#85

»INNO«

Innovative Technologies / New Applications

HIGH-PRECISION PRODUCTION PROCESSES

IVAM.

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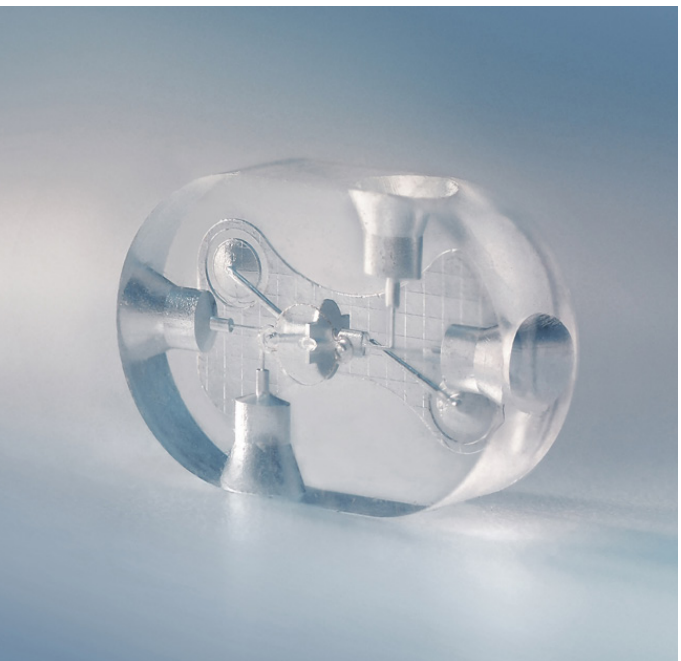
The µ-MIM technology keeps developing to cater to new and near-future requiremen especially from medical dev industries.



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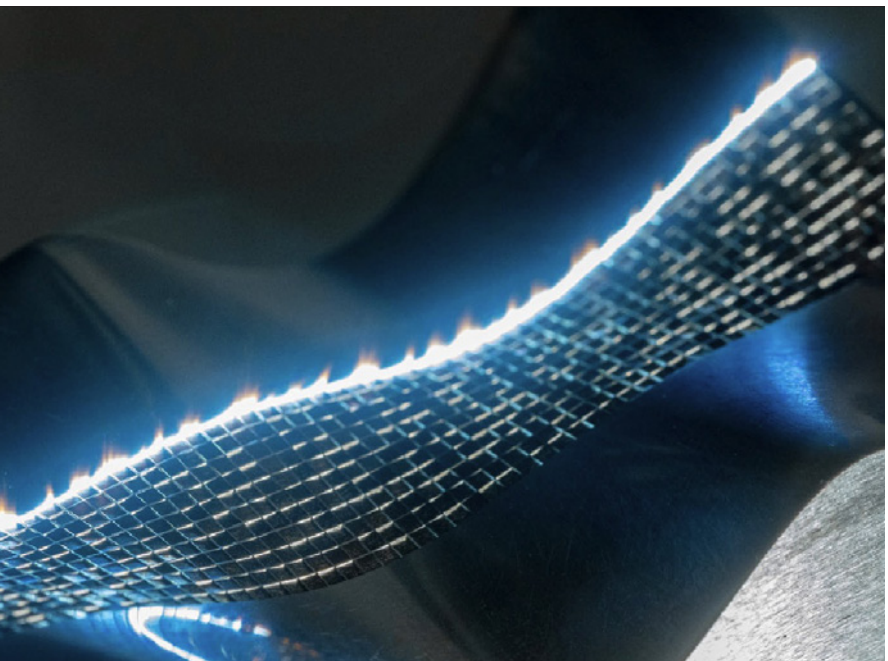


»INNO 85« High-Precision Production Processes

In the world of technology, precision has always been a hallmark of progress. High-precision production processes are the backbone of many innovations in the markets. The significance of these processes cannot be overstated. They underpin advancements across various sectors, from healthcare and electronics to aerospace, driving efficiency, quality, and new frontiers of possibility.

In this issue of INNO, we would like to have a deeper look into the world of “High-Precision Production Processes.” We have gathered a collection of articles from the IVAM members that spotlight cutting-edge technologies, from 3D printing and laser techniques to micro-assembly for robotics and micro-metalworking.

Join us on this journey through the world of high-precision technologies. I wish you an exciting and entertaining reading.

Best regards

Mona Okroy-Hellweg

IVAM.

Florian Lendner

A NEW DIMENSION OF LASER DRILLING

Holes with high aspect ratios are still a challenge, especially for small hole diameters below 250 µm. Therefore, promising applications have not yet been realized. GFH GmbH, manufacturer of high-precision laser processing machines from Deggendorf, now offers a solution for this. GFH GmbH has developed an innovative drilling process using high-power USP lasers that have recently become available and combines them with innovative drilling optics and a great deal of knowledge and experience in the production of precision boreholes in the micrometer range. And all of this is wear-free and a variety of materials can be processed.

Drilled holes in the sub-millimeter range are the key for many applications. In the beginning, it was mainly the automotive industry that required the finest and precisely defined hole geometries for the injection nozzles of their combustion engines, but today many other sectors use their advantages. From spinnerets in the textile industry to cooling holes in turbine blades to precise dosages in pharmaceuticals. Boreholes with diameters of 250 µm and less enable numerous new applications.

Challenges in drilling deep microholes

By drilling with defined wall geometry, the limit has usually been at aspect ratios of 1:10 so far. For example, in percussion laser drilling, the laser spot's beam caustic leads to conical bore shapes that become more distinctive with increasing drilling depth.
In addition, other technologies also reach their limits with deep drilling.
When eroding deep holes, a conical hole shape is formed. With diameters < 250 µm, classical mechanical drilling is mainly possible with very soft materials and is also very time-consuming and wear-intensive. So, there is no technology available in the market that can efficiently implement deep micro drilling in production.

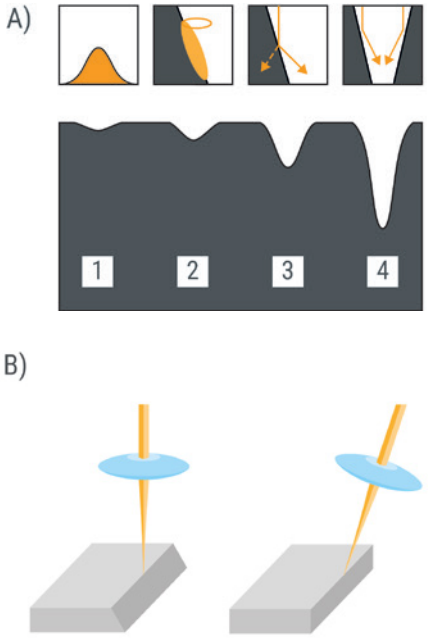


Figure 1: Challenges in laser drilling. A) The Gaussian power distribution in the focus leads to uneven ablation and a conical hole shape. B) The beam caustic guides angles in vertical drillings or cuts with the laser. This can be compensated by adjusting the angle of the beam.

Beam caustic determines the depth of the hole in helical drilling

To avoid a conical bore shape, trepanning, and helical drilling are often used in laser drilling. Good roundness and roughness values can be achieved with this but the depth of the hole is limited by the beam caustic as well. For instance,

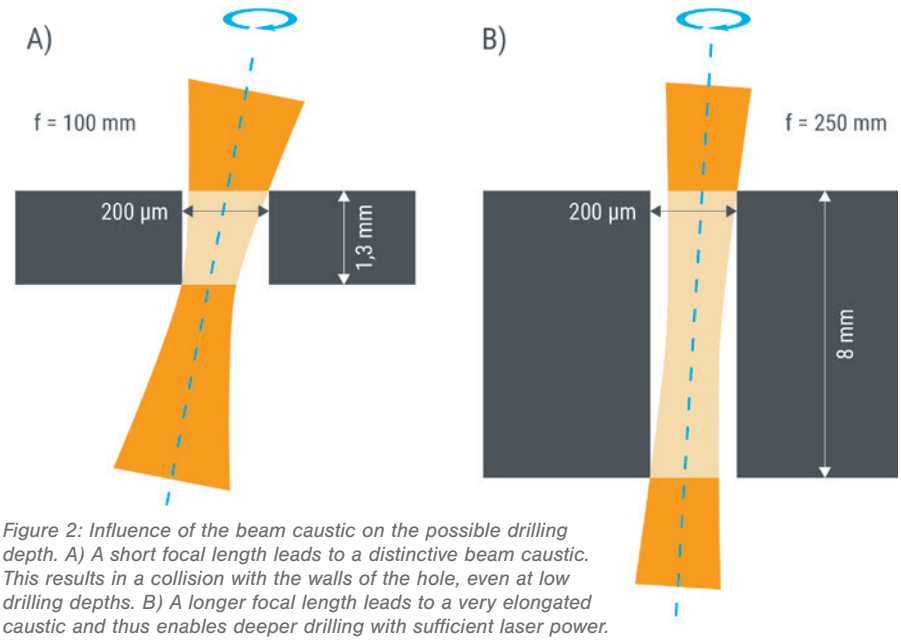


Figure 2: Influence of the beam caustic on the possible drilling depth. A) A short focal length leads to a distinctive beam caustic. This results in a collision with the walls of the hole, even at low drilling depths. B) A longer focal length leads to a very elongated caustic and thus enables deeper drilling with sufficient laser power.

