have seen equivalent quality CO_2 and Fibre laser cuts up to 6 or 8 mm. However, beyond this point it remains true that the cut edge quality for fibre laser cutting is inferior to that of the CO_2 laser. Fibre laser salesmen will point out that the edge quality is still pretty good – but some customers would be unhappy taking a reduced cut quality to the one they are used to. Typical cut edge quality for 10 mm stainless steel for the two types of laser are shown in figures 3. There is a clear increase in roughness of the cut edge towards the bottom of the cut edge in the case of the fibre laser cut.

For Oxygen-assisted cutting of mild steel the cut quality for fibre laser cutting at all thicknesses has been much improved over the past few years, and is nowadays comparable to CO_2 laser cutting.

Range of materials

Fibre lasers are better than CO_2 machines at cutting copper and aluminium alloys but cannot cut most non-metals such as polymers (plastics) or wood based products.

Most jobshops cut only a small amount of non-metals so this inability to cut plastics should have been only a minor concern. However, there is one area where plastics cutting is important to jobshop laser cutting. A great deal of the stainless steel which is cut by laser is supplied with a covering of protective plastic. The CO_2 laser beam is readily absorbed by both the plastic and the steel beneath and so the two materials are cut in one pass. In the case of Fibre lasers the plastics used are usually transparent as far as the laser beam is concerned and, if this is the case, the cutting machine needs to carry out the cut in two operations;

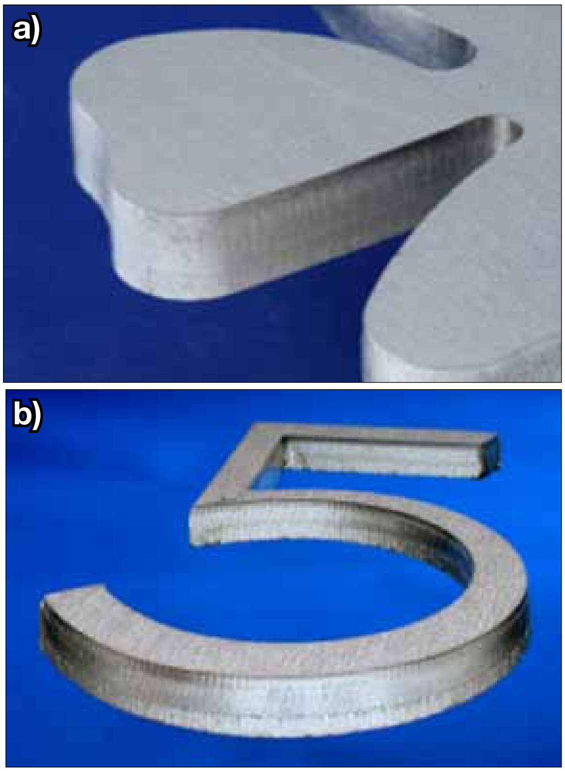


Figure 3. Comparison of edge cut quality in 10 mm stainless steel. (a) Typical CO_2 laser cut edge quality; (b) Typical Fibre laser cut edge quality (Courtesy of Fraunhofer ILT Aachen Germany).

1. Run over the shape to be cut with a defocused beam – to melt the plastic out of the way, and
2. Cut the steel with the focussed beam.

This double process has two disadvantages: it wastes production time, and it leaves a residue of melted plastic on the top face of the cut component along the cut line. The residue is fairly easy to remove. Recently the steel suppliers have introduced some new plastic protective coatings that absorb the Fibre laser beam and which therefore can be cut with the steel in the one pass – but these coatings are not easily available in the very short lead times demanded of, and by, jobshops.

Safety

Both CO_2 and Fibre laser machines are adequately enclosed to protect the operators and are classified as completely safe. The only safety-related difference between the two types of laser concerns the transparent panels which are used to view the cutting operation. In the case of CO_2 lasers these panels are made of cheap, readily available polycarbonate, and it is standard practice for a jobshop to cut their own replacement panels as the old ones get scratched and damaged. The panels used on fibre laser machines are much more high-tech and must not be replaced by polycarbonate – as polycarbonate and most other plastics are transparent to a fibre laser beam.

The verdict

If you are a jobshop boss with the usual wide spread of cutting requirements then you should buy CO_2 machines until you have enough suitable work to fill the capacity of a fibre laser. This will usually mean that you will have approximately three CO_2 machines for every fibre machine.

If you are the boss of a manufacturing firm making items from thin section metals or copper or aluminium alloys then your first choice should probably be a fibre laser.

But in either case it's a good idea to get the potential suppliers of the equipment to carry out actual cutting trials on typical jobs and don't forget to include the sheet changeover times in your assessment.

John Powell is with Laser Expertise,
Acorn Park Industrial Estate, Harrimans Lane,
Nottingham NG7 2TR

Alexander Kaplan is with the Department of Applied Physics and Mechanical Engineering, SE-97187 Luleå, Sweden.

Contact: John Powell
E: jpowell@laserexp.co.uk

John Powell is Technical Director of Laser Expertise Ltd and Author of several books on CO_2 Laser Cutting. He is a founder member of AILU and visiting Professor at Luleå and Nottingham Universities.

See Observations p 29

This edited paper appears in full in the Proceedings of ICALEO 2012, 23-27 September, Anaheim, CA, USA. It is published with the kind permission of the Laser Institute of America. www.laserinstitute.com

Laser assisted processes for tool manufacturing

Peter Hoffmann, Roland Dierken and Tobias Heinze

In principle, the advantages of using laser technology for surface treatment in tool making and mould construction have been known since the mid 1980´s, when the transfer of laser hardening technology from university research into industrial application began. However, industrial implementation was hindered by high investment costs, limited acceptance by toolmakers and the absence of industrial system technology to implement it. Today laser hardening is often used to improve wear resistance of selected tool areas; typically the edges of cutting tools, pinch edges, contact surfaces of hemming nests, closing areas of injection moulds and radii of deep drawing tools. Laser hardening is now well understood and laser systems for hardening have been commercially available for years.

A second laser surface technology which also has a high potential for applications in tool making is laser cladding. Examples are the modification of dies and moulds, the production of hard and wear resistant layers on soft base materials, repairing of sealing edges of plastic moulds and the near net shape manufacturing of cutting edges.

High power direct diode lasers began to be commercially available in 1998. They offer a shorter wavelength than the CO_2 laser, providing higher surface absorption for metal, sufficient to dispense with the need for a absorbing coating precursor. Compared to other lasers in general, direct diode lasers also offer lower investment and running costs and a higher electrical efficiency. The beam quality of high power direct diode lasers has improved over the years, to the point today's 40 mm x mrad, sufficient for fibre guided laser cutting and welding, as well as cladding and heat treatment. Nevertheless, the comparison of the process parameters for the laser hardening and cladding shown in Table 1 shows that, except for maximum laser power, there are no common parameter values: the hardening requires a rectangular spot up to 60 mm wide whereas for cladding a spot diameter of only 5 mm is typical; for hardening a process gas is dispensable, whereas shielding gas is almost essential for high quality laser cladding especially for feeding powder filler material. Nevertheless, mainly for economical reasons we undertook to develop a common laser system for both processes.

Parameter	Hardening	Cladding
Laser power	2 - 4 kW	0.3 - 4 kW
Spot geometry	Rectangular	Round
Track width	5 - 60 mm	0.5 - 5 mm
Velocity	~ 0.3 m/min	0.5 - 2.5 m/min
Process gas	Optional	Ar or He, < 5 l/min
Filler material	No	Powder
Process Temperature	Below melting point	Above melting point

Table 1: Comparison of process parameters for hardening and cladding technologies

System Technology

Special Working Head

A special working head has been developed for quick and easy switching between hardening and cladding, especially for tool making applications both processes are typically needed.

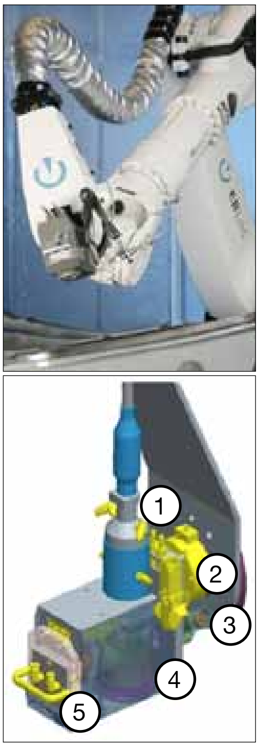


Figure 1: Laser working head for hardening and cladding applications.
1. Connectors for high pressure air etc.
2. Collision protection
3. Plug for pyrometer
4. Dichroic mirror
5. Exchangeable optics with safety lock

Fibre beam delivery guarantees a homogenous intensity distribution in the focal plane regardless of the laser source beam parameters; providing independence of process parameters from the details of the laser system.

Figure 1 shows the working head for ERLASER® systems, originally developed for laser hardening and for the integration in robot guided systems.

Figure 2: (left) working head prepared for hardening with cross jet; (middle) exchange of the mirror; (right) working head prepared for cladding with off-axis powder nozzle

In Figure 2 the change of facetted hardening mirror to parabolic welding mirror and adaption of a powder feed for cladding applications is demonstrated. The off-axis powder nozzle is mounted via a fast snap-in adapter, allowing the machine can be transformed from a hardening into a cladding system within a few minutes. For both applications a flexible cross-jet protects the optics from fumes and other process emissions. A safety lock confirms that optics are present and identifies which optics it is.

Temperature monitoring

A fibre-coupled two-colour pyrometer, fitted with a filter to cut out reflected laser radiation, is connected to the laser working head for temperature measurement and control. Workpiece temperature control is needed for laser transformation hardening (i.e. the austenite temperature has to be reached) and especially for some steel alloys where the hardening temperature is close to the melting point, with a risk of high temperature embrittlement and heat crack formation; in these cases a narrow temperature tolerances of ± 20 K is needed.

Heat flow at edges is less than in the bulk of a workpiece, so when cladding edges regions there is a risk of them being overheated; a particular advantage of using a two-colour pyrometer is that it automatically provides a measure of the highest temperature in its field of view, for preventing such edge overheating.

Closed loop control of the laser power (with a typical temperature sampling and laser power adjustment rate of 200 Hz) combined with a constant feed rate ensures stable hardening conditions and reliably constant hardness values and case depths.

Figure 3: Laser hardening and cladding system. The system comprises an articulated robot mounted on a linear axis and a fibre-guided 4 kW diode laser, a powder feeder (for cladding applications) and the working head as described above.

Machine Concepts

The standard machine is the robot system shown in figure 3. It has been designed for flexible use; mainly for hardening but with sufficient accuracy for most cladding jobs.

For the most demanding cladding applications a gantry system has been developed. Figure 4 is one such installation. It has the capability to process large size press tools for body-in-white applications in the automotive industry.

Results for laser cladding

Laser cladding is influenced by a large number of fixed and variable parameters including: Laser power P [W]; Process velocity V [mm/s]; Focal distance z [mm]; Powder feeding rate F; type of shielding and feed gas; Gas flow and pressure. This leads to a large field of possible parameter combinations. Fortunately, a good understanding of the process and a structured database to assist makes it relatively easy to find good cladding parameter sets. For example, we have found that the optimum width to height ratio for the seam is 4, for overlapping seams. The conditions for achieving this ratio with a given laser machine, cladding nozzle, base metal and cladding material, can be determined by linear extrapolation from no more than 4 trials.

