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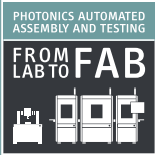
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# Quantum tech rises up the agenda at LASER World of Photonics

June event in Munich will feature presentation by Anton Zeilinger alongside application panels and numerous exhibitors offering quantum expertise.

Organizers of the forthcoming LASER World of Photonics congress say that the event will bring together a host of “leading players” in the emerging field of quantum technology – including a plenary talk by Anton Zeilinger, one of the world’s leading experts in quantum encryption and quantum key distribution (QKD).

Zeilinger is scheduled to give a talk entitled “Photonic entanglement: from foundations to applications” on the morning of Tuesday June 25, as a centerpiece of the European Quantum Electronics Conference (EQEC), one of several optics-related technical events co-located at the long-running Munich show.

“Zeilinger will give an insight into the latest research by the Austrian Academy of Sciences’ Institute for Quantum Optics and Quantum Information in Vienna,” say organizers Messe München.

The accompanying technology exhibition will also feature two application panel sessions dedicated to optical quantum technologies – the first covering sensing and computing, the second imaging and communication. Both panels will take place Wednesday June 26, and each will be co-chaired by senior executives from the local laser and photonics company Toptica.

## Strategic Advisory Board

Toptica is closely involved with the new Quantum Technologies Flagship project in Europe, which officially kicked off in October 2018. The flagship is set to receive around €1 billion in European Commission funding over the coming decade.

Earlier this month, the flagship’s strategic advisory board was revealed, with Airbus, Ericsson, and Infineon Technologies among the corporate organizations named. Individual members of the board also include Peter Loosen, deputy director of the Fraunhofer Institute for Laser Technology (ILT).

More recent developments relating to the flagship effort include the signing of a technical agreement on quantum communication by the European Space

Agency (ESA) and the “DG Connect” digital technologies section within the European Commission.

The plan is to collaborate on designing a quantum communication infrastructure for future “ultra-secure” communications in Europe, based on the principle of QKD.



*Toptica's booth at the LASER 2017 exhibition. The Munich-headquartered company is a key provider of photonics-based tools used in emerging quantum technology applications, and is closely involved in both the European Commission's Quantum Technologies Flagship project, and its equivalent in the US.*

Magali Vaissiere, ESA’s director of telecommunications and integrated applications, said in response to that agreement: “Only by stimulating innovation can Europe place itself at the forefront of technology; and nowhere is this more critical than in the field of secure communications.

“It is our shared ambition to demonstrate that space-based solutions can provide a vital part of the European quantum communication infrastructure. The ESA is therefore making available its expertise in satellite and optical communications, in order to meet the technological challenges of delivering QKD services, which are not achievable by terrestrial solutions alone.”

## Satellite QKD

EQEC plenary speaker Anton Zeilinger and his team in Vienna have already been pioneering efforts to develop satellite-based intercontinental QKD, working with partners at the Chinese Academy of Sciences and

their “Micius” research satellite to exchange quantum keys between ground stations in Austria and China.

In late 2017, the team used the keys to carry out a video conference via a conventional internet connection. “Due to the laws of quantum physics, it was impossible for third parties to ‘hack’ into the data exchange,” reported the researchers at the time.

“The exchange of quantum encrypted information over intercontinental distances

confirms the potential of quantum communication technologies as opened up by fundamental research,” added Zeilinger. “This is a very important step towards a worldwide and secure quantum internet.”

Aside from Zeilinger’s address and the two quantum application panel sessions, the Munich event will feature a whole host of exhibitors both working on such applications, and selling photonics-based equipment that those techniques rely on.

As some of the key participants, Messe München highlights the presence of private-sector participants including Toptica, Menlo Systems, and ID Quantique, as well as research and development institutes such as the Glasgow, UK-headquartered QuantIC quantum imaging “hub”, and the new Jena Innovation Center for Quantum Optics and Sensor Technology.

*Mike Hatcher, Contributing Editor, optics.org  
<http://optics.org/news/10/4/43>*

Photo: Messe München.

# Semiconductor slump 'worst in a decade'

*World's ten leading chip makers each report declining sales in key market for lasers and optical systems.*

Analyst firm IHS Markit has declared the current slump in the global semiconductor market as the worst for a decade, after all ten of the world's leading chip manufacturers reported declining revenues.

The sector, a key one for vendors of laser and optical systems used to pattern, mark, drill, trim, dice, and characterize

such decline since the second quarter of 2009, in the immediate aftermath of the global financial crisis.

## Memory failure

This time around it is a rise in excess inventory and falling demand from key end markets that is to blame, reports IHS's Ron Ellwanger. "Memory chips were the primary culprit for the sales plunge," states

35 per cent year-on-year, highlighting its exposure to the memory device sub-sector.

"The other memory-oriented companies in the top-ten also were heavily impacted by the downturn," added Ellwanger. Third-ranked SK Hynix, another Korean chip maker, experienced a 26 per cent drop over the same period, while fourth-placed Micron, US, posted a 23 per cent decline.

The slump was felt equally across both main types of memory device, with overall sales of both dynamic RAM and NAND flash chips down by around a quarter on last year.

Chip makers focused mainly on logic devices have escaped that kind of impact, but even Intel, which deals almost exclusively in logic, reported a slight decline in chip sales. As a result, the Californian firm was able to regain its position as the world's largest chip manufacturer from Samsung.

Meanwhile, Germany's Infineon has managed to jump up the rankings of the leading vendors thanks to its strong presence in automotive applications. With its chip revenues down only slightly year-on-year, it has risen three places to stand at eighth overall.

## Outlook slashed

Ellwanger's industry report comes a couple of weeks after IHS colleague Myson Robles Bruce slashed his outlook for the global chip market. Rather than the prior expectation of a slight market expansion this year, he now predicts a 7.4 per cent contraction as total sales slip to \$446 billion in 2019.



semiconductor chips and wafers, was worth \$101.2 billion in the opening quarter of 2019.

That represents a 13 per cent drop on the opening quarter of last year, the worst

the senior analyst, noting that Samsung suffered the largest drop in revenue amid plunging prices for memory chips.

The Korean electronics giant's semiconductor sales have plummeted

*continued on next page*

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## Semiconductor slump 'worst in a decade'

If accurate, that would also represent the largest contraction since 2009, when sales of semiconductor chips shrank 11 per cent. However, since then the chip market has more than doubled in value, as consumer and professional products incorporate ever greater semiconductor content.

"After the chip industry attained a heady revenue expansion of 15 per cent in 2018, many semiconductor suppliers in early 2019 remained optimistic that they could achieve modest growth this year," said Bruce, who heads up research of the semiconductor value chain at the analyst firm.

"However, the chipmakers' confidence quickly transformed into apprehension as they witnessed the depth and ferocity of the current downturn. The latest data indicates the semiconductor business

now is destined for its worst year in a decade."

While the current malaise will continue through the middle of the year, the IHS team does see something of a silver lining in the third quarter, as seasonal demand for high-end smart phones helps to drive demand for NAND flash memory.

### Laser and photonics impact

The precise impact on the photonics and laser sector is difficult to ascertain, although the stock prices of key suppliers to the chip production supply chain such as Nasdaq-listed Coherent and MKS Instruments (the parent company of Spectra Physics) have slumped in value over the past month as predictions for 2019 were updated.

Since early May, Coherent has dropped by around 27 per cent, while MKS is down a similar amount since late April.

When reporting the company's latest financial results on April 30, Coherent's CEO John Ambrose told investors that the microelectronics sector was experiencing a "lull" in demand, although

that is largely a commentary on the displays element of the business, where Coherent is a key supplier of annealing lasers.

Ambrose's counterpart at MKS, Gerry Colella, said around the same time that the recent slump in the semiconductor capital equipment sector did appear to have stabilized – notwithstanding the ongoing trade tensions between the US and China.

Colella also pointed out the historic cycles of the chip market, telling an investor conference call: "There is always doom and gloom of the semiconductor industry. Even if we stay flat this year in semi, it will be the third highest revenue year in the company's history."

