01:08

Laser Community

THE LASER MAGAZINE FROM TRUMPF

Clear as day!

The future of photovoltaics is micromachining with lasers

→ Page 10

TUBES WITH A PROFILE

INSIGHTS FROM FISCHER

→ Page 18

Top Job

Van Rob's rise at GM

Father Figure

Marshall Jones and "at risk" children

WWW.TRUMPF-LASER.COM

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The German Engineering Federation VDMA reported recently that the production value of complete laser processing machines equipped with CO_2- and solid-state lasers grew by 85 percent between 2003 and 2007. A look at the manufacturers of lasers and laser systems certainly confirms this positive picture. The important competitors on the market are, almost without exception, companies that have gotten attention through reports of good news. You could say that the laser industry is an island of successful companies that found success on their own.

Our industry is, in fact, riding a wave of success. The laser as a tool is finding broader and broader use in industrial manufacturing processes. So far, we have coped with technological upheavals that haven't led to major shifts in the industry. Growth that is to be recorded over a wide front is primarily due to highly innovative achievements across a broad range of industries. The Schumpeter Process of creative destruction is taking place as if the second part of the phenomenon – the destruction – went by unnoticed in our industry.

The price of innovation is risk!

It would be foolish to believe that success and high growth through innovation don't come without a price. In our case, that price is risk. On the one hand, we live with the technological risk that new highly innovative products will bring with them. On the other hand, we accept the business risk that expensive developments can turn out to be a miss, and the resulting shortfall, in comparison to the competition, has to be made up for at even higher costs. The price of innovation that leads to growth is therefore risk.

Along with risk comes the need for earning power by companies in our industry. The two words "risk and profit" go together in the same proportion as do another pair of words – "growth and innovation." We will only be able to continue our success as an industry by intelligently balancing the relationship between growth and innovation, risk and profit.

The fact that newer and newer lasers are being developed for a rapidly increasing number of applications is the driving force of our activities, for the benefit of our clients.

PETER LEIBINGER
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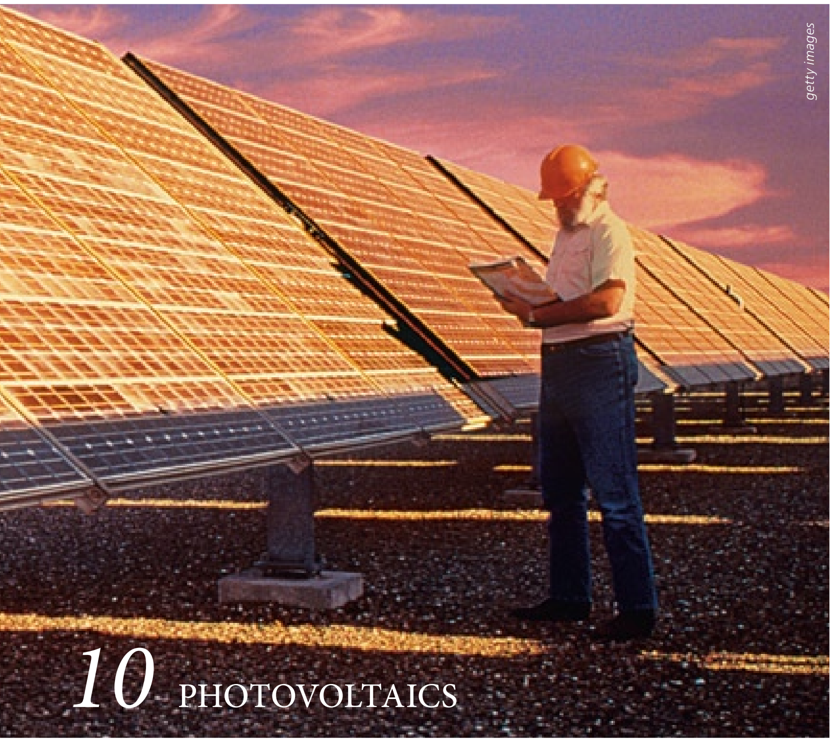

COMMUNITY

Lasers and People at a Glance PAGE 06

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TOPIC

TOPIC

Higher Yields

Photovoltaics discovers the laser. Starry-eyed: Microscopic processing technology produces major gains in efficiency. PAGE 10

Atomic Tetris Game

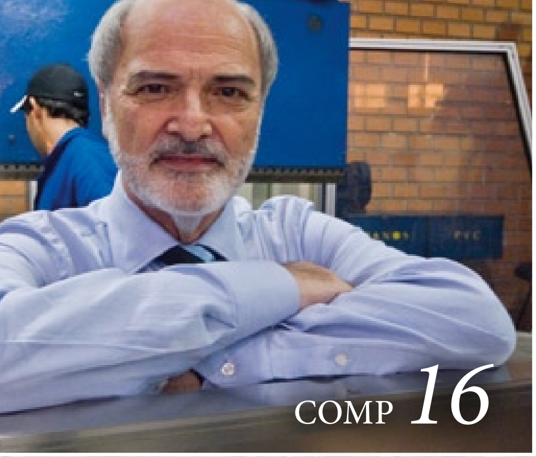
How modern, thin-layered solar cells are formed using controlled ionic currents. PAGE 14

STATEMENT

01:

"Every person, in their own way, is capable of being courageous"

Louisa von Spies wishes herself and everyone else more courage. She herself has already shown a lot of it. PAGE 15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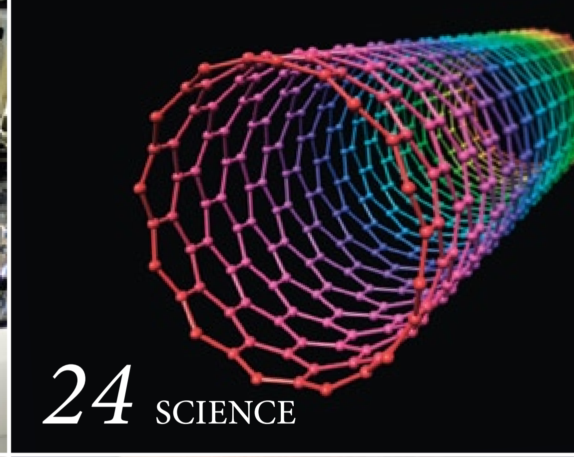
VAN ROB 21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26 DR. MARSHALL JONES

2008

S P O T

--- NEW ANSI STANDARD
The **Laser Institute of America (LIA)** has published the new standard for laser protective devices under the number **ANSI Z136.7.** The new standard is valid for systems with wave lengths between 180 nanometers and one millimeter. *www.laserinstitute.org*

--- LICENCE TO SINTER
Laser sintering is the key technology for e-manufacturing. To accelerate market growth, two German technology leaders, **EOS** and **TRUMPF,** have now issued the first pan-European license. *www.eos.info*

--- VIEW INSIDE THE PILL
Scientists at the **Rutherford Appleton Laboratory** in Great Britain have collaborated with the pharmaceutical company, **Pfizer,** to develop a laser-based procedure for analyzing medication capsules. *www.scitech.ac.uk*

--- AUTOMOTIVE WORKSHOP
The laser industry will meet with the automotive industry from May 13 to 15, 2008 for the **Automotive Laser Application Workshop (ALAW)** in Plymouth, USA. The event will address both manufacturers and suppliers. *www.alawlaser.org*

--- UP, UP AND AWAY
The goal is set: Space elevators in the 2008 competition are expected to climb one kilometer above ground level at five meter per second. **NASA** is offering a monetary prize of $2 million for the record. *www.spaceward.org/elevator2010*

--- ITALY GROWS
Market researchers at **Frost & Sullivan** expect the Italian market for laser welding to grow to a volume of 77.7 million Euro by 2011. This development is driven by Italian suppliers returning to German automobile manufacturers. *www.frost.com*

"By holding 'Stuttgart Laser Technologies' during the LASYS trade show, this event has gone beyond its regional boundaries."

Peter Berger is the deputy director of the "Institut für Strahlwerkzeuge" (IFSW), University of Stuttgart.

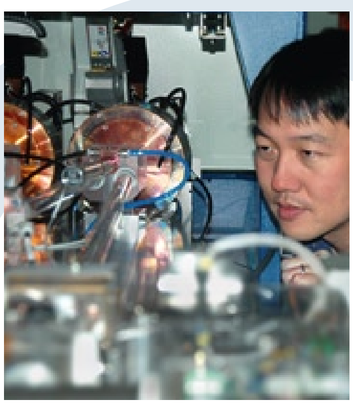
The Community meets

Best place to discuss laser technology's future: The one showing it

From March 4 – 6, 2008, laser experts and users met for the fifth Stuttgart Laser Days to discuss what the possibilities are for the laser as a tool in materials processing. For the first time, this meeting of experts was held as part of the new LASYS trade show. Peter Berger from IFSW Stuttgart: "Many participants have used parallel offerings as an ideal supplement." The meeting held every two years since 1999 serves primarily as an opportunity to exchange knowledge and information. This year, about 400 participants attended. In addition to current reference examples and intense discussions on which laser systems are ideal for which applications, the Stuttgart Laser Days dared to view future generations of laser technology. *www.ifsw.uni-stuttgart.de*

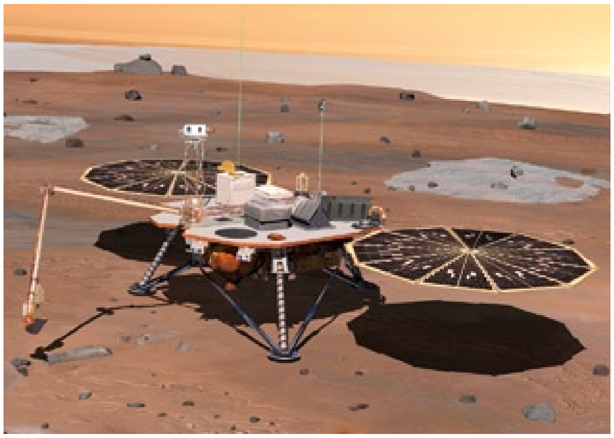
Power for Singapore

For the industry's benefit, SIMTech increases its range of systems



Dr. Daniel Lim Jye Suenn from SIMTech inspects the new disk laser

The Singapore Institute of Manufacturing Technology (SIMTech) has installed its first high power disk laser, thereby increasing its wide range of systems. The institute develops sophisticated manufacturing technology with a high potential for added value to enhance the competitiveness of Singapore's manufacturing industry. The new laser will be engaged in research on materials processing such as laser drilling, laser welding and laser additive processes. The short-term research and development activities aim at establishing a knowledge base to accommodate the industry's needs. The overall plan, however, focuses on supporting the increasing trend in Singapore in adopting laser processing technology for advanced manufacturing. *www.simtech.a-star.edu.sg*



Appreciating the partnership with NASA: Albert Bucheli, Head of marketing of maxon motor AG

Swiss Motor Technology on Mars: the Phoenix Lander

"NASA provides good tips"

How to get to Mars – and what are the advantages? Albert Bucheli talks about maxon motors' experience.

