

03:07

Laser *Community*

THE LASER MAGAZINE FROM TRUMPF

Coil-Connection

Ceaseless in the steel mill

David Belforte

The interview of his life

DISK
OR
FIBER?

FRANZ J. GRUBER
COMMENTS

→ page 30



Heavy Duty

Lasers extend stress limits

→ Page 10

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REPRODUCTION Reprotechnik Herzog GmbH, Stuttgart **PRINTED BY** frechdruck GmbH, Stuttgart

03:2007

IMPRINT



Is it a sign of maturity that the leading convention, *LASER 2007. World of Photonics*, has suddenly discovered the user? The time is past in which scientists and technology pioneers labored in the shadows. It goes without saying that the laser as a tool in industrial production has moved beyond adolescence. Now, more mature, the “tool of light” is taking over more and more new applications. Whether in the automotive industry, plastics processing, or in the offshore industry, the laser has long been cutting, welding, drilling and marking. It is always there when the highest precision, efficiency, and process security are in demand. It is now taking over the world of micro-processing — as the finest tool for the finest processing.

Growing up — but never old!

At the Munich industry summit, it was indeed clear to see that the laser has long been maturing. It is not that it doesn't have its occasional late-adolescent relapses — the raging controversies on the topic of fiber vs. disk show this clearly — yet it has all the features of a mature market. Enlightened and well-informed users are the primary indication of this. No customer today buys a laser simply because he or she is a technology fan. Rather he or she uses light as a tool because the whole package works. It is a package of technology, application and service that promises the highest availability and productivity. This makes the ongoing controversy over the correct laser beam source more than superfluous. The ultimate laser does not exist and will not exist. There is only the best laser for each particular application. With our strict application-oriented approach, we will therefore consistently continue to develop all laser beam sources.

JENS BLEHER

Managing Director

TRUMPF Laser- und Systemtechnik GmbH

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10 LASER DEPOSITION WELDING

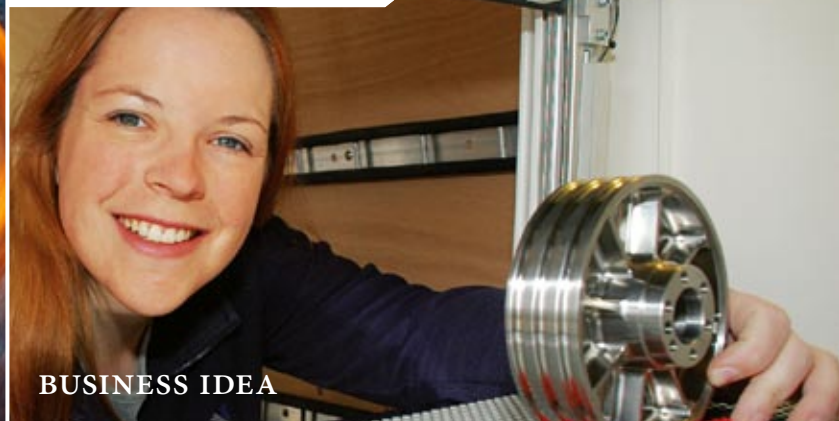
LASERMARKING



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Mission Protect

Light, gas, powder: deposition welding. Solid facts on recent protection and repair technology for high stressed components. PAGE 10

Armoring oil drill strings

How Schoeller Bleckmann protects the drill rod from wear and tear. PAGE 13

Light therapy for turbines

A repair method from Fraunhofer ILT saves airlines a ton of money. PAGE 14

“Never forget citizens’ happiness!”

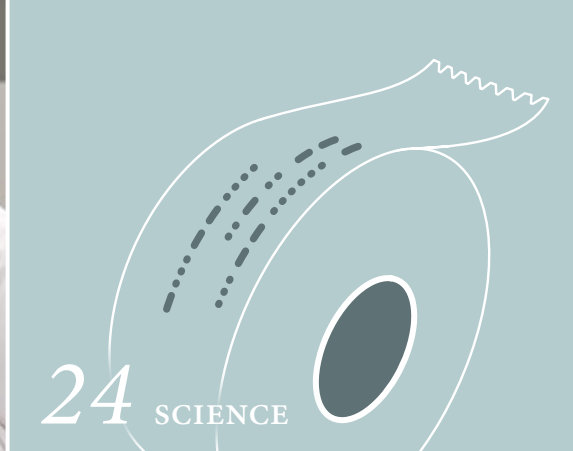
For Seoul’s mayor, “quality-of-life” and “city of industry” are not a contradiction in terms. PAGE 15



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REPORT

SCIENCE

PEOPLE

And it “clicked”

A single idea depends on two oxidizing rivets. Three tricks create a breakthrough. [PAGE 16](#)

“So how is it different in the U.S., Mr Busuttill?”

Carmakers in the USA and Europe find their way to the laser by different routes. Peter Busuttill from Comau Inc., on the results. [PAGE 18](#)

Coil Way

Heat, vibrations, dirt: Miebach’s coil welding systems weather it all out. Nonstop. [PAGE 21](#)

A secure spot

Tiny holograms crammed full of data: Dr. Steffen Noehte described how a roll of adhesive film became a nightmare for product pirates. [PAGE 24](#)

“I want to get people excited about lasers”

Almost no one else came down such a long road to popularize the use of lasers as tools as David Belforte. Here he explains what keeps him running. [PAGE 26](#)

5 Questions to ...
... Dr. Seiji Katayama [PAGE 29](#)

S P O T

--- FIBER PURCHASE

The Canadian diode laser company **nLIGHT Corp.** has acquired the Finnish fiber manufacturer **LIEKKI Corp.** nLight has announced investments in LIEKKI's Lohja, Finland, location. www.nlight.net, www.liekki.com

--- TAKEOVER

II-VI Infrared, U.S. specialist for laser optics, is taking over majority ownership of the German **Highyag Lasertechnologie**. II-VI intends to expand its product range of optics and components. www.ii-vi.com, www.highyag.de

--- LIA IN CHINA

LIA (Laser Institute of America) expands its activities in China. At **LASER China**, LIA gained broad support for the **Pacific International Conference in Applications of Lasers & Optics (PICALO)** to be held in Beijing in 2008. www.laserinstitute.org

--- HYBRID MARKETING

ESAB Welding & Cutting Products and **PLSystems** have jointly developed and marketed a system for hybrid welding, which combines laser welding with metal active gas welding. www.esab.com, www.plsystems.us

--- GERMAN ILS EUROPE

The magazine family **Industrial Laser Solutions** grows. **Franz Gruber**, former chief editor of **EuroLaser**, is launching **Industrial Laser Europe** together with **David Belforte**, the founder of **ILS**. www.industrial-lasers.com

--- KEYNOTE

At the **Photonics Marketplace Seminar 2008**, **Peter Leibinger** will give the keynote address. Vice chairman of the **TRUMPF Group**, he is also responsible for the laser division. <http://lms07.events.pennnet.com>

--- NASA PLAN

The **University of Hartford** and **NASA** want to deepen student interest in photonics, laser technology, aeronautics and nanotechnology. The **NASA-PLAN Teachers Academy** will provide U.S. teachers with the necessary knowledge. www.hartford.edu

"The major challenge to the community in the U.S. is, that laser technology is an under utilized asset in the engineer's tool box."

Neil Ball is chairman of the Cutting Certificate Programs Comitee



Towards the cutting edge

SME institutes laser-cutting certificate to meet the industry needs

■ Laser cutting gains momentum in the USA. The **Society of Manufacturing Engineers (SME) Industrial Laser Community (ILC)** has developed a laser cutting certificate program that builds on fundamental knowledge of CNC operations and part design for CO₂ laser cutting. **Neil Ball**, chairman of the SME ILC Laser Cutting Certificate Program Committee says, "The major challenge our community in the U.S. faces is that laser technology is an under utilized asset in the manufacturing engineers' tool box." Each attendee will learn how to work in compliance with the parameters of CNC laser cutting machines. The certificate program was developed to address the industry need for skilled labor technicians. A recent SME survey found that companies are in high demand of a workforce with practical laser experience which doesn't currently exist. www.laserinstitute.org

Big Winner

Great award for Dr. Marshall G. Jones



Dr. Marshall Jones among other things teaches at New York State University.

■ The **Laser Institute of America (LIA)** presented the **2007 Arthur L. Shalow Award** to the Laser specialist. **Dr. Marshall Jones** is an internationally-recognized scholar, researcher and mechanical engineer. He has received 46 U.S. patents, 31 foreign patents, authored or co-authored more than 40 publications and presented numerous talks at national and global technical conferences. In 1999, he was named **Pioneer of the Year**. The Laser Institute of America first presented the Schalow Award in 1982 to recognize individuals who have made distinguished contributions to applications of lasers in science, industry and education. Awardees become **Lifetime Members** and a **Fellow of LIA**. www.laserinstitute.org



Peter Zuber, manager of laser marking at Mathys AG Bettlach appreciates the development of software for writing on rounded surfaces in particular.