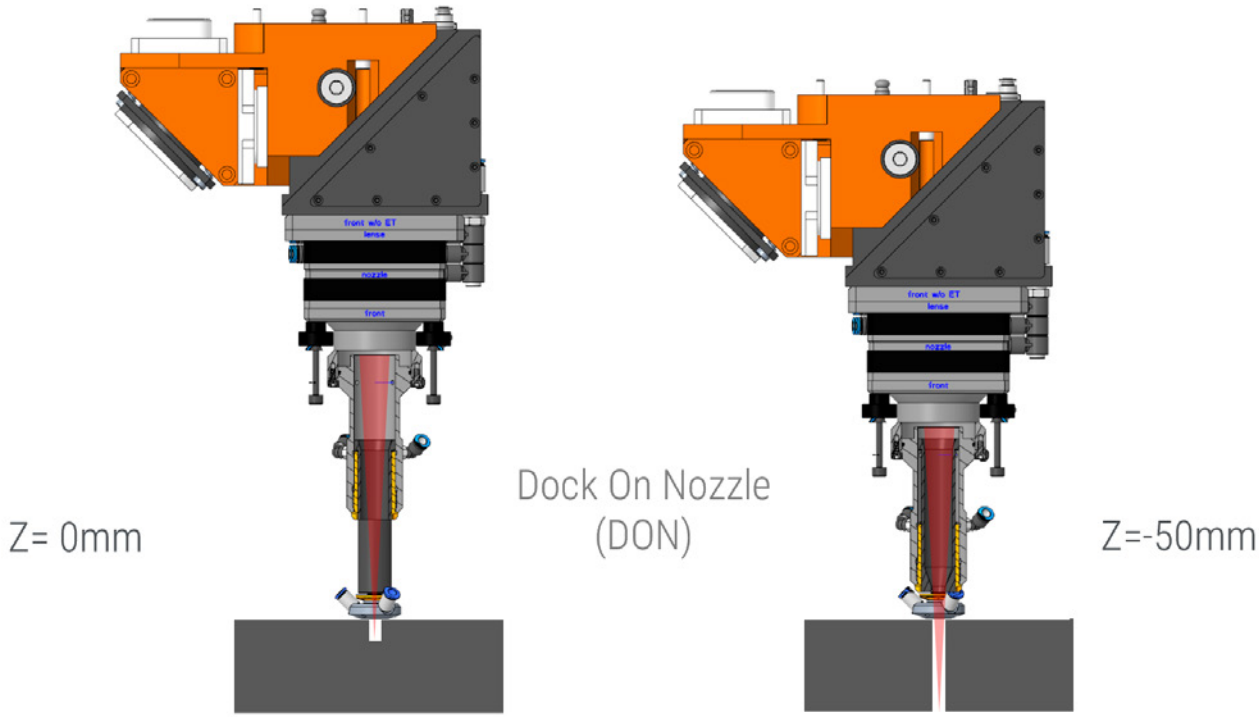


Figure 3: GFH processing head incl. Dock-On-Nozzle. To ensure high quality bores a constant supply of process gas must be guaranteed. For deep drillings the distance between the processing head and the component surface changes noticeable. Due to the interlocking cylinders of the Dock-On-Nozzle, the gas flow and thus also the laser process can be kept constantly over a 50 mm z-shift.

with a focal length of f=100 mm, a Rayleigh length RL of approximately 630 µm is obtained. Remaining within a range of 2 RL for good drilling results limits the drilling depth to approx. 1.3 mm with a diameter of 200 µm. Even with helical drilling, i.e. trepanning with additional shifting of the z-position, a depth of approx. 2 mm and an aspect ratio of 1:10 is the limit.

Basically, a longer focal length could help because the beam caustic reacts less sensitively to changes in the z-position. With a focal length of f=100 mm, the theoretical spot diameter triples with a z-shift of 2 mm, while it only changes by 10% with f=250 mm. It is theoretically possible to drill up to 8 mm deep without damaging the borehole entrance. However, only if sufficient laser power and pulse energy are available.

New high-power USP lasers enable new drilling processes

The longer focal length not only increases the Rayleigh length but also the spot diameter. With the same pulse energy, this results in lower energy densities and thus a slowdown of the process. Often, the process is no longer feasible at that point.

Thanks to a new class of USP lasers, with up to 200 W and pulse energies of 2 mJ at 100 kHz are now available. This means that the fluences required for cold ablation can also be achieved with longer focal lengths. With these increased laser powers, it is also important to optimize the optics used for the high pulse energies. Transmissive optics, e.g. with continuous gas flushing, are usually more suitable than mirror systems, which are more difficult to cool and more vulnerable to high energy densities. Even with f=200 mm, it is now possible to run an efficient drilling process.

Process control is crucial for good quality

But not only the laser has to be adjusted for this new laser process. The deeper boreholes also affect the process conditions and the planning of the process.
For example, a constant gas flow is extremely important for good drilling quality. The deeper the material gets drilled into the greater the distance to the gas nozzle. This leads to different results at the entry and exit of the bore, which affects the bore quality noticeably.
To compensate for this effect, a gas nozzle was developed to maintain the distance to the focal position constantly throughout the entire drilling process. The recently developed Dock-On-Nozzle is attached directly above the component and consists of two

“Powerful USP lasers and innovative optics and process control enable micrometer drilling with aspect ratios of 1:40 and more.”

cylinders that can be interlocked. The deeper the drilling, the more the two cylinders slide into each other, thus compensating for the changing distance between the processing head and the component surface. This allows maintaining a constant distance between the machining position and the gas nozzle over a range of 50 mm.

In addition, the planning of the process needs to be adjusted to the deeper boreholes. Even in drilling without z-axis tracking, each drilling sequence consists of multiple passes and involves continuous adjustments of the diameter and the work angle. With deep boreholes individual drilling strategies for the separate z-layers are required. For this GFH GmbH developed a simulation and planning tool that carries out the planning of the process. This brand-new software allows process optimization and visualization of possible collisions of the laser beam with borehole walls simultaneously.

Convincing results with a wide variety of materials

The use of the USP laser gives you a great deal of freedom in the choice of material, even for deeper holes. Holes can be drilled in metals as well as in ceramics, printed circuit boards, or plastics. In this process, the processing speed remains within an acceptable range for many applications, at 8-15 s/mm, providing further room for optimization in individual customer applications.

The results demonstrate that the interplay of various components, including high-power USP lasers, optical systems, and process planning and optimization, makes it possible to achieve micrometer drilling with high aspect ratios. In doing so, the advantages of the proven USP laser drilling are retained, and drilling at angles remains feasible with the new process.
The roundness and surface quality achieved in the new drilling process are noteworthy. The surface quality of the drilled holes is comparable to shorter USP laser drilling, within the range of Ra = 0.1 µm or better. The holes have a roundness ranging from 93-99%, and the diameter at the entry and exit points shows good repeatability from hole to hole, with a standard deviation of < 1.5 % of the diameter.
In summary, the newly developed process offers a reliable and efficient solution for achieving high-precision micro drilling with aspect ratios of 1:40 and greater. It has the potential to enable new innovations and applications across a wide range of industries.

GFH GmbH, Deggendorf DE

https://gfh-gmbh.de

Figure 4: Simulation and planning software. To achieve high quality bore holes parameters like laser power, focal spot size and work angle must be set continuously for each layer. In addition to the process planning the software allows process optimization and visualisation of possible collisions of the laser beam with bore hole walls simultaneously.

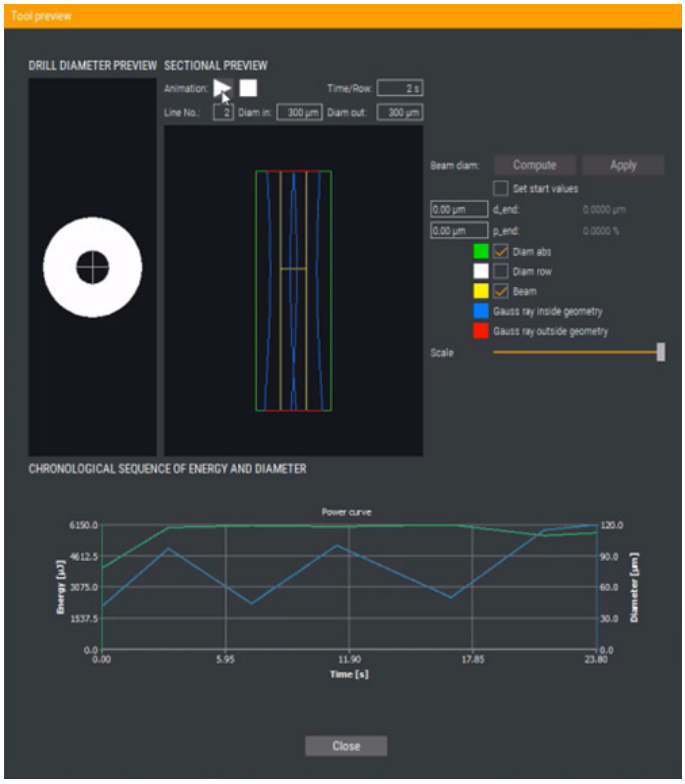
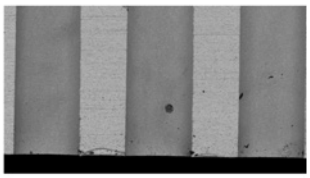
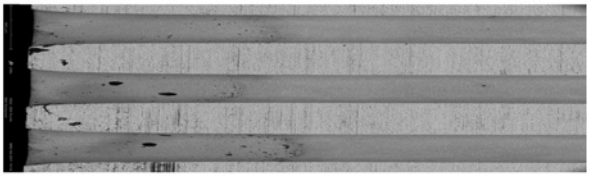


Figure 5: High aspect ratio micro drilling. The process was implemented using a TRUMPF TruMicro 6020 USP laser with 200 W, an f=250 mm focusing lens and GL.trepan helical drilling optic on a GFH machine. This resulted in holes with aspect ratios of up to 1:38.

A) Bohrungen in Edelstahl

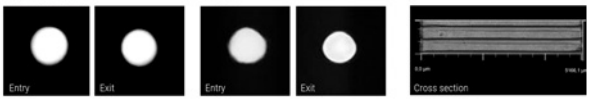
Bohrdurchmesser (Eingang / Ausgang)	200 µm / 200 µm
Länge der Bohrung	4 mm
Aspektverhältnis	1:20
Bohrrate	10 s/mm
Bohrdauer	40 s





B) Bohrungen in anderen Werkstoffen

Aluminiumoxid | Nickel | Carbid



Material	Aluminiumoxid	Nickel	Carbid
Bohrdurchmesser (Eingang / Ausgang)	200 µm / 200 µm	168 µm / 148 µm	140 µm / 126 µm
Länge der Bohrung	4 mm	6 mm	5 mm
Aspektverhältnis	1:20	1:38	1:38
Bohrrate	10 s/mm	9 s/mm	8 s/mm
Bohrdauer	40 s	54 s	40 s





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MICRO MILLING AND MICRO METROLOGY IN MICRO MANUFACTURING

The emerging techniques in micro and nano manufacturing make it possible to produce extremely complex structures with very few geometric restrictions, high design flexibility and various applications in numerous industries and professions, including medical, electronics, photonics, biotechnology, automotive and aerospace.

Micro milling for ultra-precision geometries

Micro milling is a powerful technique used in manufacturing highly complicated 3D geometries in difficult-to-manufacture materials such as hardened steels, which can be extremely suitable for creating very precise and accurate parts with microscale features of less than 1-micron tolerance on the object's form and dimensional accuracy. The extremely high speed (50,000+ rpm) improves the quality of the cut and surface finish, reduces tool breakage, and increases productive machining. Within the mold making industry, micro milling allows for highly accurate high-aspect-ratio micro structures (microchannels, ultra-

thin walls, microarrays) and precise patterned surface microstructures, which are essential in the making of distinctive applications like microfluidics and lab-on-a-chip. Using micro milling, Micro Systems have manufactured microfluidic molds for single-cell immune profiling and single-cell gene expression technologies, with molded devices precisely reproducible within 0.5 microns using polymers such as PC, COC and COP, incorporated 50-micron microchannels, integrated optics features and a surface finish less than 20-nano Ra.