How did the partnership with NASA begin?

There was a bid invitation from NASA in 1992, focusing on which motor manufacturer could produce drives that were still able to operate at temperatures to about –120 °C. Due to the use of neodymium, our motors in the 90s were the strongest, with the best performance/volume ratio. As it is cheaper to modify current products, NASA had tested several hundred of our motors, bought, then retested them before applying them to the Pathfinder.

What makes the motor suitable for Mars?

Thirty nine drives are required for each probe. Ten are required just to make it maneuverable. The others are built into the camera tower, the drill arm, the pincers, the antenna and in the solar panels. The motors must be strong, light, resistant to the cold and robust. Every gram, every watt costs money. We have used lighter metals and left out a lot. Ball bearings without lubrication withstand the extreme temperatures, and 90 percent of welding is done by laser. The welding can be tested optically – which is important in quality assurance, as nothing is allowed to break.

What have you learned from outer space?

Tips provided by NASA employees allowed us to make improvements to our process engineering, from which all products benefit. Of course the media coverage and public interest is priceless. Other than that, and this no one can take from us; it is a great feeling to have been among the first to make it possible to undertake a further step into the future.

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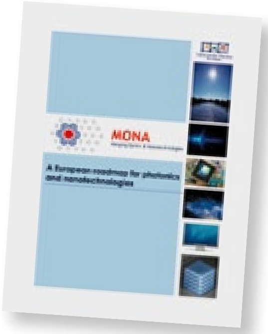
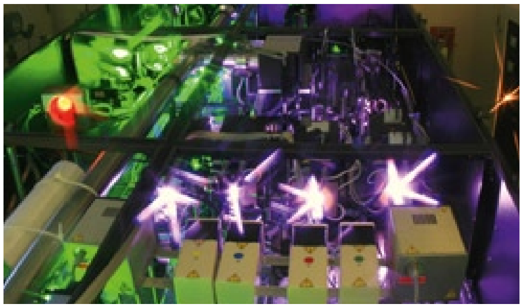


Perspectives for the future: The Mona Research Report.

Future outlook

In its recently published roadmap, the **Mona Consortium** reveals what huge perspectives are offered by the merging of the photonics industry with nano technology. Mona stands for "Merging Optics and Nanotechnologies" and was an initiative of the sixth EU Framework Program on research funding. Photovoltaics was recognized by the authors as one of the areas of growth. More than 300 experts from science and the industry contributed to this blueprint for a future industry. A free report shows in detail where this path will lead. *www.ist-mona.org*



The "record system" in Michigan

Record levels

Scientists at the **University of Michigan, US,** broke the record level of 300 terawatts of laser intensity with a pulse repeat rate of 0.1 Hz using a Ti:Saphir femtosecond laser. The immense performance yield was measured with a pulse duration of 30 femtoseconds. Research results from the pioneer of the ultra short pulse laser, **Prof. Gerard Mourou,** from the 1980s formed the theoretical foundation. The technical contribution to the world record can be found at: *www.opticsinfobase.org*

KD Busch; maxon motor AG; Mona/Europäische Kommission; University of Michigan; Singapore Institute of Manufacturing Technology

NETWORK NODE

NATIONAL CENTRE FOR LASER APPLICATIONS (NCLA)

"Internationally recognized research in laser technology in close cooperation with the industry, especially in material processing." This is the stated goal of the NCLA, established in Galway, Ireland, in 1989. The company currently conducts more than 50 research projects a year for leading customers. It provides advice, prepares laboratory-based feasibility studies and assists with the development of prototypes. NCLA offers training tailored to the industrial applications of laser technology and safety. Classes can be held on site if the customer prefers. The extensive laser machine park is available to industry partners to use for developing innovative products and processes. In addition to this close and productive cooperation with users, NCLA also actively participates in national and European research projects. This commitment has recently earned the NCLA a substantial grant as recognition of its outstanding role in national nano science and technology. *www.ncla.ie*

Quantum Leap

First contact

Elias Snitzer combines fiber optics with lasers. The telecommunications revolution is underway.

1961

New disks for Peugeot

Four networked disk lasers used to weld new Peugeot car

New technology for a new car bearing the Peugeot lion will be presented.

The **PSA Group** installed four new disk lasers with outputs of 6 kW and 4 kW at its new factory in Sochaux, France. The beam sources allow for several processing stations. In the original plan, PSA assumed that it would need six beam sources, but with the installation of the **TRUMPF LaserNetwork,** which distributes the laser output, PSA has been able to reduce the number of beam sources to four. Starting in 2008, the processing stations began to weld the tailgate and doors of a new Peugeot car.

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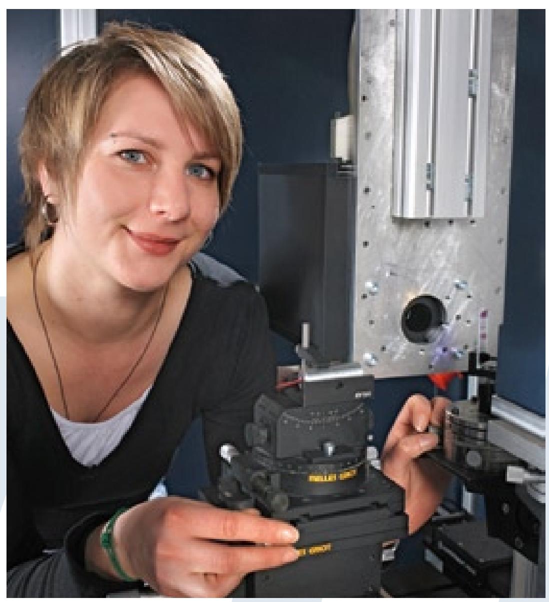
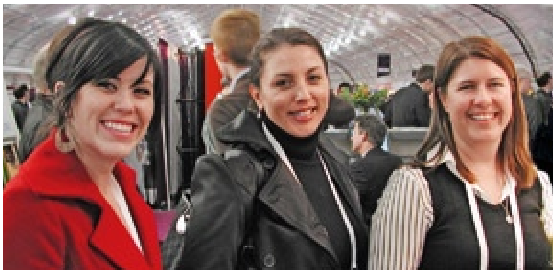
With the eyes of a robot

A seeing remote laser welding system in the laboratory

The research project **SeScan** at the **Laser Zentrum Hannover e.V. (LZH)** is expected to further simplify scan-based remote laser welding. A camera-based image processing system and a distance sensor system have been integrated into an intelligent programming and control concept to take the pressure off system operators during programming. This in turn simplifies communication between man and machine, reducing the programming effort and significantly increases productivity, especially for small lots. Researchers at LZH hope to present two simple-to-program, scanner-based prototypes by the end of 2008. Project partners anticipate a commercial implementation of the solution will follow soon after. *www.lzh.de*



Nina Wardenga manages the SeScan project and studies the integration of sensor systems.



“Technology in motion”, is what Brittany Miles (left), Nancy Castro, and Jeannette Wilson from R&D and Communications at Freescale Semiconductor wish for.

Showtime

Photonics West is the most important exposition for optical technologies in North America. Nancy Castro, Jeannette Wilson and Brittany Miles from Freescale Semiconductor talk about their visit.

“Why did you choose to attend the Exposition?”

Nancy Castro: “Jeannette is here to talk to industry experts about programmable processing and networking. This helps us determine which projects Freescale should focus on. Brittany and I are here to determine if we should exhibit at Photonics West in the future.”

What did you expect to see at Photonics West?

Brittany Miles: “I was surprised that there were not more live demos. The TruMicro was the first laser I saw running an application at Photonics West. I expected to see more exhibitors running their lasers.”

WORTH A TRIP

Japan’s International Welding Show

This is Asia’s largest welding show and one of the top three welding shows in the world. The tradeshow’s theme is “Think future, act now.” There certainly is plenty to think about here: The show’s focus will include welding robots, laser welding and surface treatment technologies, as well as non-destructive testing methods and welding materials. In 2006, the show attracted 226 exhibitors and more than 100,000 visitors. This makes the show an excellent opportunity to meet with prospects from booming Asian markets, exchange ideas, and network.

EUROSTAMPI: International dies and molds, press and injection machine show

SEMICON: Semiconductor equipment and materials

IMTS: America’s largest multi-sector manufacturing show

EUROSTAMPI
April 03 – 05, Parma, Italy
www.senaf.it/eurostampi

SIMTOS
April 08 – 13, Seoul, Korea
Seoul’s international machine tool show
www.simtos.org

JAPAN INTERNATIONAL WELDING SHOW
April 09 – 12, Osaka, Japan
The largest welding technology show in Asia
www.weldingshow.jp

MACH 2008
April 21 – 25, Birmingham, England
International trade show for metal cutting and metal forming technology
www.mach2008.com

SEMICON
May 05 – 07, Singapore
www.semiconsingapore.org

AKL
May 07 – 09, Aachen, Germany
International laser technology trade show
www.lasercongress.org

ALAW WORKSHOP
13. Mai – 15. Mai, Plymouth, USA
Automotiv laser application workshop
www.alawlaser.org

LAMIERA
May 14 – 17, Bologna, Italy
The trade show for metalworking technology with an emphasis on new consumer goods applications, www.lamiera.net

NEPCON MALAYSIA
June 03 – 06, Penang, Malaysia
Electronics manufacturing exhibition
www.nepcon.com

IMTS
September 08 – 13, Chicago, Illinois, USA
www.imts.com

AMB
September 09 – 13, Stuttgart, Germany
International metalworking show
www.messe-stuttgart.de/amb

AMT-The Association For Manufacturing Technology; euromediahouse; Getty Images/Kim Steel; PSA Peugeot Citroën; SEMI Singapore; Senaf; SIMTech

Solar farm in the US: The efficiency in manufacturing, as well as the effectiveness of the model, influence the future role of solar energy. The potential is immense, both here and there.