“It is almost like a minor miracle”

Peter Zuber was there when the laser learned to write. Here's how he views the progress.

Back then, what convinced you to rely on lasers?

Right from the start, the laser promised freedom. No tools, fewer restrictions with forming. Basically, it was the lack of contact that really hooked me. I come from the cutting and machining side of production. This involves tools, power and chip cuttings. And all of a sudden, you have the laser: just light and energy. You program the mark and it just appears. “It is almost like a minor miracle,” I thought at the time.

Which innovation has impressed you the most since then?

The first was software development. The machine has not changed considerably, but there are more and more options for increasingly complex parts. With our organically formed prostheses, we almost never see flat smooth surfaces, rather mostly curves, often even warped in all three dimensions. Software is a huge help with this. With hardware, it was the leap from the lamp to the diode. Suddenly, we were able to legibly write characters of 0.15 millimeters in height.

If you could wish for one breakthrough, what would it be?

Laser marking is essentially a mature technology. We do not need more output nor much more speed. Where advancements would really be appropriate would be for materials, especially plastics. We currently work a lot with polyethylene. Without an additive, the laser does not perform very well. Otherwise, it would probably be small things in the area of user comfort.

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Laser welding: With the IWS method, the beam also cleans the welding spot.

Burned clean

■ “Light instead of solutions” recommends the Fraunhofer Institute for Material and Beam Technology (IWS) in Dresden. Instead of chemically degreasing components before welding, the laser optics are programmed so that the beam vaporizes all impurities at the welding spot using rapid mirror motions. The surface below remains untouched. The IWS highlights several advantages to its method: the cleaning effect stays constant. There are no used cleaning baths to dispose of and the process is easily integrated into the workflow.

www.iws.fraunhofer.de



Lasers got their start in automotive manufacturing thanks to Prof. Folker Weißgerber, who passed away recently.

Obituary

■ He introduced lasers to the auto industry. Former Volkswagen AG board member Prof. Dr. Folker Weißgerber died on August 25, 2007, at the age of 66. In addition to welding technology using solid-state lasers for automotive engineering, Weißgerber, originally from Chemnitz — had an impact on other technologies and innovations as well, such as the three-liter car and the use of environmentally friendly water-soluble paint. As a teacher, Weißgerber shared his knowledge with future engineers.

NETWORK NODE

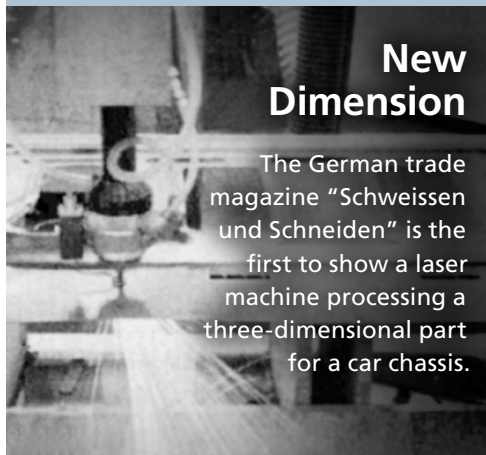
WORLD CENTRE FOR MATERIALS JOINING TECHNOLOGY, THE WELDING INSTITUTE (TWI)



■ TWI, based in Cambridge, England, is one of the world's largest independent research organizations. Some 3500 companies

representing many manufacturing sectors benefit from their expertise in all aspects of materials joining technology by joining TWI's Industrial Membership. TWI has been active in the field of laser processing since 1967 when it demonstrated oxygen assisted cutting with the first slow flow CO₂ laser prototype constructed in the UK. Three years later, it demonstrated what might have been the first deep penetration or keyhole laser weld using a TWI developed fast axial flow laser. Since that time it has been active in the development of laser materials processing applications and their transfer into industrial processes. Their current focus is on laser welding, powder deposition and novel methods of laser surface modification. www.twi.co.uk

Quantum Leap



New Dimension

The German trade magazine "Schweissen und Schneiden" is the first to show a laser machine processing a three-dimensional part for a car chassis.

1975

Lasys Comes to the User

Press conference at Daimler in Sindelfingen, Germany



Project manager Sandy Zorn is determined to establish LASYS as the new system solutions fair.

■ With a practical focus from the very start, the new trade show **LASYS** is entering the final lap. During a press conference at **Daimler AG** in Sindelfingen, Germany, the trade show coordinators explained the role that laser applications play in the body shell of the C-Class. The doors of the new Mercedes model were designed to be laser-compatible so that they could be completely joined by laser scanner welding. **Sandy Zorn**, project manager for **LASYS**, explains: "If you want to address users of laser technology as a target group, you have to have a practical approach. And that's how we get journalists and readers to think about our trade show." In addition, **Stuttgart Laser Technology Forum** — an established international user forum for the laser industry — will take place at the same time as **LASYS** in 2008.

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Portable Typewriter

Outsourcing with laser marker

■ A young engineer, an idea, a laser marker, a van — the start of a growing outsourcing business. Based near the German city of Hamburg **Ann Christin Hahn** and **LASERmobil** offer small companies on-site laser marking as part of their production process. The bread and butter of the business is brand names or logos with most of the customers working in precision engineering and tool-making. But the young company has also recorded strong growth for marking applications used to track products in the supply chain. Small suppliers are always faced with a challenge. Hahn and **LASERmobil** handle the documentation for them, allowing compliance with corporate standards. www.lasermobil.de



LASERmobil founder Ann Christin Hahn, her colleague Arne Knicker and their first laser on wheels.



*Jyh-Chyang Hwang,
Laser Stations, Inc.:
"Munich offered all
of the most advanced
lasers."*

Plentiful lasers

Every two years **LASER. World of Photonics**, opens its doors in Munich. We asked Jyh-Chyang Hwang, General Manager of **Laser Stations, Inc.**, why the long journey from Taiwan to Germany was worthwhile.

What brought you to Munich? Special expectations?

Since my company is a laser system integrator, we use various laser sources. The more laser sources we know the more support our customers get. Munich offered all of the most advanced lasers. We wanted to compare different technologies booth by booth, discuss all of our doubts and get answers immediately.

Were your expectations met? Yes, I learned a lot. To look at a real advanced laser in front of you is still quite a difference from just reading the brochure.

You also visited LASER China—what was different?

In Shanghai we had a great number of Chinese attendees, representing the progress of China's laser field. And, their progress is huge.

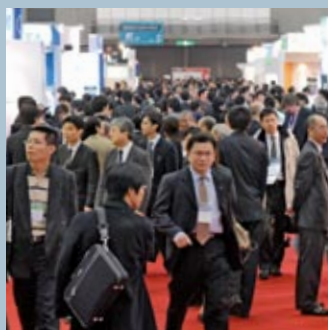
A PLACE TO GO

Photonics West



From Abet Technologies to Z-Laser Optoelektronik GmbH — at **SPIE Photonics West 2008** in California, more than a thousand international exhibitors are set to present ideas, technologies and solutions from January 14–19, 2008. And four symposia, **BiOS**, **LASE**, **MO-EMSMEMS** and **OPTO**, along with 3,000 research and development presentations promise visitors the opportunity to learn and discuss the latest innovations while gaining insight into other industries. No wonder North America's most important trade show for photonics, lasers and optical technologies attracted approximately 17,000 visitors in 2007.

C A L E N D A R



*SEMICON Japan:
Exhibition of semiconductor
equipment and materials*



*LASYS: International trade fair
for system solutions in laser
material processing*

*Stuttgart Laser Technologies: The
acknowledged German industrial laser
application forum will address an inter-
national audience for the first time.*



*Tube: International tube trade fair
along with METAV, international
fair for manufacturing
technology and automation*

SEMICON JAPAN

December 05–07, 2007, Chiba
www.semiconjapan.org

EUROMOLD

December 05–08, 2007, Frankfurt, Germany
World fair for moldmaking and tooling,
design and application development
www.euromold.com

NORTEC

January 23–26, 2008, Hamburg, Germany
Trade fair for manufacturing technology
www.hamburg-messe.de/nortec

EALA

Jan. 31 – Feb. 01, 2008, Bad Nauheim, Germany
European Automotive Laser Application-
conference, www.automotive-circle.de

LASYS

March 04–06, 2008, Stuttgart, Germany
www.lasys-messe.de

STUTTGART LASER TECHNOLOGIES

March 04–06, 2008, Stuttgart, Germany
www.slt.uni-stuttgart.de

MEDTECH

March 11–13, 2008, Stuttgart, Germany
European fair for medical device design
and manufacturing
www.medtecstuttgart.com

TECHNISHOW

March 11–15, 2008, Utrecht, The Netherlands
Trade fair for industrial production technology
www.technishow.nl

LASER. WORLD OF PHOTONICS CHINA

March 18–20, 2008, Shanghai, China
International trade fair and conference for
photonics
www.world-of-photonics.net/en/laser-china/start

TUBE + METAV

**March 31–April 04, 2008,
Dusseldorf, Germany**
www.tube.de

IWOTE

22.–April 23, 2008, Bremen, Germany
International workshop on thermal forming
and welding, www.bias.de/iwote08



Mis

*Brutal forces act on drilling rods.
This is why drilling companies
using more modern procedures
increasingly look to welded-on
"armor" for protection.*

sion

Protect

The answer to aggressive wearing, critical applications and tight resources: Laser deposition welding.