Figure 4: Laser Gantry System for hardening and cladding in operation at a automotive manufacturers. The press tool to be treated is clamped in the jig below the working head. With an integrated rail system, manually loadable worktables can be placed inside the machine. The laser working head is equipped with two rotating axes and a tilting axis.

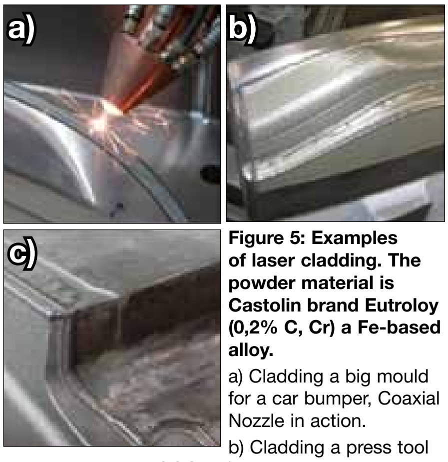


Figure 5: Examples of laser cladding. The powder material is Castolin brand Eutroloy (0,2% C, Cr) a Fe-based alloy.

a) Cladding a big mould for a car bumper, Coaxial Nozzle in action.

b) Cladding a press tool stamp made from GGG70 (commonly used for press tools)

c) Repairing a sealing edge of a plastic mould made from 0.4% C, 1% Cr Mn Mo alloyed steel (1.2311)

Examples of cladding automotive press tools are shown in figure 5. Cladding layers are adjustable between 0.2 and 2.0 mm

Net shape cladding

Near net shape cladding using the gantry system supported by offline CAD modelling programming and simulation (Toplas 3D®) is illustrated in figure 6.

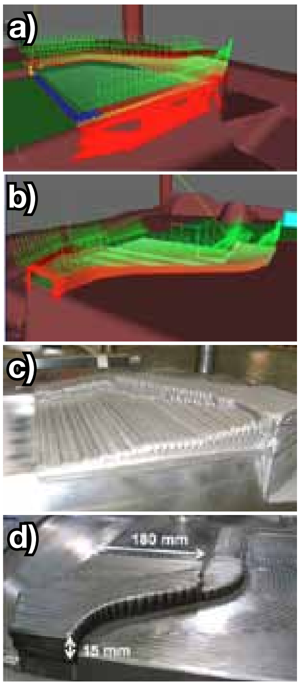


Figure 6. The pictures show the process of modifying a stainless steel tool for molding plastic components.

a, b) The initial profile of the tool and the intended final profile and the intended layers of cladding are visualised.

c, d) related views of 'a' and 'b' respectively, after cladding to the simulated program.

Results for laser hardening

Examples of hardening of automotive press tools is shown in figure 7. Table 2 below provides typical hardness values. A general rule is that good laser hardening results require a smooth structure (if necessary annealing) with initial hardness of 20 – 30 HRc

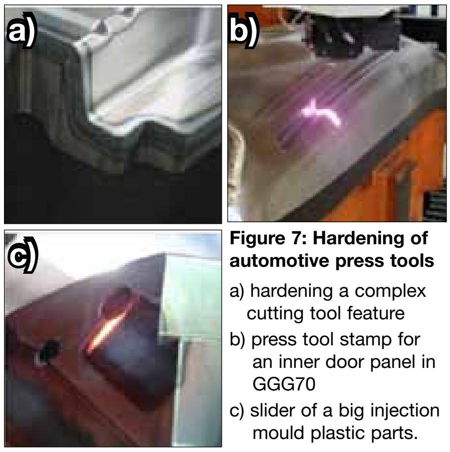


Figure 7: Hardening of automotive press tools

a) hardening a complex cutting tool feature

b) press tool stamp for an inner door panel in GGG70

c) slider of a big injection mould plastic parts.

DIN	H	DIN	H
C 45 W	57	X 45 NiCrMo 4	57
40 CrMnMo 7	57	X 22 CrMoV 5 1	50
60 CrMo 10 7	60	42 CrMo 4	57
59 CrMo 18 5	60	50 CrV 4	57
X 38 CrMoV 5 1	55	GG 25 CrMo	59
X 100 CrMoV 5 1	62	GGG 70 L	61
40 CrMnNiMo 8 6	57		

Table 2. Hardness values for selected materials. DIN standard material specifications are listed together with hardness values (HRc ± 3)

Summary and Outlook

Laser hardening and cladding have proved themselves at an industrial level and successful technology transfer into industry has been made. The paper presents state-of-the-art system technology for laser surface treatment. The latest diode laser technology in combination with a special processing head that is easily adaptable for both hardening and the cladding, is the basis for economic and flexible use.

A database for hardening has been implemented successfully, supplemented by a database of cladding parameters. Optimum parameters for cladding can be quickly established and the control of the laser power, powder feed rate and workpiece movement have established a reliable industrial process.

The authors are with the ERLAS Erlanger Lasertechnik GmbH, Kraftwerkstr. 26, 91056 Erlangen, Germany

Contact: Roland Dierken
E: r.dierken@erlas.de

Roland Dierken is Head of Marketing and Sales at ERLAS. He has a PhD in Material Science and from 1996 –1999 worked at BLZ Bayerisches Laserzentrum as a Project Manager in applied laser technology.

See Observations p 29

Laser cladding at Tata Steel

Nick Longfield, Sam Lester, Justin Griffiths, John Cocker, Christian Staudenmaier, Gary Broadhead

Components used in the manufacture of steel strip work in exceptionally aggressive environments and have to withstand service at high temperatures in corrosive atmospheres under mechanical wear and frequent and heavy impact loading. Conventionally, components that are subject to high wear or corrosion are manufactured from rich chemistry steels or are hardfaced using submerged arc cladding with martensitic stainless steel (MSS). This increases their campaign life and therefore maximises line throughput by extending maintenance intervals without any sacrifice to product quality.

MSS welded alloys generally have good wear and corrosion characteristics; however, they are not suitable for severe metal on metal abrasion and also lose their mechanical and corrosive-resistant properties at high temperatures. Arc welded MSS alloys also suffer from weld sensitisation in grain boundaries in the Heat Affected Zones (HAZ), a process whereby chromium carbides are precipitated, leaving the surrounding areas depleted in chromium and therefore susceptible to localised corrosion.

Thermally sprayed coatings are also in wide spread use throughout the steel industry due to their flexibility in the types of alloys and Metal Matrix Composites (MMC) that can be applied. However, their mechanically bonded interfaces have relatively low strength (unless post spray fusing is employed) and this limits their practical use in an environment where they will occasionally suffer very heavy impacts.

The production laser cladding facility

In 2009, a laser cladding system was built in Port Talbot (UK) for coating critical works components to increase their service lifetime.This was encouraged by results from the rolling mills in the steel industry which showed that laser clad coatings can extend the lifetime of components by up to six times.

Although commercial laser cladding systems can be purchased directly from suppliers in Europe and America it was decided that a bespoke production laser cladding machine would be built by Tata Steel engineers. The system, shown in figure 1, is based on a Laserline LDF series 4kW fibre coupled diode laser with a Precitec YC52 cladding head and a Metallisation mass flow controlled powder feeder. The system is controlled by Fanuc robot with an additional 7th axis for rotating cylindrical parts up to 6 tonne in weight and 3.5 m long. Figures 2 show the cladding head and figure 3 shows options for powder deposition.

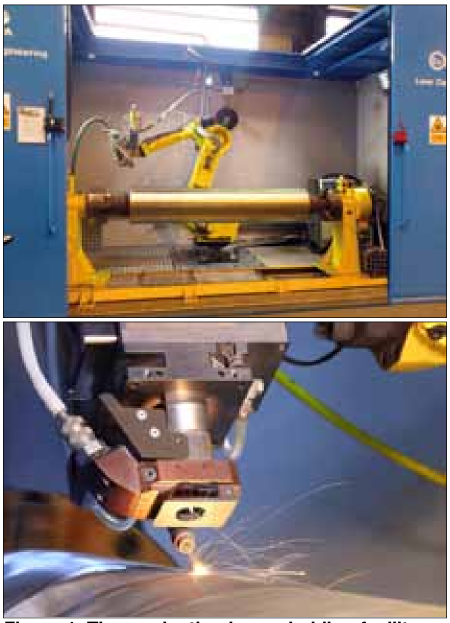
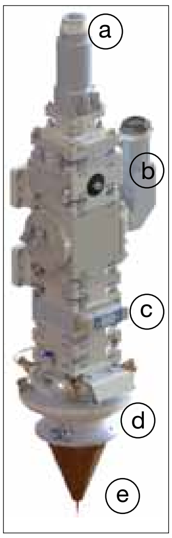


Figure 1: The production laser cladding facility at Tata Steel Strip Products UK. (top) Cladding system; (bottom) cladding head in action



a) A water cooled connection for the optic fibre cable carrying the laser beam

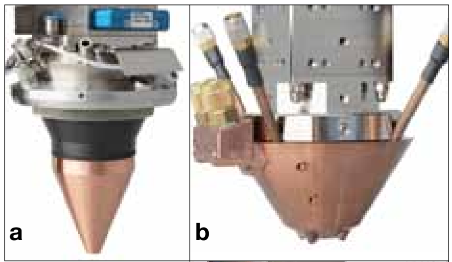
b) A camera can be used to visualise the process and a sensor can monitor the process temperature and dynamically control the laser power.

c) A cover glass slide protects the collimator and focusing optics from weld spatters and fume

d) A water cooling circuit maintains the temperature of the inner and outer cladding nozzle

e) Two co-axial copper nozzles direct the powder and process gases to the workpiece

Figure 2: The Precitec YC52 cladding head with co-axial nozzle



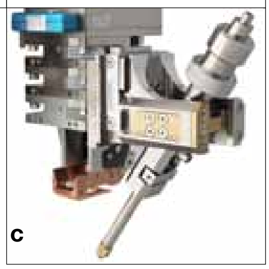


Figure 3: A choice of powder deposition nozzles enables a full range of components to be clad with maximum powder efficiency.
(a) The coaxial ring is used for fine detailed work;
(b) The four port (discontinuous coaxial) nozzle enables all positional cladding;
(c) The off-axis nozzle is used where process robustness is required e.g. for beam-on times of several hours.

The operation of the machine is controlled through a touch screen HMI. The system was designed to operate in an autonomous manner, whereby the robot is capable of automatic programming. This is achieved by the incorporation of a distance measurement laser that determines the geometry of the component, the start and stop locations, and the laser head standoff distance. This ensures that the state-of-the-art process can be operated with very little training.

Detailed monitoring ensures that the process is stable whilst an automatic stop and retract function prevents damage in the event of an unexpected interruption.

The laser cladding process

The laser cladding process is a method of hardfacing which can be used to increase the wear / corrosion / impact performance of metallic components. The process utilises a partially focussed high power laser beam to create a weld pool into which a metallic powder is applied. The powder is carried by a stream of inert shielding gas and is blown through the laser beam.

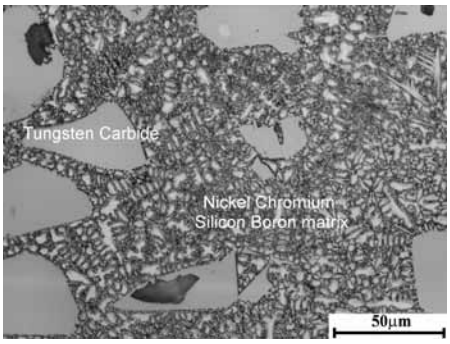


Figure 4: Laser clad micrograph illustrating a typical deposit of Tungsten Carbide in a NiCrSiB matrix

The accurate nature of the laser beam allows fully dense cladding with minimal dilution (<5%), yet with a perfect metallurgical bond. Numerous coatings can be applied to a component, the composition of the coating being tailored to combat the component's failure mechanisms.