In a recent project, using the Kern Pyramid Nano machine within a temperature-controlled environment, Micro Systems was able to maintain 0.0005 mm (0.00002”) positional accuracy, and the spindle speed of 55,000 rpm could machine fully hardened steel using cutters as small as Ø0.050mm (0.002””). At this level of micro manufacturing, proprietary techniques are used to ensure all cutters can be perfectly aligned to ensure the finished manufactured parts are without any cutter steps.

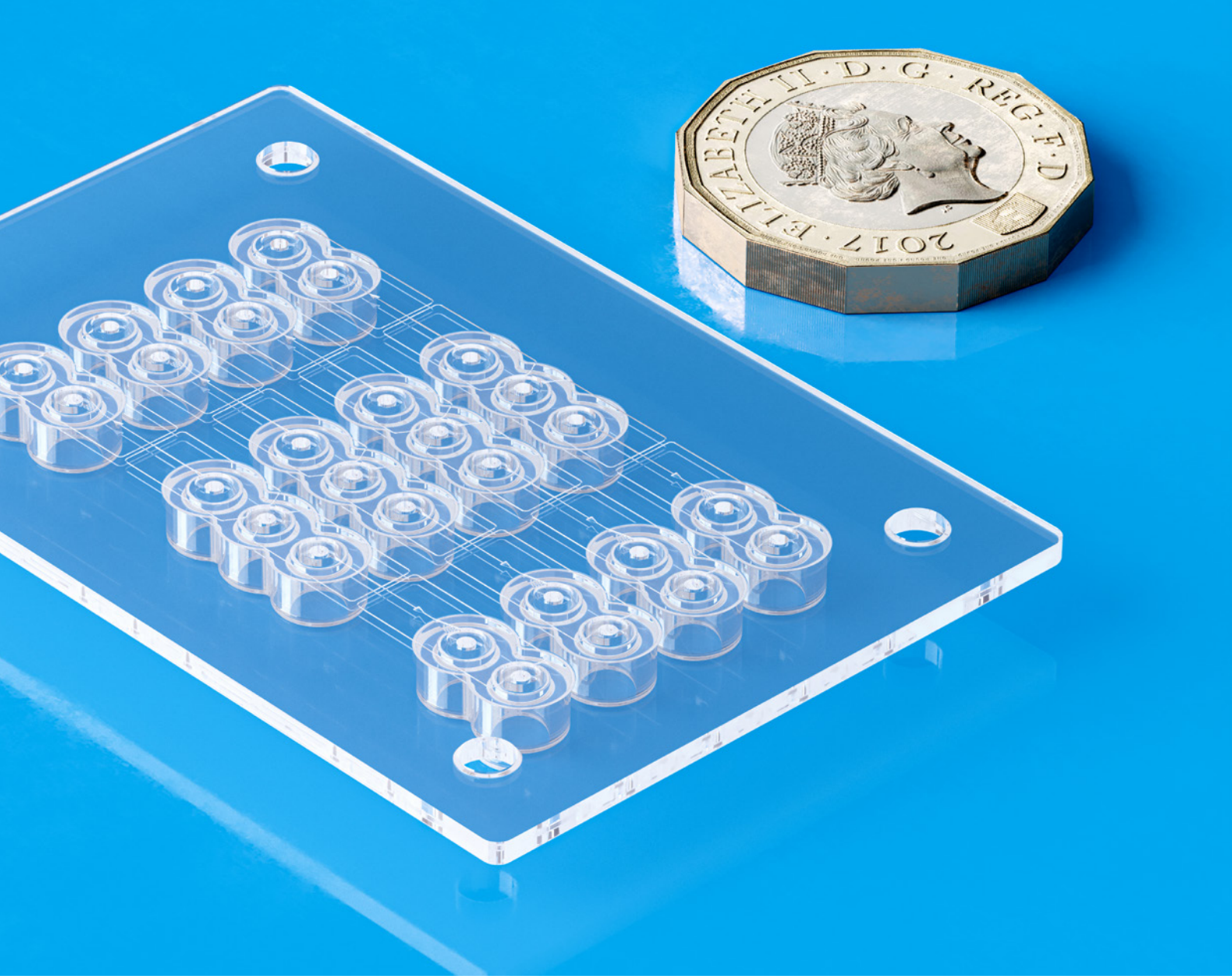
In addition, the UK-based mold maker closely controls all other crucial factors, including material characteristics, tool geometry, air temperature control, manufacturing environment, and cutting parameters, to achieve the desired outcomes with the highest efficiency and optimization.

Using innovative CAD/CAM software, collective experience and knowledge on material performance, time-cost efficient machining strategies, and micro milling excellence from designers, technicians, and engineers, Micro Systems is advancing into much smaller ranges of dimensions with extremely high levels of precision, accelerating the disruptive miniaturization trend especially in the medical and diagnostic sectors.

Micro metrology enables manufacturing precision

The increasing complexity involved in micro manufacturing requires advanced measurement and verification techniques that can only be found in micro metro-

Figure 1: Microfluidic chips with incorporated 30-micron microchannels, integrated optics features and a surface finish of less than 20-micron Ra.



logy. For all micro parts manufactured of various length scales, quality assurance requires a range of different advanced micro metrology technologies and systems, for example, non-contact white light interferometry (surface measurement and inspection) or focus-variation (shape and roughness measurement), that can generate color 3D models for comparison against CAD models and other data analysis. The capabilities to precisely scan and measure manufactured items in the process can beneficially shorten project lead times, resulting in the faster turnaround on design or steel iterations, more reliable measurements, and potentially lower costs.

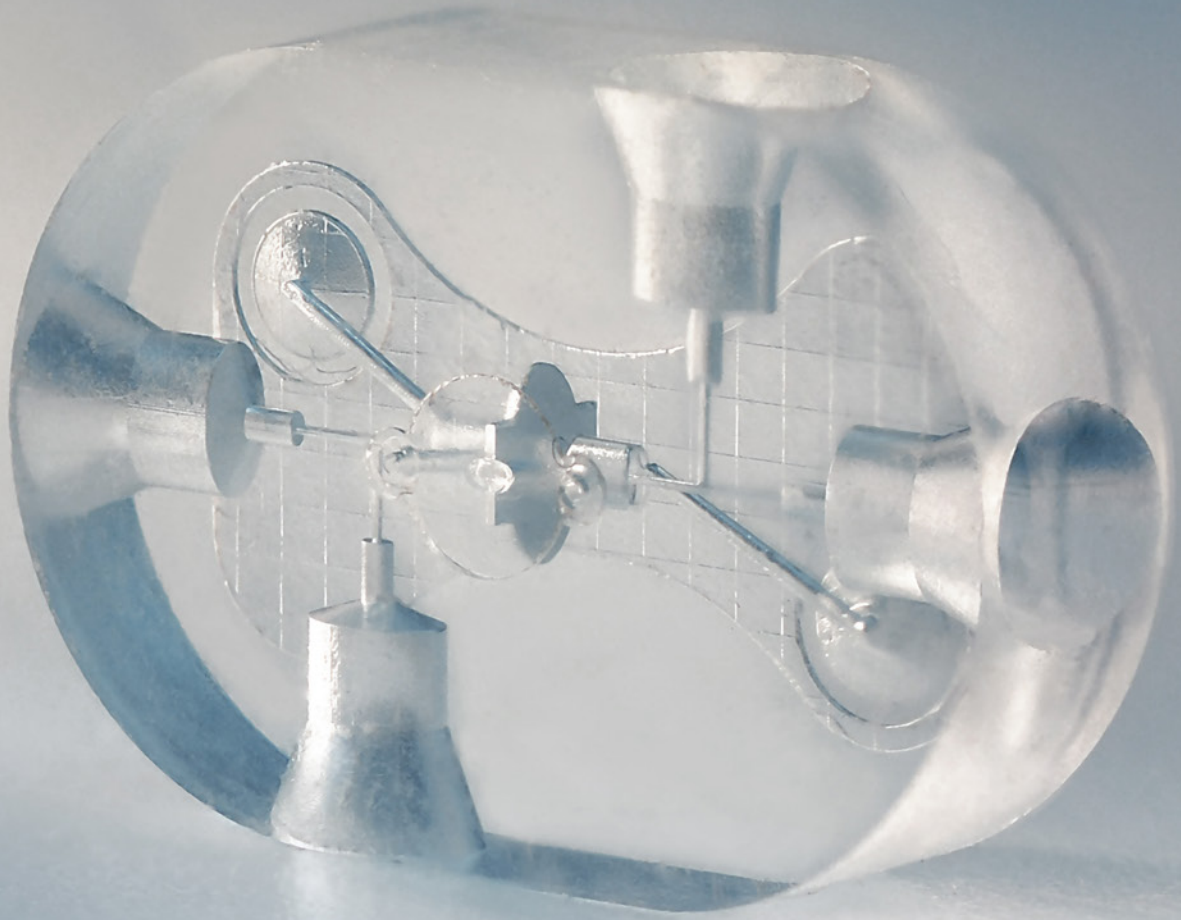
Certain machines, for example, the Keyence VHX6000 digital microscope, could be used to check the parts while they are still on the machine (IPCs - in process checks). The ability to mount the micro metrology system onto the KERN machine for IPCs without removing the parts being manufactured ensures no positional accuracy is lost due to the loading and unloading of parts for measurement checks. Micro Systems also utilizes Alicona InfiniteFocus G5, to conduct thorough 3D surface analysis at the nano level, surface roughness 2D Ra and 3D Sz results, with a 10 nm resolution, to identify, if any, corrosion, burns and surface detects, and all measurements are traceable to ISO standards.

By utilizing many groundbreaking techniques and expertise in micro machining to solve complex micro-manufacturing problems, at Micro Systems, significant progress is being made as we move from micro to nano manufacturing. With in-house mold design, mold manufacture and micro molding capabilities, Micro Systems can provide one-stop solutions for challenging ultra-precision manufacturing projects for medical, pharmaceutical, ophthalmics and diagnostics markets.