➤ The steel fist pounds its way relentlessly deeper. Searching for oil, the multi-ton drill head gnaws at rock formations millions of years old, guided by sensors around stony corners and edges, eating down to the deep sources of black gold. In its wake is a drill string, equipped with electronics and filled with a fluid that drives the head downward and the drilling mud upward along the outside of the string under maximum pressure. Nothing can stop this drilling worm. Except for its natural enemies abrasion, tribochemical reactions and surface breakdown. Wear-and-tear goes by many names — and is a central problem for oil explorers. If a pipe is no longer able to withstand the enormous stresses and strains of being far underground, the resulting downtime of the drilling system can cost up to a million dollars. A day. A good reason for the oilfield industry and its suppliers to search for reliable protection against wearing.

Now engineers have discovered laser deposition welding, also called laser metal deposition or LMD. LMD is a generative laser process in which metal is deposited on existing tools and components in layers. The laser generates a molten pool on an existing surface in which one or more metal powders are sprayed through a nozzle. The powder melts simultaneously and bonds with the underlying surface. The gradual result is a new material layer. For example, this process thoroughly armors the par-

Grinding, scouring, pressure, heat, acid, moisture — unwanted material changes and losses are very expensive.



ticularly sensitive areas of oil drill strings. A highly wear-resistant nickel alloy layer forms the basis for spherical wolfram carbide particles. This “hardfacing” stands up to the toughest stresses, has no pores and reliably adheres to the pipe’s base material. It’s a huge improvement over the old protective process of soldering hard metal platelets.

Raw power and aggressive fluids Grinding, scouring, pressure, heat, acid, moisture — abrasion and corrosion take their toll in more than just the oil drilling industry. Troublesome material changes and the loss of valuable components create an enormous expense in aviation and aeronautics, machine and tool construction as well as in many areas of heavy industry. To counter these problems, a wide range of thermal, mechanical, electrochemical and other surface treatment methods are available. One of the most recent and effective methods is laser metal deposition, which was developed in the USA in the 1970s, but whose use was restricted for many years to the military, research laboratories and scientific institutions. And, it has only been in recent years that complete technology packages have been available for the automated industrial use of this laser-based welding process.

Optimize, correct, repair There are many uses for laser deposition welding. Surface finishing, as is practiced for example with oil drilling systems, can optimize specific material properties and can be customized to particular requests. Engineers can specify preferred properties for certain surfaces by combining several materials. Different metal powders can be deposited alternately, forming specific layer systems. Ductile material can contain hard surfaces. Thermally insulating substrates can be given conductive layers. In addition to improving the quality of components, LMD can also save resources and money. For many applications it is sufficient to deposit a thin layer of high grade material onto an inexpensive base material like cast iron.

Repairs offer a number of possibilities for the use of this method. Instead of having to scrap components and tools prematurely and replace

them with new ones, damaged structures can be restored by laser deposition. Airplane engine components for example, can be repaired more often. When birds fly into and damage the turbine blades, repairs made by LMD are faster and six to seven times less expensive than a new part — with the same quality and functional reliability. Car makers regularly use laser deposition to restore expensive forming tools. In addition to these industrial, fully automated applications, there are also manual systems with a wire feed or semi-automatic powder nozzle, used for example in mold and tool construction. The laser welding process offers enormous savings for small modifications and design changes to the end product and for correcting processing errors. Volume deposition can correct mistakes, create preset nominal dimensions, and restore old components to operational condition with little time, money and effort. The material properties and load capacity of the original component are retained.

On behalf of progress Both solid-state lasers and CO₂ lasers are used for laser deposition welding. The specific properties of the laser, such as its focusing ability and energy density, make it an ideal tool for metallic layer bonding. Compared with other welding processes, LMD’s quality with respect to joints, connection, intermixing, distortion and reproducibility is impressive. The metallurgically critical heat-affected zone is very small. Fast cool down times enable almost distortion-free

welding. Various materials can also be mixed, and welding is possible in areas unreachable by conventional methods. For microscopic tasks, the laser beam can be focused to less than 50 micrometers. If flat layers are needed, the beam is strongly defocused. The amount of energy can be controlled precisely and the risk of

weld penetration or joint modifications through excessive heat entry is minimal. Structuring rates of up to 300 cm³/hour are possible depending on the spot size, power and track speed. The layer thickness ranges between 0.1 mm to 2 mm depending on the application. The powder efficiency during deposition approaches 90 percent — the supplemental material, which is often very expensive, is well used. →

Depending on the power and setting,
the laser can deposit up to
300 cm³ of material per hour.



Feed for substances like inert gas

ARMORING OIL DRILL STRINGS

The greatest challenge in drilling for oil is not finding oil, but rather protecting the drill rod from wear and tear and costly breakdowns. That's why Schoeller Bleckmann Oilfield Technology GmbH in Austria uses the technology of Laser Metal Deposition (LMD) to armor its drill string components. A five-axis laser system welds a protective coat to the individual pipes. The coat consists of a supporting layer and up to three extremely durable layers. Up to 40 kg of material is layered in total for each drill string. Because the heat-affected zone must be kept small, the base material of the drill rod is not harmed and distortion is minimal. This prevents cracks under the rib that could cause the armor to chip off or the pipe to break. By the same principle, worn out rods can be repaired or re-manufactured. Certain coatings can be reproduced again and again with constant quality as all laser parameters are stored.

Feed for powdered supplemental material

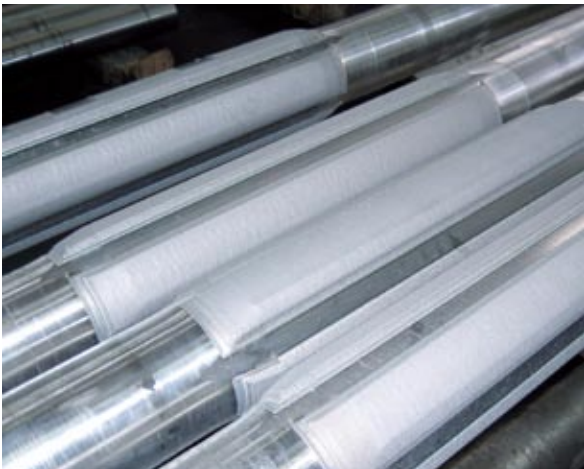
Highly wear-resistant nickel-based alloy with wolfram carbides

Intermediate layer

The laser generates a melt bath on the existing surface in which the nozzle sprays and melts the metal powder.

Drill string made of salt water-resistant steel

The inert gas at the focal point displaces the oxygen, forming an envelope of inert gas around the melt bath



Drill string components with welded ribs.

The base material of the workpiece can be made of iron, nickel, titanium or cobalt alloys. In addition to the same base materials, the supplemental material could also be wolfram, ti-

Repair methods often pay for themselves quickly, which is why such applications are so popular.

tanium and chrome carbide — typically in a cobalt or nickel matrix. The component can be refinished by milling, grinding, drilling, turning or eroding. Heat treating is also possible. The workpiece can then be polished, etched or coated with PVD/CVD methods.

Laser deposition welding is still a new procedure with a variety of potential uses. Repair applications are currently the most common — the repair welding process often pays for itself with small quantities due to the significant added value. Finishing methods, on the other hand, are still comparatively rare because the specific improvement of workpiece properties by systematically combining materials is still unfamiliar. The wide range of part geometries, batch sizes and the manifold process parameters and variables present great challenges to system and laser technology. Applications already exist in the offshore industry, in aviation, and the construction and agricultural machinery industries while some top-of-the-line manufacturers use them for engine production. In addition to the growing maturity of the methods and systems, the development factors include growing cost consciousness — the “total cost of ownership” — and unpredictable raw material prices for high-grade substances. ■

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The laser gradually restores the turbine blade to its former shape. Right: Repaired “tips” of compressor blades.

Light therapy for turbines

Engine manufacturers using integrated compression rotors save a lot of money. Replacing them when they are worn out is very expensive. The Fraunhofer Institute for Laser Technology discovered the solution.