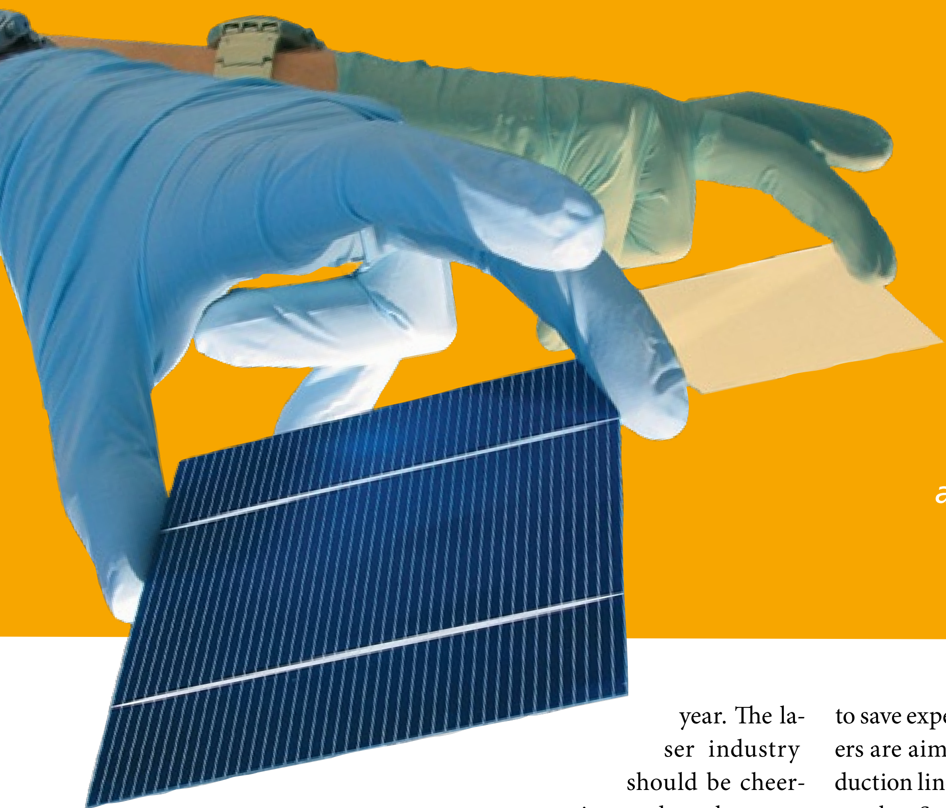
Getty Images / Lester Lefkowitz

Higher yields

Capillary conducting paths, wafer-thin layers and micrometer precise drillings: The success of solar energy is determined by the tiniest of things, which result in overtime for the laser.

Solar cells on roofs have progressed to become a status symbol. They protect the environment and they look chic – especially due to the silver shining conducting paths, which span the front side of the crystalline silicon solar cells like a net. But what pleases the eye does not necessarily please the manufacturer and their customers. This is because the conducting paths, which are positioned onto the semiconductor material using a screening process, and which discharge the load carriers, waste valuable surface space no longer available to collect sunlight – up to ten percent is lost due to these paths. Engineers found a solution about 15 years ago. A laser etches grooves into the silicon, which are then filled with metal using a galvanic process. This costs only about five percent of the surface, making cell efficiency accordingly higher. “With the laser-grooved solar cells, laser processing in photovoltaics manufacturing was born,” remembers Andreas Grohe, head of laser and coating processes at the Fraunhofer-Institut für Solare Energiesysteme in Freiburg, Germany.

Much has happened since then. Lasers are now used in the photovoltaics industry for drilling, cutting or removing layers – with an increasing tendency. This is mostly thanks to the market. The growth rate of the photovoltaics industry in the last five years was above 40 percent – per



These 160 µm thin silicon solar cells are applied to the front side using the screening process. A laser is used to connect the 10,000 contact points to the back side of the reflective aluminum surface visible in the background. These contact points, each measuring a one-hundredth of a square millimeter, convey the load carriers via an insulating intermediate layer.

year. The laser industry should be cheering, and yet the exact opposite is the case. "Laser manufacturers often do not know what fantastic things they could make with their products when manufacturing solar cells," Grohe observes surprised.

At the limits of mechanics

Sometimes companies are quickly discouraged – as, for example, with edge insulation. About four years ago, the entire solar industry converted to lasers in order to remove a few millimeter fractions of semiconductor material from the edges of the silicon wafer, which could otherwise lead to undesired short-circuiting around the edges, by firing it with light. Wet chemical procedures are now taking over the laser, and laser suppliers doubt whether the market is becoming overrated. This is not, however, the end of laser – much the opposite, according to Grohe: "The industry has to recognize that this was the first admission ticket into the solar industry and that many new applications are yet to be unlocked." The Verband Deutscher Maschinen- und Anlagenbau VDMA also confirms this. Dr. Eric Maiser, Head of the "Forum Produktionsmittel für die Photovoltaik" at VDMA, believes German suppliers are well equipped for the solar market: "Manufacturing processes in photovoltaics are similar to those in conductor board, semiconductor or display production – and German companies have a lot of experience in this area."

The times when crystalline solar cells, which still continue to dominate the market with well over a 90 percent share, are mechanically drilled or sawed, will most likely soon come to an end. Two trends are the door opener for the laser. One is that wafers are becoming increasingly thinner in order to save expensive silicon – the goal is 0.1 mm. The other is that manufacturers are aiming at a production rate of one cell per second, as well as production lines. According to the unanimous opinion of 130 specialists, who met last September in Hameln, Germany for the international conference "Laser Technology in Photovoltaics" this is almost impossible without the use of a laser. The fact that production costs for new production and cell concepts are increasing at the same time does not interfere, because the solar cell will quickly recoup these costs due to its higher energy yields.

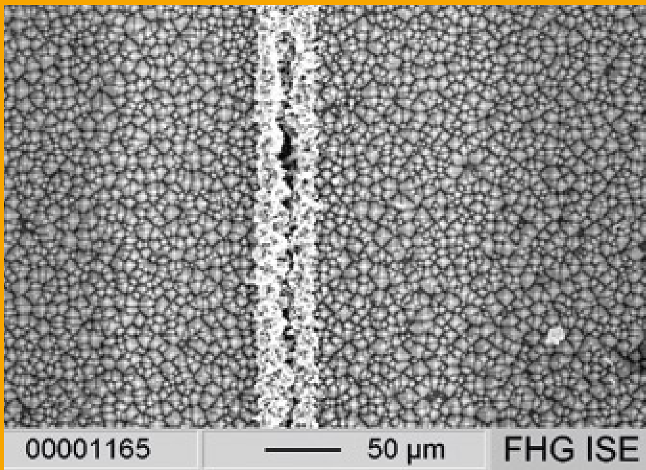
Ultimately, all development projects share a common goal: increase the efficiency of a solar cell, or, to be more precise, the performance yield per cost. Scientists at Germany's Fraunhofer ISE in Freiburg developed a solar cell together with the Institut für Solarenergieforschung in Hameln, Germany, and a manufacturer, which accomplishes an efficiency of 21 percent instead of today's standard 17 percent. This was achieved by integrating four steps with laser processing into the manufactring process.

The knack of the back side

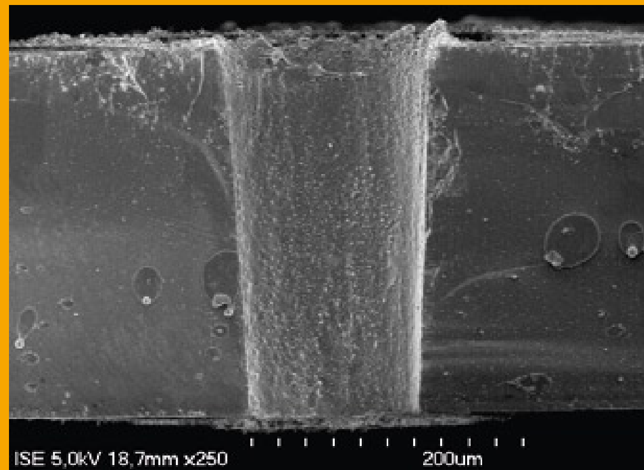
The Institut für Solarenergieforschung in Hameln, Germany, follows another concept. It installs the emitter contacts on the back side – this means there are no more conducting paths blocking the sun on the front side. Instead, tiny conducting holes in the silicon substrate allow the load carriers to flow from the front side to the back, where they are collected using standard metallic lines and are then fed into the electricity network. A lot of holes are required to keep the distances as short as possible, at least one per square millimeter. For cells with about 15 cm long edges, this represents up to 30,000 holes that can only be drilled with a pulsed infrared laser in a matter of seconds and at production speed. The surface loss caused by the holes is less than one percent.

Another reason the silicon disks should be thin is that they can more effectively collect short-wave light that only penetrates the surface by a

Fraunhofer ISE, KD Busch



Edge insulation as seen through the microscope: the separating laser-drawn line runs trough the center.



A cut-through view of a laser-drilled hole in a silicon wafer

> "Edge insulation was only the admission ticket for laser into photovoltaics."

Connecting lasers and photovoltaics: Andreas Grohe from Fraunhofer ISE

few millimeters. What is practical for ultraviolet light has disadvantages for long-wave infrared radiation, which penetrates a millimeter deep and partially leaves the semiconductor at the back, without contributing to electricity production. This is why aluminum is applied to solar cells from behind as a reflective coating. While aluminum has good reflection features, it also leads to recombination of the load carriers and therefore performance loss. A wafer-thin layer of silicon oxide between the actual energy producing layer and the aluminum would be ideal, as this would prevent the recombination. This layer must, however, be opened to allow contact with the conductive paths. The Fraunhofer-team therefore pierces the sandwich from behind using a laser that forces the aluminum into the silicon oxide layer, creating contact. Here, too, the points of entry must be set only millimeters apart. This process is so new that it has not yet been implemented into bulk production. However, Andreas Grohe believes it is only a matter of time.

Costs compared with profit Thin-layered solar cells are a relatively new player on the photovoltaic market. While these convert less light into electricity, they are cheaper. In addition, they please the eye even more because they completely forgo the metallic wiring on the front side. The load carriers must however, still be collected. This is why, between the coating steps, manufacturers etch several thin lines into only a few micro millimeter thin layers that are made up mostly of amorphous silicon, but also copper, indium and selenium (CIS cells) or Cadmiumtellurid, and are then evaporated. This so-called "patterning" helps divide the flow of the load carriers when lighting the semiconductor material into portions, so that these flow to the edge of the solar panel with higher voltage, but less electricity. With CIS cells, this is still done today using CNC machines, which scratch over the semiconductor layer with a needle; the laser has already established itself for cells made of amorphous silicon or cadmium telluride. Even expensive and complex photolithographic processes are still common in thin layer manufacturing. The industry is convinced that lasers will in the future take over these tasks. Lasers work contact-free, wear-free and faster. This makes them, in the final count, also cheaper.

They are also more precise. A 30 µm narrow patterning requires the surface of two neighboring light spots to overlap by 25 – 30 percent in order to produce an even structure. To remain with-

50 billionths of a second is still too slow for patterning.

in this margin, a 20 µm fine light spot must be positioned with an accuracy of one micrometer. The cells made of amorphous silicon that dominate in the thin layer division can be easily processed with a nano second laser with a pulse duration of 50 billionths of a second – this is where laser manufacturers can gain the most business. They are still too slow, however, for patterning efficient CIS cells. The trained eye would be able to recognize melted material remains and fine cracks under a microscope. These can be avoided using new laser sources with ultra short light pulses, lasting ten trillionths of a second. A picosecond laser has the advantage that it can concentrate a high power of up to 50 million watts onto the layers of a thin layer solar cell and then evaporate them. Because each individual pulse is, however, so extremely short, the surrounding material heats up only slightly. Whoever thinks that short pulses are synonymous with slow is wrong. The newest laser from TRUMPF fires 200,000 times per second and etches nicks thinner than a hair into the semiconductor material – several meters per second. ■

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*How it works: An extremely stabile generator ignites the plasma, the ions of the plasma meet on a block of material, releasing atoms, and these embed themselves evenly across the surface.**

Atomic Tetris game

Every atom counts when it comes to a layer thickness of only a few millionths of a millimeter.