"If I was Nostradamus, I'd give you great predictions, but I feel that generally it seems to be coming together," added the MKS CEO. "When I look internally of the order rates, they appear to be pretty healthy at this point."

*Mike Hatcher, Contributing Editor, optics.org  
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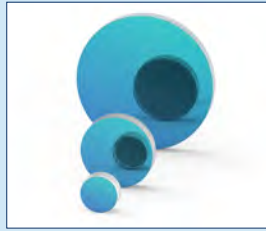
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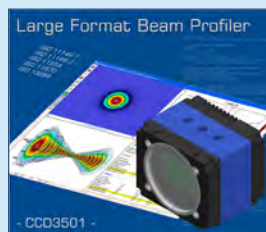
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# Yole tips edge-emitting lasers for rapid growth spurt

French analyst team predicts that market will more than double in value by 2024.

The market for edge-emitting laser diodes will more than double in value over the next five years, and be worth an annual \$5.1 billion in 2024.



Image: SLD Laser.

Laser headlamps, such as these powered by devices from SLD Laser, could represent a future "killer" application for edge-emitting lasers. Currently the market for such devices is dominated by applications in optical communications, although demand across sensing, lighting, and materials processing applications is expected to grow quickly.

That's the bullish prediction from analysts at Yole Développement, the market research and consultancy company based in Lyon, France.

Unsurprisingly, Martin Vallo and colleagues say that the compound annual growth of 13 per cent will be powered largely by the optical communications sector - currently in rude health, it seems.

Right now, applications for edge-emitters in communications networks account for just under \$1.4 billion of the total \$2.5 billion sector.

By 2024, demand for more and faster communications will propel that figure to \$3.4 billion of the total \$5.1 billion - an even higher proportion of the wider market than the current 56 per cent reported by Yole.

On the other hand, the demise of optical data storage - once the largest market for laser diodes - will continue. Now worth just \$155 million every year, that combined value of data storage and printing applications will shrink to just \$50 million by the middle of the next decade.

## Potential killer applications?

Sensing applications represent another key area of growth, although one where edge-emitting diodes are in direct competition with vertical cavity surface-emitting lasers (VCSELs) - especially in smart phone security, but potentially also in automotive lidar systems.

Yole says that, of the other markets served by edge emitters, materials processing and display applications are the most significant, representing 16 per cent and

14 per cent of the market respectively in 2018.

"However, their market shares will decline in the future as 3D sensing in lidar, and face/gesture recognition, medical, and lighting applications emerge in the next five years," predicts the analyst firm. "Those might represent potential killer applications for edge-emitting lasers in the middle/long term."

The Yole report also notes the large degree of fragmentation in the edge-emitter industry, something that it has in common with the wider photonics industry.

"Each application addresses a specific supply/value chain, and different positions have to be developed by industrial [companies] to access different markets," explains Yole. "Leading players in the material processing domain are vertically integrated from [edge-emitter] device to laser system, for example making laser dicers, as customers require turnkey solutions for their specific manufacturing process.

"For sensing or lighting applications, the trend is for companies to be much more specialized, as in pure [edge-emitting laser] device manufacturers, as there are still plenty of challenges at device level with increasing performance, beam shaping, and decreasing cost," it adds.

"Another good example is the datacom industry, which highlights a diversity of positioning along the supply chain."

*continued on next page*

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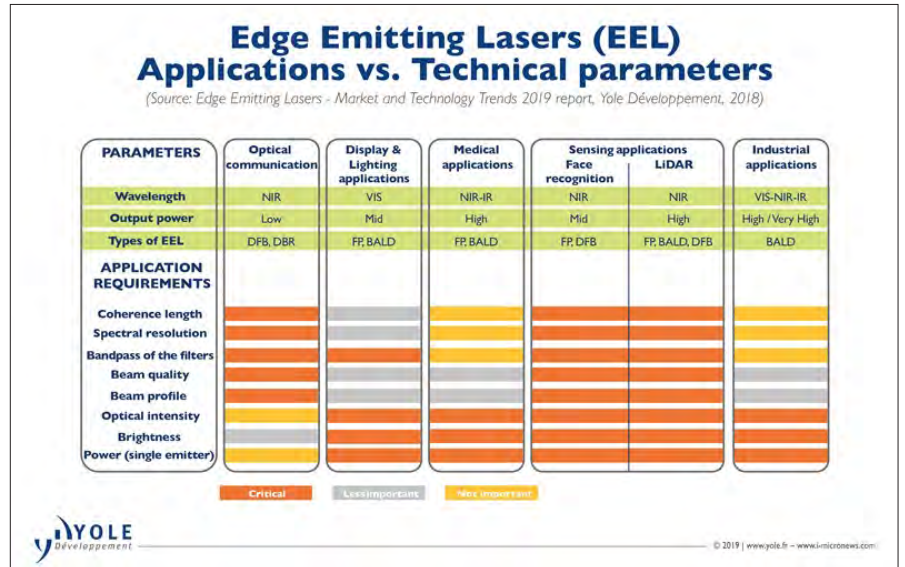
## Yole tips edge-emitting lasers for rapid growth spurt

### Laser lighting

One example of the potential for laser diode devices in lighting applications comes from SLD Laser, the Californian company set up by Nobel laureate Shuji Nakamura and colleagues. At last week's LightFair International trade show in Philadelphia, SLD launched its "SkyBeam" product, described as the world's first 12000-lumen laser spotlight for outdoor applications.

Aimed at applications in entertainment, architecture, avionics, search and rescue, and more, SkyBeam is said to deliver an extraordinary 6 million candelas of luminous intensity, and able to operate over a range of 5 kilometers.

The much higher brightness of this kind of source, compared with LEDs, could – in



Yole points out that some very different technological requirements for the various applications in which edge-emitting laser diodes are used have created a highly fragmented market. An obvious example is optical intensity - critical for materials processing applications but of little or no consequence in communications.

SLD's view – revolutionize the lighting industry just like LEDs did a decade ago.

Company president James Raring said that by delivering more than ten times the brightness of LEDs, these kinds of products can extend the range of illumination dramatically, and offer

precise shaping alongside minimal power consumption. "Beyond lighting, [it] provides the capability for high-speed data transmission and 3D sensing," he added.

Mike Hatcher, Contributing Editor, optics.org  
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Image: Yole Développement.

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# nLight reports dip in first quarter trading

Revenues, income and margins slide against previous year's same quarter due to "seasonal softness and aggressive competition" in China.

nLight, a developer of high-power semiconductor and fiber lasers used in the industrial, microfabrication, and aerospace and defense markets, has reported financial results for the first quarter of 2019.



Image: nLight.

nLIGHT's Corona CFX-5000 is the first fiber laser on the market that gives users the ability to tune the beam settings based on their application.

First quarter revenues of \$41.9 million were down 1.4% compared to \$42.5 million for Q1, 2018. Gross margin of 32.3% for Q1, 2019, was also down compared to 34.7% for Q1, 2018. Non-GAAP net income for the first quarter of 2019 was \$0.7 million, compared to non-GAAP net income of \$3.1 million, for Q1, 2018.

Scott Keeney, nLight's President and CEO commented, "In the industrial end market, we saw increased activity outside of China driven by interest in our Corona lasers and a focus on customer support and serviceability. Within China, normal seasonal softness was amplified by aggressive competition in the lower-power segment.

"We are excited by the initial customer response to our recently-introduced 12kW fiber laser, which enhances our ability to address the growing ultra high-power market in China.

nLight's Corona lasers, which offer multi-kilowatt outputs for industrial materials processing, feature programmable beam quality that is enabled by the company's all-fiber technology. Rapid tuning of the laser spot size optimizes machine tool performance across all metals and thicknesses.

## Higher powers

During the associated analyst conference, Keeney was asked by David Ryzhik of Susquehanna Financial Group to elaborate on the interest nLight was seeing in its 12 kilowatt laser: "Should we expect 12 kilowatt to be a bigger driver, over the next few quarters, than the 10 kilowatt?"