➤ Airplane engines are subject to extreme conditions and must meet the highest safety standards. The rotating engine compressor blades are often damaged by foreign particles — for example birds flying into them — and therefore, need to be replaced regularly. Modern engines have blade integrated disks (blisks). Rotors and blades are manufactured in one piece to lower costs and weight.

Expensive exchange Damaged blades cannot be individually replaced, so a very expensive component assembly has to be installed. Engineers at the Fraunhofer Institute for Laser Technology, ILT, have developed a method based on laser deposition welding in which damaged blisks can be quickly and safely repaired at a fraction of the cost of a new part.

As good as new The material properties match the strict specifications for the original part after repair. The scientists were able to achieve the breakthrough for wide industrial use of the process. Key to the solution was the development of a special nozzle. It positions and guides the inert gas for shielding the welding spot along with the metal powder. The process is already being used on an everyday basis. The famed engine manufacturer Rolls Royce has certified ILT for repair work on engine components. ■

Contact:

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“Never forget citizens’ happiness.”

An industrial city such as Seoul can offer superb quality of life for its citizens, believes Seoul’s Mayor Oh Se-hoon. Excerpt from a visionary inaugural address.*



Oh Se-hoon, Mayor of Seoul

Seoul has grown to become one of the world’s great metropolises. We should not, however, be satisfied with the fact that Seoul is just one of many great cities. Seoul ought to be able to compete with the world’s other great cities — not only in terms of the range and variety of the business done here, but also by way of new ideas and creative imagination. Only if a city responds to and promotes other aspects aside from industrial development does it become and continue to be a desirable place to live.

Needless to say, it is essential to build a business-friendly environment by abolishing obstacles that restrain productive business activities. New administrative services can help to encourage more dynamic economic activity. The development of some branches of industry can act as a growth engine. All this results in economic benefit for a city — and ideally for the entire region. But, in order to assure good quality of life, you must never lose sight of the residents. Their happiness is the crucial component of a city worth living in.

A clean, attractive, global city is a city of culture and the arts, where tradition and hi-tech live in harmony. Creating a city of culture means not only building facilities and holding events. Rather, culture has to permeate everyday life: space for family fun and outdoor activities in every district, schools as an open and accessible cultural space for the local community. Moreover, culture is linked with the economy to create added economic value, and with the environment to guide people to a better life.

Furthermore, a city worth living in is an environmentally friendly city where nature is in harmony with people. Improving air quality and developing public green spaces are closely connected with citizens’ happiness.

Seoul’s residents say that traffic congestion and air pollution are two of the great evils in their lives. Consequently, building an efficient public transportation system to drastically reduce the use of private vehicles is also fundamental for a desirable city.

It is thought that changes people, and people who change the world. Men and women of all ages, wherever they might live within the city, ought to feel that each and every one is a very special citizen. Only with citizens’ support, knowledge, creativity and passion can a clean, attractive global city be created. Moreover, one must never forget the public servants in the city administration. They are valuable resources for a city that is facing new challenges. City governments need to generate more energy and turn themselves into dynamic organizations in which civil servants can unfold their excellent capabilities. Again, we need to have an environment full of fun and voluntary participation, encouraging citizens to generate creative and imaginative new ideas. In Seoul, I will institute “citizen /customer-centered management” based on the idea of “citizen governance”, in which citizens move to center stage for the city administration. By providing better services, conceived by creative imaginations, I intend to raise the happiness index for our citizens — and, hence create a clean and attractive global city of Seoul. ■

Information: www.seoul.go.kr

* Delivered on July 3, 2006, in Seoul. Some of the central points in that address have been extracted for this statement.



FRENZ 07 06
Niederhoff OHG
PAT. NO. 199 15 927 0

An idea's success often
depends on the details.
For this special buckle, the
details are two rivets.

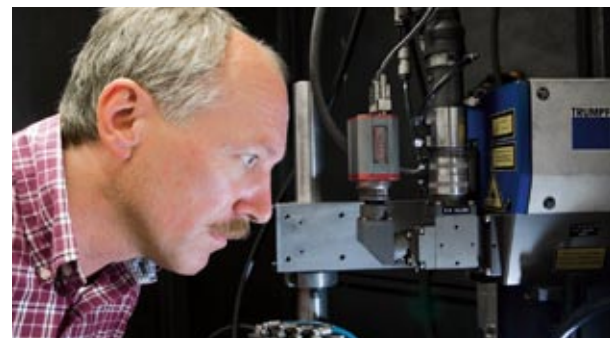
And it “clicked”

Josef Papenheim, of the metal and plastics processing company Miederhoff, was looking for a solution for a welding spot that tended to rust and found it in the laser.

■ Josef Papenheim opens his right hand. The buckle he calls “Direct Buckle 2000” is made of stainless steel, is 15 centimeters long, five centimeters wide and has two parts. The then head of tool construction at Miederhoff in Sundern, Germany, closes his hand again. The buckle closes with an audible snap. “The connection took a lot of hard work,” said Papenheim. Two rivets hold the buckle’s two parts together. Each rivet has a rounded head on the outside while the inside is welded. And there’s the problem. The welding spot was subject to rust. Welding only took two seconds, but then someone had to spend two minutes grinding it. This was the only way to protect the stainless steel, which started to discolor from rust during welding. If the quantity was only 1,000, you might overlook this additional work, but Miederhoff manufactures several thousand buckles a year.

The company filed its patent for the “Direct Buckle 2000” in 2000. Truck drivers can use it to fasten their tarps in one motion. Buckles with belts, which Miederhoff also produces, require more of an effort to handle, and the driver always has to readjust them. The Direct Buckle saves time and money and puts less strain on the driver — all vital, considering the tarp structure of a 40-ton truck has about 50 buckle connections. But because the belt buckle has significant advantages, Miederhoff continues to sell almost three times as many.

The Method Question “We had to find a solution to reduce production costs,” says Papenheim. Out of 100 employees at the central plant in Sundern, Germany, sixteen work in tool construction because, he says, “we manufacture almost all devices, tools and sometimes entire machines ourselves. The tool builders rack their brains, plan, build and develop so the actual products can be produced with as little effort as possible”, explains the department head. The problem-solving bunch also took on the challenge of this special buckle. “For a while we fooled around with the idea of continuing to weld using WIG, but also blowing argon into the weld seam to displace the oxygen, thereby preventing oxidation and rust,” says Papenheim. But, the cost of noble gas was higher than the cost of polishing. Papenheim knew there had to be another way and he found it at the EuroBlech trade show. He visited the TRUMPF booth and watched demonstrations of laser welding. “At that moment, I had hope,” he remembers. He described his problem to experts at the exhibit and agreed to send a sample of the “Direct Buckle 2000” to TRUMPF. The tests at the showroom demonstrated that a laser could prevent the welding spot from rusting. The industry experts back at Miederhoff didn’t



Encountering the laser was Josef Papenheim’s “aha moment.” But, the solution came with a couple of challenges.

waste any time. They drove south to Schwabia and saw the proof for themselves. Shortly thereafter, they ordered a 1kW laser with programmable focusing optics. That was only the first step; the second step involved Papenheim’s team building a worktable with a cabin to shield the focusing optics. An employee places the two parts of the buckle onto the device, a flap opens, the rotating worktable turns. The workpiece disappears into the cabin and the flap shuts again. “Because the outside cladding is only a few millimeters thick at the welding spots, the parts must be inserted exactly,” says master electrician Franz-Josef Vormweg. The parts are therefore fastened to the worktable and their position is electronically checked. The mirror can now focus the laser beam exactly and guide it from one welding spot to the other. “But we got excited too soon,” remembers Papenheim. Although the focusing optics solved the problem of precise positioning, the initial problem remained. The Direct Buckle continued to discolor. Then the staff had the idea that the nitrogen feed might be too wide. As a result, the nitrogen hose is now plugged into a device that blows the gas through eight nozzles onto the weld seam. The thin cladding is then reached by nitrogen. Since then, the process has been trouble-free. “We are now producing twice the quantity over the same amount of time,” says Papenheim proudly. The laser fan looks once more at the “Direct Buckle 2000” in his right hand and grins. Then with a click he shuts it again. ■

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■ *Mr. Busuttill, how does the integration of laser technology into car manufacturing differ between Europe and the United States?*

In Europe, car companies generally develop laser processes internally. They nurture and evolve with laser technology. Most of the understanding, and risk, is internal to the company. Laser technology is built into the company itself, so it becomes a philosophy. As a result, we see an acceptance of laser technology within Europe that doesn't exist anywhere else in the world today.

And in the United States?

Traditionally, U.S. automotive manufacturers do not develop laser processes internally, but instead use integrators. Integrators spend a lot of time developing the business case for bringing in technology, which is then digested by

How advanced, or behind, do you think laser technology is in the U.S., especially when compared with its application in Europe and Asia?