The coating of thin-layered solar cells functions similarly to the well known computer game Tetris – only faster and with more precision. Atoms that are knocked out of a block by gas ions hit a glass plate, and a wafer-thin layer forms within seconds. The process then starts again – the layers of semiconductors and contact material are only a few micrometers thick.

Just no arcing

The plasma that produces the gas ion must be extremely consistent, so that the layer can grow as smoothly as possible – and this is only possible with stable generators. They ignite the plasma with voltages between 800 and 1500 V and adhere to it at frequencies between 0 (d.c. voltage) and 27 MHz. The major challenge: As the plasma is never completely homogeneous, arcing can occur every now and then. These discharges disrupt the sensitive layers. Microscopic craters that could, for example, break through the insulation layer are created wherever the undesired arcs strike.

An intelligent sensor system in the generator must then turn the generator off and on again within less than a billionth of a second; otherwise stripes will occur on the solar cell, running under the plasma cannon. The generators of the TRUMPF subsidiary HÜTTINGER Elektronik in Freiburg, Germany, are especially precise and fast for the so-called Arc Management. ■

*Still taken from "Elektrisierende Verwandlung", www.huettinger-electronics.com/123.film.html

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Louisa von Spies graduated in 2008 from the "Max Reinhardt Seminar" in Vienna

"Courage please!"

It requires courage to start something without knowing where it will take you. Still it is the only way to find out. Louisa von Spies does know what she demands here.

The first thing I thought of when asked to prepare a statement on "courage" was: "Do I have the courage to write down my thoughts on courage? And before you know it, here we are. That's what you and I run into when courage is required: Our fear. Where does this fear come from? It is always there. Fear of the truth, fear of failure, fear of being alone… Was it always like this? Was I always so fearful? – No. It was different as a child. I just acted, without long negotiations, risking a cut lip, and without thinking twice. There were the dares and the showing off, fights with the little sister… but, above all, there were dreams. Courage to dream as if I was crazy. To play, laugh, scream, surrender yourself and broadcast it loud and clear to the world.

These days I am an actress I don't generally have the courage to call myself that. Immediately there is this fear of not living up to it. I'm only a beginner. And then there's that term "raw recruit". That's me. A "raw recruit". Because in my profession, in this vocation, you are raw and have to suffer. You have to be courageous and conquer your fears. But, first of all, you must confront your fears and be like a child. After all, we never really stop being a child. The child that we suppress because we think only grown-ups are accepted. This is not true. Being a child is wonderful. To be a grown-up child is wonderful. Dream, dream great dreams and have the courage to believe in them, with all your heart and soul.

Just one thing is important: Be careful of cockiness! It is not about over-estimating yourself. It is important for me to always reassess and scrutinize myself. I want to be courageous, which I am. I am active, live my dreams, hold on tight to my ideas, defend them and always re-think them, because life will re-shape them. And I notice that courage is healthy. It is correct not to avoid your own courage and I know, every person, in their own way, is capable of being courageous.

In 2004, I began studying acting or "performing arts", at the Reinhardt Seminar in Vienna, Austria. It was not easy for me to live my dream. Family, friends, strangers and even myself – we all had doubts. I am now completing my studies (hopefully with a Master's degree) and am starting to work at the Staatstheater Braunschweig, Germany. The road there was not easy going. To assert yourself, fight it out and then to take a deep breath again. Decide. Don't lose your courage. The joy. Wanting to risk, win, and, yes, lose. But this effort is not in vain.

I love my path. I passionately love the theater, the search for magical moments, for that which we call art. The infinite freedom that theater gives me and that I have not experienced anywhere else. And when I suffer, because the world is not waiting for my dreams and does not greet them with open arms, because reality likes to kick dreamers awake, the joy I feel when I succeed is so immense, that I am more than compensated for all my troubles.

And I can only recommend: Be courageous! In your life, in your career, always. Drink a cup of healthy self-confidence every morning. Don't be taken in by competitive thinking and the pressure of success. It is not about being better, faster, more successful than the next, no matter what the costs. It is about finding your own pace, acknowledging your own qualities and working with these. Not forgetting the ensemble around you, finding your own space within, and to shine therein.

I wish both you and myself all the necessary courage!

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“Specialize? It’s too risky in Brazil.”

Wilhelm Werner Mertens from Comp on job shop strategies in a vertiginous economy.

How established is the laser as a tool in Brazil?
Things have a long way to go here. Only laser cutting has become a generally accepted practice in the industry. You don’t see complex techniques like welding being used very much. Comp is the first company in all of South America to offer laser hardening. Industrial customers in Brazil purchase about 50 laser machines a year. That’s not a lot, considering the potential that the market has to offer laser users. With the exception of the CTA – the Centro Técnico Aeroespaciale – and the Instituto Technologico Brasil-Alemanha, or ITBA for short, there are hardly any scientific research and training institutions that work with laser technology.

What is the reason for the lack of distribution of lasers in the industry?
Thus far, volume has been fairly low in the automotive and machine tool sectors. Also, in many industries, quality standards have not come up to the point that they would basically be forced to use lasers. Finally, the cost of labor is quite a bit lower here than in highly industrialized countries, but that’s all changing very quickly.

Why is that?
Brazil is undergoing rapid growth, and companies are better able to bankroll. They’re also exporting more and more products. Because of this, auto manufacturers, for example, have to comply with international standards if they want to sell their cars in the EU. Or a manufacturer has new tool drawings coming in, and suddenly it has to make certain parts with a laser.

In other words, you often invest without being able to exactly assess the market requirement.
We never import cutting-edge systems because there’s a customer standing there with an order in his hand for it. When it came to laser tube and pipe cutting, for example, we had to work long and hard to persuade potential customers to outsource that work. So far, we’ve always done well with our investments, and every year, we’ve grown two to three times faster than the market as a whole. In a country like Brazil, you can’t let yourself be deterred by the many ups and downs and possible changes in terms and conditions. In the last ten years, Brazil’s economy has been through two major crises. The currency would be devalued one day and revalued the next. Still, we’ve never been in the red.

You offer a broad range of services, similar to a vendor’s tray. Why don’t you specialize?
That would be too risky in Brazil. We’ve always tried to serve as wide a spectrum of customers as possible across many industries. Today, we have 400 customers that run the gamut from automotive industry to kitchen appliance manufacturers. This is the only way that we can ride out a downturn in one industry or compensate for losing a customer. The “vendor’s tray,” as you call it, keeps us strong.

Do you ever lose customers because they invest in laser machines themselves?
Sure, that happens. We always take note when a good customer starts asking a lot of questions. We even provide consulting services seing that they’re underestimating the time and expense involved. For example, they count on being able to take in contract work whenever they have excess capacity available. Of course, that’s easier said than done because you can’t land contracts until you familiarize yourself with the market, and that takes a while to do. And buying the machine is really only the first step. However, Brazilian companies tend to be very focused on turning a quick profit. Companies like that aren’t interested in investments that take years to bear fruit. They’d rather cut themselves loose in a hurry.

You mentioned there is little research and education on laser technology. Is it difficult to find capable employees?
Yes, and it keeps getting harder. Because the economy is booming, workers with specialized skills are in short supply. We consistently have to make a major investment there. Thirty employees have already gone to Germany, Austria and Switzerland for training. For a more optimal use of resources, it would be helpful if the manufacturers of these machines and systems could offer orientation and training here in Brazil, similar to what TRUMPF is already doing.

Brazil currently imports all its laser machines. Do you think there will ever be a national manufacturer?
No, I think that’s actually more and more unlikely as time goes by. Technology is developing and advancing in heavily industrialized countries at such breakneck speed – Brazil just doesn’t have the depth to keep up with that. Furthermore, I don’t see the Brazilian market growing enough in the near future to justify domestic production. ■

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Comp *has used laser technology since 1995. Comp is a leader in the South American market for cutting, welding and laser hardening steel components.*

Wilhelm Werner Mertens*, 63, has been Comp's technical director for 13 years. Before coming to Comp, the German engineer and manager worked for 20 years at a German automotive company in São Paulo.*

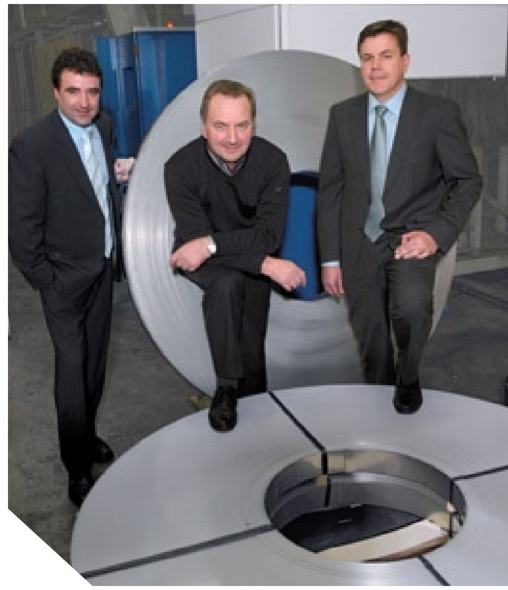
Cool down!

To cool down emissions as quickly as possible: The task set upon the winglet pipes from Fischer is simple. The production, however, is not.

“This work demands nothing less than the very highest quality and precision,” says Hans-Peter Fischer, balancing a rather ordinary-looking, foot-long, thin-walled stainless steel RHS in his hand. “This is why a laser is the only possible choice for welding and marking,” Fischer, the 36-year-old CEO adds. His father, Hans Fischer, founded the international Fischer Edelstahlrohre Group. Why does he insist on using laser-welded stainless steel? Once the steel has been shaped, the finished piece must tolerate temperature variations of up to 800 degrees Celsius, remain impervious to corrosive sulfur precipitates, and withstand extreme mechanical stress ranging from high-frequency vibration to severe impacts. Upon closer inspection, one immediately notices the symmetric protrusions on the part that resemble airplane wings. And it is these formations that give the part its name. Called “winglet pipes,” the parts are used in engine exhaust systems – more specifically, in EGR coolers.

From aircraft construction to exhaust systems Most people are familiar with winglets on airplanes. On airplanes, winglets improve flight aerodynamics; in automotive EGR applications, winglets create desirable turbulence for optimal cooling of emissions passing through the exhaust pipe. Exhaust gases are subjected to pressures of up to four bar as they are forced through winglet pipes bundled very tightly inside a housing. Engine coolant flows through the gaps between the pipes. This reduces the exhaust temperature by several hundred degrees so that the gases can be recirculated and mixed with the fresh air intake. This after-

Within 15 meters, a simple stainless steel band becomes a high-tech product, known as the winglet tube.