One of the major benefits associated with laser cladding is the ability to finely control the heat input, which allows two phase Metal Matrix Composite structures to be deposited, namely:

- A matrix – typically a nickel based alloy. This matrix provides toughness, ductility, and impact resistance whilst being wear resistant at elevated temperatures.
- A reinforcing hard phase – typically a tungsten carbide but can also be, chromium carbide etc.

Such a structure is shown in figure 4, where the fine control of the heat input allows the matrix to be completely melted and alloyed to the substrate surface, whilst at the same time the ceramic particles remain un-melted and are distributed evenly throughout the matrix, giving an extremely wear and impact resistant coating. The ratio between the

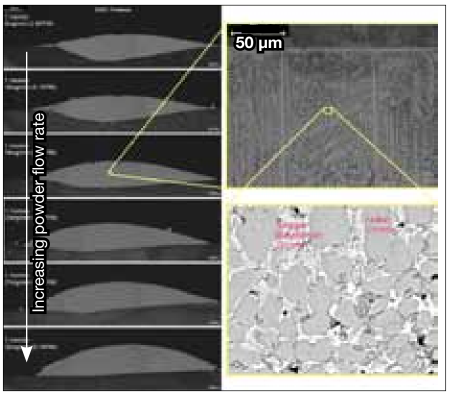


Figure 5: Transverse sections of a NiCrWMo alloy illustrating the dilution as a function of the powder flow rate; a higher magnification light microscopy image detailing the dendritic structure; and a high magnification SEM image illustrating the extremely fine cellular dendritic structure of the same alloy

hard phase and matrix can be adjusted according to the service conditions i.e. greater hard phase fraction for greater wear resistance, and less hard phase for greater impact resistance.

Other benefits of the process include:

- Minimal heat input and therefore fast cooling rate with very fine microstructures and negligible distortion.
- The ability to achieve the desired coating chemistry in the 1st layer due to the minimal dilution.
- Ability to produce hardface coatings with exceptional surface finish (possibility of coating rolls and installing without machining).
- A full metallurgical bond with the substrate, unlike all other low heat input spraying processes (HVOF, Cold Spray, D-Gun etc).

Among the numerous parameters involved in laser cladding, powder mass flow rate is particularly important. Having optimised laser spot diameter, cladding speed and laser power for a particular application, the powder mass flow rate can be used to control the clad thickness, hardness and dilution as shown in Figure 5 where an increasing powder flow rate can be seen to effectively control the dilution.

Once the optimum parameters have been identified for the single track bead-on-plate weld, mass area coverage is achieved by producing overlapped tracks. The amount of overlap then determines the coating thickness, which can range from 0.3 to 3.0 mm in a single pass.

To demonstrate and quantify the potential benefits of laser cladding versus conventional hardfacing techniques, a number of samples of both laser clad and submerged-arc clad were produced and wear tested by Tata Steel RD&T at Sheffield University, UK. Results of wear tests carried out at low and high temperatures are shown in Figure 6. They demonstrate that the laser cladding process significant improvements in wear resistance over standard materials and hardfacing techniques.

Summary

Since the installation of the laser cladding system in Port Talbot, the process has been developed and numerous nickel, cobalt and iron-based cladding materials alloys have been assessed in terms of microstructure, mechanical properties, wear and corrosion resistance. Detailed ongoing process development is addressing the tailoring of coat-

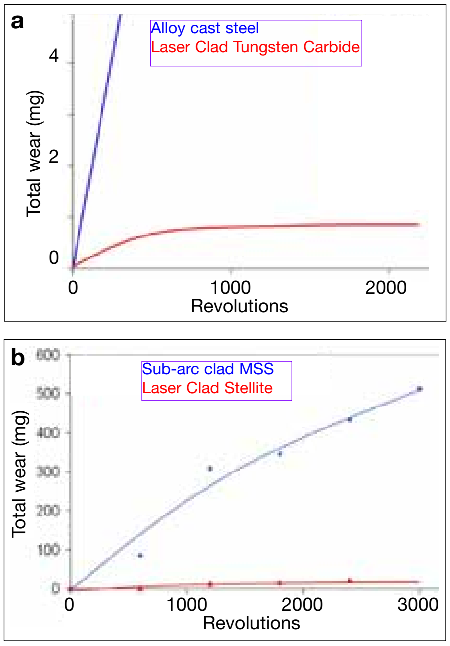


Figure 6: Wear comparisons. (a) Room temperature sliding wear test of laser clad tungsten carbide vs. high carbon alloy cast roll steel; (b) High temperature (700ºC) sliding wear test of laser clad Stellite 6 vs. submerged arc clad MSS

ing properties to each application within the steel works.

The laser cladding process has shown substantial benefits for increasing the critical lifetime of works components in the steel industry, and with the advent of high power diode laser systems and dedicated laser cladding nozzles, a robust cladding process is now far simpler to design and integrate for hardfacing applications.

Nick Longfield*, Sam Lester and Justin Griffiths are with Tata Steel (UK); John Cocker is with Laser Trader in the UK; Christian Staudenmaier is with Precitec in Germany; and Gary Broadhead is with Laser Lines Ltd in the UK.

*Now with the Manufacturing Technology Centre, Coventry

Contact: Sam Lester
E: sam.lester@tatasteel.com

Sam Lester is Manager of the Joining and Laser Hardfacing Group at Tata Steel, Port Talbot. Sam started his EngD at Tata Steel in 2008 and in 2013 won the AILU Young Laser Engineer Prize.

See Observations p 29

Control of cooling behaviour in hyperbaric gas metal arc welding by laser assistance

Usani Ofem, Supriyo Ganguly and Stewart Williams

Underwater welding in an environment of inert gas at elevated pressure is referred to as hyperbaric welding. It is a technique that is used for high quality installation and repair of offshore steel structures [1]. To date, hyperbaric welding projects executed by petroleum companies are diver-assisted and have been implemented at relatively shallow water depths using the semi-automated Gas Tungsten Arc Welding (GTAW) process [2]. The increasing exploitation of deep water oil and gas fields has created a need for cost effective solutions to equipment installation and repair in increasingly remote offshore environments. This cannot be achieved with the current hyperbaric GTAW system, which has been shown to become increasingly unstable beyond 300 m [1]. This, as well as consideration for the safety of operating personnel and the environment, has driven research efforts to develop and implement driverless or remotely operated hyperbaric welding.

Cranfield University has been involved in research and development on hyperbaric welding for over three decades. The University has a unique hyperbaric welding chamber that has been designed to simulate pressure conditions up to 250 bar, which is equivalent to 2,500 m water depth, twice that of any other chamber of comparable size in the world [3].

EPSRC as well as companies including Statoil, Subsea 7, BP, Chevron, Texaco, Isotek, and Esab have funded a series of research programmes based around the Cranfield hyperbaric welding chamber. Statoil has further invested in hyperbaric welding procedure qualification for deep water pipeline repair and hot tap welding application. These programmes have led to the development of a fully automated hyperbaric Gas Metal Arc Welding (GMAW) process with operational capability of welding up to 2,500 m of sea depth for pipeline repair and hot tap welding operations.

Figure 1 shows a field trial underway in a Norwegian Fjord. Hot tap and sleeve repair applications carried out at sea

Figure 1: Picture of trial vessel, submersible remote pipeline repair and hot tap welding equipment [8]

depths of 370 m and 940 m respectively have proved the robustness of the process [4]. This was followed by the first ever completely remotely operated hot tap installation on a live gas pipeline, without the pipeline being produced in advance. This feat was achieved by Statoil when a tie-in point was welded on to the Asgard B production flow line at a water depth of 265 m [5].

The thick section of subsea pipelines requires a lot of energy to bring the entire section to required preheat temperature. The cold sea water acts as heat sink; a situation that worsens as water depth (and therefore gas pressure) increases. Induction heating is usually employed but reliably transporting the electrical power for inductive preheating to greater depths is an increasing practical challenge. There are also the problem that fast cooling of the weld metal can cause the formation of microstructures susceptible to Hydrogen Assisted Cracking (HAC).

Maintaining heat in the weld pool is vital to avoid such cracking, especially since moisture pick-up may be unavoidable since the chamber has to be opened for access to divers or Remotely Operated Vehicles (ROVs), etc. Longer heating would reduce the weld metal cooling rate, and would allow enough time for absorbed hydrogen to diffuse out before solidification.

The GMAW process performs significantly better than other arc processes at higher pressure because it is less sensitive to variations in pressure [1, 6]. Nevertheless, in order to achieve a stable welding process, it is operated with a very short arc length of the order of 1 to 2 mm, which implies a low heat input.

In this article, laser assisted conduction welding is being investigated for the purpose of providing additional heat input to control the weld thermal cycles of hyperbaric GMAW. The laser beam can be delivered through optical fibre from a surface vessel to the welding habitat. The approach requires using a defocussed laser beam, or at a sufficiently reduced laser power, so as to keep the irradiance below ~10^3 Wmm^{-2}, so as not to cause any material vaporisation' The laser beam is used in combination with the GMAW process, the beam laser merely assisting the arc by providing additional heating to reduce the cooling rate; hence the term laser assisted arc welding.

Characteristics of laser assisted GMAW

<u>Experimental Set-up</u>

Bead-on-plate welds were made on a 165 × 60 x 25 mm section API X65 pipeline steel using an 8 kW ytterbium fibre laser and a GMAW (Fronious TPS CMT) power source.

The laser beam was transmitted to the laser head through a 300 µm diameter optical fibre and defocussed onto the test piece. The laser head was mounted on a Fanuc robot head manipulator, and the focal length of the focusing lens was 500 mm. The GMAW torch was fixed at an angle of 78.5° to the horizontal while the laser head was positioned at 66° as shown in Figure 2. The work piece was clamped on a jig that was fixed to a translation stage. The separation distance between both heat sources, is referred to here as the *process distance*. At a process distance of zero the tip of the filler wire just touches the edge of guide laser beam.

The wire feed speed and travel speed were kept constant at 5 m/min and 0.42

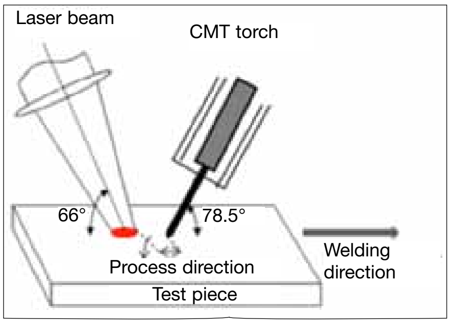


Figure 2: Schematic illustration of experimental set-up of laser assisted GMAW process. The laser beam trails behind the CMT (Cold Metal Transfer) torch in order to provide post weld heating.