Keeney replied, "For the ultra-high power, the area where there's significant growth

today is in China. Likewise, we see very limited competition on companies that can produce that 12 kilowatt.

"What's going on in this space is, as you go up in power for key end-users, their productivity goes up, they get paid based upon how many pieces they cut and doing it faster means that they get paid more. There are limited companies that can do it and there are limited companies that obviously can provide the lasers. So we do see it as an attractive market that will continue to expand over time."

Keeney then continued, "The aerospace and defense end market delivered another strong quarter with increased contribution from several long-standing programs. Our innovative semiconductor laser technology and long track record of executing on government engagements positions us well for continued growth in this market."

## Outlook

For the second quarter of 2019, nLight expects revenues to be in the range of \$46 million to \$50 million, gross margin to be in the range of 32.0% to 35.0%, and adjusted EBITDA in the range of \$4.0 million to \$6.0 million.

Ran Barket, nLight's CFO, told the analysts' conference: "Looking at the full year [forecast] for of 2019, we continue to believe we can deliver a moderate amount of revenue growth compared to 2018. This reflects our expectation for increased revenue from new product as the year progress, improve contribution for the microfabrication end market to the first quarter and continue the strength in aerospace and defense."

Matthew Peach, Contributing Editor, *optics.org*  
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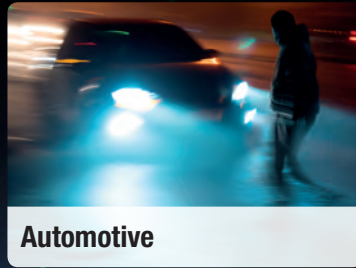
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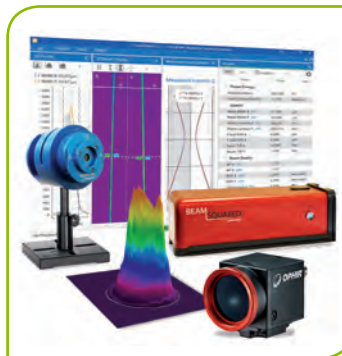
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# Jenoptik cheered as order book swells

**Sharp increase in sales and bookings from 'Light and Production' division keeps German firm on track despite weakness elsewhere.**

The Germany-based optics and photonics company Jenoptik has posted a decrease in sales and profits for the opening quarter of the year, but remains confident of hitting its annual targets after a sharp uptick in orders related to automation technologies.

At €184 million, sales in the three months to March 31 declined 3 per cent year-on-year, while pre-tax earnings dropped to €12.8 million, down nearly 40 per cent from €20.8 million a year ago.

defense business are inhibiting growth... we are, however, seeing continuing good demand in our important semiconductor equipment and automotive markets and, overall, remain on course for growth, as our order book shows."

## Automation boost

While other companies in the photonics sector have reported sharp slowdowns in sales of equipment used to manufacture microelectronics devices and



Photo: Jenoptik AG.

Jenoptik CEO Stefan Traeger.

Those figures appeared to prompt a 5 per cent fall in Jenoptik's stock price on the Frankfurt exchange, but the Jena-headquartered firm maintained an upbeat tone, pointing to strong performance in its "Light and Production" division and an order book now at record levels.

CEO Stefan Traeger highlighted the mixed picture in a company release, saying: "On the one hand, export restrictions in the

semiconductor chips, Jenoptik has had a more positive experience thus far.

Its "Light and Optics" business unit, posting a slight increase in quarterly revenues to €83.2 million, was boosted partly by what Jenoptik described as "continuing good business within the semiconductor equipment industry". However, order intake was down compared with last year, when the company experienced a boom in high-volume bookings.

Sales growth was much stronger within the "Light and Production" division, with quarterly revenues up nearly 30 per cent on the prior year's figure. That increase was largely attributable to recent acquisitions including Canada's Prodomax, with profitability and bookings also up sharply and strong traction in the North American automotive market.

"Demand for automation solutions saw particularly strong growth, as shown by the orders worth over €30 million received from North American OEMs and automotive suppliers in the first few months of the year," reported Jenoptik. "Deliveries will include several assembly lines and cutting-edge systems for material processing and handling.

Jenoptik also has high hopes for its new "SYIONS" digital imaging platform. In March it signed a long-term development agreement with a "leading international life science company" that is expected to realize some €30 million in revenues over the next few years.

## Saudi arms embargo

While the photonics-related part of the Jenoptik business appears robust, the current drag on sales comes largely from the company's "Vincorion" division, which is the relatively new brand name for the company's mechatronics product lines sold into defense and civil infrastructure applications.

That was hit by the German government's decision to extend arms export restrictions, including the embargo on sales to Saudi Arabia in late 2018, a response to the killing of dissident journalist Jamal Khashoggi inside the Saudi Consulate in Istanbul.

Vincorion posted a quarterly loss as its sales fell nearly 30 per cent year-on-year, although strong orders for other defense-related projects have since boosted the division's book-to-bill ratio significantly.

CEO Traeger, who is still predicting full-year revenue growth in the region of 5 per cent on the already record-breaking 2018, summed up: "On the back of sustained good demand in key markets, recently acquired projects, and good order intake growth, we are confident to see good business performance, particularly in the second half of the year, and to achieve our financial targets for 2019."

Mike Hatcher, Contributing Editor, *optics.org*  
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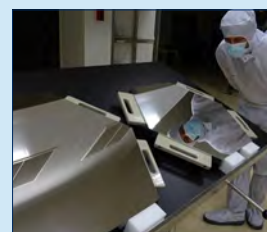
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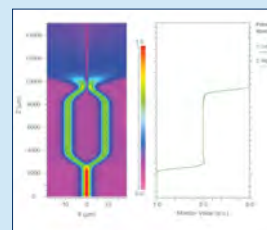
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# Novanta steady despite macro worries

**Overall sales up but photonics segment down amid weak macroeconomic environment and microelectronics slowdown.**

Nasdaq-listed Novanta has reported a year-on-year decline in sales for its photonics business unit, as it deals with sluggish industrial markets and a temporary slowdown in demand for lasers used in DNA sequencing equipment.

The Bedford, Massachusetts, company, which owns beam-steering specialist Cambridge Technology and laser providers Synrad and Laser Quantum, posted revenues of \$157.2 million in its opening quarter of 2019, up 7 per cent on last year.

But that total masked a decline within its photonics unit, where sales slipped to \$59.2 million, down from \$61.8 million a year ago.

Strong demand in the medical sector helped offset that decline, however, helping Novanta's "vision" business record a 17 per cent boost in sales, to \$65.9 million.

## Microelectronics weakness

Amid what he called an uncertain macroeconomic and capital spending environment, company CEO Matthijs Glastra declared himself pleased with the overall performance but forecast a slight sequential dip in sales during the current quarter.

That appeared to play badly with the financial markets, sending Novanta's stock down 9 per cent on a trading day that was already marred by fears of an escalating trade war between the US and China.

In a call with investors to discuss the latest results, Glastra said that the microelectronics market was particularly weak, with Novanta's sales into that sector down 20 per cent year-on-year.

However, microelectronics represents only around 10 per cent of the company's business, helping to mitigate that negative momentum. While the medical sector remains strong, and Novanta's executive team remains excited about the potential in new areas like robotic surgery and DNA sequencing, demand for lasers used by the latter has slackened compared with the same time last year.

But Glastra said that was largely due to the particularly strong order flow experienced last year, telling investors that the current "lumpiness" in demand reflected "temporary customer launch dynamics" rather than any slowdown in the wider market.

He added: "In fact, we couldn't feel more excited about the long-term growth prospects of this business as DNA

sequencing is still in the early stages of penetration into clinical applications, with numerous positive catalysts on the horizon."

Laser Quantum's sales have also been impacted by the wider industrial market slowdown, however, as have those of the carbon dioxide laser specialist Synrad.