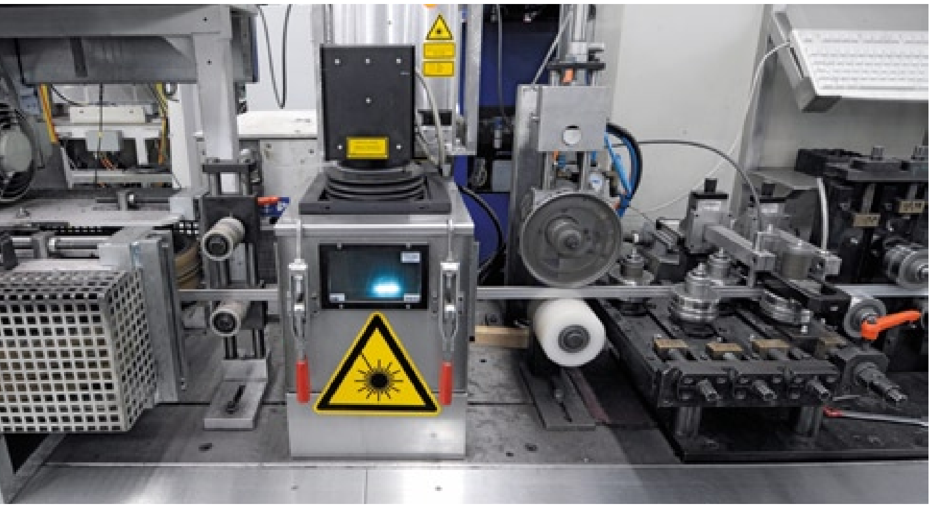


Christian Behrle (left) participated in establishing the production of the winglet tube and has been supervising it since the tube was produced by the company's founder, Hans Fischer, (middle) in 1974. Today, the group of companies is led by himself and his son, Hans-Peter Fischer.

burning reduces fuel consumption, thus reliably reducing emissions from car, truck and bus engines around the globe. For more than 20 years now, Fischer Edelstahlrohre GmbH has been processing stainless steel strips into components for automotive exhaust systems. "The introduction of catalytic converter technology in the early '80s helped us make a breakthrough internationally," explains Fischer. The company, which now runs production facilities in five continents, has two primary factors to thank for its success: its own in-house profiling technology and laser welding technology.

Laser at work The above technologies are used to manufacture winglet pipes on special profiling machines designed and developed by our own engineering department. For the weld seam, we relied on a CO_2 laser from TRUMPF. „We thereby have over 15 years of experience with this technology and have been able to establish ourselves as a global specialist for demanding applications," explains Christian Behrle, who has headed up the further development of this product division right from the start. When it comes to the production of components with tight tolerances, the laser truly shines: It provides touchless, load-free welding at high processing speeds while minimizing the thermal load on the workpiece. This results in seams with very small heat-affected zones and zero distortion in the pipe.

Component traceability plays a very important role in the automotive industry. Each of the winglet pipes built into an EGR cooler bears a



Left: A laser records all important data on the passing tubes to be able to retrace every batch.
Right: The tubes are later packed very closely together. Precision, therefore, plays a major role.

The systems in South Africa are identical in construction to those in Achern, Germany. Only in Pretoria, the tubes are already cut by laser.

batch number behind which stored all production and material information documented until the steel is melted for scrap. Fischer also relies on TRUMPF laser technology to mark these parts. Laser marking can not only handle the extreme conditions, it can also be performed “on the fly” as an additional step in the production process, and it is touchless and non-wearing as well. This protects the material and cost centers.

Today, Fischer produces different types of winglet pipes in Germany and South Africa. The systems used in Achern, the company’s headquarters, are no different than the production lines in Pretoria. “To set world-wide standards for quality, we produce internationally under identical conditions. This means we are currently using about 60 TRUMPF lasers, including sensors, worldwide,” says Hans-Peter Fischer with a view to the EGR cooler housing also produced at Fischer. ■

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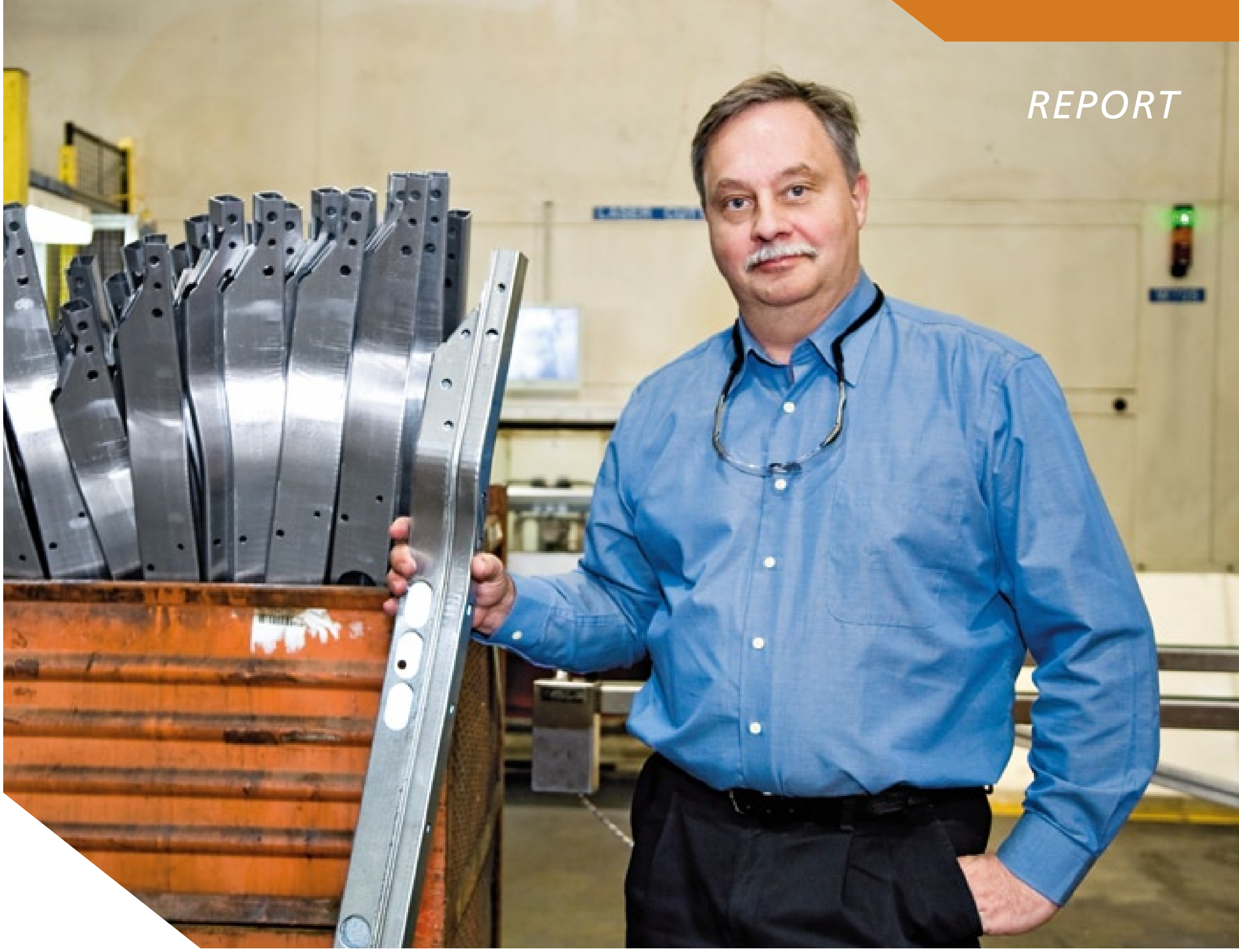
FROM AN IDEA TO MASS PRODUCTION

The roots of the Fischer Unternehmensgruppe reach back to 1969. Hans Fischer, a resourceful master mechanical engineer, supplied customers with tools that soon garnered him a reputation as a problem-solver. Today, 1974 is considered the year that tube production began. Confronted by a bottleneck at one of his suppliers, Fischer decided to produce stainless steel tubing himself. For months, he worked on building his own profiling system, laying the foundation for his future success. He broke into the automotive industry in the early 1980s. Demand for stainless steel tubing skyrocketed with the advent of new exhaust system technology, and Fischer won many customers with his solutions.

Today the Group employs more than 1,600 employees around the globe in Europe, North and South America, Africa and Asia. The Group consists of three companies. Fischer Edelstahlrohre produces tubing. Fischer Rohrtechnik processes the tubing into finished components. And Fischer Maschinentechnik develops, designs, and produces the machines for tube profiling and tools for creating finished components. The son of the founder and CEO Hans-Peter Fischer describes it so: “This keeps our expertise bundled in-house and makes us an important industry partner. We have the experience to develop our customers’ product ideas and take them all the way to series production.”



Part of Van Rob's success: decisive advantages were gained by using steel. The price: a new design, and a new process. Bo Lindgren believes this is the key.

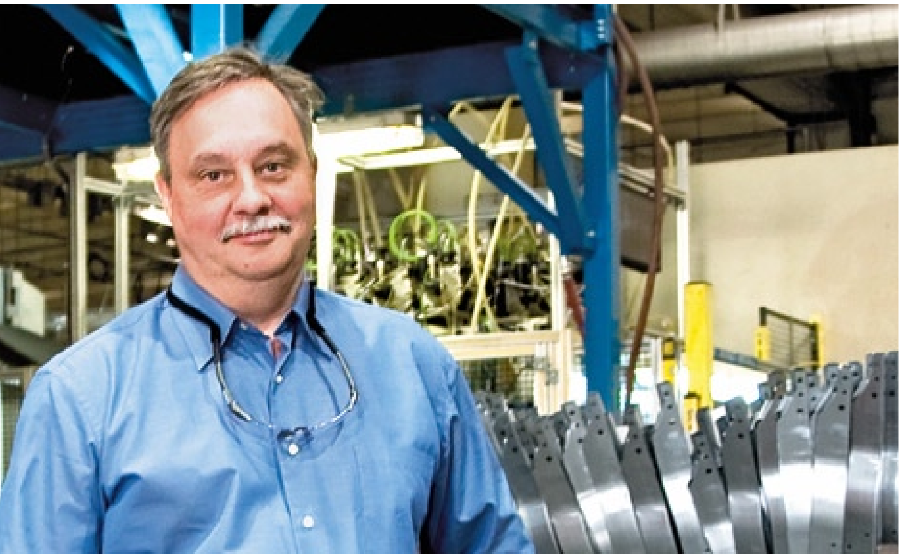
Trucks of steel

GM decides to contract out a central aluminum part of its SUVs and pickups. Van Rob decides to redevelop the part in steel.

In 2005, General Motors started production of the GMT 900 platform used in its GMC Yukon and Sierra, and Chevrolet Tahoe, Suburban and Silverado vehicles. At the time, industry analysts called the GMT 900 full-size sport utility vehicles (SUVs) and pickup trucks a "make or break" product line for General Motors. Van Rob was asked to manufacture the GMT 900 "rad support"– a critical front end component that supports the radiator and connects to the fenders, hood latch, headlights and grille.

Because General Motors sold about 1.8 million of the preceding GMT 800 vehicles annually, volume expectations for the next generation GMT 900 were high. Van Rob would produce approximately 900,000 rad supports for new pickup trucks and a similar amount for the SUVs.