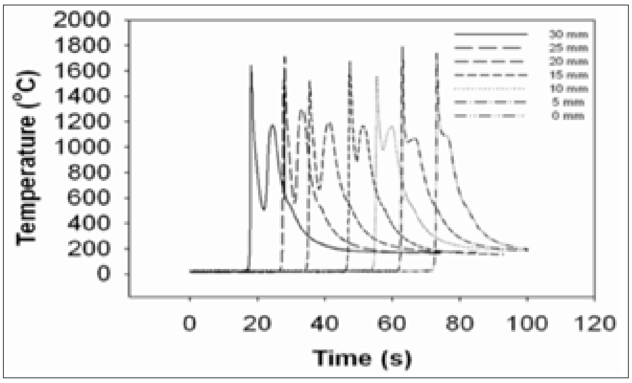


Figure 4: Effect of process distance on the thermal cycles of laser assisted GMAW for a 20 mm diameter laser spot of 6 kW power

Process distance (mm)	Time at 300°C(s)
30	17.85
25	16.60
20	15.37
15	14.64
10	14.30
5	14.15
0	13.95

Table 1. Duration of temperatures at 300°C as a function of process distance

m/min respectively. The contact tip to work distance (CTWD) was fixed at 15.5 mm and 100 % argon was used as shielding gas with a flow rate of 15 l/ min. The laser, positioned in trailing configuration was employed to provide post weld heating.

Weld quality

The laser assisted GMAW process produced defect-free welds. Figure 3 shows a section through such a weld.

As seen in figure 3 the laser beam does not affect weld penetration depth. However, it reduces the bead height and smooth transition between the weld toe and pipe material. In terms of fracture mechanics, this would give improved fatigue properties. The laser serves as post weld heating, reheating and reshaping the weld bead and reducing the cooling rate.

Thermal Cycles

Measurement of weld metal temperature during and beyond the passage of the CMT torch followed by the laser

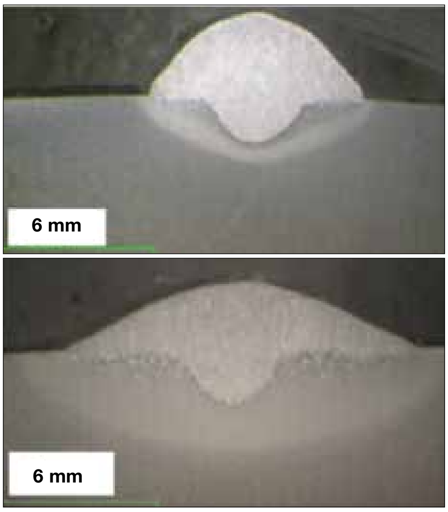


Figure 3: Comparison of welds with and without laser assistance. (top) Macrographs of a GMAW weld at 5 m/min wire feed speed and (bottom) the laser assisted weld. For the latter weld a laser power of 6 kW in a spot of 20 mm diameter was located at a process distance of 20 mm

confirms that the cooling rate of GMAW can be significantly reduced by the additional laser heat input, the process distance significantly affecting the shape of the thermal cycle that the welded part undergoes as shown in figure 4. At the farthest process distance (30 mm) two distinct peaks are clearly visible: the first produced by the arc source, the second from the laser: the weld pool produced by the GMAW heat source cooling down to about 500°C before being subsequently reheated by the laser to about 1200°C, then before finally cooling down to room temperature. As the process distance approaches zero the two temperature peaks more closely overlap.

It is possible that the main effect of process distance on the final weld is in removal of diffusible hydrogen. As shown in Figure 5, for process distances ≥ 15 mm the weld cools down to below 800°C before it being reheated by the laser. Now it has been shown that the hydrogen diffusion coefficient of steel increases with temperature increases sharply above 200°C [7]. By selecting a process distance such that the laser beam impinges on the weld metal when it has cooled down to just above 200°C, then the period for which the weld temperature is maintained above 200°C will be maximised, which will favour greatest removal of diffusible hydrogen.

Table 1 shows the duration of temperatures at 300°C (i.e. a temperature above 200°C) as a function of process distance. These times are to be compared with 4.63 s for the GMAW weld without laser assistance.

We conclude that a process distance of 30 mm provides the longest period for hydrogen removal. Indeed, greater distances may be even more effective.

Effect of laser parameters on cooling rate

Figures 5 and 6 show the primary results for effect of laser power (1, 3 and 6 kW) and spot size (10, 15 and 20 mm) on weld cooling rate, where $t_{8/5}$ is the average rate between 800 and 500°C.

Useful terms for describing these results derive from considerations of a point lying directly in the path of the laser beam as it passes across the workpiece: The Interaction Time (i.e. the duration of the laser beam exposure of the point) and the Specific Point Energy (the product of the laser beam power and the Interaction Time) [8].

Specific Point Energy, $E_p = 2rP / v$ (1)

Interaction Time, $t_i = 2r / v$ (2)

In equations (1) and (2), P, r and v are

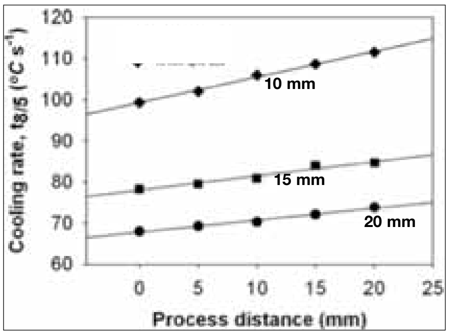


Figure 5: Effect of spot diameter and process distance at constant (6 kW) laser power on cooling rate

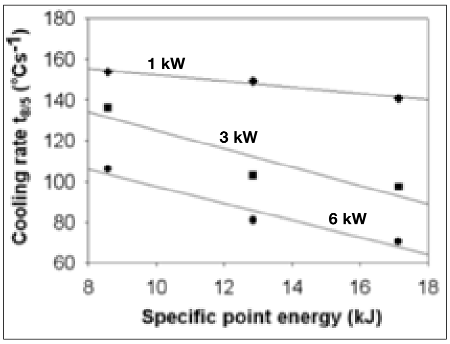


Figure 6: Effect of specific point energy on cooling rate for a range of laser powers and at 5 mm process distance

laser power, beam radius and welding speed respectively.

Figure 5 shows that at constant laser power the cooling rate ($t_{8/5}$) is lower the greater the beam diameter, which corresponds to a greater spread of laser power over the surface of the material. The figure also shows a gradual but steady decrease in cooling rate ($t_{8/5}$) as both heat sources are brought close together. As a result, the cooling rate at zero process distance was found to be the lowest for all laser powers and beam diameters investigated. However, the $t_{8/5}$ cooling rate does not take into account the overall time that the weld temperature is above 800 °C. As seen in figure 4, the overall time the weld stays above this temperature is longer for process distances ≥ 15 mm.

Equation (1) shows that at constat laser power E_p is proportional to beam radius, so in figure 6 the trend of lower weld cooling rate with increasing E_p is consistent with the trend shown in figure 5. More important, figure 6 also shows that the cooling rate is lower the higher the laser power.

Slower cooling will reduce the likelihood of formation of hardened metallurgical phase such as martensite, consequently reducing HAC sensitivity.

The benefit of using additional laser heat input has been shown both in terms of reduction of cooling rate and longer time at high temperature. Since diffusible hydrogen is the main cause of hydrogen assisted cracking among other factors, reducing it to acceptable limits should be given more emphasis. The reason is that even if a susceptible microstructure is formed due to a higher cooling rate, the absence of diffusible hydrogen means that the likelihood of cracking is lower. Therefore, the time at high temperature will be more beneficial than reduction of cooling rate in this regards.

Conclusion

We have demonstrated that by adding a high power laser in conduction mode to GMAW we can control both the cooling rate and time at high temperature. This will be very useful in reducing hydrogen cracking sensitivity in critical application welds. This is especially important in hyperbaric welding where there is high cooling rate due to the high pressure and a moist environment.

References

1. Richardson, M. I., Woodward, N. J., Armstrong, M. A. and Berge, J. O. (2010), "Developments in Dry Hyperbaric Welding", 3rd International Workshop on Stat-of-the-Art Science and Reliability of Underwater Welding and Inspection Technology, November 17-19,2010, Houston, Texas, USA, .
2. Branch, I. (2011), Hyperbaric Welding Today, An Overview, available at: www.nui.no/.../NUIPresentation-HyperbaricWeldingTodayAnOverview (accessed 01/20/2012).
3. Marino, R., Blackman, S. A. and Woodward, N. J. (2004), "Metallurgical Investigation of Hot-Tap and Riser MIG Welds Produced under Deep water Hyperbaric Conditions of 160 Bar", Pipeline World, 6, pp. 11-17.
4. Physorg.com (2011), Cranfiled University reaches Record Breaking Depths in Deep Sea Welding, available at: http://www.physorg.com/news/2011-04-cranfield-university-deep-sea.html (accessed 5/07/2011).
5. Statoil (2012), Remote-controlled World Record at Asgard, available at: www.statoil.com/en/NewsAndMedia/News/2012/pages/13sep_hottap.aspx (accessed 10/17).
6. Fostervoll, H., Aune, R., Berge, J. O. and Woodward, N. J. (2011), "Remotely Controlled Hyperbaric Welding of Subsea Pipelines", Pipeline Technology Conference, 4-5 April, Hannover Messe, Germany, Germany, .
7. Iacoviello, F., Galland, J. and Habashi, M. (1998), "A Thermal Outgassing Method (T.O.M) to Measure the Hydrogen Diffusion Coefficients in Austenitic, Austeno-Ferritic and Ferritic-Perlitic Steels", Corrosion Science, vol. 40, no. 8, pp. 1281-1293.
8. Suder, W., Williams, S. and Colegrove, P. (2009), "Absolute Spot Size Effect on Penetration Depth in Laser Welding", Lasers in Manufacturing (LiM 2009), 15 - 18 June, 2009, Munich, Germany, Scientific Society for Laser Technology, Germany, .

The authors are with the Welding Engineering and Laser Processing Research Centre, Cranfield University, Cranfield MK43 0AL

Corresponding Author: Usani Ofem
E: u.u.ofem@cranfield.ac.uk

Usani Ofem is a PhD research student at the Welding Engineering and Laser Processing Research Centre, Cranfield University.

See Observations p 29

Applications of laser functionalized surfaces in the transport sector

Frédéric Mermet

"Laser surface functionalization" refers to the process of using laser techniques to endow a surface with a particular property. Laser techniques include marking, engraving, ablation, micro-machining and additive manufacturing.

Amongst the various laser capabilities in IREPA LASER we present here the MUSE platform: “Micro Usinage Système Expérimentale” (Experimental micro-machining system), which is dedicated to texturing applications. This Class 1 machine houses a femtosecond and a nanosecond laser, allowing processing with pulses from 300 fs up to 240 ns in the near infrared wavelength band and from 300 fs up to 10 ps at wavelengths in the visible (green) and ultraviolet. Of the work described below the MUSE was used (only) for the sharkskin.

The MUSE platform has 4 mechanical axis, 3 optical axis and associated galvo heads, a microscope lens and one cutting head. This system offers a 300*300 mm working area and produces focal spots from 1 to 100µm Ø. The associated driver software features include a display of the depth and dimensions of the processed area.

Car personalization

IREPA has undertaken work to evaluate the aesthetic potential of laser surface treatment of polymer decorative materials used in car interiors (PVC, TPO, PP and PU) without reducing wear and UV behaviour. The properties achieved with three laser wavelengths (10.6 µm, 1 µm and 0.35 µm) and three marking patterns were investigated. Figure 1 shows a selection of results; all of which were tested for wear and UV resistance.