## Uncertainty spreads

Summarizing the current situation, Glastra said that Novanta's broad diversification would position it well for the remainder of this year and beyond, with the current industrial weakness continuing to be balanced out by demand from the medical sector.

"We see a long-term need for our motion, vision and photonics capabilities in a large variety of applications on the back of macro trends of Industry 4.0, precision medicine and healthcare productivity," he added.

At around one-tenth of sales, the company's exposure to China is relatively modest, but the CEO is still expecting to see some impact from the current trade uncertainty. Glastra said that although this uncertainty was now spreading to the rest of Asia and Europe, it was not evident across all sectors, with "good market momentum" in laser additive manufacturing.

• Despite slipping 9 per cent immediately following the latest results announcement, Novanta's stock price has risen in value strongly since the start of the year. Trading at just over \$85 on May 8, it remains close to long-term highs, and is up around 33 per cent since January 2.

*Mike Hatcher, Contributing Editor, optics.org  
<http://optics.org/news/10/5/9>*



Novanta's stock price has risen steadily over the past two years, and despite dropping in value by around 9% following the latest results it remains close to a 20-year high on the Nasdaq.

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# MKS execs highlight synergies with Electro Scientific integration

Newport and ESI businesses now benefiting from collective photonics expertise under the MKS umbrella.

MKS Instruments, the Massachusetts-based technology and process equipment company that has pivoted strongly towards photonics in recent years, has posted revenues of \$464 million for the opening quarter of 2019 – the first to feature its latest acquisition, Electro Scientific Industries (ESI).

Said to be integrating very well with Newport and its Spectra Physics laser division, which MKS acquired back in 2016, ESI specializes in laser micromachining systems for applications including printed circuit board (PCB) drilling.

Speaking at an investor conference call to discuss the latest results, MKS' CEO Gerry Colella explained that the ESI business – now referred to as the company's "equipment and solutions" division – had contributed around \$35 million to the quarterly sales total over two months. The deal was completed February 1.

## Laser 'cornerstone'

Summing up the quarter, Colella said: "We continued to see strength in our advanced markets, and in particular our 'surround the workpiece' offerings. Our laser business is the cornerstone of this strategy, on which we deliver leading products and services to laser, photonics and optics markets and grow our share.

We also had a strong quarter in China in both the semiconductor and solar markets."

Following a recent lull in the semiconductor capital equipment

MKS' COO John Lee told investors that the ESI integration was progressing well, with plenty of scope for collaboration and leverage with the various Newport-related brands.



Launched at the Photonics West 2019 exhibition earlier this year, the latest version of the "IceFyre" industrial ultrashort-pulsed laser from MKS-owned Spectra Physics operates in the UV region and is aimed at applications across consumer electronics and related sectors, including displays and PCB production. Spectra Physics is said to be integrating well with ESI, the latest acquisition by MKS, which specializes in laser micromachining systems.

market, a critical one for both MKS' photonics and non-photonics offerings, the CEO added that this area of the business now appeared to have stabilized, although the situation in China remained "dynamic" amid ongoing trade tensions with the US.

One example is the recently released "CapStone" system from ESI. The high-productivity PCB drilling tool now features a nanosecond-pulsed laser provided by Spectra-Physics, with Lee

*continued on next page*



continued from previous page

## MKS execs highlight synergies with Electro Scientific integration

noting “significant orders” in Asia and Europe.

“The ESI acquisition further broadens our ‘surround the workpiece’ offerings by adding advanced systems expertise and deep technical understanding of laser materials [processing] interactions,” Lee said. “We expect ESI leadership and complex PCB processing systems to provide MKS the opportunity to accelerate the roadmaps and performance of our laser, motion, and photonics portfolios.”

### 5G opportunities

Lee added that the roll-out of 5G wireless networks would prove to be a long-term growth driver for all of MKS’ divisions. He pointed to the need for new laser-based processes to manufacture new antenna designs as one example of the likely market pull.

Responding to a question about the potential cross-over of laser-related

expertise between the Newport and ESI businesses, Lee indicated that there was scope for genuine synergy, telling the call:

“I think the capability was a little surprising to each side. Some of the modeling capability and assistance capability of ESI was unknown to the light and motion [i.e. Newport] side, and some of the laser and motion capability was unappreciated, or under-appreciated, by the ESI folks.”

Looking towards the second quarter of the year, which will be the first to include a full contribution from ESI, Colella and his team said that they expect to post a revenue figure somewhere between \$460 million and \$510 million – somewhat reflecting the historic volatility of the ESI business and the vagaries of the semiconductor equipment cycle.

### Balance sheet shows leverage

The impact of both the ESI acquisition – at a cost of around \$1 billion in cash, financed partly through a \$650 million term loan – and the recent market lull was in evidence on the bottom line of MKS’ latest results.

For the three months ending March 31, the Andover-headquartered company

delivered a net income of \$12.5 million on the \$464 million sales. This time last year it had posted net income of \$105 million on quarterly sales of \$554 million.

Meanwhile, the firm’s balance sheet now shows cash and equivalents totaling \$418 million, up against around \$1 billion in long-term debt.

A crucial goal for MKS now is to de-leverage that balance sheet over time, something that it had achieved over the past couple of years with the similar-sized Newport acquisition.

- Investors appeared to react negatively to the MKS outlook, with the company’s Nasdaq-listed stock price falling in value by around 10 per cent immediately following the financial release.

However, trading at around \$91 the stock has still made strong gains since late 2018, and currently MKS’ market valuation stands at around \$5 billion.

*Mike Hatcher, Contributing Editor, optics.org*  
<http://optics.org/news/10/4/49>



Despite falling in value by close to 10% following the latest quarterly results announcement, MKS’ stock price has recovered strongly since late 2018. This image shows how the company’s value has increased in value steadily over the period in which it has pivoted towards photonics. MKS acquired Newport Corporation in late 2016, and recently completed the buyout of Electro Scientific Industries (ESI).

# Zeiss continues upward march

Sales and earnings up strongly again, thanks in part to the growing contribution of extreme ultraviolet optics.

Zeiss has posted another solid increase in both sales and profits in its latest financial results, as its focus on key growth markets continues to pay dividends amid growing macroeconomic worries.

The Germany-headquartered optics giant has just posted a 9 per cent jump in revenues to €3 billion for the six months ending March 31.

With significant contributions from sales of state-of-the-art reflective optics used inside extreme ultraviolet (EUV) lithography systems built by key partner ASML, profits also rose strongly. At €443 million, earnings before interest and taxes were up nearly 17 per cent on the same period last year.



Photo: Carl Zeiss Group.

Despite growing macroeconomic worries, Zeiss CEO Michael Kaschke looks likely to oversee a tenth successive year of record sales at the Germany-headquartered optics and optical systems giant.

## Resilience

The growth of EUV lithography is one of the areas that Zeiss describes as "future-proof", at a point in time where escalating geopolitical tensions and protectionist measures arising from the US-China trade dispute continue to spook markets.

Zeiss' CEO Michael Kaschke warned of that threat in a company release, saying: "Despite achieving strong growth thanks to our innovations, we will continue working on our resilience in order to keep growing profitably in a potentially fraught economic climate."

Kaschke and the Zeiss executive team reported consistent growth across each of the company's four main sectors. The largest of those by sales, "industrial quality and research", posted an 11 per cent jump in revenues to €820 million – partly through the integration of recent acquisitions.

That looks set to continue after Zeiss completed another buy-out, this time the acquisition of the optics-based metrology systems specialist GOM. Sales from Zeiss' semiconductor manufacturing technology (SMT) division rose at a slower rate, up 5 per cent to €769 million, reflecting the current sluggishness of the wider sector – EUV lithography equipment aside. A year ago, the reported rate of growth stood at 35 per cent.

"Despite a generally more cautious and less consistent development in the semiconductor industry, the SMT segment achieved healthy

growth, due in particular to the latest generation of EUV lithography optics, whose revenue has now grown to a rather considerable size," noted Zeiss.