"With that kind of volume you have to be sensitive to manufacturing costs," says Bo Lindgren, vice president of engineering at Van Rob's Corporate Centre in Aurora, Ontario Canada. "The challenge was to achieve the best manufacturing environment with high quality and low fallout. We'd have to weld at a high speed to get that output." →



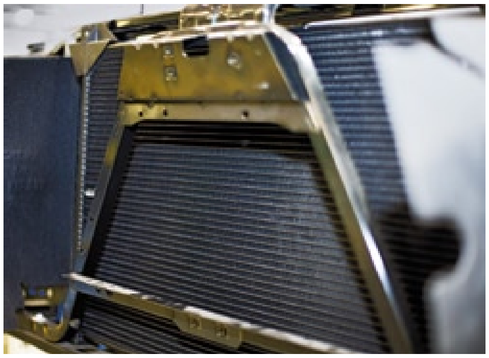
Bo Lindgren is the vice president of engineering at the Canadian supplier, Van Rob.

> "Either it works or it doesn't. If it doesn't work, you shut down the car plant and who wants to be that guy?"

The aluminum rad supports, used in the GMT 800s and initially the GMT 900 SUVs, posed some manufacturing challenges. "We asked ourselves how we could build the part smarter, making it better and cheaper," says Lindgren, whose goal was to have a new part ready for the pickup truck production which began a year later. "We looked for ways to redevelop the part in steel to lower the cost, while maintaining the weight."

New welding method

Traditional MIG welding was too slow and distorted the profile. The production speed and quality Van Rob wanted required a new welding method. Van Rob conducted a number of tests and studies, reviewed various welding options, and decided upon CO_2 laser technology, primarily for its high output rates and low distortion, but also for its safety and beam switching capabilities. "With a cycle time of twelve seconds, you have to weld fast and produce a nearly perfect part," explains Lindgren. "There's no time for repair work. Either it works or it doesn't. If it doesn't work, you shut down the car plant and no one wants to be the one to do that."



The assembled rad support holds not only the cooler, but also connects the headlights, front end, radiator grill and fender.

Because laser welding is much faster than MIG welding, fewer manufacturing cells are needed to accomplish the work in the same amount of time. "When you can laser weld five times faster in one cell, you need fewer cells," Lindgren explains. "The number of MIG weld cells required would have taken up too much room. Also, five times more equipment would have put more heat into the parts and distorted the profiles." The speed of laser welding also meant fewer weld fixtures and reduced tooling costs. "If you weld faster, you can remove one or two fixtures," says Lindgren. Eliminating fixtures was good news, especially for the automotive company, for which tooling is classically an upfront cost.

Lindgren's team began running part trials, testing different joint configurations, and investigating logistics such as part clamping and challenges posed by material coating. "All of this homework is important, especially with laser welding," he says. "You have to understand the part design and make it as good as possible for the production method. It was during this process that we got heavily involved with TRUMPF."

Lindgren and his team went to Europe to learn more and discover how others were using the technology. Through TRUMPF, Lindgren was able to witness Volkswagen using lasers in manufacturing. Using their new knowledge and existing manufacturing expertise, Lindgren's team developed prototypes for validation testing involving a fully built-up car. "80 percent through the lifecycle tests, even the skeptics agreed the process would really work, and work well," says Lindgren.

A twist in weld selection

Six pieces in the rad support assembly are laser welded. Lindgren estimates that they laser weld about 14 miles a day for this assembly. His team selected a mix of weld joints to best fit each profile. A butt weld was used on four of the parts for efficient material usage. In profiles longer than 1.6 meters, they chose an overlap weld that would work well even in material with a heavy side bend (camber) in the coil.

It is anticipated that GM will use the rad support over 1.8 million times in SUVs and pickups.

Another creative weld solution was required when a last-minute change introduced galvanized material. “Welding zinc-coated (galvanized) steel creates a lot of gas and the welds can get porous,” explains Lindgren. “So we used a t-joint, which gave us two sides where the gas could disappear very fast and that worked out quite well.” Variable thickness material proved to be another challenge ably handled by the laser. With weld parameters set up to change on-the-fly, the laser welded well in both thick and thin material. Going from 1 mm to 1.9 mm material in the same blank was not a problem.

Award winning results Using steel in place of aluminum resulted in an automatic cost savings. The laser technology also saved valuable time, floor space, and equipment and fixturing expenses. Van Rob’s design yielded another benefit: quality improvement. “The new part performed better than the original,” says Lindgren. “At the end of the durability cycle, the aluminum part had some cracks, which were acceptable, but amazingly, in the steel parts there was no fatigue at all. The steel design was stronger.” No wonder Van Rob has been a GM Supplier of the Year for the last 10 years. The secret to its success? “We’re constantly working on the product to make it better and manufacture it smarter,” explains Lindgren. “That’s why we buy the latest technology from TRUMPF. You have to be a leader, or someone else sets the benchmark and you just try to catch up.” ■

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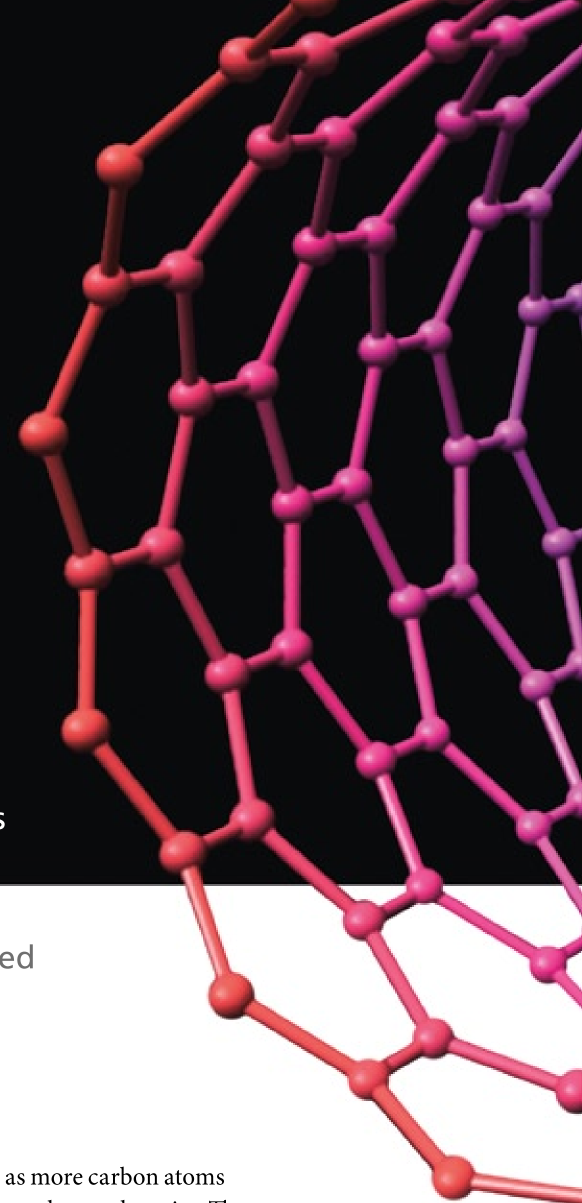
A speck of dust to change the world

By Dr. Bradley Edwards



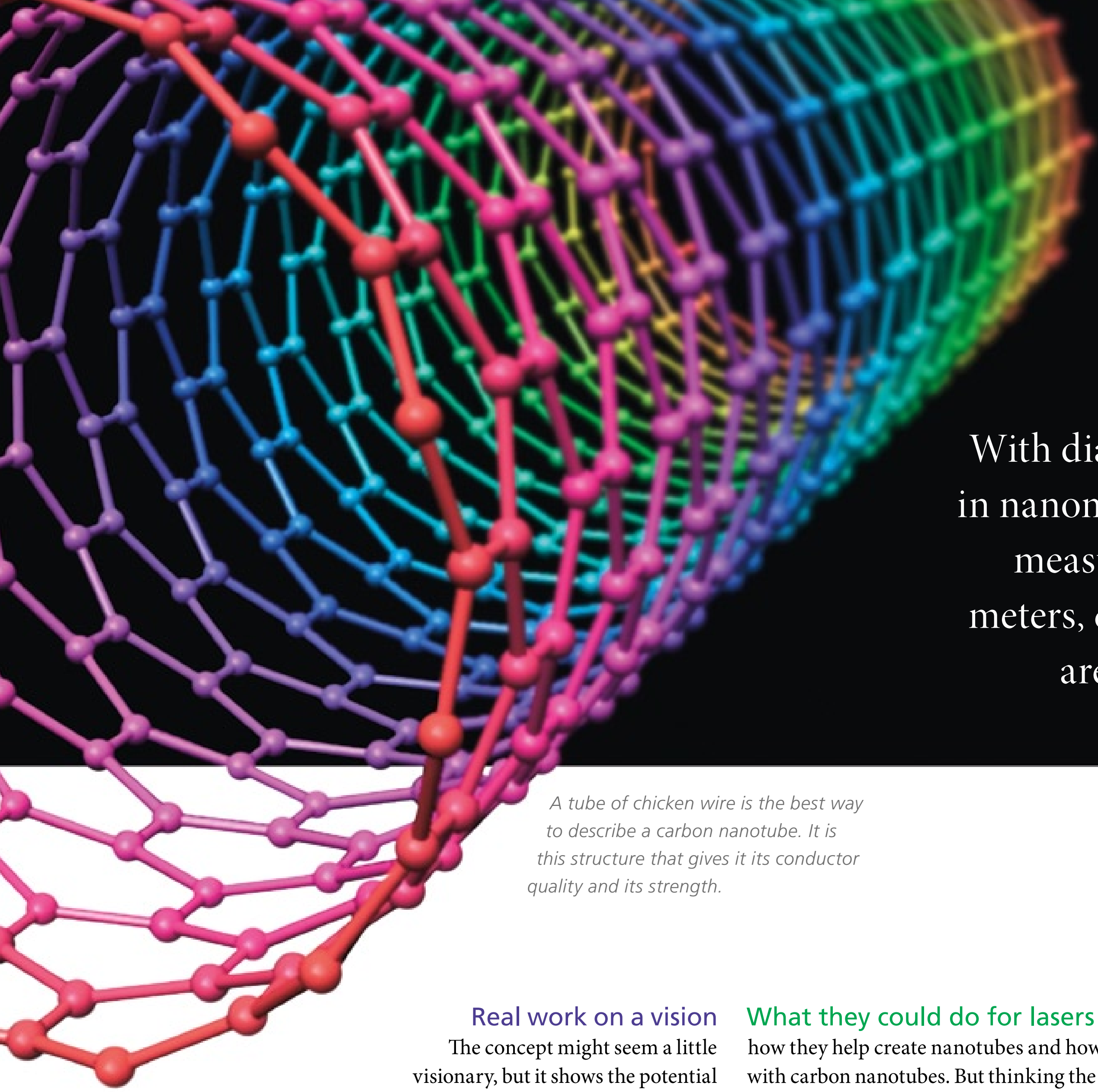
A material seventy times stronger than anything we know and formed by a tool made of pure light? Who is to say: "science fiction"?