In certain areas we are ahead and in certain areas we are behind. We are ahead, for instance, in laser cutting in the body shop. We've had fiber-optic YAG robotic cutting systems in automotive since 1991 — in full on-line production, which means that if the system didn't work, the company couldn't produce cars. That is a different kind of production scenario than building parts on a subassembly line fed into the final build. Laser welding was a different story. When cw-YAGs came out, a lot of European car companies bought them as soon as they were made. Once they started playing with and really understanding the lasers, they developed a lot of welding systems and applications utilizing the technology. In the U.S., we had a few systems at par with this by the year

“So, how is it different in

Who has a leg up using lasers in the automotive industry? America or Europe? What beam sources are now sparking the imagination? And what is Asia up to?

Laser integrator Peter Busuttill of Comau Inc. answers these questions.

the companies, who are looking for quick payback periods for their investments. But, lasers and their applications are not cheap. Often, if companies don't see a one-year payback period they're almost not interested. Consequently a lot of business cases are deemed “too expensive” and placed by the wayside. We've attempted to address this challenge with our Advanced Process Development Center.

Tell me more about the Advanced Process Development Center. The development center is a place where we actually try out lasers for the applications we have in mind. It provides a relatively low-cost method to prove out lasers without the impact of internal costs on the car companies. We're a systems integrator; ultimately our core business is to produce systems and, of course, this is a means to that end. We use it to help our customers understand the technology and processes, and give them a sense of how lasers apply in real-world scenarios.

2000, but the sheer volume of applications in Europe sets them apart.

Can U.S. manufacturers catch up?

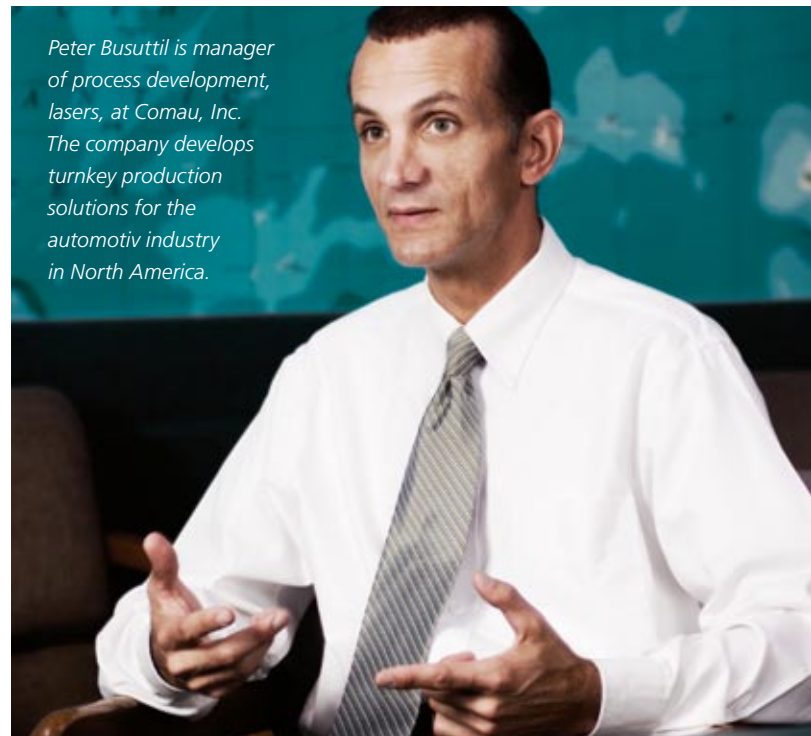
Yes, definitely. Our industry is going through big changes with regards to technical applications and lasers will surely be an integral part of that change.

What applications would you like to see?

We've had quite a bit of success joining aluminum and bringing it into production. That's something I'd like to see more of — aluminum welding replacing rivets, WIG or MAG welding. Lasers offer a lot of interesting engineering and payback capabilities in this area. We don't do enough laser brazing. The payback periods for laser brazing can be within one year without a problem. Laser brazing was brought into production on roof-to-body side type systems by 2000 in Europe and flourished. We finally saw the first U.S. automotive ap-



the U.S., Mr Busuttill?”



Peter Busuttill is manager of process development, lasers, at Comau, Inc. The company develops turnkey production solutions for the automotive industry in North America.

plication just this year. →

What trends do you see in automated assembly using lasers?

There are a host of things lasers do for automated vehicle assembly — producing and joining hollow structures, reducing weight, adding stiffness, changing vehicle styling. This is not new in Europe, but in North America it's changing production. The conventional way of building a car, through resistant spot welding, requires welding on two sides. Lasers are capable of single-sided joining processes. Lasers open up a whole new world of structural capabilities and materials. Not only is the body lighter weight, but safer and more structurally sound, with improved fuel economy and sometimes

“It will be interesting to see if high-brightness, solid-state lasers take over the predominance CO₂ lasers have today.”

with dramatic style changes.

Which technology do you think will do best in which future applications?

CO₂, disk, fiber lasers ... all have their place. CO₂ traditionally offered high-quality beams. Within the next few years, it will be interesting to see if high-brightness, solid-state lasers become cheaper than CO₂ and take over the predominance of CO₂ lasers have today. Twenty years ago, if you said you wanted to use a solid-state laser in production, everyone would ask why you'd want to do a silly thing like that. Now, it's the other way around.

On a consumer level, people are paying more attention to how “green” a company is. Do you see laser technology fitting into this trend?

Yes, laser efficiency is becoming more important as we head toward a greener environment. Lasers convert electrical energy into light energy, and we're starting to see some serious efficiency gains, but I'd like to see it go even further if possible. It also makes it easier to market and apply lasers with lower running costs. The push actually started in Europe and Asia where companies were paying about three to four

times more per kilowatt than we paid in the U.S. The better the quality, the higher the brightness, the better the beam, the better we can do our tasks and the more attractive lasers become for everybody.

If you could direct scientific and technological progress, which laser applications and technologies would you want to advance?

As I mentioned, I'd like to see more advances in efficiency and quality. There are new micro- and nano- technologies which could enable us to change how lasers work and how they are built to make them fundamentally simpler, smaller and more efficient. Also, I'd like to see more development in optics and end effectors for high-brightness solid-state applications.

One thing we haven't discussed is the industry in Asia.

Asia is quiet. It's difficult to gauge exactly what manufacturers are doing with lasers, but the sheer volumes of purchases and demand for lasers show that they are definitely involved in laser technology.

So, if you had a crystal ball, you'd look at what Asia is doing with lasers?

We'd all love to find out more about what Asia is doing. China is evolving. They're still trying to catch up, but specifically, I'd like to know what is going on in Japan and Korea. We know that they're remote laser welding and utilizing a lot of high-brightness solid-state lasers, but there has to be even more than that.

What trend excites you the most as you look toward the future of industrial lasers?

Better quality, smaller size, and greater efficiency — all of which bring about more application diversity. More and more, lasers are advancing into manufacturing and normal everyday production. We still need to overcome some hurdles, but as we resolve them, we're going to see a lot more growth, experience and integration. ■

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COMAU: INNOVATIVE INDUSTRIAL AUTOMATION

With thirty-eight locations in nineteen countries, the Comau Group is an international producer of automated robotic welding and assembly systems. Its Michigan-based subsidiary, Comau Inc., has more than fifty years of experience in automated assembly tooling and is one of the largest full-service suppliers of automated systems for the automobile industry. Comau Inc.'s core business is building robotic welding and assembly systems, but it also offers a wide range of other products and services to the North American market. The company integrates the latest technology into complete turnkey systems crafted to meet the design and manufacturing needs of its customers.

*The calm before the steel:
The “command bridge”
of a preassembled coil
welding system seen from
the perspective of the
outbound coil. The yellow
cabin houses the laser.*



Coil-Way

It doesn't get any tougher: Dirt, vibrations, heat — laser welding machines do their work reliably at the entry to the roll train. Nonstop. Coil by coil.

■ The laser welding system looms as large as a house behind Dr.-Ing. Christian Binroth. “This machine will be delivered to Mexico in November,” says the head of the welding machines business division at Miebach. The system will weld hot-rolled strip coils in the steel mill of APM in Monterrey, Mexico, before the steel is rolled into its final dimensions by the cold rolling mill. “Our welding systems make it so that the hot-rolled strip coils do not have to be individually loaded into the roll train. Instead, they can be run continuously through the system or continuous rolling mill,” explains Binroth.