## Decade of records

Looking ahead, an 11 per cent jump in orders should see Zeiss post yet another record year, despite predictions of a macroeconomic slowdown.

The company's executives say that yearly revenues should end up "considerably above" €6 billion, compared with the total of €5.8 billion it reported for 2017/18. If correct, that would represent a tenth consecutive year of sales growth for the Oberkochen-based company. "We are delighted with the successful developments of recent years and with the results of the first half of 2018/19," Kaschke concluded. "We will certainly not rest on our laurels but continue to press ahead."

That intention appears evident in Zeiss' spending on research and development activities – something that the company has referred to consistently as the engine for its future growth. At €332 million in the six months to March 31, R&D spending rose 8 per cent on last year's figure. Annual R&D spending is set to eclipse the 2017/18 total of €642 million, which was itself up nearly 50 per cent in just two years.

Highlighting the impact of that investment, Zeiss CFO Christian Müller said: "Today, we generate almost half of our revenue with products that are less than three years old."

Mike Hatcher, Contributing Editor, *optics.org*  
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# Powerful new pulsed laser to boost car production

PULSE consortium receives a grant of € 5.2 million from EU via the H2020 program, comprising partners from six countries.

A team of European scientists is developing a new pulsed laser system, similar to that developed by Gerard Mourou, the 2018 Nobel Prize in Physics winner, to cut and shape ultra-high-strength industrial materials that are notoriously difficult to process at high speed, while producing significantly less waste.

With the ability to cut and shape ultra-high-strength boron steel up to one thousand times faster than existing technology, the pulsed laser looks set to boost the car industry, say its developers, "reducing material wastage by 10%, chassis costs by 5%, and manufacturing time by two-thirds."

Operating at 1.5 km/s, the new laser is specified to be powerful enough to cut the hardest boron steel used in car construction at one cubic centimetre per minute – which is more than a thousand times faster than existing technology that currently ablates steel at one cubic millimetre per minute.

Exerting an average power of 2.5kW, or 100kW in a single pulse, and with repetition rates up to 1GHz (one thousand times more rapid than the current 1MHz upper limit), the laser will have the control and capability to etch moulds for vehicle parts at micron-scale accuracy as well as micro-weld dissimilar metals for solar thermal absorbers. Aiming to improve car manufacturing speed and efficiency, while reducing the potential production costs and environmental impact, the new pulse laser system has received a €5 million development grant from the European Commission.

## Boron steel cutter

Boron steel, which is used in car bodies because of its super strength, is so durable that it is often difficult to cut or shape. The processes used to ensure its durability usually remove many of the steel's fundamental properties, such as the



Image: Centro Ricerche Fiat.

*The PULSE consortium expects a prototype to be ready by 2021.*

workability. Although boron steel can be cut with a plasma arc torch, (a tool that cuts using high pressure, accelerated jet of hot plasma), this can instantly heat the metal to over 650 °C (1,200 °F) and is not as precise or as quick as a pulse laser.

Going by the acronym PULSE, the consortium behind the powerful new laser draws on expertise from 11 research institutions and industry partners from six different European countries, coordinated by Tampere University in Finland.

Project coordinator, Dr Regina Gumenyuk commented, "While ultrashort-pulse laser technology has been around for decades, breakthroughs have meant it has become something of a buzzword, being awarded the latest Nobel Prize for physics, and increasingly being deployed in industrial production.

"Laser technology exists today that can cut boron steel, but it is far too slow for any

large scale production. By harnessing the unique characteristics of patent protected tapered double-clad fibre amplifiers power-scaled multichannel laser, the PULSE project will create unparalleled high-power beam qualities, with  $M2 < 1.1$ , and pulse energies of 2.5  $\mu\text{J}$  to 250  $\mu\text{J}$ ."

## Environmental impact

The new system looks set to have what the developers call "a positive environmental impact, by being so efficient that waste products will be reduced." Dr Gumenyuk added, "PULSE is committed to improving manufacturing, but also reducing its impact on the environment, therefore we can confirm that a 10% reduction in waste products is certainly achievable."

The laser system is expected to enable an improved digital design to lower vehicle

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## MKS execs highlight synergies with Electro Scientific integration

chassis weight with consequent benefits for fuel economy and an increase in the range of electric vehicles. The consortium anticipates a prototype to be ready as soon as 2021.

The PULSE consortium received a grant of € 5 206 207.50 from the EU via the H2020 programme and is made up of partners from six countries:

- United Kingdom (Aston University and Modus Research & Innovation Ltd)
- Finland (Ampliconx OY)
- Germany (Lunovu and Hochschule Mittweida)
- Greece (Nanotypos OE, Foundation for Research and Technology HELLAS, and Prime Laser Technology Iliaka Systimata Thermansi Anonimi Viomichaniki Emporiki Etaireia)

- Italy (Centro Ricerca Fiat and Onostampi SRL)
- Latvia (Ceram Optec Sia)

### Objectives of PULSE in detail

The acronym PULSE stands for High-Power Ultrafast LaSers using Tapered Double-Clad Fibre (Call H2020-ICT-2018-2). The CORDIS website, which describes the aims of European collaborations, states:

"A world record power 2.5kW laser providing from picosecond- down to femtosecond-pulses at repetition rates up to 1GHz with excellent beam quality is being developed and brought to the market at highly competitive costs enabling widespread industrial uptake. By harnessing the unique characteristics of patent protected tapered double-clad fiber amplifiers power-scaled multichannel laser, unparalleled high-power beam qualities,  $M^2 < 1.1$ , and pulse energies  $2.5\mu\text{J}$  to  $250\mu\text{J}$  will be achieved.

"Using the state-of-the-art highly stable laser diodes as seed lasers allowing parameter flexibility by ultrafast electrical control of pulse duration and repetition rate will a broad range of high-power laser processing application requirements to be

### Project information

## PULSE

Grant agreement ID: 824996

Status

Ongoing project

Start date

1 January 2019

End date

31 December 2022

Funded under:

H2020-EU.2.1.1.

Overall budget:  
€ 5 206 207,50

EU contribution  
€ 5 206 207,50



Coordinated by:

TAMPEREEN KORKEAKOULUSAATIO SR

Finland

PULSE is completely funded by the EU.

met. An extremely stable advanced all-fiber based configuration allow development of a compact ultrashort pulse laser system."

Matthew Peach, Contributing Editor, optics.org  
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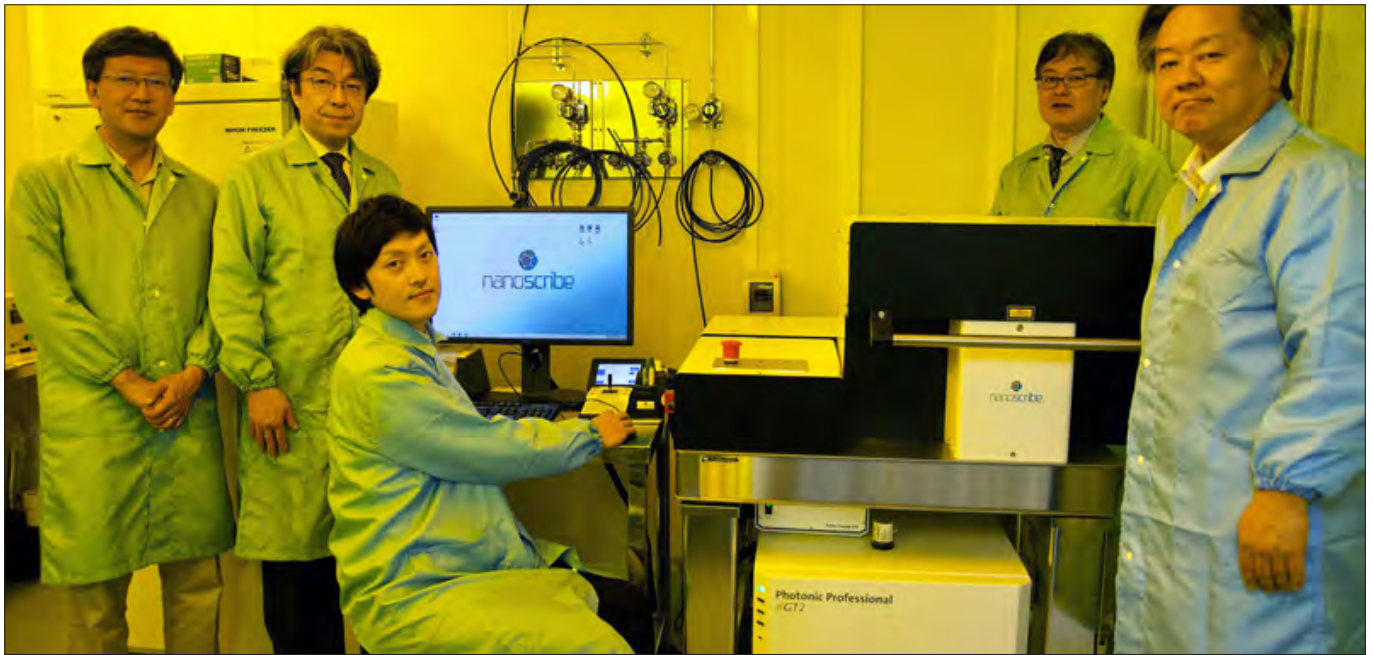