The project has now been transferred to an integrator to implement a machine prototype. Although the UV laser treatment results showed a wider range of effects and better accuracy, the 1 µm Fibre laser offered the best compromise because of its easy industrialization.

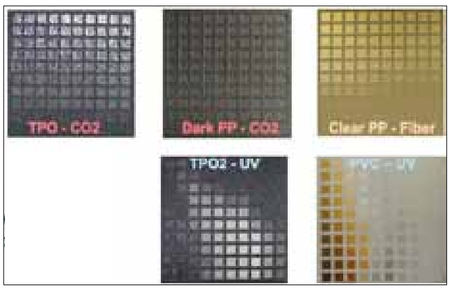
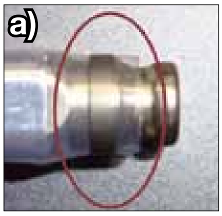


Figure 1: Results of car interior personalization study. The main observed effects were: browning, shining, smoothing, engraving, clearing up and colouring.



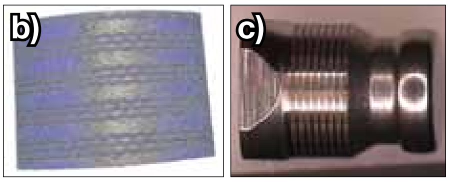


Figure 2. Metal cylinder with elastomer sheath, indicating the contact area (Ø 7.5 x 3.5 mm)

(a) Assembled unit

(b) optical investigations of zigzag texture

(c) part entirely textured

Fuel injector

The challenge here was to create a grip effect between a metallic and an elastomer pieces while preventing from any leaking problems. The contact area in question is identified in figure 2.

To respond to our client requirements, IREPA developed a process to apply various textures on the cylindric part: lines, including the zigzag (see fig. 2b). Surprisingly, the process optimization favoured the creation of burrs for improved grip. All textures were been produced in a cycle time scale from 13s to 26 s per part.

Critical points were the software optimization of pattern overlap and the reliability and reproducibility of burr formation.

Functional improvements were achieved and two laser systems have been installed in production lines.

Cycling performance

The challenge in this study was to improve the aerodynamic performances of a bicycle wheel by texturing the side walls of the tyre. By using a CO_2 laser high-resolution patterns could be engraved directly onto the polymer, obviating the need to manufacture a series of molds.

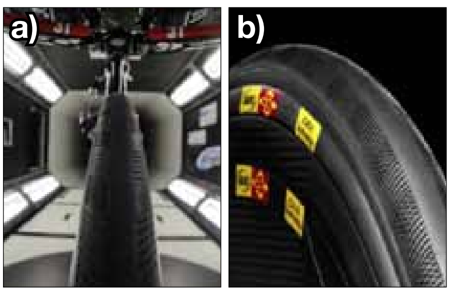


Figure 3: Texturing of bicycle tyres. (a) a textured tyre under text in a wind tunnel; (b) The commercially produced tyre.

Having identified the most efficient texture (i.e minimum drag) the tyres are produced by injection molding. It is claimed that this innovative product allowed competitors to gain 60 secs on a 40km ride at a speed of 50km/h.

A bio-inspired application: sharkskin

Figure 4: Model of shark scales for reduced drag in water

The LATEXDRED project objective was to develop a textile with shark scales (see figure 4) for swimwear applications. Efforts to replicate the sharkskin pattern have been undertaken by femtosecond laser ablation, directly on textile and on stainless steel (for pattern impression).

The shark skin characterisation is now complete and textile machining is underway. CAD file generation is in progress and the first tests on stainless steel have been undertaken, see figure 5. The project will end in 2014.

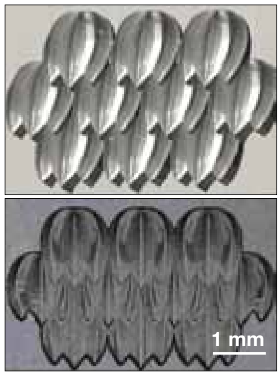


Figure 5. (top) CAD file visualisation; (bottom) first fs laser engraving on stainless steel sample

This brief presentation of potential industrial applications for laser surface functionalization gives some indication of the wide variety of industries can benefit from this process

Frédéric Mermet is with IREPA LASER, Pôle API, Boulevard Sebastien Brant, 67400 Illkirch, Strasbourg, France

Corresponding Author: Frédéric Mermet
E: fmm@irepa-laser.com

Frédéric Mermet is the micro-processing manager at IREPA. An engineer in laser applications and processes, he has since 2004 undertaken experimental and R&D activities in industrial projects.

See Observations p 29

OBSERVATIONS

Short comments on papers in this issue

HARDENING: Where are the UK laser jobshops? Editorial

and

An introduction to laser hardening and its industrial applications
Antony Bransden

We were I believe the first to develop the laser process for body-in-white tooling for Ford Dagenham in 1985, starting with clinch (or hemming) dies made from S.G. Iron castings, several tonnes in weight. This led to monthly lorry loads from Ford Cologne. We went on to work for GM with suites of tooling for tri-axial (LTP) press lines for the Astra (amongst others) and also large draw and punch sets for Jaguar/ Landrover, Coventry Motor Panels and other European car manufacturers.

I think Tony's page is thorough on the technical advantages but the commercial history can also be revealing and the decline of the British tooling industry and demographics certainly reflected on our trading in this field.

I like the point about soak (austenisation). This is important in short heat cycle treatments (induction/laser/flame) and the presence of chromium carbide, with its slow diffusion/dissolution rates means some steels, particularly those designed for vacuum hardening, can be problematic to treat. We also developed extended line heating techniques for stainless cutting edges.

The flame method was the traditional mainstay for car body tooling but the skills are being lost and modern steels need better control of temperature and cooling rate. I have seen many intricate tool steel castings that have succumbed to a 'Krakatoa moment' under the flame which were then sent to me, repaired with porous weld with the instruction 'please harden'.

Now I would say there is as much development in induction hardening these large expensive tools as there is in laser, given the improvements in induction power supplies, tooling heads and robotics.

I do not think that flame hardening is the main competitor to laser in most industry sectors: The turnover in conventional steel heat treatment shows Induction heating a poor cousin to furnace treatments (used largely because they are more cost effective); one could say that laser is induction’s lost love child!

There are many potential applications for laser hardening other than car body tooling. We used to harden 5,000 precision cast hydraulic actuators per month for the mining industry and were involved in turbine blade hardening for the UK power generation industry. The laser is more flexible but not as power/cost efficient as induction for larger hardened areas and quantities, so applications must exploit its unique advantages.

The first application that inspired me was at Saginaw Steering Works. It culminated in 1983 with 15 lasers hardening 33,000 power steering castings a day. This metallurgical solution to hardening castings with virtually no pearlite content was unique. The beam treatment caused incipient melting of the bore surface layer with no distortion. This induction could not do.

Ian Hawkes Inducto-heat (Tewkesbury)

My PhD was on laser hardening, actually mathematical modelling of the thermal history for laser hardening. I was very fortunate to share time on my PhD with Ian Hawkes, and in my years as UK Laser Services, help Ian look after the 2.5 kW laser he used for laser hardening at Inducto-Heat in Tewkesbury. I also have had some hands-on experience of laser hardening 6 hemming tools destined for a vehicle manufacturer using a 5kW CO_2 and 5 axis system.

So laser hardening is one of those processes that I have a natural interest in, and Mike and Antony’s articles illustrate the contradiction of this process in the UK. A relatively simple process with many applications and yet no-one currently offering this in the UK on a subcontract basis. In the 90’s and early 2000’s there was Ian at Inducto, and I remember calling in to see him on a busy day when he was waiting to ship a press tool back to Ford in Germany, receiving another one for hardening at the same time.

There is a resurgence in the UK automotive sector and a desire to bring back supplier manufacture in to the UK and shorten supply chain lines, coupled with the emergence a small number of companies offering mould tool repair services for whom laser hardening might provide an additional service. So I hope that we will soon see companies offering a laser hardening service in the UK again.

The advent of diode laser based systems with pyrometric temperature feedback coupled to robust scanning heads and the potential for robotic integration has made for a robust usable process that should be much easier to use than the kit I was brought up with!

Martin Sharp Liverpool John Moores University

A comparison of fibre laser and CO_2 laser cutting
John Powell and Alexander Kaplan

Having now had our fibre cutting machine installed for nearly six months It seems to performs better than we originally thought it would. I take the point about comparing the times, loading unloading etc. but we have found that the machine is far quicker to set up than a CO_2 laser machine, so from start to production cut is quicker than for a CO_2 machine.

As was pointed out in the article, running costs are shown to be significantly lower but only time will tell about the cost of major breakdowns.

Dean Cockayne Midtherm Laser

I once knew a very bright electronic engineer who had a passion for playing the electric guitar, quote: “A Valve (tube) amplifier sounded better than the modern solid state transistor version.” As a budding electronic student this came as some surprise. Since then I have appreciated and considered this comment as a prime example of ‘opinion for the traditional versus advocates for change’. There is many a purist out there who will most likely agree with this opinion for many reasons; these reasons could include the more culturally accepted sound distortion that you get from the magnificently crafted 'Pentodes', but was this enough to stop or halt the imminent change and untold benefits that solid state devices were about to offer this industry? The answer, 40 years on, is ‘clearly not’. I believe that this respected colleague still holds that opinion; however, the manufacturer of his ‘glass vacuum master piece’ has long since turned off the 'amp'.

Dr Powell has made a strong and convincing case as to why he wants to hold on to his CO_2 lasers. From this paper we can all appreciate the respect he has for this technology and his unrelenting opinion of CO_2 benefits.

Manufacturers of Fibre lasers and other 1 μm sources however are not in the least bit phased by this stoic stance. The industry (metal job shops included) have accepted with open arms the advantages in wall plug efficiency, dramatically lower maintenance costs, ease of integration, laser beam energy to metal coupling efficiency (i.e. speed of cutting on most generally accepted thicknesses), ability to process bright metals such as copper/brass which is something far more valuable to the job shop owner than the ability to cut wood or plastic on this significant 'capital goods' investment.

In the winter edition of the AILU magazine Dr Dirk Petring expertly summarised these advantages with clinical precision. Talking of this it is appropriate to mention that the comment that was 'overheard' was exactly that; 'overheard'. Dr Petring made a bold statement in 2011 at the ILAS event on the advances of Fibre laser cutting that the institute (Fraunhofer) had made to date. Thin metal was mentioned in the context of the advantages that fibre had brought to the market vs CO_2. Two years on, the same conversation could be had about fibre laser cutting on medium to thick material (i.e. mild steel). Cut quality vs thickness remains a strong but opinion-based argument depending on who's in the 'band'.

Many machine integrators can show prospective clients the cut quality on mild steel up to 15 mm that is perfectly acceptable with little or no debate. The converging speed vs thickness comparisons alluded to between 10 micron (CO_2) and 1 micron (Fibre / SS) cutting. This highlights how the major speed advantages gradually converge to CO_2 performance as the material thickness increases. However to purport that CO_2 is better, based on cut quality on thick material, is to be in my opinion a little too reactive or subjective especially in the face of the evidence that strongly suggests otherwise. Then again by the writer’s own admission he does not have a laser machine of this ilk and has to rely on the hearsay of others who support his current position on CO_2 vs Fibre. The phrase ‘itching ears’ comes to mind.