Micro Systems (UK) Limited, Warrington, GB

https://www.medicalmoulds.com

“The unique properties of glass”



Martin Hermans

EXPLORE THE FUTURE WITH 3D GLASS PRINTING

Technical glass, and especially fused silica, enables unique features that are interesting for a wide variety of applications. Glass is chemically inert, therefore it remains chemically stable in harsh environments. Moreover, glass is resistant to high temperatures and enables excellent optical transmission without any autofluorescence from deep UV to mid-IR. These properties together with the mechanical specifications regarding hardness, Young's modulus, and high isotropy degree make glass an interesting choice for many applications. The downside of using glass is that classic machining technologies as grinding or cleaving can leave stress or sub-surface damage. Consequently, engineers often do not consider glass as a suitable material for their application. Fortunately, a new laser machining technology is able to overcome the aforementioned disadvantages.

3D freeform manufacturing in glass

Selective Laser-Induced Etching (SLE) is a new technology that enables the production of complex 3-dimensional structures from dielectric materials such as glasses, crystals & semiconductors, that are transparent to the wavelength of the laser radiation that is being used (mostly 1030 nm). The SLE process comprises a combination of spatially selective material modification by means of laser radiation and subsequent removal of only the afore-modified material by wet-chemical etching. The reason for materials to be transparent for a specific wavelength of light is that the energy of a single photon is insufficient to overcome a threshold energy for the excitation of electrons in the material from the valence band into the conduction band, known as the bandgap. Thus, a single photon will pass the material almost with any effect let aside e.g. the effect of refraction and diffraction.

This situation changes drastically when many of these low-energy photons are present at the same time within a small volume. Applying strongly-focused ultrashort-pulse (USP) laser radiation gives rise to a non-linear effect, the so-called multiphoton absorption: electrons can absorb a multitude of the low energy photons at once as if it was one photon of the corresponding higher energy sufficient to overcome the band gap. Once electrons are present in the conduction band, they can absorb every photon that comes their way. By avalanche-like impact ionization, almost the complete energy from the laser radiation can be deposited at a well-defined spot of a few μm^3 even arbitrarily positioned within the transparent material. The deposited energy causes a multitude of processes like bond breaking, heating, melting, evaporation, etc., each of these processes having its own specific timescale. By using tightly focused USP laser radiation one can strongly emphasize the short timescale processes that lead to altering bonds in the solid instead of the ones leading to macroscopic heating of the material (large timescale processes).
Due to the small heated volumes and the small total amount of energy the cooling rate is extremely high and the exotic high-pressure high-temperature state is quenched and thus frozen in. The typical pulse duration for these processes is in the range of 200 to 2000 fs and pulse energies are in the range of 200 to 2000 nJ. Focal spot sizes, thus the tool size, are in the range of a few microns in diameter. By moving the focal spot through the bulk of the material one can inscribe lines, surfaces, and volumes of permanently altered material. Due to the appropriate laser settings for the specific material, this altered material has a preferential etching rate in certain etching fluids compared to the un-altered material. When exposed to this etching fluid, the altered material will etch a factor of 500 to 1500

faster than the un-altered material only if the altered material has contact with the outside of the workpiece to let the etching fluid work its way from outside to inside, almost only dissolving the altered material. This enables the fabrication of complex 3D structures comparable to 3D printing but in this case in a subtractive way. In fused silica, one can achieve feature sizes to a depth of 20 mm, as small as 5 µm, long 3D channels with diameters of 50 microns or less, and standard deviations on geometries in the order of 1 µm.

Various applications

Selective Laser-Induced Etching enables and enhances manufacturing technologies such as polishing surface treatment, writing optical patterns, drilling, and cutting on a microscale and glass-to-glass encapsulation. Highly-integrated 3D micro-parts from glasses are needed to bring various applications to a new level.

• Nozzles in injection, extrusion, or print processes

• MEMS devices in actuation or sensing applications

• Glass devices to precisely position bundles of optical fibers incorporating even micro-lenses, mirror mounts to form an optical micro-bench for passive precision alignment e.g. in optical data communication

• Various micro-fluidic applications such as cell-sorting and -analysis

LouwersHanique is a contract manufacturer that develops and manufactures high precision components and sub-assemblies made of technical glass, ceramics and other brittle materials. This includes full support throughout the lifecycle of a project from concept, engineering, machining, assembly and UHV cleaning to production and quality control. LouwersHanique works on mission critical components that make a difference in high tech applications for customers in the semiconductors, medical and lifescience industry.

LouwersHanique, Hapert, NL

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“HIGHLY-INTEGRATED 3D MICRO-PARTS FROM GLASSES ARE NEEDED TO BRING VARIOUS APPLICATIONS TO A NEW LEVEL.”

Emma Wilson / Sarah Charette

SMALL SCALE FLUID CONTROL IN HIGH PRECISION PRODUCTION PROCESSES

Controlling & dispensing precise volumes of fluid, down to the microliter and nanoliter range, is a common challenge in production processes. Whether you're designing a high throughput production line for lateral flow assays, consumable manufacturing, drug discovery or inkjet printing, the success of the system is often based on control of three main variables: pressure, nozzle or orifice precision, and valve speed. Here we discuss design considerations to control those variables in two applications.

Inkjet printing – controlling the meniscus

Within inkjet printing, the quality of the print output hinges on the precision with which ink droplets are formed and land on the substrate. Controlling the geometry and stability of the meniscus, that is, the surface curve of the ink droplet when in contact with the nozzle, is most critical for proper droplet formation and jetting. Ensuring a stable meniscus requires precise control over the negative fluid pressure in the ink reservoir.

Too high a vacuum can lead to air ingestion and starvation (Figure 2), while too low a vacuum can result in nozzle plate flooding or 'wetting-out' (Figure 3). Pulsatility in the ink reservoir can lead to periodic changes in print output (Figure 4).

Figure 1: Primary Components.

A disc pump

Smart Pump Module: Disc Pump with Integrated Electronics Enables Closed Loop Feedback Control

VHS Valve

Figure 2: Air ingestion in the printhead.

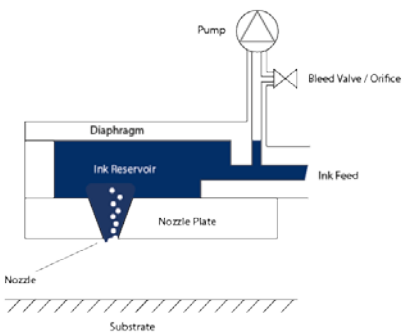


Figure 3: Wetting-out on the printhead.

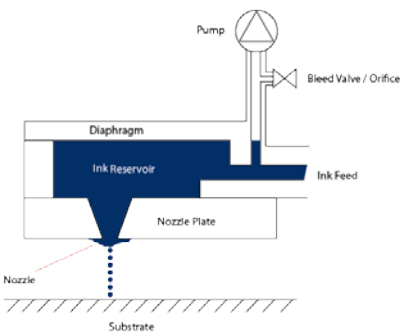
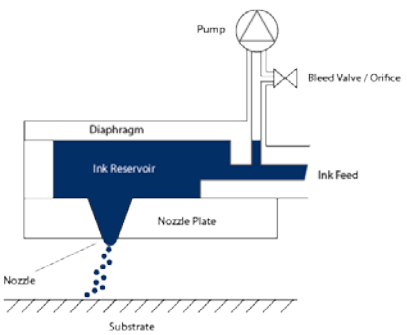


Figure 4: Irregular jetting of ink droplets



These effects lead to irregular jetting and compromised print quality. Many current systems use a motor-driven diaphragm pump to provide the negative pressure in the ink reservoir. Such pumps are pulsatile and offer limited controllability, meaning that additional components such as pulsation-dampers and proportional valves are required to achieve acceptable printhead performance.

The pulsation-free output of the Lee Company's piezoelectric disc pumps and their infinite turn down ratio ensure there is no pressure variation in the printhead, eliminating the need for those additional components. At just 29 mm in diameter and 5 grams, the disc pump is small enough to be directly integrated with the printhead. This enables a modular approach, with the ability to tailor vacuum levels for each print head, ultimately reducing system complexity and size while increasing design freedom. To provide a more plug-and-play solution, The Lee Company also offers precision orifices, bleed valves and solenoid valves which can be integrated with a disc pump into a fully tested and assembled manifold solution.

Precision reagent dispensing - time-metered dosing

The consistent control of dispensed fluid volume, or droplet size, is a critical factor when dispensing reagents in the production of lateral flow assays or rapid diagnostic tests. For example, reagent volumes dispensed on porous media or into consumables directly relate back to the sensitivity and specificity of those tests, hence the emphasis on precision dispensing during production.

For these types of applications, time-metered dosing systems offer simplicity while providing accurate liquid dispensing across a wide range of dispense volumes - from nanoliters to milliliters. In these systems, a constant pressure is generated and a dispense valve, also known as a microvalve, opens and closes to control the volume being dispensed through the nozzle or orifice. The precision of the nozzle or orifice has a significant impact on the precision of dispensed volumes. Manufacturing tolerances of the orifice can lead to differences between various dispensing channels. Burrs can lead to splitting streams or unwanted satellite droplets. The speed, or response time, of a dispense valve controls how quickly fluid is ejected from a nozzle, and how little fluid can be dispensed at a time. A faster actuation speed creates more predictable dispenses because flow starts and stops very quickly. These faster, consistent solenoid valves can also eject droplets, breaking the surface tension of the liquid.

Pressure can be generated by several sources but most common is the "air over liquid" system, which uses air pressure supplied by a compressor and regulated to a dispense pressure. New pumping technologies, such as the Lee Company's piezoelectric disc pumps, generate pressure and use a closed loop feedback system to act as an all-in-one pump and regulator solution (Figure 5). This eliminates the need for separate compressors and regulators, thus reducing system costs and size. Their pulsation-free output and infinite turn down ratio enable maximum accuracy when holding a target pressure above the fluids, resulting in a fine-tuned, highly repeatable system that redefines what it means to generate and hold a constant pressure.