Image: Keio University / Nanoscribe.

Prof. Dr. Kotaro Oka, Dep. of Biosciences and Informatics / Prof. Dr. Keiya Shirahama, Faculty of Science and Technology / Ryosuke Terada, Central Service Facilities for Research / Hayato Tsuruta, Japan Laser Corp. / Tomoaki Mitani, Central Service Facilities for Research (LTR).

# Nanoscribe installs GT2 3D printer in Keio University

First installation offers optimized design, new printing materials to enable high-resolution microstructures up to 8mm.

Keio University, one of Japan's most prestigious private universities is the first customer to receive Nanoscribe's latest 3D printer, known as model Photonic Professional GT2.

The installation at the university's Center for Research, Faculty of Science and Technology is expected to open up "completely new opportunities in many fields of applications such as mechanical, electrical, chemical and life sciences," say the partners.

Following the successful installation of the system, Tomoaki Mitani, manager at Central Service Facilities for Research, commented, "Both, the School of Medicine and the Faculty of Science and Technology, will have access to this powerful microfabrication tool." The range of possible applications extends from the printing of microchannels for electrochemical sensors to the development of novel optical elements and tissue engineering research in 3D cultures.

## 'Pioneering ideas'

Nanoscribe's CEO Martin Hermatschweiler said that he is pleased that users at KEIO can now realize pioneering ideas that were beyond their reach before. Already, more than 180 Nanoscribe systems worldwide are used for various applications in science and industry. "And our user community is steadily growing due to a large number of multi-user facilities," said Hermatschweiler.

The company added that this first installation of a GT2 could be considered as "a journey back to the starting point of the technology of two-photon polymerization ("2PP"), which is the technological base of Nanoscribe's 3D printers. In 1997 Professor Satoshi Kawata provided the experimental proof of two-photon polymerization in Japan.

Now, for more than ten years, Nanoscribe says it has taken advantage of 2PP's strengths "to expose photoresists with

extreme focus and highest resolution enables the direct fabrication of nano- and microstructures that would otherwise be impossible to produce."

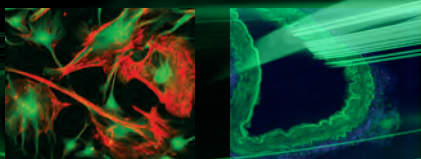
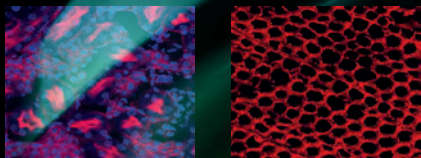
Relaunched in December 2018, the GT2 is said to "push the boundaries of nano- and microfabrication offering new solutions for additive manufacturing and maskless lithography."

With optimized hardware and software components as well as new printing materials specially developed for larger volumes, high-resolution microstructures up to a height of 8 mm can be produced for the first time. Nanoscribe devices are designed for additive production of fine structures. Now objects with submicrometer details from typically 160 nm up to the millimeter range on a printing area of up to 100x100 mm<sup>2</sup> can now be produced rapidly.

Matthew Peach, Contributing Editor, *optics.org*  
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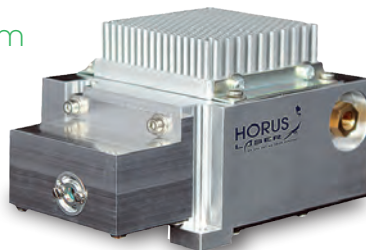
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# Laser processing to turn moondust into building blocks

**MOONRISE project to take 3D-printing to the moon to build "village" and for space exploration.**

The moon is of great importance as a research station and starting point for further space expeditions. However, the cost of flights and transports to the moon are enormous – a kilogram of loading capacity costs approximately €700,000, says Laser Zentrum Hannover, Germany, which is a partner in a lunar laser R&D program, called MOONRISE.

Therefore, LZH contends, infrastructure, components and devices would at best be manufactured directly on the Earth's satellite. But using what materials?

and convert them into versatile structures subsequently.

The opportunity to fly their MOONRISE technology to the moon in 2021 with the first moon mission of the Berlin-based New-Space company PTScientists offers the researchers from Lower Saxony the opportunity to test their pioneering technology under real conditions.

Stefan Linke from IRAS commented, "The planned direct proof, that we are able to process lunar regolith with already available hardware components is crucial for the planning of future missions. Thus, larger and



Illustration: LZH.

Artist's impression of how MOONRISE technology could work on the moon. Left the lunar module ALINA, right the rover with the MOONRISE technology – with the laser melting moon dust.

This is where the MOONRISE technology comes in: "We want to take a laser system to the moon, designed to melt moon dust, the so-called regolith. We would thus take the first step to take additive manufacturing to the moon," said Niklas Gerdes from LZH.

In this way, scientists from Braunschweig's Institute of Space Systems (IRAS) and LZH want to prove the following: a laser system that weighs no more than 3kg and has the volume of a large juice package could melt down local raw materials on the moon

more sustainable projects on the surface of our cosmic neighbor are becoming possible."

## A fall of moon dust

Specifically, the scientists from Braunschweig and Hanover want to melt regolith (moon dust) on the lunar surface in a controlled manner using their laser system. After cooling, it forms a solid form that would be suitable, for example, as a building material for a future "Moon Village" – an outpost in space.



The targeted melting of regolith into predefined structures is to be monitored and observed using high-resolution cameras. The findings from these experiments are expected to have a fundamental impact on exploratory missions in general.

The team comments that if the experiment succeeds on the moon, then the MOONRISE process can be scaled up to produce larger structures. Thus, in the long term, whole infrastructures such as foundations, paths, and landing surfaces could be built using the MOONRISE manufacturing technology.

Project MOONRISE has been running for almost nine months. The team says results from early tests are promising: The laboratory setup is adapted; suitable, common laser hardware identified and tested, the optics designed and tested [specifics such as brands, powers and wavelengths have not yet been revealed].

Currently, the team is working on adapting the laser to the load compartment of the lunar vehicle, the so-called rover. The laser is integrated into a tunnel at the bottom of the rover. After the adjustments, the entire system is tested for its space suitability: because on the way to the moon, the laser system must withstand shocks and massive temperature differences.

## Countdown to lift-off

The project has already scheduled a "big day" in the calendar – in 2021: The MOONRISE laser of LZH and IRAS will be part of the moon mission of the PTScientists, to be launched to Earth's satellite, and integrated into the "moon rover". The ambitious and future-oriented research project is funded by the Volkswagen Foundation within the scope of its Off the Beaten Track program.