In the 1960's lasers came into being – an amazing technology looking for an application. In 40 years lasers have evolved into many forms and more critical applications than can be counted. Yet with every new field, lasers find more roles, and the latest is in nanotechnology. In one of the many branches of nanotechnology, carbon nanotubes, the connection has become complex and inescapable. For those of you who are unfamiliar with carbon nanotubes, they are rolled up graphitic carbon sheets that look like atomic chicken wire tubes. These unassuming carbon tubes are the next wonder material. With diameters measured in nanometers and lengths measured in millimeters and centimeters, they are certainly unique. The interesting part though is in their physical characteristics – 70 times stronger than any other material, electrically conducting like gold, thermally conducting like diamond,… the list of records continues to grow. Now imagine how we might combine this new material with our omnipresent laser.

How to grow them Lasers first became linked to carbon nanotubes in 1996 when Richard Smalley's group used a laser to ablate carbon and grow carbon nanotubes. A powerful laser is focused onto a mixture of carbon and metal catalysts vaporizing the mixture into the surrounding 1200 °C furnace. The metal catalyst forms nanoparticles where the carbon atoms adhere and move about to combine into rings and then graphite sheets. These sheets wrap around the catalyst particle and form a tube that begins to extend out as more carbon atoms are added to the end where the catalyst sits. The graphitic arrangement of carbon atoms is a favorite state of carbon and growth proceeds rapidly, and with few defects. As the catalyst slowly erodes, more metal is added and the process continues. On this scale, van de Waals forces dominate and the tubes tend to stick together in co-aligned bundles of tens to thousands of tubes. Nanotubes grown by this method can become tangled masses like spaghetti or aligned arrays like microscopic grass. Depending on the application, the tubes will be removed as intact arrays on substrates or as loose material visibly indistinguishable from soot. Arrays of carbon nanotubes like these are the heart of the next generation of flat panel displays, electronics, and high-strength structures, as well as conductive additives to paint and plastic. This nanotube growth process, along with several others, has become popular for rapid growth of carbon nanotubes and in some cases is being used for production.

Lasers and carbon nanotubes are being linked in applications, as well as production. One ingenious application utilizes functionalized carbon nanotubes that only attach themselves to cancer cells. A laser at 808 nm is then used to selectively heat the carbon nanotubes and quickly kill the cancer cells without damaging the surrounding tissue. This is a promising demonstration, but my favorite application where lasers and carbon nanotubes collide is in the space elevator.

With diameters measured in nanometers and lengths measured even in centimeters, carbon nanotubes are certainly unique.



A tube of chicken wire is the best way to describe a carbon nanotube. It is this structure that gives it its conductor quality and its strength.

Real work on a vision

The concept might seem a little visionary, but it shows the potential carbon nanotubes have to change the world – just like the laser has. Imagine a spun carbon nanotube ribbon 62,000 miles long extending from Earth to space. A connection that can be ascended by mechanical climbers and dramatically cut the risk and cost of traveling to space. For decades this idea solely existed in science fiction until the advent and culmination of extremely strong materials (carbon nanotubes), an efficient power delivery system (high-powered lasers) and our growing experience in space.

Carbon nanotubes at seventy times the strength of our best materials are the only fibers that can be spun and woven into a ribbon strong enough for the space elevator. Now being grown in large quantities and lengths near that of conventional textile fibers, nanotubes are quickly moving from the lab to manufacturing. At the Space Elevator Games in 2008, ten teams will run their climbers up a one-kilometer cable. The power source will once again will be the laser. It's beam is directed at a set of solar cells on the climber, where its light is converted to electricity and used by the climber's drive system. The lasers will be provided by corporate sponsors (TRUMPF and Dilas) and are close to what is needed for a real space elevator.

What they could do for lasers

Talking about lasers, we've seen how they help create nanotubes and how they can be used in applications with carbon nanotubes. But thinking the other way around they might also help make better lasers. A few paragraphs back it was mentioned that carbon nanotubes thermally conduct like diamond – 300 times better than gold. So imagine the heat that can be moved with a small volume of carbon nanotubes. Specifically, we are thinking about the heat produced in a stack of laser diodes and currently removed with fluid flowing through micro channels. If instead of fluid in microchannels, a thin layer of carbon nanotubes was implemented, that same heat might be removed more simply.

At first glance, carbon nanotubes and lasers seem to be two technologies with little in common. But at the intersection between the miracle technology of the 1960's and the miracle material of the new century, researchers and engineers are finding many methods to combine the two technologies and produce outstanding discoveries. ■

__Dr. Bradley Edwards__ received the Arthur C. Clarke Innovators Award, and was named one of the top twenty space visionaries of 2007 by the National Space Society. His experience ranges from space missions at Los Alamos National Laboratory, to start-ups developing carbon nanotube materials.

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Gernot Walter, Jessika Drenger

In 2007, Dr. Marshall G. Jones received the Arthur L. Shawlow Award. It was never handed to him on a silver platter. He therefore hopes his career will encourage others.

"For the Children"

If you come to a brick wall, you can either hammer away at it – or be lucky enough that someone will help you climb over it. Schawlow Award winner, Dr. Marshall Jones, is such a person. Here he explains why.

Dr. Jones, on paper you seem like a numbers-oriented person, but you also wrote a book?
Yes, the book is about the things in my life which almost prevented me from succeeding. That's why it's titled "Never Give Up." If you work hard and ask for guidance, you can overcome most anything. Most people will help you if they see you're trying to help yourself. That's the thing that I want kids to understand. You don't have to be a genius to achieve something that will make you feel successful. You just need to follow your passions, and if you have setbacks, don't give up.

Were you a good student as a child?
I was always good in math and better than average in science. It was the non-technical things that I wasn't very good at. That's the reason I repeated fourth grade.

Why did you repeat fourth grade?
My teacher saw something in me. That's why she held me back. Parents today would have resisted, but it was the best thing that could have happened to me. I was doing eighth grade math, but I could hardly read. So I repeated fourth grade and those skills improved.

How did you get through those tough times?
I made new friends, so it wasn't so bad. It wasn't as hard as another crisis in my life. In high school, I played football, wrestled and ran track. I was supposed to get a wrestling scholarship, but I got hurt as a junior and that changed the course of my career. I spoke with a guidance counselor who suggested a two-year college, which was more affordable. In many ways it was a good a thing for me; the school had smaller classes than a university and eased my transition to college. That's where I became a student, staying up until midnight or later studying.

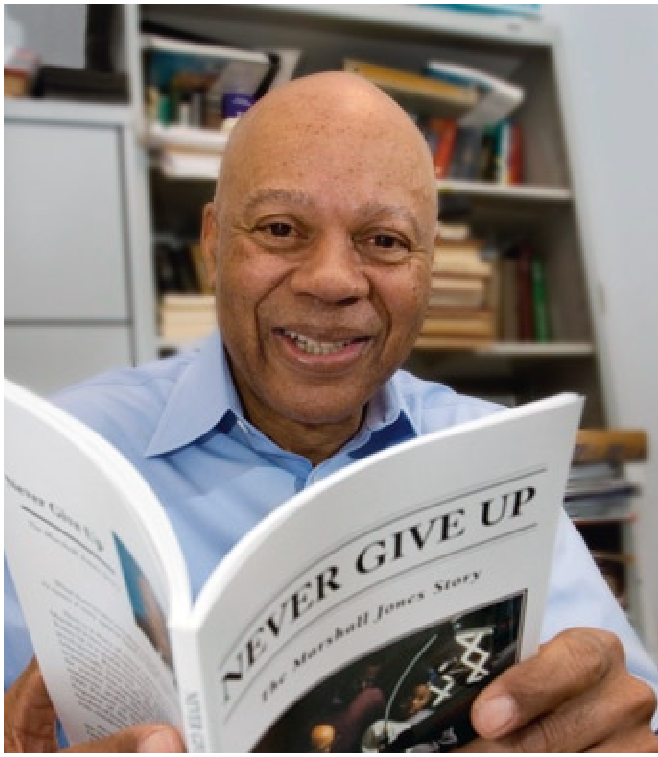
Did things get easier then?
Growing up on a duck farm in a small town on Long Island, I hadn't been exposed to very much prejudice. College was my first exposure to it. The school didn't have dorms, so students lived in people's homes. When I went to the house where I was supposed to live, the lady saw me and said I couldn't stay. I ended up someplace else with a white roommate who, to this day, is still my best friend. He is the reason I transferred to the University of Michigan. I was the only African-American in my engineering class at Michigan. African-Americans didn't pursue technology in those days.

Growing up in the '60s, you had a number of experiences where people wouldn't let you do things because of your race. How did you keep their prejudice from holding you back?
My great aunt and uncle (who raised me) taught me to always be positive. I was never raised to hate. If you're raised that way, no matter what anybody does, it's difficult to be angry.

What made you start doing community work?
I look back on all the people who played a role in my journey – however small or big – and know that if they hadn't, I might not have gotten through. I felt it was incumbent on me to do something to help young people realize their dreams. I get excited when kids smile because they see something they hadn't seen before. Whatever I can do to help, I always try to do.

How do we get more children interested in science and technology?
This is a critical issue. We need to expose kids to different things, especially related to science and technology, and show them the connection between their science and math classes and real life. Engineers typically have someone in the family with a math, science or engineering background. It is something like 90 percent. So you can imagine that excludes a lot of people. That's part of why I give talks to students and do my laser show – exposure. →

Almost 80 patents, more than 40 publications and a career at General Electric — this is Dr. Marshall Jones' professional side.



DR. MARSHALL G. JONES

A pioneering scientist at the prestigious General Electric Global Research Center, Marshall Jones is quite comfortable on the cutting edge of laser research. Dr. Jones' work has focused on fiber optics, laser material processing and laser device development and has earned him GE Global Research's highest individual honor, the Coolidge Fellowship. The Laser Institute of America awarded him the 2007 Schawlow Award for innovative design and implementation of industrial laser applications, recognizing his groundbreaking advancements in laser-robot integration, fiber delivery, and laser shock peening.

"I was never raised to hate. If you're raised that way, no matter what anybody does, it's difficult to be angry."

Tell me more about your laser road show.
I go to local elementary schools and explain laser technology to the kids, at their level. I show them some of the neat things you can do with a laser and the application of laser technology in their daily life. I pass around laser-processed parts. It's a lot of fun. The kids get really excited when I play music and use baby powder to help them see the laser beam move around to the music. All the kids just say 'oooohhhh.' I did this one show for kindergarteners and they stayed in their seats for the whole thing. The teachers couldn't believe it.

How do you balance all your commitments and community outreach?
My work is never compromised because of my community-related activities. In fact, I received a community service award from GE; the Phillippe Award is one of GE's top awards and receiving it held a lot of meaning for me.