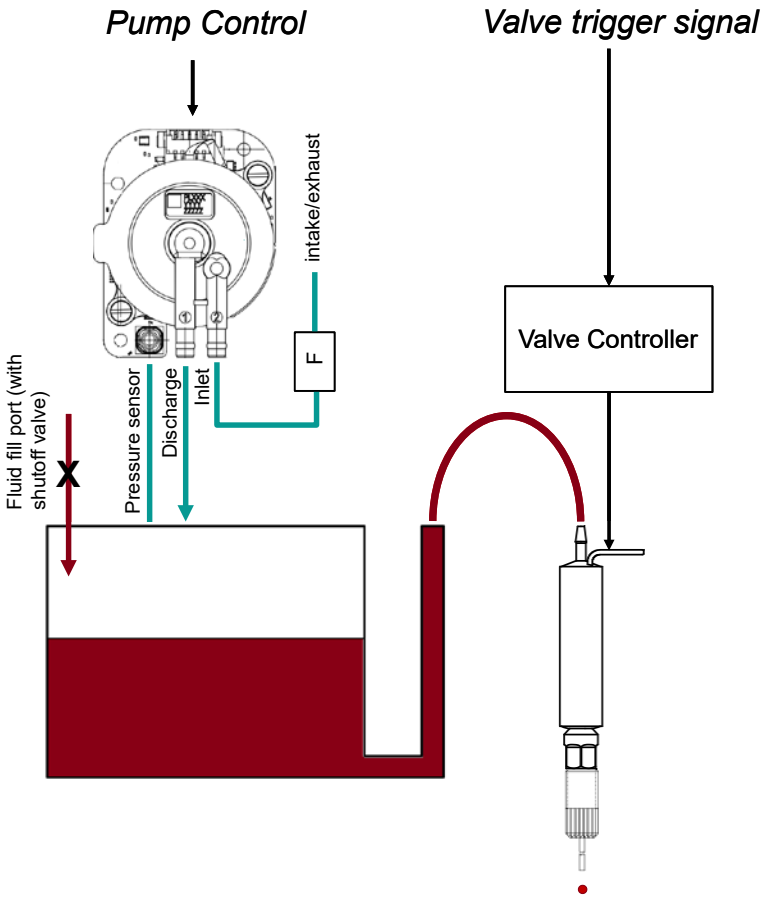


Figure 5: Time Metered Dosing System with Disc Pump's Smart Pump Module, VHS Series Solenoid Valve and Dispensing Nozzle.

The Lee Company offers wide ranging fluid control solutions. Visit theleeco.com for more information on our disc pumps, valves, precision orifices and nozzles.

LEE Ventus , Melbourn UK

https://www.theleeco.com

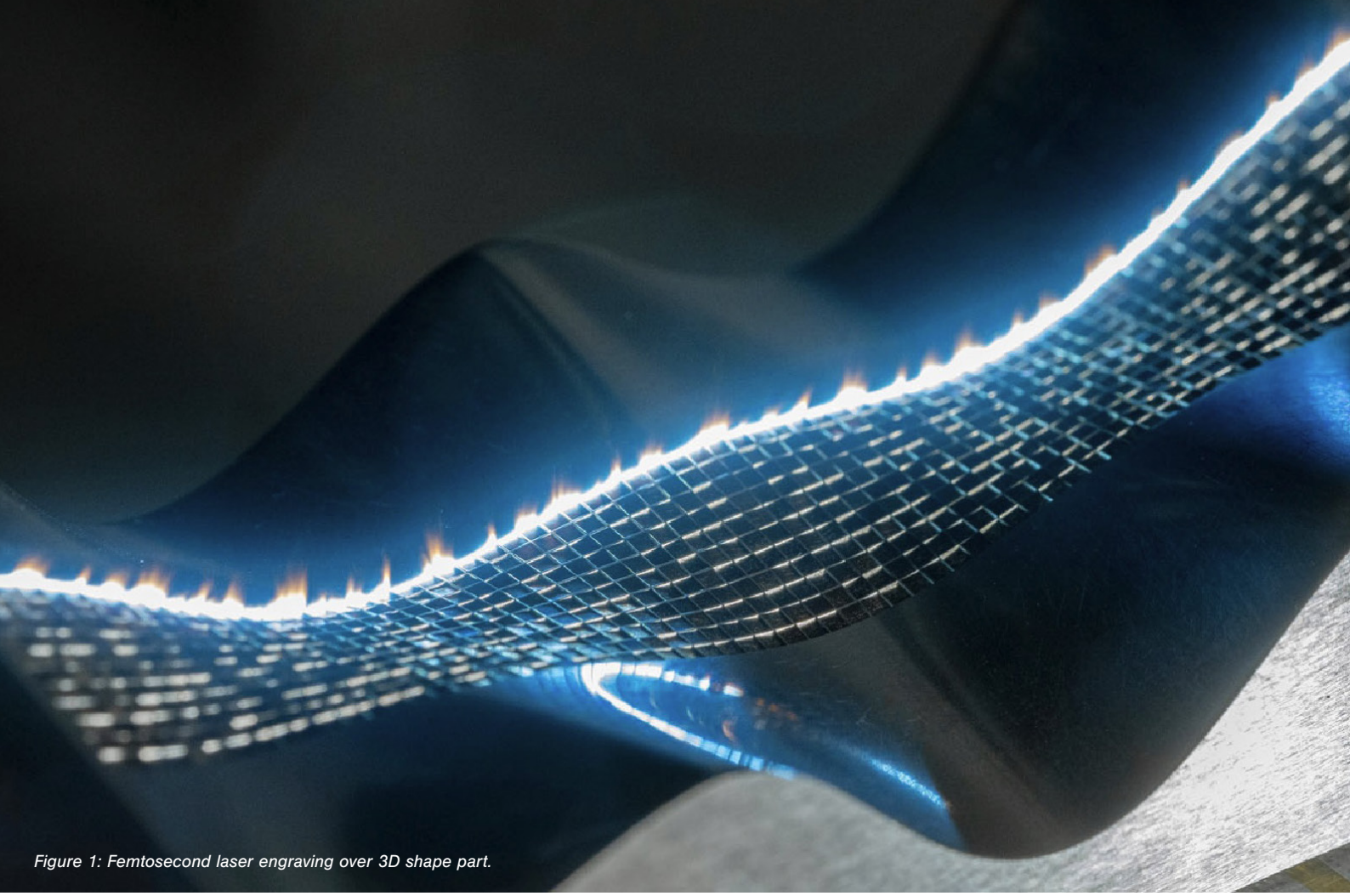


Figure 1: Femtosecond laser engraving over 3D shape part.

Raúl García

MICROSTRUCTURING & TEXTURING FOR FUNCTIONAL PARTS

How could we radically change the functionality of a product with a simple action such as engraving it? Traditionally we engraved products to identify them or to enhance a brand, but there are many more possibilities by dramatically reducing the size of the engraving down to the range of microns, for the creation of microstructures and microtextures.

Femtosecond laser technology

Conventional technologies like milling machines or die-sinking EDM have a limitation in the size of the detail of the engraving given that the use of a tool with a radius that radically limits the size of what you are able to engrave is needed; miniaturization is not possible. The power of those technologies, among others, resides in the possibility of milling or engraving big and heavy tools and parts over any 3D shape.

Femtosecond laser (USP or ultra-short pulse duration laser), on the other hand, enables the engraving of extremely small details with amazing precision although this has only recently been possible since the release in the market of cutting-edge femtosecond laser machines that allow the engraving over any 3D shape. Before, the limitation in size and 3D surfaces with this technology were huge and it was only possible to microengrave small flat areas.

However, the products that we use directly or indirectly in our daily lives often present more complexities in size, 3D shapes, geometries, and textures and are not reduced to being simply flat and small.

Imagine being able to microstructure and texture with high precision big and heavy tools and parts, with no limitation in the geometry. The possibilities would be limitless, wouldn't they? Microrelleus, a Barcelona-based company, has offered femtosecond laser services in 5 axes since 2016 and femtosecond laser services in 5 axes for big and heavy tools and pieces since 2022 with an innovative machine that integrates a last-generation femtosecond laser source into a big 5 axis machine to be able to engrave workpieces up to 1,200kg with high precision.

Surface functionalization

By laser surface texturing of molds or pieces, it is possible to engrave a specific pattern or texture to enhance, change, or improve properties of the material. Just think about protecting the authenticity of your product in the market with an extremely precise engraving or hologram for anti-counterfeiting purposes, or individualizing it to unimaginable levels, making it hydrophobic, reducing its friction, increasing adhesion, controlling the light intensity and diffusion or even reducing the reflected light on it with anti-glare textures. There

"Imagine being able to microstructure and texture with high precision big and heavy tools and parts, with no limitation in the geometry."

Figure 2: Superhydrophobic texture.

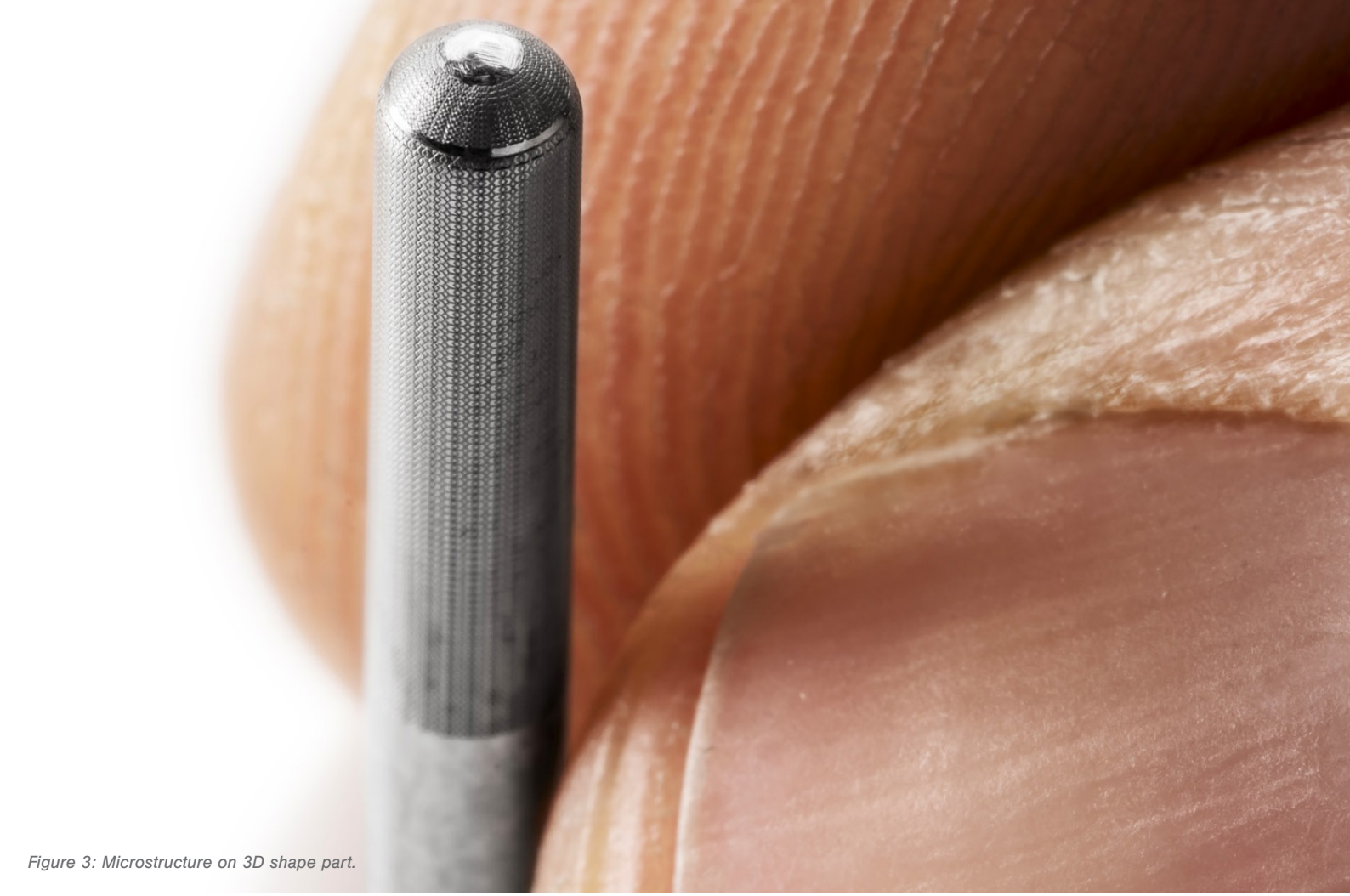


Figure 3: Microstructure on 3D shape part.

are limitless functional possibilities on your product by engraving controlled textures with the femtosecond laser.