The MOONRISE project will provide the scientific and technical basis for 3D printing on the moon. "With the newly opened research center at Hannover Institute of Technology and the so-called "Einstein Elevator", we have the necessary infrastructure at our disposal in the metropolitan region of Hannover-Braunschweig to carry out top space research," said Prof. Ludger Overmeyer from LZH.

Matthew Peach, Contributing Editor, *optics.org*  
<http://optics.org/news/10/5/45>





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# Fraunhofer IWS discovering superalloys, new AM processes

Aim of German researchers is to speed up AM systems for components; project futureAM accelerating process by factor of 10.

Scientists at the Fraunhofer Institute for Material and Beam Technology (IWS) in Dresden, Germany, have developed innovative methods enabling more types of materials to be processed in additive manufacturing systems.

For example, additive manufacturing systems could facilitate better future aircraft engines with lower fuel consumption using novel designs and lighter, stronger "super alloys". However, engineers must first improve the current industrial 3D printers in such a way that these machines can also process very strong and extremely heat-resistant alloys.

The researchers have used their significant experience with laser powder buildup welding technologies and added artificial intelligence. They are contributing their materials expertise to the ongoing Fraunhofer joint project futureAM (see below). The aim of the project partners is to speed up additive manufacturing systems for metal components by a factor ten and also to manage superalloys.

IWS engineers have refined laser powder buildup welding over decades in order to allow more materials to be applied in additive manufacturing. In this procedure, a system feeds various filler powders into a process zone. In that, a laser melts the powder and deposits it on a workpiece surface. As a result, the desired part is generated in a layer by layer process.

"One of the advantages of this additive procedure is that we can adapt the process very flexibly to the requirements of high-performance materials," said Fraunhofer IWS project administrator Michael Müller. In this way it is also possible, for example, to print nickel-based alloys that are difficult to weld and process using traditional methods.



© Fraunhofer IWS Dresden

*By means of laser powder build-up welding, components made of different materials can be integrally manufactured. Thus, specific materials can be placed exactly where their properties are required. This offers, for example, the prospect of lighter, better and cost-reduced blades for gas turbines.*

However, this only works if the temperature, powders, feed rate and other parameters are correct.

"We have to adjust all the set screws precisely," said Müller. "This is the only way we can find the right recipe." Within the framework of the Fraunhofer lighthouse project futureAM Next Generation Additive Manufacturing, IWS engineers are recording numerous sensor data with high sampling rates for this purpose. However, this generates large amounts of data that can be difficult to understand.

## AI learns to decide

Nevertheless, the Fraunhofer team is using advanced methods of artificial intelligence and machine learning in a working group led by Prof. Karol Kozak, Head of Image Processing and Data Management at IWS, to find hidden

connections in these signal floods. Special analysis algorithms can link the measured sensor values with the institute's powder database and evaluate further process parameters. Thus, the machines can learn to make their own decisions.

For example, they can determine for themselves whether a slight rise in temperature in the welding process can be tolerated or whether they have to take immediate remedial action before the entire component is wasted. "Industry is looking for more and different materials which are often difficult to process," said Prof Frank Brückner, Business Unit Manager Generation & Printing at Fraunhofer IWS.

*continued on next page*

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## Fraunhofer IWS discovering superalloys, new AM processes

### Aircraft engines

Aircraft engines mentioned above are examples illustrating this prospect: they could work more efficiently and at higher temperatures – if most materials did not

already fail at temperatures of around 1200 degC. There are materials that can withstand such high temperatures, but they are very cost-intensive and difficult to process using traditional methods.

Additive manufacturing is intended to solve this problem. Moreover, it could help to achieve a more cost-effective design: "Using laser powder buildup welding, we can feed different powders into the process zone simultaneously or successively with precisely adjustable feed rates," said Prof Brückner .



© Fraunhofer IWS Dresden

Fraunhofer IWS Dresden has developed a process and material database which stores all details of the manufactured components. This database allows complex conclusions between the welding result and already obtained data.

Designing an entire component out of a singular material is not very effective since the component is not exposed to the same heat at all points." Preferably, the expensive, highly resistant material should only be used where it gets really hot," said Müller. "In other areas, a less expensive material will be sufficient." This is precisely what can be achieved with additive manufacturing systems – once they have learned to process the required superalloy.

### futureAM develops additive manufacturing

In the "futureAM" joint project, the IWS and five other Fraunhofer Institutes are pooling this technology and further expertise to push additive manufacturing to a new level. By summer 2020, they want to integrate all their expertise into the additive manufacturing process chain and demonstrate it on realistic components.

In November 2017, the Fraunhofer lighthouse project futureAM was launched with the aim of accelerating additive manufacturing of metal components by at least a factor of ten. The focus is on a holistic view of digital and physical added value from incoming order to the finished metal 3D printing component.

The central goal is a leap into a new technology generation of additive manufacturing. Five other Fraunhofer institutes are participating in this project under the leadership of the Fraunhofer ILT: IWS, IWU, IAPT, IGD and IFAM. Fraunhofer IWS will be exhibiting at LASER World of PHOTONICS in Munich, Germany, June 24-27th.

Matthew Peach, Contributing Editor, optics.org  
<http://optics.org/news/10/5/36>

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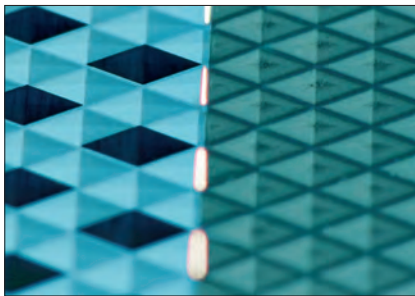
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# Laser structuring raises toolmaking productivity

Fraunhofer ILT project eVerest develops laser machine that triple production rate of tools for car parts.

Car makers employ a variety of methods to emboss plastic panels for vehicle interiors. But the manufacturing the tools required for this purpose is typically an extremely time-consuming process.

Now a new laser-based machine triples the rate at which these tools are produced while enabling more complex structures. The expertise required for the various components and processes was developed as part of the "eVerest" project in collaboration with partners from research and industry.



*Reduced reworking and creation of selective polishing effects through the sequential process of USP laser cleaning and USP polishing after structure generation.*

© Fraunhofer ILT, Aachen, Germany / Volker Lannert.

A key aim of the car industry is to produce vehicle interiors that convey an impression of superior quality. For example, the finer the texture of plastic surfaces, the closer they can create the appearance of leather or other high-quality materials. It takes auto suppliers a matter of minutes to fabricate this kind of surface.

Producing the metal tools required for this purpose takes significantly longer, usually up to four weeks for the tool structuring itself. The three-dimensional texturing is either etched onto the tool in dozens of individual steps or created by means of a laser process with ablation rates in the region of approximately 1mm<sup>3</sup>/min. The eVerest research project saw five companies and three research institutions join forces to radically improve laser structuring technology with resolutions in the micrometer regime.

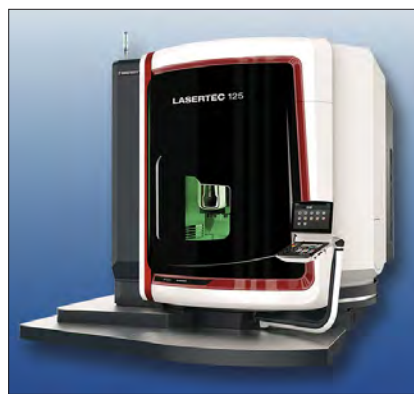
"Our aim was to make the processes much faster while simultaneously achieving even higher texturing quality," commented Andreas Brenner from the Fraunhofer Institute for Laser Technology (F-ILT), summing up the project's objectives.

## Enhanced laser power

To optimize the processes, the engineers examined the efficiency of all the components. Significant progress was made by reducing "dead times" in the scan paths. To achieve this, the team tested new algorithms and worked with scientists at Münster University of Applied Sciences, who evaluated a range of concepts for highly dynamic focusing using convex piezo mirrors. They eventually succeeded in tripling the throughput using innovative scanner technology developed by Scanlab.