However, back to the cut quality comments, IPG Photonics have recently cut 20 mm mild steel with equally good edge quality as any CO_2 comparison. These samples will be on display at the IPG Stand at the Munich Laser Word of Photonics show in May Hall C2, Booth #271, all are welcome to visit and to experience this first hand.

With the advances that Fibre Lasers have made in the past 2-3 years compared to CO_2 over the last 50 years; CO_2 will be slowly relegated to the back of the shop where there will be only one semi-retired guy who knows how to switch it on.

Stan Wilford IPG Photonics UK

Continued over

Laser assisted processes for tool manufacturing
Peter Hoffman Roland Dierken and Tobias Heinze

A presentation of the same title was due to be presented at ILAS 2013 but due to snow the presenter being unable to get a flight from Germany. It is therefore particularly welcome to see this summary article instead.

Both laser cladding and laser hardening are useful and complimentary processes which offer solutions to wear-related issues, particularly in the field of industrial tooling design. The article points out the very different requirements each process has in terms of laser parameters used and describes the development of a system at ERLAS which enables the user to switch from hardening to cladding within a few minutes, although this appears to be limited to an off-axis powder feed, which it appears therefore relies on robotic positioning to be able to achieve full multi-directional cladding. The paper then describes larger robot and gantry based systems for laser cladding, which will provide additional competition for those similar systems which have been available on the market for some time.

The comment that the optimum width to height ratio for an overlapping clad bead of material is 4 is broadly correct This certainly provides a good starting point for parameter optimisation, although the actual optimum deposition parameters used in practice will be a function of a number of variables, including the materials involved, substrate geometry, thickness desired and, in commercial applications, the cost to achieve the desired result.

The results in this paper also raise the as yet unanswered question as to why the use of laser hardening seems to be much less commonplace in UK industry than is the case in Germany for instance.
Paul Goodwin Laser Cladding Technology Ltd.

The article presents information on a new processing optic combining the functions of laser hardening and cladding repair or modifications of tools and dies. Laser transformation hardening and cladding are two of the oldest applications of industrial lasers with a number of commercial operations found around the world now. The tooling industry in particular has a need for both operations in areas as outlined in the article so any technology which can deliver on both applications with improved flexibility and with potential economic benefit will be of interest to industry. The authors started with an existing hardening head and modified it for cladding by changing its facetted mirror for a parabolic welding mirror and added a side-injecting powder nozzle connected to it with a fast snap-in adaptor. According to the authors the change over from hardening to cladding is rapid, a matter of minutes, which is important from a work planning perspective. For both applications a cross-jet protects the optics from fumes and a safety interlock identifies which optics is in use.

Overall, a value adding article on laser processing optic combining hardening and cladding functions. Of interest to any company involved in tool and die manufacture and application.

Milan Brandt RMIT University, Australia

Applications of laser functionalized surfaces in the transport sector
Frédéric Mermet

This article presents a number of practical applications of laser surface texturing or funcitonization. I particularly like the tyre and shark skin textures. Humans can learn a lot from nature and the opportunities are wide. Laser surface texturing is becoming more widely investigated and applied. The work done at IREPA is certainly at the forefront of industrial applications of this exciting technology.
Lin Li University of Manchester

This is an interesting contribution to the magazine that covers a range of different texturing applications of laser micro machining technology for functionalising surfaces. We need more of such articles that share with laser the material processing community open issues related both to specific application requirements and corresponding implementations of laser machining technology to address them. I agree fully with the author that in each application area of laser surface texturing/structuring there are many open process design issues that have to be addressed concurrently in order to come up with a viable manufacturing solution. It will be really good this contribution to be followed by in depth investigations/discussions of laser micro machining applications outlined in this article.
Stefan Dimov University of Birmingham

It is always useful for those of us studying laser interactions to be surprising to see the ways in which laser processing can add value to products. This article brings out the important point that whilst serial laser processing may not be viable on a production line due to speed, it does offer flexibility in the experimental phase. The ability to change the pattern without re-tooling allows many more designs to be explored. Once the texture has been decided, the laser still has a part to play in forming the machine tools. I would expect that it is likely that femtosecond lasers that have sufficient pulse energy to machine metals will be confined to this role for some time to come.
Howard Snelling University of Hull

Laser cladding at Tata Steel
Nick Longfield, Sam Lester et.al.

This article describes the development of a production scale laser cladding system at Tata Steel UK's Port Talbot works specifically aimed at the hardfacing of steel process rolls. It indicates that the use of such laser clad coatings can extend component service lifetime by up to six times and that ongoing process development is addressing the tailoring of coating properties to each different application within the steelworks. The bespoke design of the production facility has been very well thought through to minimise problems and therefore maximise consistency.

The section of the paper highlighting the ability to deposit two phase MMC materials consisting of, for instance, tungsten carbide (WC) particles in a nickel base alloy, is a little unnecessary in my opinion. Such materials have been laser clad and used commercially in a number of industries for over a decade already. The space would have been better used to expand the results shown in Figure 4, illustrating the effect of powder flow rate on dilution, perhaps into two separate figures.

Nevertheless, these minor points should not detract from what is a very useful contribution that highlights just how well the laser cladding process can be modified and controlled to achieve consistently high quality results and provide significant benefits in terms of extended component lifetimes, thereby reducing part replacement costs and minimising unproductive machine downtime.
Paul Goodwin Laser Cladding Technology Ltd.

A very interesting article showing how laser surface cladding can directly benefit UK industry. The relevance of the technical case for laser cladding built by the team at Sheffield to Tata's current requirements is a prime example of how technology transfer can work at its best, illustrated by the incorporation of the new system in a production capacity. It is also a point well made that the laser cladding process is now mature enough that Tata's engineers had the ability to choose from a variety of suppliers to build their ideal powder delivery system and were thus able to more rapidly generate the final flexible and well integrated solution. This rapidly evolving 'off the shelf' availability of laser cladding system components shows the continuing movement of these processes into mainstream engineering.
Eamonn Fearon
Lairdside Laser Engineering Centre

Tata Steel was aware of the benefits laser cladding offers compared to other surfacing technologies for components used in the manufacture of steel strip. Although not discussed in the article the company must have done some economic modelling before embarking on this project. The company considered commercial laser cladding systems but having engineering expertise decided to assemble their own. The innovation is automatic programming of the robot using a laser range finder that determines the geometry of the component, the start and stop locations and the cladding head stand off distance from the workpiece surface. This approach obviously was more economic compared to purchasing a commercial system.

I commend Tata Steel for both the adoption of laser cladding technology in production and the approach taken to implement it. Maybe we can have a follow up article in future discussing cladding issues observed in production which can feed into new research in laser cladding.
Milan Brandt RMIT University, Australia

Control of cooling behaviour in hyperbaric gas metal arc welding
Usani Ofem Supriyo Ganguly and Stewart Williams

This is a good project to study cooling rate control laser-assisted GMAW process. The intention was control the heat delivery for deep water applications. Although the title has the word "Hyberbaric", the experimental condition used for the work seems to be under normal atmospheric condition. I guess the high pressure work is to follow in the future. The cooling curves provided may be from theory or experiments; it was not clear to me how they were obtained. They show interesting relationships. Some relationships are opposite to standard high power laser heating where higher laser intensity gives higher cooling rates.

Lin Li University of Manchester

12 & 13 March 2013

The Nottingham Belfry Hotel, Nottingham

ILAS 2013

The UK's premier event in Laser Materials Processing

A review of ILAS 2013: contributions from (most of the) session chairs

WELDING

1.1.1 Welding

We has an excellent keynote presentation from Darek Ceglare from Warwick University on the EU project Remote Laser Welding System (RLW) Navigator for Eco & Resilient Automotive Factories. RLW has been shown to have several advantages over resistance welding for automotive applications, including being five times faster, a single sided process and allowing new design opportunities. Part fit up, the major issue, is a main area of study in this project.

Chris Allen from TWI discussed two different approaches to the use of lasers for thick section welding. The first approach was to weld under vacuum using a sliding local shield. At a pressure of 25-50 mbar the penetration was double that obtained at atmospheric pressure. The second approach was to use multipass welding. Difficulties with defects were encountered when welding in keyhole mode. Use of a defocussed or scanned beam improved things but there were difficulties in getting the beam down the narrow gap. Weld quality still needs significant improvement.

Lin Li from Manchester University presented some early work on welding SA508 steels for nuclear applications. Although only on thin sections the work showed no drop in properties compared to the 5% found with TIG welding.

Sonia Meco Martins from Cranfield University presented her studies on joining steel to aluminium. Laser weld brazing produces brittle inter metallic layer thickness that can be accurately controlled but an alternative using copper as in interlayer, thus avoiding the inter layer problem, was thought to be a potentially better solution

Goncalo Pardal, also from Cranfield University, presented his work on joining titanium to stainless steel. First trials were carried out In the overlap condition and precise control of the mixing ratios of iron to titanium was obtained. Despite this, cracking remained a problem. A nickel interlayer was tried: No problems were found joining the nickel to the stainless steel but joining it to the titanium required precise control of the mixing ratio. Nevertheless, welds without cracks could be obtained with this technique.

Stewart Williams Cranfield University

1.1.2 Welding

Mark Daichendt from Laserline presented welding and cutting with high power diode lasers; a topic of increasing interest.

Stan Wilford from IPG Photonics reported on the use of 2μm fibre lasers for welding clear polymers. Steffen Reinl from DILAS gave an overview of diode lasers welding of polymers.

Jon Blackburn TWI Ltd

1.1.3 Welding

In the keynote presentation, Christian Föhl of Trumpf compared deep penetration welding by CO_2 and solid state lasers. This is a hot topic these days, especially in sheet metal cutting where high power fibre lasers are penetrating into the traditional CO_2 laser market. For the thicker materials discussed (10-15 mm steels) the CO_2 laser still offers process advantages (larger process window, less spatter), but the gap could be narrowed as understanding of the solid state laser processes grows. The balance might then swing in favour of fibre lasers because of their lower operating costs and easier beam integration.

Daniel Lloyd of Laser Optical Engineering gave an interesting presentation on the advantages of laser beam profile shaping using a tailored diffractive optic. Using the optic to optimise the original Gaussian beam profile for case hardening an automotive valve seal produced a clear improvements over use of a conventional lens.

Nick Longfield from the MTC raised the very practical question of how to reliably transfer laser processes developed on one laser to another laser with different power or beam quality and different beam delivery options. By using the concepts of Power Factor and Interaction Time he showed how a degree of universality could be obtained in defining the optimum process parameters.

The last two presentations, both from Cranfield University, took a marine theme. In Wojciech Suder's presentation described the production of low distortion fully penetrating filet welds when joining steel plates at right-angles, and how to optimise a hybrid MIG-Laser welding operation. Usani Ofem's paper was concerned with deep water laser assisted arc welding. The high pressure inert atmosphere that was needed, affected the welding characteristics. The laser was shown to control the weld cooling rate to produce a less brittle weld with lower adsorbed hydrogen.

Mark Richmond JK Lasers Ltd

SOURCES AND SYSTEMS

1.2.2 Laser Sources and Systems

Otto Marten of Primes GmbH, Germany discussed beam diagnosis sensors for process monitoring and machine integration. He reported an in-process laser beam diameter, caustic, power and intensity profile measurement system for use during material processing. The system can be integrated into a laser processing head.

Andrew Chesworth of Lee Laser Inc from the USA described the generation of a square beam profile from the output of a high power 532 nm laser by using a rectangular optical fibre beam delivery. Clear benefits were demonstrated for a silicon wafer scribing application. The maximum power demonstrated was 50 W.