In 1957, with the rise of the steel industry and the introduction of continuous rolling and strip treatment processes, Miebach delivered the first welding machines to weld strips up to 6.5 millimeter thick. At the time, the company used the flash welding method — after all, Miebach, founded in 1907, was an expert in the use of electricity for welding. In 1910, a patent was filed for electrical preheating of wheel tire, and in 1926, the first resistance welding machine was brought to market. A variety of resistance spot welding and flash welding systems would be built in subsequent years — “Miebach can



A production cycle in the steel mill takes at least three weeks, and the laser needs to keep pace.

solve any welding problem” was the motto at the time. Wideband flash welding machines were only a logical extension to their product range. The machines quickly conquered the world — starting with Europe. In the 1970s, you could find the machines at Hylsa, the leading cold rolling mill at the time in Mexico, at Sidbec-Dosco (now Arcelor-Mittal) in Canada, CSN in Brazil and Posco in South Korea. Additional orders came from Wuhan Iron & Steel Works, Anshan Steel, and Baoshan Steel in China.

Change of technology The slow goodbye of flash welding began in the 1990s. “Steel mills started introducing a casting method on a growing scale. As a result, the entry thickness of the hot-rolled strips in the welding unit grew thinner and thinner, so that now the average thickness is only two to three millimeters,” says Friedhelm G. Dibowsky, head of sales at Hugo Miebach GmbH. “In addition, the steel industry developed ever stronger steel that had to be put through the strip units continuously. Both developments brought flash welding up against its limits.” With flash welding it is almost impossible to weld such modern materials. It also became more and more difficult with the thinner hot-rolled strips for the sheets intended for welding to cleanly come into contact with one another — which is necessary for a high-grade welding

seam. “Hot-rolling and subsequent cool down produce internal stresses that cause cross-waves and buckling in the sheet metal. In the case of thin sheet metal, it is difficult to line up the sheets cleanly for flash welding,” explains Dr. Binroth.

Miebach found one solution for the new requirements in the form of laser welding technology. Friedhelm G. Dibowsky remembers that “wide-band laser welding systems were not possible until the 1990s. That’s when TRUMPF brought its 12 kW CO₂ lasers to market.” TRUMPF allowed almost any kind of steel to be welded to any other kind of steel for the first time — precisely the flexibility that the steel industry wanted. The strip system could then run nonstop, regardless of what grade of steel the customer needed. High-powered lasers were necessary to apply enough energy to the material. “We needed an adjusted laser beam focus to compensate for the waves and cracks in the material,” says Dibowsky. “Only through high power can you reach an adequate welding speed.” In terms of seam weld durability, laser technology has an advantage over flash welding. “With a laser, I have a heat-affected zone that is three to four millimeters wide. With flash welding, that’s about 14 to 16 millimeters,” explains Binroth. “That means the overall bond is less impaired.” The laser weld seams can now be better cold rolled, even for special alloys. The steel



Left: The heart of the system is a CO₂ laser. Miebach engineers love it because of its power and because it is rugged enough for the steel mill. Above: The other side of the laser bridge with a section of the welding system. Right: Dr. Christian Binroth heads the welding machine business division. Friedhelm G. Dibowsky is the head of sales at Hugo Miebach GmbH.

processing concept of coupling the pickler and the cold roll train became reliably feasible for these newly developed steels.

Hostile conditions But, the welding quality alone did not usher in the breakthrough of laser welding technology in steel mills — the system first had to withstand the hostile conditions of the rolling mill. When a 6.5 millimeter steel strip enters the system at up to 600 meters per minute, powerful forces are at work. The laser beam source must hold up against both vibrations and the aggressive vapors of the pickling acids. Rust, dust and extreme temperature fluctuations make matters even worse. “An extremely high level of reliability must be ensured because the continuous production cycles take at least three weeks in the steel mills — without interruption, around the clock. Every instance of maintenance, every disruption would be exorbitantly expensive,” says Dibowsky emphatically. TRUMPF’s CO₂ lasers have proven their value with a rugged design, high resonator thermo-mechanical stability, and a no-maintenance turbo-radial fan with magnetic bearing. After all, TRUMPF allowed Miebach to deliver the world’s first laser welding machine for mild steel in 1996 to BaoSteel in China. The ultimate proof of the new method came in 1998. The American company AK Steel set up a new cold roll plant in Rockport,

Indiana. For strips up to 2,100 millimeter wide, three laser welding machines from Miebach together processed the world’s first strips made of carbon steel and stainless steel in one line.

Laser welding technology has now been on the scene for some time. In fact, laser welding machines are almost exclusively used for new rolling mills or for renovations as with the APM plant in Monterrey. “For our small wideband welding system sector for picklers and cold roll mills with entry thicknesses of one to 6.5 millimeter, we now have a global market share of about 80 per cent,” says Dibowsky. Now, at the company’s 100th anniversary, almost 90 laser welding machines can be found in its reference list. ■

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A secure spot

Nine years ago a roll of adhesive tape astonished the world. Two researchers had lasered data onto it as holograms. The roll is history, the technology is more current than ever: as a high security label

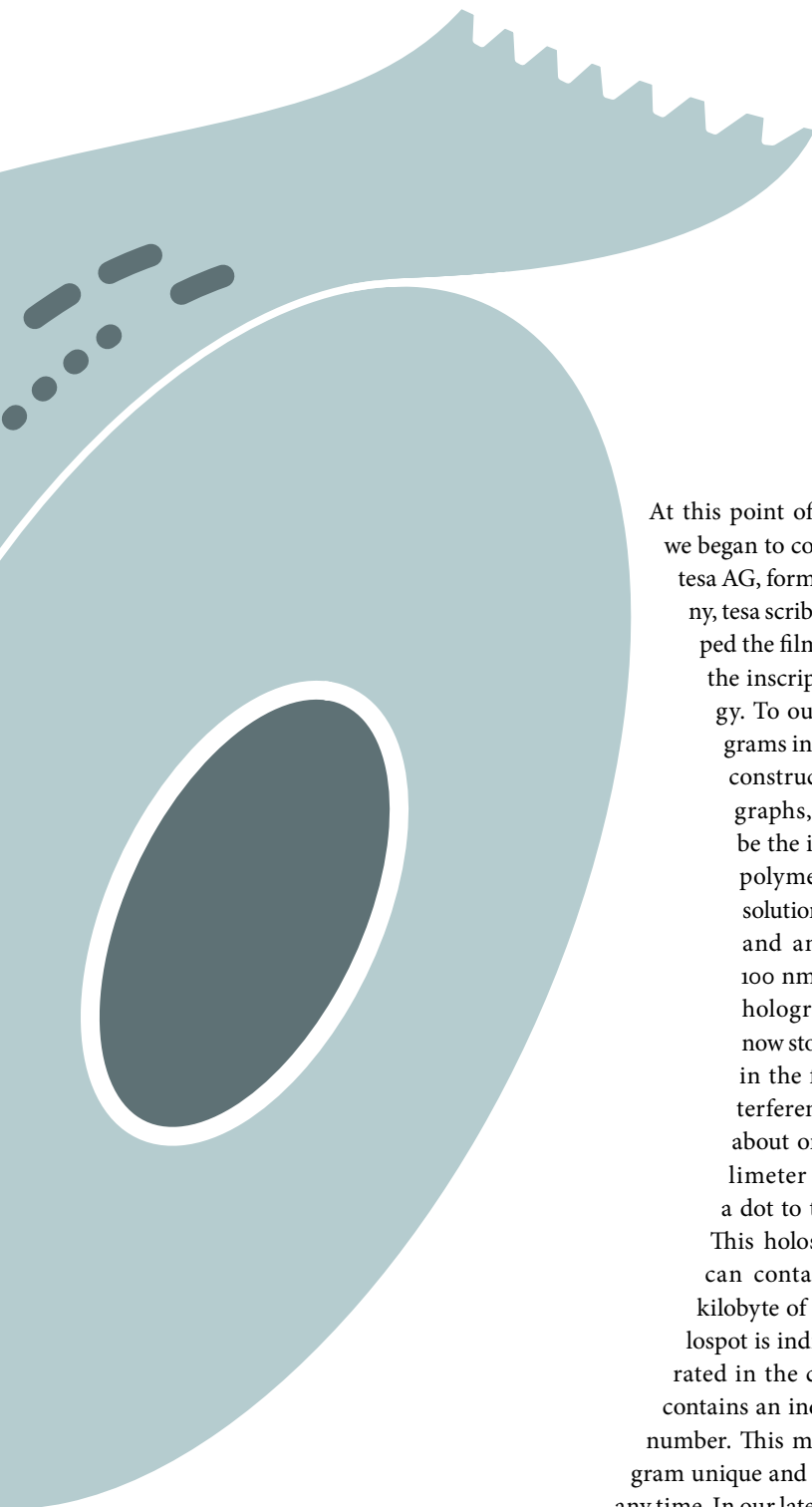
■ The more complex and encrypted the information is in a security label, the better, because product piracy becomes that much more difficult. Our holospot technology generates holograms in adhesive polymer film that only reveal their information by the light of a laser. What makes this special is the fact that every hologram and every individual security label is an individual piece.