The researchers also took the laser technology itself to a new level. Ultrashort pulse (USP) lasers are recognized for their precision in the nanometer regime. The eVerest team therefore decided to incorporate a USP source in addition to the standard nanosecond laser.

USP lasers have been criticized for their low productivity. In this case, however, the Fraunhofer ILT process engineers employed a powerful, actively cooled fiber-coupled USP laser from Amphos – a Fraunhofer ILT spin-off firm, and part of the Trumpf Group since 2018 – to obtain the same ablation rate per watt as that offered by the ns laser.



*The technology developed in the eVerest project allows up to three times faster machining in a fully automated 8-axis system.*

© DMGMORI AG.

The USP laser makes it possible to reduce surface roughness to less than 0.5 μm.

Quality assurance is also key both during and after processing, and the team evaluated two fiber-coupled OCT systems from Precitec Optronik for this purpose. The inline system facilitates resolutions of 5 μm, while the post-process achieves as low as 1 μm.

## Reduced rework

The individual components were incorporated into a machine based on the Lasertec 125 from DMG Mori. The developers had two key goals: firstly, that the machine should be easy to operate, without requiring any specialist expertise in the technologies used, and, secondly, that the number of processes should be reduced to a minimum. The simplicity of the processes represents one of the main advantages over etching, which frequently still relies on the instincts and dexterity of the machine operator.

The software plays a key role in making the fully automatic eight-axis machine easy to



© RWTH Aachen University.

*Simulation software enables users to view the laser-structured surface against a realistic backdrop.*

use. The team at RWTH Aachen University developed special tools that enable users to precisely simulate the desired structures on the surfaces and visualize their appearance in real time.

The machine's new process control system also makes it possible to perform several tasks in succession in the same clamping. Engineers at Fraunhofer ILT have filed a patent application for the USP laser polishing technology developed as part of the eVerest project.

## Rapid laser structuring

The process itself is now being tested in collaboration with partners at Volkswagen, but the potential applications of the core technology extend far beyond the confines of the auto industry. From embossing rollers in the printing industry to large bearings for rotor shafts in wind turbines, structured and functional surfaces are required across a broad variety of sectors.

"A detailed understanding of the process is essential whatever the application. The key is to combine this with modifications to the process technology and comprehensive control software," said Andreas Brenner, summing up the project team's approach.

eVerest project at LASER 2019 From June 24 to 27, visitors to the fair can learn more about the results of this collaborative research project at LASER World of Photonics 2019 in Munich on the joint Fraunhofer booth.

*Matthew Peach, Contributing Editor, optics.org*  
<http://optics.org/news/10/5/11>



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# Rapid-fire terawatt laser up and running at ELI-ALPS

Extreme Light Infrastructure (ELI) facility in Hungary switches on 'Sylos 2A' femtosecond source in ceremony with Gérard Mourou.

2018 Nobel prize winner Gérard Mourou has attended the ceremonial inauguration of a state-of-the-art laser system at the Extreme Light Infrastructure (ELI) facility in Hungary. Overseeing "first pulse" of the "Sylos 2A" system, built and installed by the Lithuanian laser companies Ekspla and Light Conversion, Mourou pushed an improvised black button to start the

beamlines at ELI-ALPS (ALPS is short for attosecond light pulses source), where users will carry out fundamental research across industrial, biological, and medical applications.

One intriguing possibility is that Sylos could be used, by driving a secondary source, to reduce the radioactivity of spent nuclear fuel, according to the

science leaders like Vilnius University professor Algis Piskarskas, Jasunias also noted the unprecedented combination of speed and power provided by Sylos.

Martynas Barkauskas from partner company Light Conversion added: "Pumped by dedicated all-solid-state short-pulse (picosecond-scale) sources and their (low-order) harmonics, this approach will be competitive with conventional Ti:sapphire laser femtosecond technology in terms of pumping efficiency, and will dramatically outperform previous technologies in terms of average power, contrast, bandwidth, and - as a consequence - degree of control of the generated radiation."

Currently offering the highest average power produced by any multi-terawatt, few-cycle OPCPA system, Sylos combines a "Pharos" industrial-grade femtosecond laser from Light Conversion with a specially designed diode-pumped Nd:YAG picosecond pump laser from Ekspla.

## User facility transition

Recent months have seen significant developments at the ELI-ALPS site in Szeged, as it transitions out of the construction and installation phase to become an operational user facility. Key moves have included the appointment of attosecond pulse and user applications expert Katalin Varjú as science director, and László Jakab as managing director.

Allen Weeks, director general of the ELI Delivery Consortium, said last month that the nuclear transmutation proposal, led by the University of Szeged, was "just the sort of project" that one would expect to see being developed by host countries involved with ELI.

"The scientific potential of the facility should be realised in particular by the ELI host countries," Weeks announced. "This is the justification for investing in the facility in the first place."

Meanwhile, negotiations with "non-host" countries regards joining the facility are described as "promising".

*Mike Hatcher, Contributing Editor, optics.org  
<http://optics.org/news/10/5/27>*



Photo: Ekspla.

*Gérard Mourou and Katalin Varjú at ELI-ALPS. The new Sylos laser system delivers an unprecedented combination of powerful femtosecond pulses at a high repetition rate, and could be used to research "transmutation" of spent nuclear fuels.*

source delivering 32 mJ, 6.6 femtosecond pulses at a rate of 1 kHz.

The laser system is based on optical parametric chirped-pulse amplification (OPCPA), the technique for which inventors Mourou and Donna Strickland won a share of the 2018 physics Nobel.

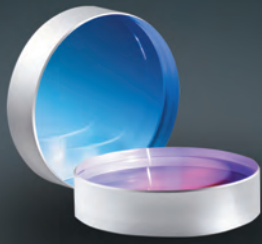
## Unique combinations

The system's 4.9 terawatt peak power equates to an average of 32 W, and will be used to drive four of the 12

method of laser-related transmutation.

Ekspla's CEO Kestutis Jasiunas said in a company statement that the collaboration between the team of scientists and engineers at ELI-ALPS and the two Lithuanian firms, whose expertise originated at Vilnius University, had resulted in a unique combination, namely "extreme parameters plus extreme user-friendliness".

Thanking Mourou and Lithuanian



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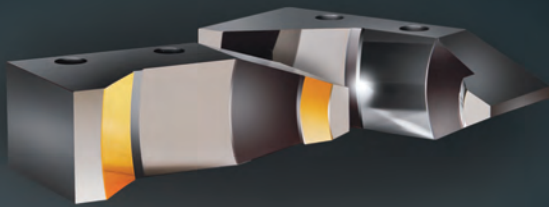
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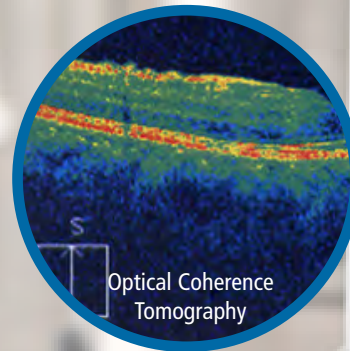
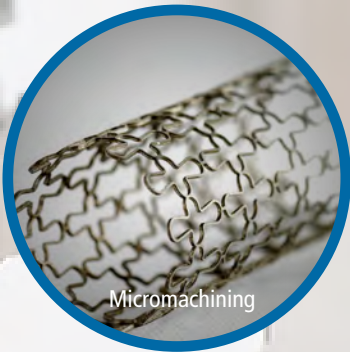
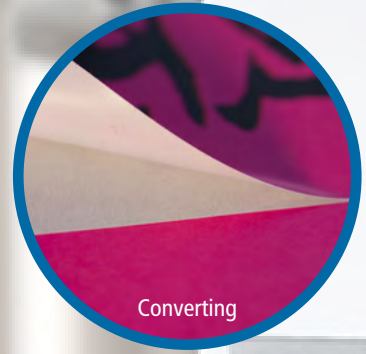
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