Phil Jones of Lasermet Ltd presented test results for a patented "Laser Jailer" active guarding system for high power lasers. The system generates a signal to switch off the high power laser 'in jail' within 50 ms of a laser beam starting to burn through the guard. Two such systems are being installed in the UK.

Lin Li The University of Manchester

CUTTING AND DRILLING

The cutting and drilling session included four excellent papers – and one from myself, which my mum assures me was also marvellous.

Dirk Petring from the Fraunhofer institute in Aachen is the world's leading expert on laser cutting. His keynote talk revealed a lot of the background detail behind the cutting process with emphasis on both CO_2 and Fibre (or Disk) machines.

Ali Khan from TWI described feasibility tests for using laser cutting in the decommissioning of nuclear power stations. It was interesting to see a process where cut quality simply doesn't matter. Ali showed us some superb videos – my favourite being the one about the laser snake which cuts holes in chambers before putting its head inside to have a look around – very Dr Who.

My talk, on the difference between fibre laser and CO_2 laser cutting machines from a purchasers point of view. (See article on p 19)

PhD student Majid Hashemzadeh from Nottingham university presented a detailed study of the mechanisms by which fibre lasers pierce steel and suggested a new technique which would allow the pierce hole to lie on the cut line.

PhD student Matthew Leach from the university of Hull concluded the session with a very well put together investigation into the fumes given off during laser processing of carbon fibre reinforced plastics. (See extended abstract on p 3.)

John Powell Laser Expertise

MICRO-MACHINING

1.3.1 Micro-machining

Guido Hennig from MDC Daetwyler, Switzerland gave a keynote presentation describing the use of Laser Induced Forward Transfer (LIFT) for high speed printing applications. The development of their "Lasersonic" printing machine represents perhaps the only example of a truly industrial application of this process to date. Challenges in the development involved

Continued over

integrating together a 300 W cw laser with an acoustic optic modulator operating at frequencies in excess of 10 MHz, a 17,000 rpm in-vacuum polygon scanning mirror and an f-theta focusing lens which together provided line scanning speeds up to 2,000 m/sec across 530 mm web sizes at 600 dpi resolution. Unlike other printing techniques, the LIFT process requires no special inks and Daetwyler predict it to be the most cost effective method for proof, customized décor and packaging printing for print runs less than about 1,000.

The broad interactive mix of the capability for technology adoption, an intimate knowledge of the end application, the ability to implement R&D programmes of process development in a complex area such as laser-material interactions, an awareness of emerging laser technologies coupled to the technical expertise necessary to exploit them in process tool development all interacting together in a single well-focused organization have no doubt been key factors in this remarkable success story. As such it represents a classic example of a company having the foresight to develop and adopt laser technology in order to improve the performance of its products and obtain an edge over its competitors.

Charly Loumena from ALPhANOV presented work on the use of ultrafast lasers for micro and nanoprocessing of materials. They compared the process quality of cutting carbon fibre reinforced polymer materials with the results achieved using nsec lasers, concluding that pulse duration is not a critical parameter for achieving a low HAZ of < 50 µm. They also demonstrated that ultrafast lasers can be used to produce a variety of rippled and spiked textured structures for potential applications in surface marking, decoration, wetting and for modifying optical absorption properties.

Taku Sato from M-Solve described the HINTS EU Framework 7 project. He demonstrated that the inorganic top contact layer on OFET devices can be laser patterned without damaging the underlying OSC layer and that the field effect mobility obtained by laser patterning is comparable to that obtained using shadow mask and lithographic processes.

Dimitris Kanarkis from Oxford Lasers described work in the EU Framework 7 Fast2light project. Using DPSS lasers they demonstrated PEDOT:PSS material (a potential alternative to the transparent conductive ITO layer in organic electronic OLED lighting devices) can be laser patterned without significant debris in a layer selective manner.

Eleri Williams from Cardiff University described parameter studies of the material removal rate and surface finish when machining aluminium with a nsec pulsed Yb fibre laser. Different pulse durations between 25-220 nsec, repetition rates and spatial pulse overlaps were investigated; it was concluded that 'track displacement' was the parameter making the largest contribution to achieving the highest removal rate and lowest surface roughness.

Malcolm Gower Imperial College, London

2.2.2 Micro-machining

David Gillen of Blueacre Technology gave the keynote presentation, a fascinating talk describing the similarities between laser micro-machining workstations and systems for high resolution biological cell imaging. Recently, Blueacre has produced such cell imaging systems for screening in cancer research. In both systems there was a need to accurately control the position and tight focus of an ultra-short pulse laser beam, for either machining or the excitation of florescent dyes by multi-photon excitation.

Adam Rosowski of Liverpool John Moores University presented research into processing semiconductors using a hybrid technique combining laser processing and chemical etching. The work attempts to find methods of machining semiconductor materials with a quality close to that of conventional anisotropic etching but without the need for lithographic masking. The approach has been to use laser exposure during the etch process to enhance the etch rate of exposed regions over non-exposed areas. The results were encouraging several mechanisms behind this interesting technique were proposed.

PhD student Frank Albri from Herriot Watt University presented work aimed at manufacturing cantilever sensors using picosecond lasers. Cantilever structures were machined into the end of optical fibres to allow small displacements in the cantilever to be interferometrically detected from the light reflected from the cantilever back into the fibre. Frank discussed the challenges and solutions to a range of manufacturing issues such as the prevention of micro cracks in the cantilever through to the taper angle and reflectivity of the of the cantilever's surface.

Julian Burt University of Wales, Bangor

2.2.3 Micro-Machining

Walter Perrie from the Lairdside Laser Engineering Centre showed some interesting results on the use of a picosecond system for material modification and material removal.

PhD student Lingyi Ye from the Lairdside Laser Engineering Centre group presented his work on parallel processing of a Bragg grating on PMMA with a 387 nm picosecond laser.

PhD student Olivier Allegre of the University of Liverpool described his work on polarised ultrafast lasers with reference to improving efficiency in femtosecond micro-cutting of thin stainless steel. He showed a 10% improvement when using radial polarisation.

PhD student Omanigho Otanocha from the University of Manchester presented of his work using a KrF 248nm Excimer laser for mask imagining of a particle lens arrays to produce repetitive patterns. He showed the results on Polycarbonate coated with 100 nm thick GeSb2Te5 (GST).

Manuela Pacella from Nottingham University show a number of structured surfaces which have been produced on monocrystalline CVD and polycrystalline. These strikingly geometric features appear to offer routes to enhance grinding performance

Clive Grafton-Reed Rolls-Royce

SURFACE MODIFICATION

Lin LI from The University of Manchester gave a keynote presentation in which he showed a kaleidoscope of applications in which micro features have been created on a macro scale.

PhD student Abdeslam Mhich of The University of Manchester described improvements in paint adhesion through the use of Excimer laser surface modification.

Michal Švantner of the University of West Bohemia showed how the beam quality and the selection of laser based parameters could improve the corrosion resistance of dark marks made on stainless steels with a fibre laser. This application is highly relevant to many industries but of special importance to the medical industry for the marking of devices.

Ching Goh of Liverpool John Moores University described the effects of textured polymer surfaces and their influence and control of cell behaviour. A fibre laser micro textured a metallic mould from which polymer imprints were made. Although in its infancy this technique could be important in wound healing applications.

Caroline Earl of Cambridge university presented a study on the influence of laser parameters on the efficiency of the Surfi-Sculpt texturing technique.

Jack Gabzdyl SPI Lasers

PRECISION FABRICATION

Gay Penfold from Birmingham City University gave a keynote talk summarising laser applications in the jewellery industry. Laser processes that have been applied include marking, welding and additive manufacture. A clear advantage of lasers in this industry is its ability to generate personalised jewellery (an excellent example of mass customisation). Furthermore, many of the laser processes provide a much greater design freedom than more conventional technologies, and some of the applications of additive manufacture are particularly fascinating in this context: examples included highly complex forms, some of which look almost organic.

Tara Murphy from SPI Lasers addressed the pulsed laser cutting of highly reflective metals. She demonstrated how a fibre laser with an optimised pulse profile could provide high quality cutting. Clearly the details presented by Tara are applicable the jewellery industry and its requirements to process "shiny things".

Aos Al-Waidh from Liverpool John Moores University moved the theme from shiny things to invisible things. He described the use of laser processing in the manufacture of invisibility cloaks for the THz part of the spectrum. The work involved a cold ablation process using a ns UV laser in order to remove a metal layer without damaging the sub-hundred micron thick PCB substrate.

Jack Gabzdyl of SPI Lasers reviewed metal engraving using high average power pulsed fibre lasers, with examples of the high quality of engraving that these lasers can achieve on a range of metals.

Duncan Hand Heriot-Watt University

PDFs of almost all the presentations made at ILAS are available for download at www.ailu.org.uk/laser_technology/events/presentations.html; passwords are provided free to ILAS delegates, otherwise for £50 + VAT per ILAS day

EVENT REVIEW

ADDITIVE MANUFACTURING

2.1.1 Additive Manufacturing

Emma Ashcroft from TWI gave a keynote presentation took an applications based view and showed a number of interesting products that have been developed through several European Funded projects. Kiran Gulia from Birmingham University showed some interesting deposition and analysis of crack susceptible alloys, in particular Mar-M-247. Adam Clare from Nottingham University showed some novel approaches using hard facing and other materials. Filomeno Martina from Cranfield University showed what the competition to laser additive are up to with their arc-based deposition process that is enhanced by rolling methods. Finally, Robin Weston from Renishaw presented their view of Additive Manufacturing developed since their entry into the market around two years ago.

AM Net, incorporating the AILU SIG, held a meeting to discuss strategic issues around AM at the MTC on 10th of April. Thanks to David Wimpenny for hosting this. Robin Wilson from the TSB presented on some details of the recent call regarding design freedoms and AM, and proposed ‘Call back days’ for the AM topic. Chris Sutcliffe and Martin Baumers gave details on EPSRC CIM centres, and I presented the work that Amanda Allison at TWI has been doing on the European AM Strategic Research Agenda. This event went well, with good audience participation and feedback. The next AM Net meeting will be in a few months’ time. Many thanks to all the speakers in both events.

Rob Scudamore TWI Ltd

CLADDING & HARDENING

Antony Bransden from Ionbond Germany GmbH presented a comprehensive review of the industrial applications of laser hardening, highlighting its particular use in the tool, automotive and power generation industries. This also raised the interesting question of why the use of laser hardening as a surface improvement technique is not as widespread in the UK as it clearly is in Germany.

Andrew Cockburn from the University of Cambridge described the development of supersonic laser-assisted deposition. This process seeks to combine the advantages of using the supersonic powder stream delivery used Cold Spray with laser heating of the deposition zone. This reduces the gas velocities required to achieve good quality deposition with consequent reductions in the cost of processing gas.

The final presentation in the session had been due to be made by Dr Roland Dierken of ERLAS Erlanger Lasertechnik GmbH, who was unfortunately unable to attend due to unavailability of flights caused by snow in Germany. However, his paper on ‘Laser Assisted processes for tool manufacturing‘, covering both laser hardening and cladding, is presented on p 22. His slot was filled at very short notice by a talk from myself (Paul Goodwin) describing a number of practical applications of laser cladding under development in areas as diverse as rail transport, power generation and security product manufacture.

Paul Goodwin Laser Cladding Technology Ltd.