How is that possible? Let's ignore the fascination of holographic images for a moment and look at holograms from a purely technical viewpoint: An object is "illuminated" by a laser. The reflected beams overlap with a reference beam. If you catch this light with a photo plate, a two-dimensional, very fine interference pattern occurs. This pattern can in turn be "read": If you illuminate the developed photo plate with a laser beam, then the interference pattern reflects it in such a way that the object's image reoccurs — three-dimensional and floating. Originally, this effect alone was so expensive to achieve that holograms became popular security features — especially as so-called rainbow holograms, which can be seen even in daylight at a certain angle. But these simple "debit card holograms" are relatively easy to copy now. The time was ripe for a new technology. One that perfectly identifies the secured product.

The hologram in the film At first we developed a process in which we managed without a photographic structure. A computer program was to simulate the reference pattern that the structure would generate. Not only does that lower the cost of the structure. But we can also use texts or numbers as "images" like serial numbers. In addition, we can change the simulated structure at will by simply varying the parameters. We also incorporate digital encryption and concealed information. Now the hologram can enter the "real world." The calculated structure is outputted into a suitable material and is shown as a hologram when it is illuminated by a laser beam.

Surprisingly, we discovered that a completely normal adhesive was a suitable supporting material. Ninety layers of a polymer film are stacked in a strip. Then comes the adhesive layer. Nonetheless, the film is clear as glass. Not only were we able to inscribe a hologram on the first try, but we were also able to read it again. A laser beam focused up to the bending limit changes the optical properties of the film only at a single spot. So the data of the computer-generated hologram are written into the film spot by spot. If another laser beam hits these spots later on, they function like optical lenses. They break the beam and the hologram becomes visible. Because the data points are not located on the surface but rather in a deeper film layer, they are well protected against destruction.

The film for the security labels came from normal adhesive tape. The lasers write the data as holospots into the interior of the multi-layered polymer film.



The smallest hologram is a square millimeter in size. But it contains a kilobyte of data that makes it unique.

At this point of development, we began to collaborate with tesa AG, formed our company, tesa scribos, and developed the film material and the inscription technology.

To output the holograms into the film, we constructed fast lithographs, which inscribe the image into the polymer film at a resolution of 50,000 dpi and an accuracy of 100 nm. The smallest hologram, which is now stored in the film in the form of an interference pattern, is about one square millimeter large — only a dot to the naked eye.

This holospot, however, can contain up to one kilobyte of data. Each holospot is individually generated in the computer and contains an individual serial number. This makes the hologram unique and identifiable at any time. In our latest lithographs, 1,000 beams from a rapidly pulsing frequency-doubled Neodymium YAG laser operate simultaneously at a wavelength of 530 nm. They process up to 100

megabytes per second. In this manner, we can produce a large number of unique copies very quickly. A single holospot costs only a few cents to make.

The three security levels We also use other technologies. A barcode with a numerical sequence is often a part of the label inscription as well as a rainbow hologram which is connected to the holospot and thereby secured. Our labels are therefore complex data memories that can be read with varying degrees of effort, offering different levels of security. We developed a special magnifying glass for the first level, the naked eye. This helps to read a part of the data stored as the rainbow hologram. Another handy reading device contains a semiconductor laser. This makes it possible to view the actual hologram in the holospot that is in fact only visible with a laser. But only a device that also contains a digital camera in addition to the laser and magnification and that can be connected to a computer makes it possible to evaluate the digitally encrypted information at the holospot. These reading devices are designed for use on an industrial scale: A single device reads and identifies up to 50 labels per second.

This multi-level security configuration enables the authenticity of the label fastened to the product to be checked with the right devices. For example, Beiersdorf was able to identify counterfeiters of Nivea products in Russia. Once counterfeit-proof labeling was introduced with holospots in 2004, the counterfeits were eliminated from the market and sales of the product increased by forty percent. ■

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“I want to
get people
excited
about lasers”

David Belforte has been on the move with lasers for nearly 40 years now. Here he explains why he set out on this journey, and what a failed start-up and a group of German engineers had to do with it.

■ *How did you get started in technology, given that there was no such thing as a laser when you were in high school?*

I have been interested in how things work since a very early age. This was probably inspired by listening to my father describe his work, in building and repairing synchronous electric clocks. After high school I served in the Army and worked with radar. Subsequently, I went to college at Northeastern University in Boston and received a bachelor's degree in chemistry.

With electronics just entering a boom period, why did you choose chemistry and not electronics — given your radar experience and your father's background in electro-mechanics?

I really had no interest or aptitude for electronics. I had trouble visualizing what I couldn't see with my own eyes; the electrons moving in the circuit and creating power. Chemistry seemed more tangible to me, and, as a child, I enjoyed mixing chemicals together and causing reactions.

What did you do with your chemistry degree after college? How did you get involved with materials?

My first job after college was in a materials science research group at Raytheon, a major electronics company. We investigated ceramic oxides to support the company's efforts to improve vacuum tube technology (this was just before the transistor appeared). I loved that job, which was almost pure research. A highlight was my work as co-developer of pyrolytic boron nitride which interested Raytheon because of its unique anisotropic electronic properties.

What made you leave a job that you so enjoyed?

I had become well-known in the vapor deposition community because of my work in boron nitride — through attendance at conferences and by presenting papers and lectures. Because of this a company specializing in electron beam deposition equipment offered me a job in sales engineering at double my Raytheon salary. I had just started a family, and I couldn't say no to this new and well-paying challenge.

Chemistry and then electron beam deposition, it sounds like you were still a long way from materials processing. How and when did you make that transition?

Based on what I knew about electron beams, I started a company with several colleagues to develop and commercialize the technology for welding. The venture was so successful that the company that had financed us, a manufacturer of conventional welding equipment, took us over and I eventually became a vice president and part owner. I was always interested in new welding processes to expand the offerings of the company, and it occurred to me that a new tool, the laser, had potential. So I met with engineers at American Optical, then a leader in laser technology, to talk about this. Fortunately, their parent company, a large personal products manufacturer, was also interested in funding technology startups and several of us set up a business within AO to investigate laser welding and other industrial applications.

My personal interest was in applications for the then powerful (up to 1kW) CO₂ lasers which were licensed from Ferranti. After the AO

David Belforte at his office in Nashua, New Hampshire, USA. Behind him the most important tool for his work, the magazine *Industrial Laser Solutions*.

PEOPLE

venture dissolved, I set up a new company for this purpose, funded by Ferranti. Laser cutting of sheet metal was just starting to take off in Germany and the UK, using gas nozzles with oxygen as the assist gas.

Lasers were only slowly adopted at that early time in the U.S. With your materials processing background, did this surprise you?

Yes. The laser offered some real benefits — high quality edges, faster cutting, flexibility, reduced scrap and process automation, but industrial engineers in the U.S. are very conservative and my message fell on deaf ears. After three years, Ferranti decided to pull their funding. However, this experience taught me the importance of market development through education — telling potential end users about the benefits of laser technology in language they can understand. I also realized that I enjoyed the process of market development as much as developing applications. So, in 1974 I became a free-lance consultant determined to do my best to spread the use of industrial lasers in the U.S. and beyond.

These days, you are probably more widely known for your magazine — industrial Laser Solutions — than for your consulting work. How did this magazine get started?

Believe it or not, it was German leadership that prompted this. In 1985 a group of German en-

gineers at a conference on material processing in Düsseldorf kept pointing out to me that there was no informational resource on industrial lasers or their applications. So, in collaboration with Morris Levitt, then publisher of Laser Focus, I set about producing the first Annual Industrial Laser Handbook, published in 1986. The first half of the book was filled with processing data, and the second half contained technical articles about applications.

However, readers began pressing for more frequent updates than we could achieve with an annual handbook, which led to the publication of Industrial Laser Review, a monthly newsletter with a paid subscription, that started in June 1986. Immediately, several companies wanted to advertise their products and services. Eventually, we transitioned into a conventional trade magazine.

Your time was now split between your work as a magazine publisher/editor and your work as a consultant, but you are also well-known for the lectures and courses you have taught about laser applications.

That's true. I had also become busy as a laser advocate working with various professional organizations in order to promote industrial lasers to the widest possible audience. For instance, I became very involved in the Laser Institute of America, eventually serving as president in 1978. For my contributions to advancing the tech-

nology of industrial laser materials processing, in 1995 the LIA, awarded me the prestigious Schawlow Medal, named in honor of one of the fathers of laser technology. I also persuaded the SME (Society of Mechanical Engineers) to underwrite a three day course on lasers and their applications. These activities have continued and grown right up to the present. I also conceived and organized, with the support of the SME, the first Laserobotics conferences held in 1985 and 1987, the precursors to the wide implementation of these combined technologies.