Engraving on the tool for plastic injection replication

But…is it expensive? Is it scalable? How could I engrave the thousands of products I produce?
Microrelleus can engrave any plastic injection mold, usually made from tempered steel. The engraving done in the tool has the opposite shape of the microstructure needed in the final part. When plastic is injected, it replicates the microstructures and microtextures engraved in the tool and directly acquires the properties coming from the engraving.
One example is the tail lamp of the Range Rover Sport 2023.
Microrelleus engraved micro-optics on the tool with the femtosecond laser to achieve them in the final injected part. Thanks to that engraving there is a great light homogeneity and intensity in the rear lamp, in a process which is cost-effective for obtaining an innovative component.

Cost-effective solution with design and environmental benefits

Avoidance of coatings or films in the injected plastic part, use of monocomponent materials, achievement of functionalities on ultra-thick pieces, beautiful surface finishings, energy and weight reduction, and processes simplification are some of the benefits of using femtosecond laser to engrave a production tool.
Contact Microrelleus to obtain beautiful, functional, environmental-friendly, and cost-effective product enhancements by using this innovative solution!

Microrelleus SL, Sabadell, Barcelona, ES

https://microrelleus.com

Figure 4: Tail lamp of Range Rover Sport 2023.

Gefördert durch:
Bundesministerium für Arbeit und Soziales
aufgrund eines Beschlusses des Deutschen Bundestages
Funded by the European Union
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SPOTLIGHTS ON MICRO- AND NANOTECHNOLOGY

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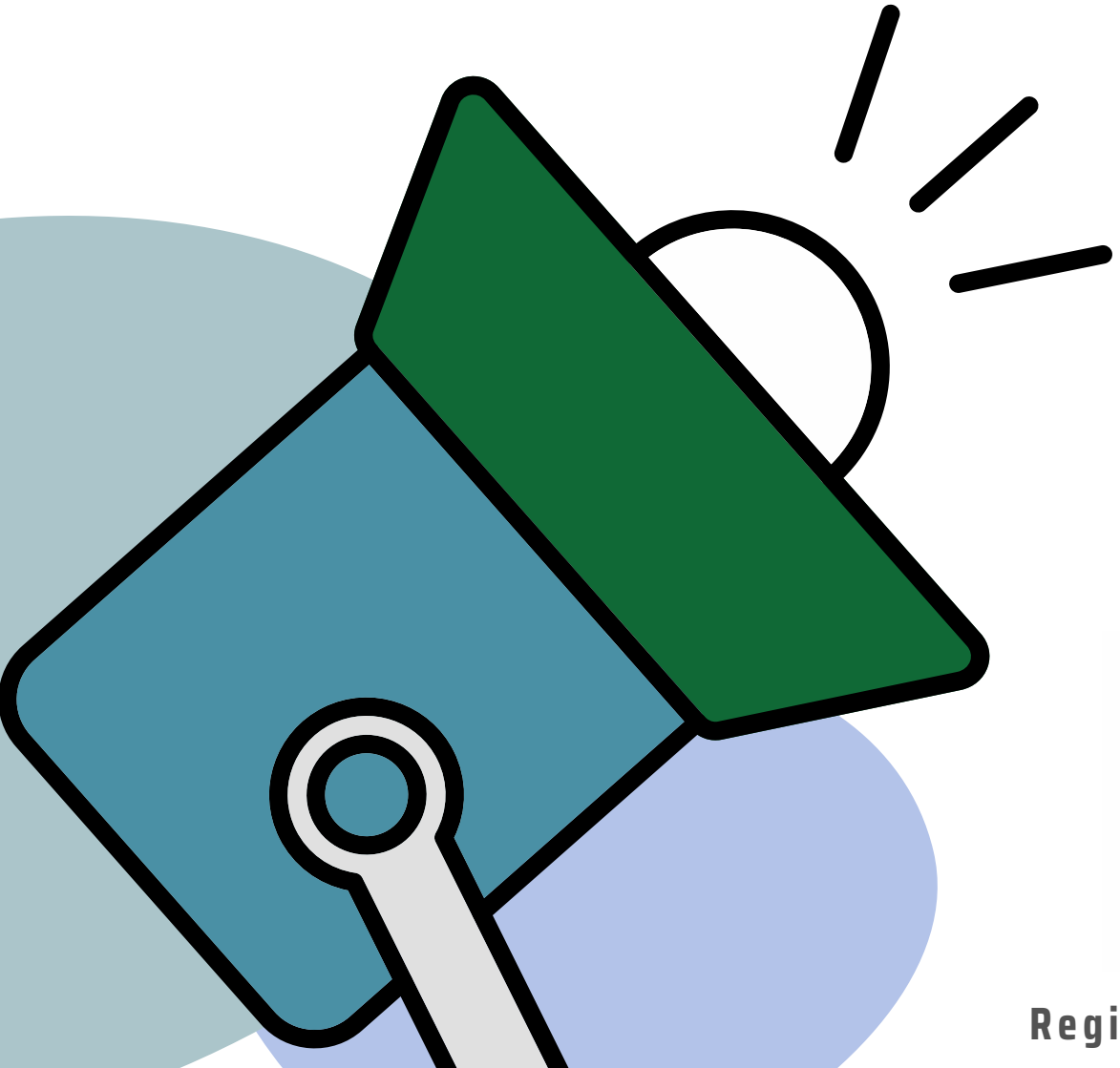

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INTEGRATED SENSOR TECHNOLOGY: THE NEXT STEP IN ADDITIVE MANUFACTURING

The Fraunhofer Institute for Laser Technology ILT will be presenting the latest research results in additive manufacturing technology at the Fraunhofer joint stand at formnext in Frankfurt am Main from November 7 to 10, 2023. Among other things, the Aachen engineers will be showing additively manufactured sensors that are printed directly onto components and that can provide real-time data for predictive maintenance. A new process makes it possible to seamlessly insert sensors into a component during the additive manufacturing process Laser Powder Bed Fusion (LPBF).

Trends such as Industry 4.0 and the Internet of Things are making the precise recording of the condition of machines and components increasingly important. To face the challenges in collecting sufficient data, the Fraunhofer Institute for Laser Technology ILT has developed a sensor infrastructure for smart industrial applications and implemented it using additive manufacturing processes.

Usually, sensors are manually attached to the surfaces of components. In addition to sensors on the component surface, the newly developed process can also integrate sensors directly into the components. This way, important characteristic data can be collected about the load within the component.

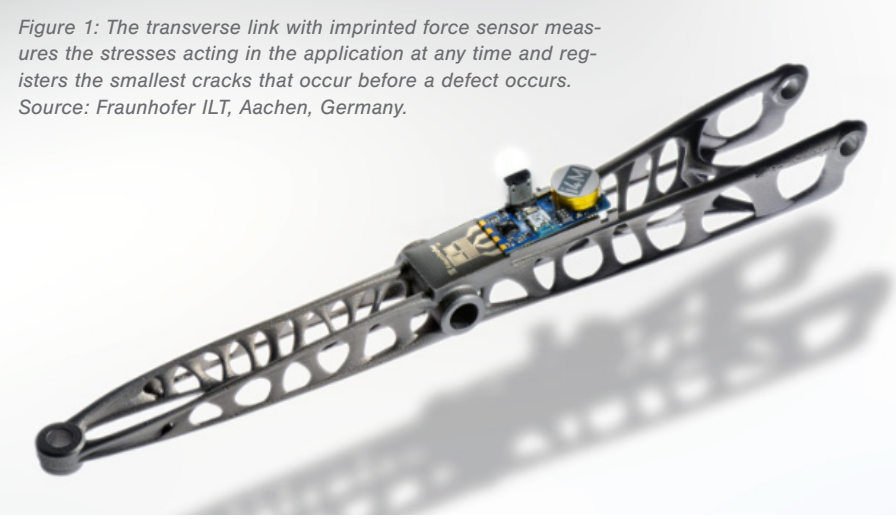


Figure 1: The transverse link with imprinted force sensor measures the stresses acting in the application at any time and registers the smallest cracks that occur before a defect occurs. Source: Fraunhofer ILT, Aachen, Germany.

Manual application of sensors is often not accurate enough; after all, the sensors need to register vibrations, accelerations or the smallest deformations in the µm range. Samuel Moritz Fink, Group Leader Thin Film Processes at Fraunhofer ILT explains: “Manual application of sensors is too imprecise and not reproducible in many cases. In addition, users are increasingly demanding processes that can be automated.”

Printed sensors for more precision

The Fraunhofer Institute for Laser Technology ILT will be exhibiting a passenger car transverse link with an additively manufactured sensor at the Fraunhofer joint stand (hall 11, booth D31) at formnext in Frankfurt am Main from November 7 to 10, 2023. “The force sensor that we printed on the transverse

Figure 2: Strain gauges were integrated into a cutter head during the printing process. Before: The LPBF printing process is interrupted and the strain gauges, which were also printed, are integrated. Source: Fraunhofer ILT, Aachen, Germany / Volker Lannert.