BUSINESS FORUM

2.3.3 Business Forum 2

The audience was treated to some very valuable and detailed analysis of the current laser market worldwide and the status of research in Europe and UK .

Dr Kunihiko Washio of Pradigm Laser Research, Japan, gave a detailed account of the industrial industrial laser activity in japan and a wide range of laser-based Japanese machines and LMP applications. Statistics include: national production of laser processing products represent only ~4% of Japan total optoelectronic production, about half of which was display and solid state lighting equipment (2011 data). There are ~644 laser job shops in Japan.

Mark Richmond from JK Lasers presented an analysis showing the increasing importance of high power fibre lasers into the market, especially sales in the Asia Pacific region.

Rob Scudamore of TWI addressed strategic research agendas and laser processing research at the European level.

Nick Longfield from the MTC addressed the Centre's planned laser materials processing capability. Activities fall into six themes, including additive manufacturing of complex components and the joining of automotive and aerospace components.

Martin Sharp of Liverpool John Moores University presented the AILU report on the UK laser materials processing strategy and the central position that the Association is taking in pushing this forward (see Issue 67, p22)

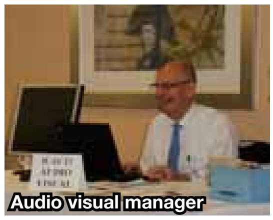
Neil Main Micrometric

ILAS captured on camera


Exhibtion


Best extended abstract


Registration


Audio visual manager


Break time


Posters


Magic show


Plenary preentation


Exhibtion

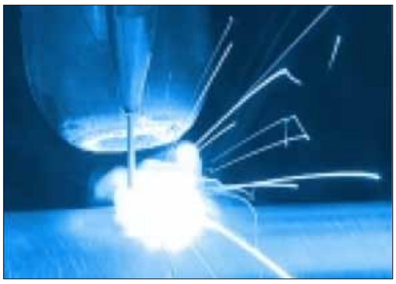

Networking


Symposium dinner


Exhibition

LASERS in MANUFACTURING

13 - 16 May, 2013 - Munich, Germany



AILU members enjoy the 'Full WLT Member' rate: EUR 428 compared to EUR 529 for non-members.

The Lasers in Manufacturing (LiM) 2013 - organized by the German Scientific Laser Society (WLT) - is a scientific conference that focuses on the latest developments as well as future trends in the field of Laser Material Processing. Dealing with Process Engineering, System Technology and Process Optimisation, the LiM 2013 addresses anyone interested in the potential of lasers in theory and application.

With a focus on Green Production, priority topics of the LiM 2013 will include laser material processing in E-Mobility, laser CFRP & lightweight material processing, laser processes for a flexible automated mass production and additive laser manufacturing for lightweight applications, besides others.

It is the aim of LiM 2013 to bring together international experts from research and industry in order to match scientific advances and economic needs for mutual benefit. Application-oriented contributions do not have to run through the scientific review process and are published separately.

www.wlt.de/lim

AILU-supported events

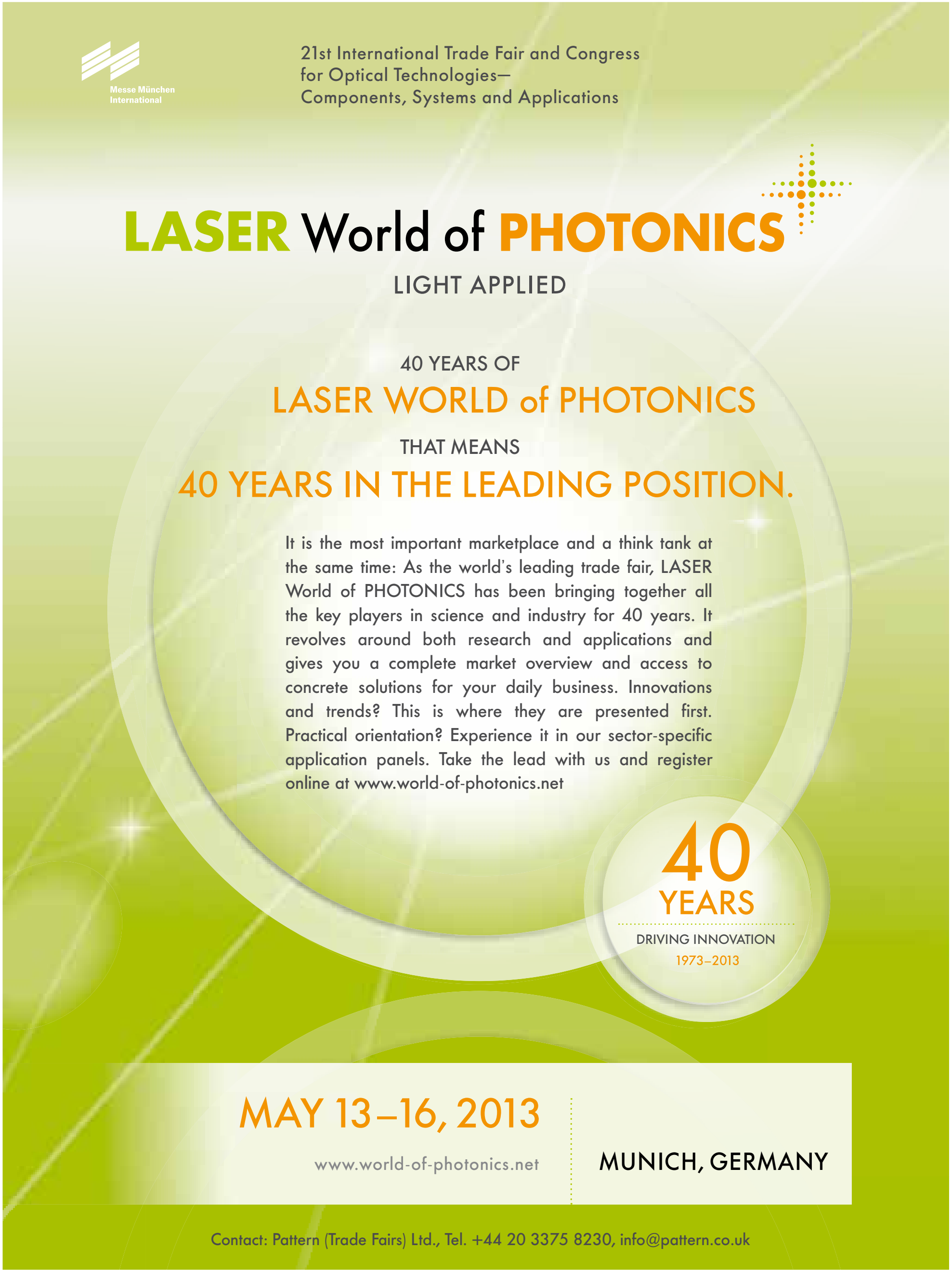
May 2013

13 **Lases in Manufacturing 2013 (13 - 16)**
Munich, Germany
(see advert opposite)

October 2013

6 **ICALEO (06 - 10)**
Miami FL, USA

Full information can be found at www.ailu.org.uk/events



Choosing the hard option

“How is it that a laser technique popular enough in Germany to warrant at least one dedicated jobshop in just about every city is absent as a subcontract technique in the UK?”

Not by planning but rather by coincidence there is a strong laser cladding and hardening bias in this issue.

Before ILAS there was but one paper on hardening and cladding, that from Roland Dierken at ERLAS Erlanger Lasertechnik GmbH (see page 21). Then at ILAS I had a long discussion with Antony Bransden (a Welshman whom I have known for many years and who now runs a laser hardening jobshop in Nürnberg, Germany). To paraphrase his question: How is it that a laser technique popular enough in Germany to warrant at least one dedicated jobshop in just about every city is absent as a subcontract technique in the UK? Hence the editorial on laser hardening on page 14 and Antony's paper on page 17. The final hardening/cladding coincidence was that the recipient of the 2013 Young Laser Engineer's Prize, Sam Lester, works on laser cladding. With perfect timing, one of his co-authors sent in a paper, see page 23.

In his observations on page 29, Ian Hawkes of Inducto-heat in Tewkesbury, a jobshop that used to offer laser hardening, mentions that he did great business in the 1980's hardening press tools for car manufacturers in Germany. One would think that with the resurgence of the automotive business in the UK, not to mention the opportunities in many other sectors that could benefit from the quality and precision that the technique offers (see examples on page 15), there would be scope for a few specialist laser hardening job shops in the UK.

The success of ILAS 2013, for which Martin Sharp as its Chair should feel well satisfied, coincided with the end of his 2 years as AILU President. Martin made great efforts to raise the profile of the Association during his tenure. He is also one of this magazine's most prolific contributors and I'm hoping that without his presidential responsibilities he will find time to fire off more of his provocative 'Sharp Comments'.

With the change at the top AILU now has, for the first time, a laser subcontractor as President. Neil has many years of experience in the engineering subcontract sector and imparting the 'Design It for Laser' message to UK industry. In declaring that he will strive to make AILU more relevant to industrial laser users (see page 16) he is, I'm sure, very aware that this is going to be hard work.

Mike Green, Editor
mike@ailu.org.uk

Editorial Policy

The Laser User is the house magazine of the Association of Industrial Laser Users. Its primary aim is to disseminate technical information and to present the views of its members.

The editor reserves the right to edit any submissions for space and other considerations.

Authors maintain the right to extract, in part or in whole, their material for future use.

'The Laser User' is published quarterly by AILU for its members

The Laser User
Editor: Mike Green

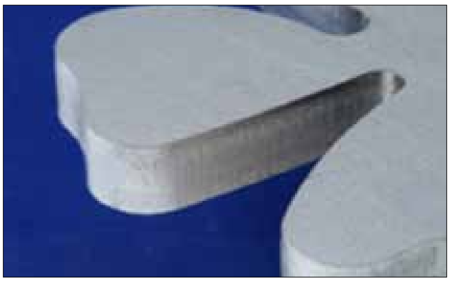
ISSN 1755-5140

AILU
Oxford House
100 Ock Street
Abingdon Oxon. OX14 5DH

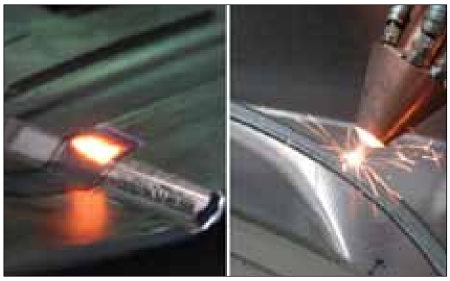
T: +44 (0)1235 539595
F: +44 (0)1235 550499
E: info@ailu.org.uk
W: www.ailu.org.uk

CONTENTS

Opportunities with laser hardening p 17



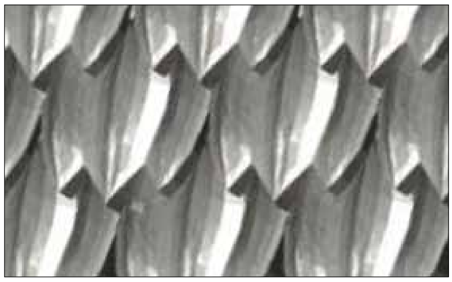
'Final' word on CO_2 vs fibre laser cutting p 18



Hardening and cladding with one machine p 21

Massive component life extension p 23

Laser post-weld heating deep underwater p 25



Wide applications for laser functionalisation p 28