Have you ever inspired someone to become a scientist?
After a speech once, a student came up to me, a young lady, who was getting an electrical engineering degree. She told me she had heard me speak seven years earlier and after that she knew she wanted to become an engineer.

What about your speech motivated her?
I think it was being aware of the choice. I don't think she thought it was a possible for a young woman to become an engineer before that.

How did you get inspired to become a mechanical engineer?
I grew up near an air force base, so I saw fighter jets flying all the time. I still remember when they broke the sound barrier. I spent hours drawing planes and wanted to be a pilot. But when I turned 14, I found out I didn't have 20/20 vision. Pilots today can fly with corrected vision, but in those days you couldn't. I continued to draw and in high school I was very good at mechanical drawing, so my guidance counselor suggested I major in mechanical engineering.

As someone known for innovative thinking, how do you keep your mind fresh?
I have a continued thirst to learn, which puts me in the position of being able to innovate. That, in combination with the passion for laser technology and the fact that the technology keeps changing, keeps me excited. My son keeps asking me when I'm going to retire. I guess when I stop having fun, I'll hang it up, but there are too many exciting things happening now. ■

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"Given the situation, the laser was never invented?"

5 QUESTIONS TO PROF. DR. ANDREAS TÜNNERMANN

"Without laser technology, there'd be no Internet as we know it today."

Which application seemed impossible ten years ago?
Ten years ago, no one could have guessed the key role that lasers would play in automotive technology. It's also fascinating to look at the progress we've made in producing microelectronic components – advances that the use of lasers in photolithography systems made possible in the first place.

What do you wish lasers could do?
Today, laser systems for science and technology applications are often too complex. We should make them simpler while still maintaining "control" over the photon.

What change in laser technology are the most important to you?
The transition from tube-based to semiconductor-based technology was a watershed change in laser technology. Gas laser systems dominated for a long time, but now solid-state diode lasers are grabbing a larger share of the market. Diode-pumped disk lasers and fiber lasers will become the standard for industrial production applications.

Prof. Andreas Tünnermann, Fotolia.com

Do you have any laser technology role models or "idols"?
First, there's Professor Herbert Welling from Hanover, who got me interested in this area and inspired me to go into the field of laser technology. I also admire Professor Robert L. Byer of Stanford, one of the pioneers in this area.

Professor Tünnermann played a major role in the international development of diode-pumped solid-state lasers. Tünnermann, who hails from the Lower Saxony region of Germany, has also conducted research on fiber lasers, waveguide lasers, and ultrafast optics. He has directed the Institute for Applied Physics at the University of Jena since 1998 and became the director of the Fraunhofer Institute for Applied Optics and Precision Engineering. His current research involves the generation and control of light.

More questions to
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Plastic blades are celebrating their first successes within ice hockey. It is yet to be seen what advantages they will bring to figure skating.

Hot gliders

Plastic ice skating blades melt the ice faster.

"Faster, lighter, better" is how the sons of the Schwenninger inventor Holger Würthner wanted their ice hockey skates to be. Würthner's approach to ideas began there, where the blades meet the ice. Ice skates glide because of the film of water that is created between the metal blade and the surface of the ice. The higher the frictional heat, the better the gliding properties. The high thermal conductivity of conventional steel blades causes a lot of heat to rise instead of being conveyed into the ice. Holger Würthner therefore concluded that this was where the "weakness" was. Only the gliding surface itself must be made of steel; the body of the blade could be made of plastic. Plastic is light and has very little thermal conductive properties. What the inventor was missing was a thin track with a top side that could be soundly attached to the plastic blade and a bottom side that would provide a highly polished gliding surface. He found the affordable solution in the combination of two steel strips. A 0.7 mm thick tread band with a hollow profile and a 0.3 mm thick ribbing band were so precisely joined and pressed together, that the contact is as good as complete. Neither undulation nor wobbling of the band is permitted. A solid state laser is used to weld the only millimeter thin side surfaces together simultaneously and warp-free. The unbreakable tread band ensures excellent skating characteristics and the ribbing band clings to the plastic blades. Now the frictional heat stays where it is created and is needed – directly on the ice. ■

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This has potential

Siegfried Heißler comments on the combination of lasers and robots within automated welding technology

Car bodies. Airplane parts. Facade elements. Stainless steel housing. Just a few examples out of many which prove that the application scope for laser robotic welding is wide. This also means a large market. It is therefore no coincidence, but clear strategy, that, wherever the focus is on cutting apart and joining together, both future technologies of laser and robots work hand-in-hand at KUKA Systems.

As product group manager for Laser Applications, Siegfried Heißler experiences daily how robots and lasers are being integrated.

The demand for flexible laser processing systems has been growing for years, the latest growth of 14 % being above average. Robots are being increasingly used as handling systems for the application areas of welding and cutting. Bulky, expensive beam guidance systems with reflective deflections were still necessary when, over 20 years ago, KUKA Systems began with the integration of lasers in production cells and robots as guidance components for the laser. This initially limited the number of possible applications extremely.

The fact that the innovation did not start as a whole, but grew from details, is exemplary of the initial solutions for welding vehicle roofs with the car body side panel. At that point, there was no suitable tool for laser processing on the market that enabled a combination of clamping and welding. KUKA Systems provided the solution. The so-called roller head was born: Mechanics on robots that carry the laser processing optics and, with the support of a pressure roller, enable a targeted force introduction close to the welding process. A large number of these machines were installed in the following years. Industrial relationships played an important role in the refinement and optimization, and remain today the driving force of progress. The results: Due to their flexible beam guidance using fiber optics, solid state lasers have quickly increased the number of applications in robot systems over the years. While the automotive industry was the main industry for which KUKA Systems produced complex manufacturing systems in the initial years, applications in other industries using sheet metal processing have been increasing over the last years.

A substantial potential for clean and quick processes which optimize manufacturing sequences and therefore reduce costs – this requirement, valid across the sheet metal processing industry from automotive manufacturers through to tier 1 suppliers, the aerospace or solar industries and medium-sized customers, has further inspired the demand for intelligent concepts for laser robot applications. Today, more than half of all installations at KUKA Systems are to be found outside the automotive industry.

Increasing laser performances, reduced costs for beam sources and automation facilities means that robotic-based laser processing systems have secured an above average future growth in the market for automation systems. This is mainly because, along with the established markets in Europe, the upcoming industrial nations in East Asia have also shown a considerable demand potential.

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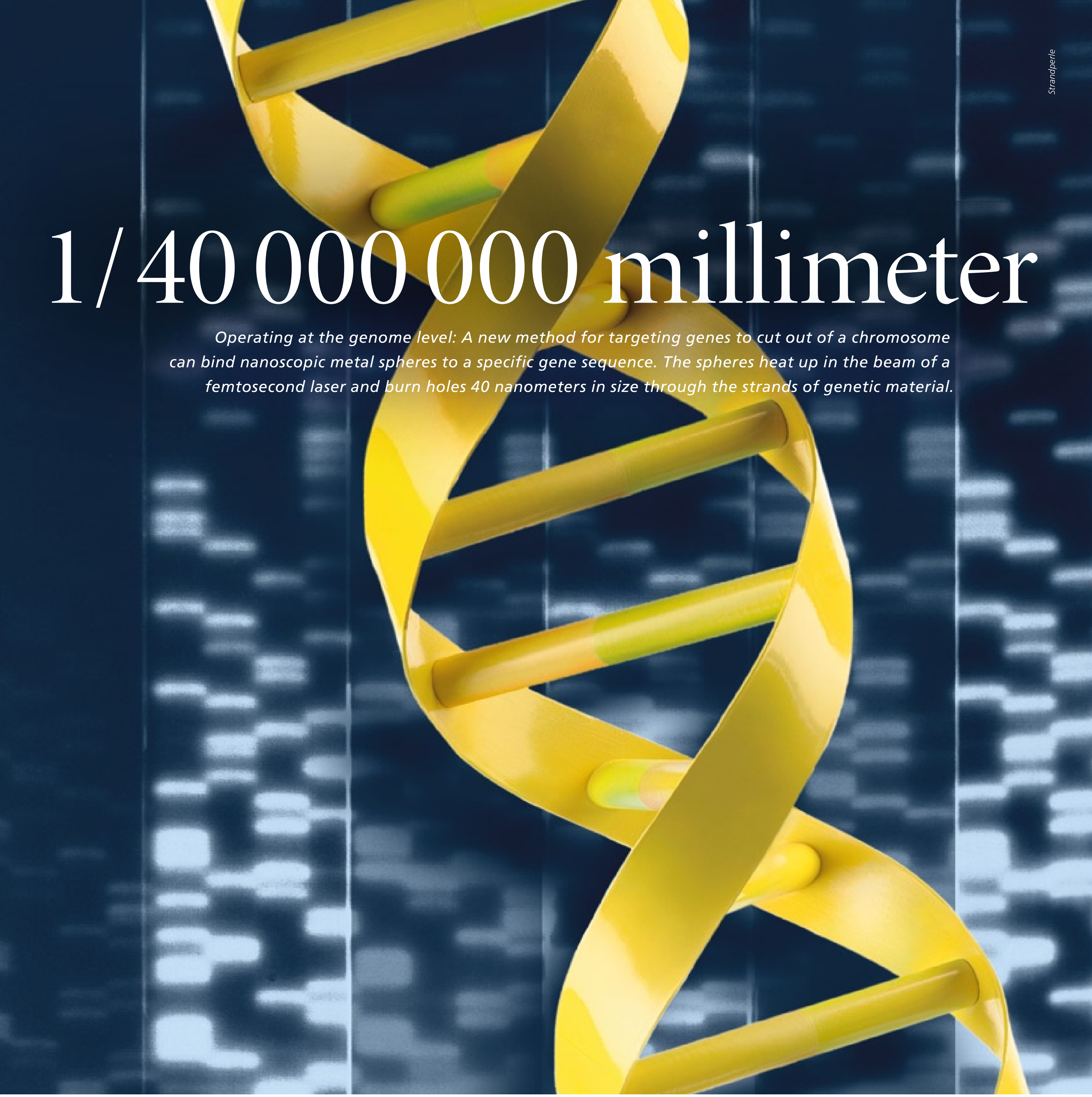
Where's the laser?

IN THE "SNAP" OF A SWISS ARMY KNIFE: With a solid "snap," an implement extends from the main body of the Swiss multi-purpose tool. This sound exemplifies Swiss attention to detail, precision, reliability and quality. It also means that the other implements are locked securely in place and out of the way. Small leaf springs in the knife housing are responsible for both the sound and the stability. These springs are cut to size under inert gas with a laser. The tolerance for the machined surface, called the slot width, is only 0.25 – 0.35 mm. The slot width is honed to razor-sharp precision to ensure that corrosion and wear don't stand a chance.

Gernot Walter


Strandperle
1/40 000 000 millimeter
Operating at the genome level: A new method for targeting genes to cut out of a chromosome can bind nanoscopic metal spheres to a specific gene sequence. The spheres heat up in the beam of a femtosecond laser and burn holes 40 nanometers in size through the strands of genetic material.