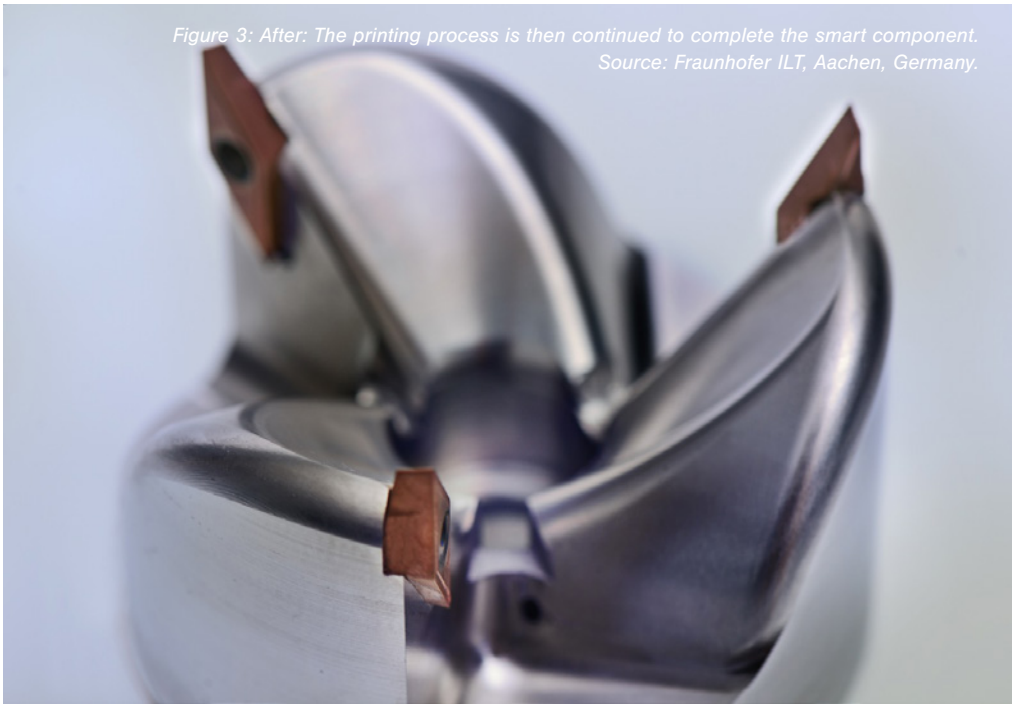


Figure 3: After: The printing process is then continued to complete the smart component. Source: Fraunhofer ILT, Aachen, Germany.

link is less than 200 µm thick, including the insulation and protective layer as well as electrical connections," says Fink. "We can determine the forces acting in the application at any given time." The sensor continuously measures the change in force during cornering, for example, and warns of defects before they occur.

"The force sensor registers the smallest cracks that occur before they lead to component failure," says the group leader. In addition to a force sensor, other sensors can also be applied to a component, for example, to detect temperature, vibrations or sound, pressure or acceleration, light, tension, different gases and liquids. Special polymers for the insulating and protective layers can withstand temperatures of up to 300 °C.

The range of applications for this process is immense, especially because it provides reliable real-time data for predictive maintenance: "It can be used, for example, to monitor battery cells individually, optimize maintenance intervals for offshore wind turbines or improve processes in mechanical and plant engineering," continues Fink.

Multi-stage process for manufacturing smart components

Another remarkable innovation presented by Fraunhofer ILT at formnext is the seamless integration of sensors during the additive manufacturing process. With the help of 3D structural printing processes such as laser powder bed fusion (LPBF), printed sensors can be integrated directly into components as they are created.

The Fraunhofer researchers will demonstrate this technology with an additively manufactured milling head. The structural printing process using LPBF is interrupted to integrate strain gauges using a digital functional printing process and laser-based thermal post-treatment. The structural printing process is then continued to complete the smart part.

By combining structural and functional printing with laser-based post-treatment, the institute has shown that components with integrated sensor technology can be manufactured completely additively. This not only enables them to precisely place sensors for sophisticated condition analysis, but also to protect these sensors from mechanical environmental stress.

"The geometry of the sensors can be customized depending on the component. In the future even additional functional elements such as integrated heaters are conceivable," says Samuel Fink. "This technology opens up a wide range of possible applications, from manufacturing in the areas of tool-making and mechanical engineering to the automotive industry and beyond in the energy, aerospace and aeronautics sectors."

Fraunhofer Institute for Laser Technology ILT, Aachen DE

https://www.ilt.fraunhofer.de

Yann Buaillon / Isabelle Faggianelli

OPENING THE PATH TO INDUSTRIAL MICRO-ASSEMBLY

The latest few decades have seen a tremendously growing demand for handheld devices with a constantly increasing number of integrated functionalities – and a similar trend is ongoing in all medical devices. Miniaturization is then at the center of strong strategical interests in the global modern technological race, may it be in photonics, electronics, or even the medical market. This ubiquitous quest has revolutionized the sector of manufacturing, producing, and testing industries. While many new technologies have now been developed to manufacture sub-millimetric – or even micrometric scale - components, having reliable assembly solutions for these remains a delicate challenge.

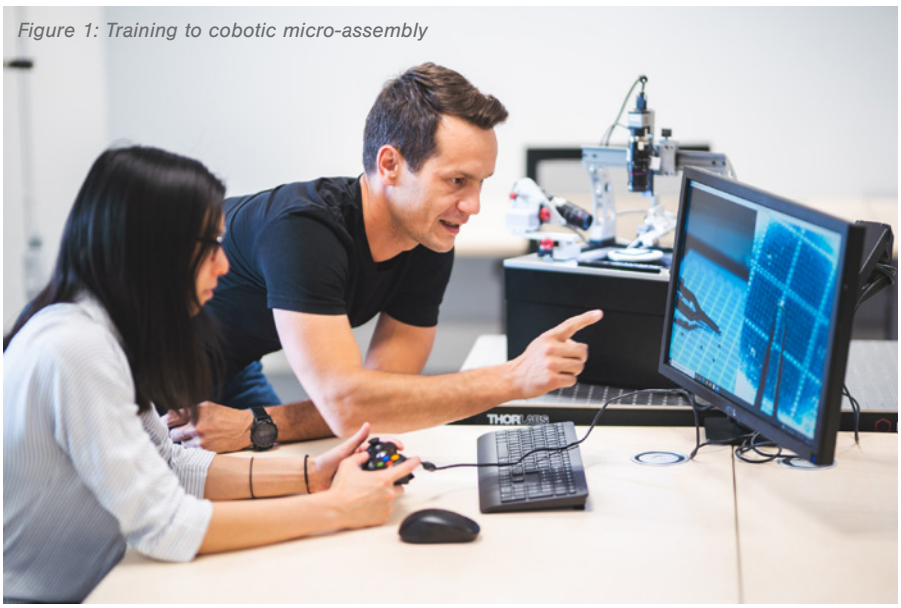
Percipio Robotics, an ambitious French Deep-Tech specializing in the development of industrial robotic solutions for micro-assembly, has spent several years developing flexible and efficient tools to answer micro-assembly challenges. Among these are a range of grippers capable of manipulating parts down to 5 µm size, a modular software suite for industrial high-definition vision and robotics control, and a range of processes dedicated to the specificity of these challenges. From the first few programs developed and qualified, Percipio Robotics realized that developing such innovative solutions raises several specific needs to reach the expected industrial & service performance level, which led to thinking that things should be handled differently to ensure optimal project satisfaction. The path to a new, collaborative methodology has then been opened to overcome the specificity of this market.

Design for assembly & education

From the very beginning of a design phase for an ultra-miniaturized product, for which assembly solutions are unknown, first questions show up. Which features should be designed to allow proper handling and positioning? How should my parts be arranged to get optimal process efficiency? These matters, if not properly handled, can bring numerous back-and-forth steps, impacting the product time-to-market.

To answer this, Percipio Robotics has built a collaborative methodology, bringing product and process designers to work together from the very first steps. By doing so, the path to a design-for-assembly procedure is opened, which will optimize product costs and investments. This collaboration will be continuous through the whole development process, during

Figure 1: Training to cobotic micro-assembly



“Development of industrial robotic solutions for micro-assembly, developing flexible & efficient tools to answer micro-assembly challenges.”

which the customer participates in the technical trials, getting progressively educated to the capabilities and specificities of micro-assembly processes. This will of course bring him the knowledge he needs to improve his product, but, more importantly, bring him to a deep understanding of the way the final industrial solution will work. This takes all its value when specifying that machine scripts are fully opened to the final user, thus breaking the well-known dependency link generally present between a manufacturer and his special machines vendor. The independence acquired will be a tremendous opportunity to optimize process performance, reliability, and flexibility at optimized time and cost conditions.

Flexibility & independence

Second, ambitious miniaturization programs are subject to product redesigns and variations in the first product years' life. Indeed, once technical possibilities are validated, it opens the path to design creativity, and optimization, and often leads to the creation of a wider product range to serve more customers. As such, it is crucial for the industrial assembly solutions to bring real flexibility, so that these innovations can be managed with the same equipment with a minimum added cost.

All solutions developed by Percipio Robotics are based on the use of robotics: flexibility sits in the software. A wide majority of the products evolutions can then be pretty simply managed by acting on the script, making sure that the money spent on the equipment will be amortized on an optimal duration. Above mentioned customer training also allows him to be independent on most of these updates, without having to go back to the vendor. Percipio's most important customer has been working with the same machines for the last seven years and releasing constant updates, in components shape, materials and assembly configuration without having to suffer any corresponding additional hardware cost.

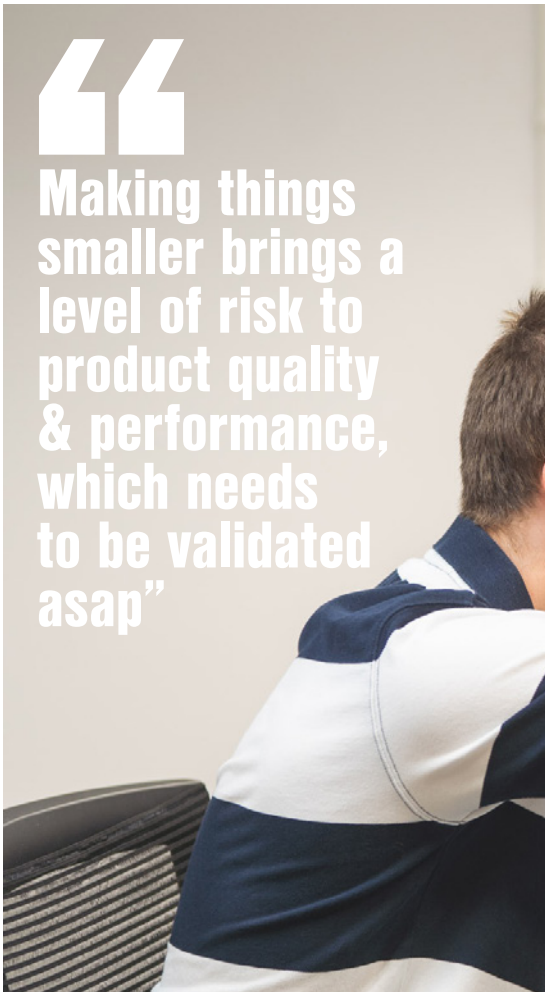
Scalability

Making things smaller brings a level of risk to product quality and performance, which needs to be validated as soon as possible. This is not an easy task: if no serious assembly process is available, I can not validate my product. On the other hand, no one wants to spend high amounts in developing industrial processes for products that did not prove their potential. It is therefore necessary to be able to have early prototypes, manufactured with the same process as the final one at a reasonable cost. Having the possibility to get early prototypes is ensured from the very first step by using cobotic solutions, which will simultaneously allow getting the first samples and determining which processes can be capable of the technical target. This solution will then be progressively automated for an enlargement of the process throughput, until a potential mass production version. The scalability provided ensures an optimally sized investment and technical continuity throughout the whole development.