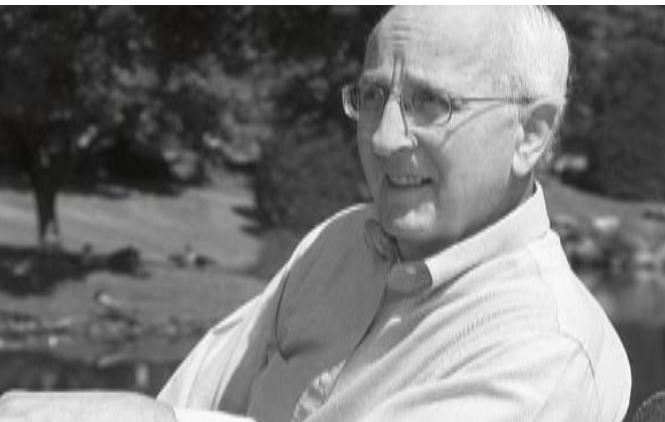
Finally, where do you see the industry and yourself in 10 years time?

I see continued growth for the industry, with new applications appearing all the time. As established applications, such as metal cutting mature, new ones like micro-ablation continue to advance the technology.

I honestly have no intention whatsoever of retiring. I love this industry and value the many wonderful friends and acquaintances I have made through my involvement in it. I have hobbies, but there's nothing else I could do that would be as much fun as my work in lasers. ■

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“After three years Ferranti pulled their fundings. This experience taught me the importance of market development through education.”



DAVID BELFORTE TODAY

David A. Belforte has a long association with industrial lasers and materials processing as a researcher, process developer, marketer, business strategist, journalist and educator. He is the Publisher/Editor-in-Chief of Industrial Laser Solutions, the preeminent international publication focusing on industrial laser processing. His annual forecasts of the laser market are highly regarded by the laser industry. For his contributions to the world-wide advancement of industrial laser processing, he was awarded the prestigious Arthur L. Schawlow medal.

“Given the situation, the laser was never invented?”

5 QUESTIONS TO DR. SEIJI KATAYAMA

“I don’t suppose so. Some genius men should do it sooner or later.”

Which application seemed impossible ten years ago?

Industrial application of remote welding; the development of high power fiber lasers; laser annealing or crystallization technologies; laser welding for airplanes and plastics; laser peening of austenitic stainless steels in nuclear power plants, and so on.

What is your wish, that lasers should also be able to do?

Cost-effective lasers and high performance lasers should be developed for further applications of laser welding technology. Another wish is the spread of laser-joining technology of dissimilar combinations of metals and plastics developed by us.

What change in laser technology is the most important to you?

Monitoring systems have been developed for high-throughput welding and adaptive control systems for stable production in

manufacturing. We have the adaptive in-process repair system for pulsed YAG laser spot welding. The next important change would be intelligent machines based upon the understanding of laser materials processing phenomena.

Do you have any laser technology role models or “idols”?

My role models may be three emeritus professors of Osaka University, since I have learned a lot from them. I was a graduate student under the guidance of Prof. Fukuhisa Matsuda at Prof. Yoshiaki Arata’s laboratory in JWRI of Osaka University for seven years, and then I worked with the late Prof. Akira Matsunawa for 20 years.

Dr. Seiji Katayama has been fascinated by the laser since he joined the JWRI, Osaka University in 1981. Becoming a professor himself in 2002, he successfully worked on welding phenomena and defect formation mechanisms concerning laser and hybrid welding. His current interest is to develop laser-assisted metal and plastic joining as well as to develop laser and hybrid welding with a high quality laser.

More questions to

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Hearing and hearty laughter. Laser-generated nanoparticles make implants like hearing prostheses for deaf children more compatible with the human body.



Mixing Nano-concoctions

Nano-solutions made to order?

Ultrashort pulse laser is a vital ingredient.

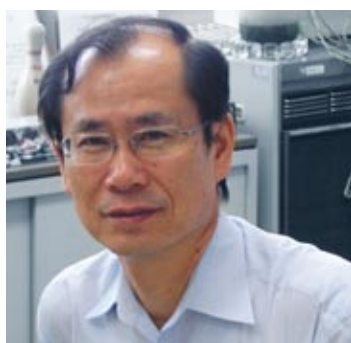
Take some solid material and an ultrashort pulse laser. The laser removes minute particles from the surface, nanoparticles. Trap these particles in the right host liquid, such as oil, water or a solution, which stabilizes the particles for further processing. Then repeat these steps with other solid materials and host fluids. The nanoconcoction is ready.

What sounds so simple is actually a doubly exciting new method for producing nanoparticles by using an ultrashort pulse laser. First, this “Rapid Nanomaterial Manufacturing” by the Laser Center of Hanover is not a chemical process. So, impurities from additives are limited. And, the size and mixing ratio of the particles can be controlled more precisely. Second, the laser can generate nanoparticles from almost any material, opening up a wide range of applications for medical, automotive and energy technologies. Likewise various

particles can be mixed to combine nano-effects. Families with hearing-impaired children, for example, can benefit from these new possibilities. A type of inner ear hearing aid, a co-chlear implant using electrodes, is surgically implanted to stimulate the auditory nerves. To modify the surface of these implants, the new process of “Rapid Nanomaterial Manufacturing” is used. But that’s just one example. There are no limits to what the engineers could come up with. After all, the laser abrasion method can mix any kind of nanoconcoction. ■

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I just don't know ...

■ There is hardly any topic in industry that brings up the question of the future like industrial laser technology. Every technological leap leads to the question of whether it will become the dominant concept of the future. That remains so today. But what drives the industry to worry about the future chances of a technology far beyond the amortization period of a machine? And why do the seers of the industry feel obliged to see the future in only one technology?

Perhaps it has to do with the fact that laser technology still belongs to branches of technology that are on-the-whole younger. Every new beam source technology that came to market in recent years was accompanied by an initial either / or argument. Let's not forget: The first high performance solid-state laser was seriously considered as a substitute for all CO₂ laser applications. The level of effectiveness and compactness of the first multikilowatt diode lasers temporarily gave this class of lasers the title "laser source of the future." However the reality of recent years has shown that there has been practically no replacement of existing technologies; every new beam source has found a secure place on the market and on the whole expanded the capabilities of lasers in industrial applications. This can best be seen from the fact that big players in the worldwide beam source business all offer a wide-ranging assortment of laser technologies. Anyone still investing in one technology today is only considered a niche supplier by the market. This is the reality in the year 2007.

However it is also a current reality that the fiber laser has ignited another either / or discussion in the industry. "So what" might be the response; it will again be the case that a new technology expands the application spectrum, only in individual cases at the expense of established technologies.

Disk or fiber?

Franz J. Gruber on the current industry controversy



Franz J. Gruber is chief editor of the industry magazine EuroLaser. He has given much thought to the question of how the fiber laser is changing the market.

But everything is different in the case of fiber laser technology. For the first time in the young history of industrial lasers, many insiders are not sure. The fiber laser is indeed ascribed an even greater substitution potential. Excellent beam quality, high energy efficiency, as well as extraordinary compactness and the other advantages that hardly need to be listed here fire the imaginations of users of all known industrial laser applications. This is the case throughout all application areas. That fiber laser technology has an equal opponent in the disk laser does nothing to change this fact. Both technologies have already shown that they know how to implement their individual strengths in all application areas. They face each other as immediate competitors, which explains the ubiquitous arguments that always end up in the headline "Disk vs. Fiber." If one focuses the substitution question on these two technologies, the conclusion remains: everything remains the same, each can find its place.

You don't really start to wonder, however, until you look at the vehemence with which the solid-state laser is approaching the classical "megamarket" of laser cutting. Industry experts no longer preclude great numbers of 2D laser cutting systems with fiber lasers in the near future. That is as good as a declaration of war on the good old CO₂ laser. Personally, I do not see it happening. But I have to admit, I am just not sure. We will have to wait and see. ■

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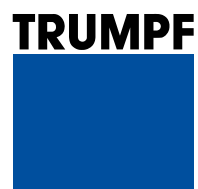
Where's the laser?

IN THE AIR BAG IGNITER: If it cracks outside, it has to crack inside.

Only an explosive cartridge can blow up the neatly folded airbag into a steering wheel-sized pillow fast enough to catch the driver's head. And, in production the propellant is explosive. During manufacturing of the airbag, the igniter is welded into a stainless steel sleeve but, it must not overheat. For almost ten years, continuous-wave lasers have made sure that it stays cool. With great precision, the continuous beam heats only the focused welding spot.

100,000 Kilometers

Across this distance, laser beams may one day power the motors of the so-called space elevator. For now, this way up from the Earth to outer space is still a technical dream. If and when it is ever realized is written in the stars.



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