Percipio Robotics' objective is to provide simultaneously the highest standard of robotic micro-assembly solutions, together with volume and process flexibility, on equipment that can be fully controlled, mastered and customized by the customer.

Percipio Robotics, Besançon FR

https://percipio-robotics.com



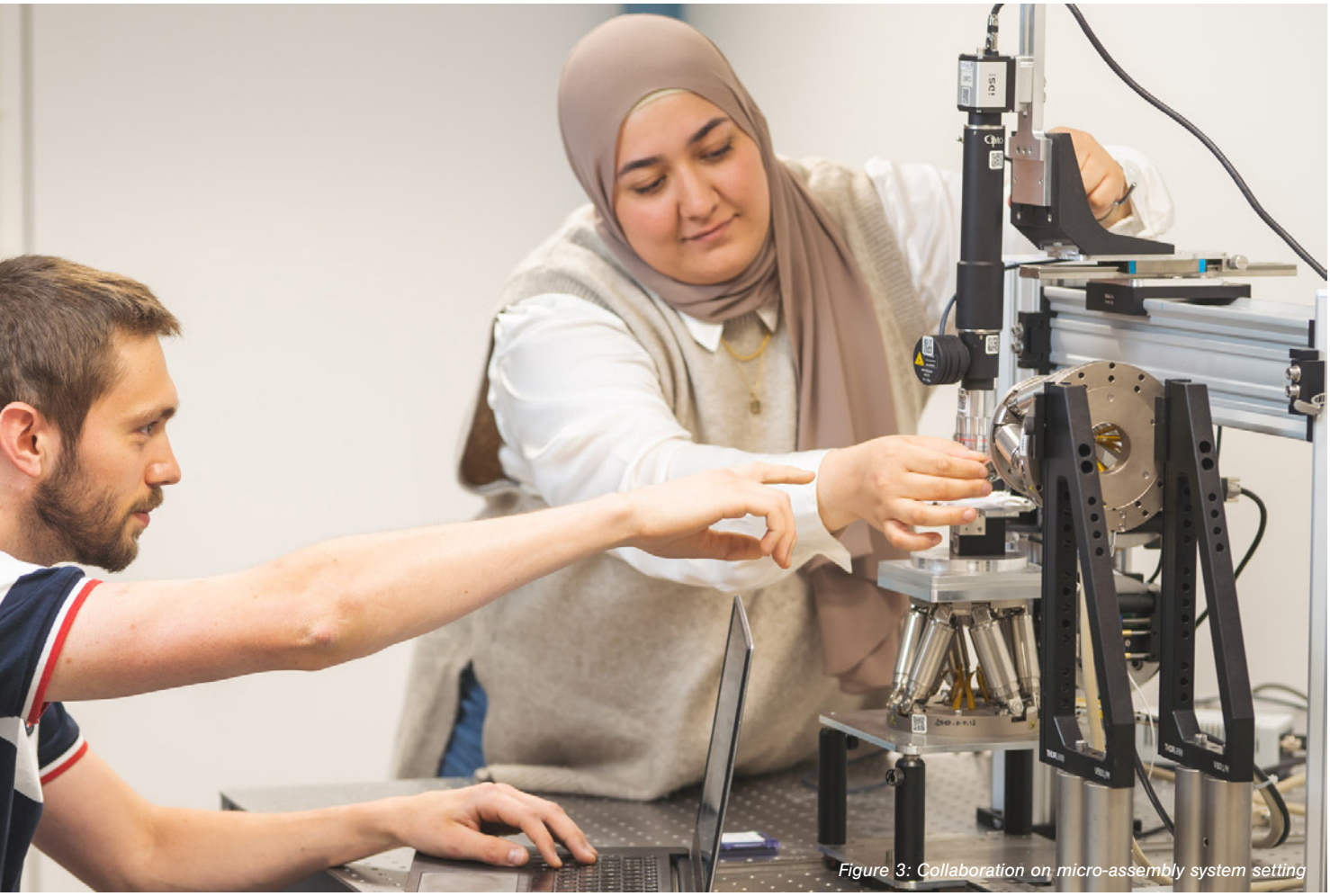


Figure 3: Collaboration on micro-assembly system setting

Figure 4: Teaching systems flexibility

Izumi Nakamura

μ-MIM TECHNOLOGY TO SOLVE TECHNICAL ISSUES

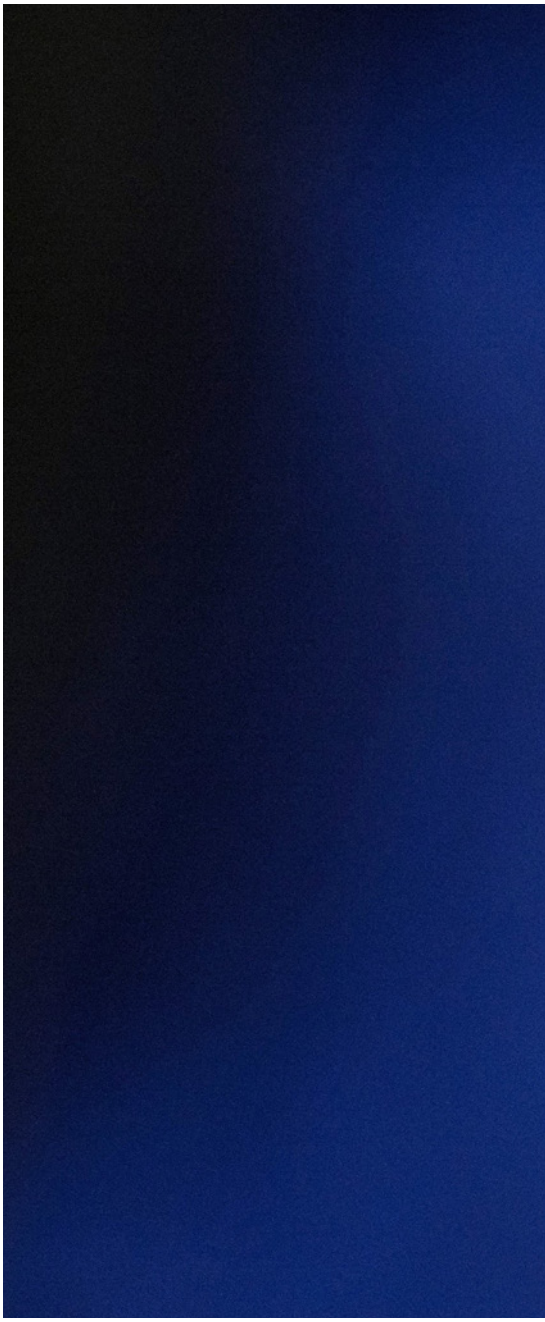
The μ-MIM technology is developed for especially small-size metal parts with strict dimensional tolerances. We have focused only on a small complex designed metal part production in a net shape, thus, the trend related to MIM parts larger than 30 mm in size is not covered. The demand increment of micro parts in various industries is never slowing down.

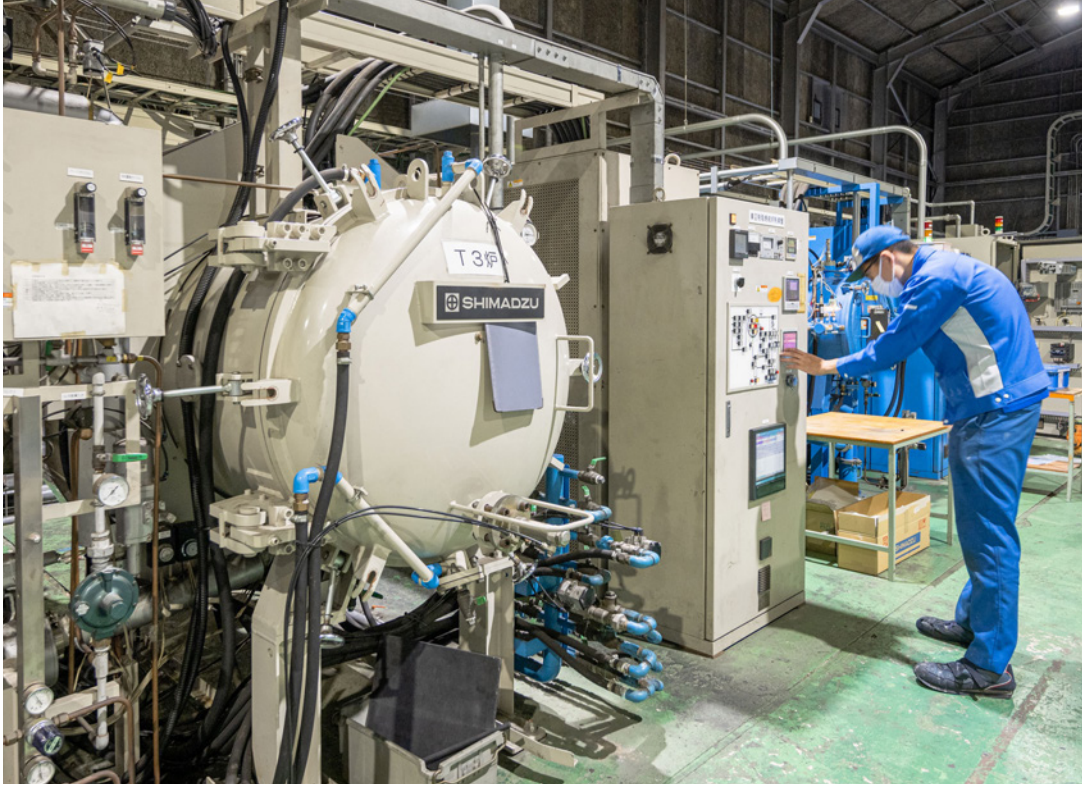
Background: Plastic injection molding

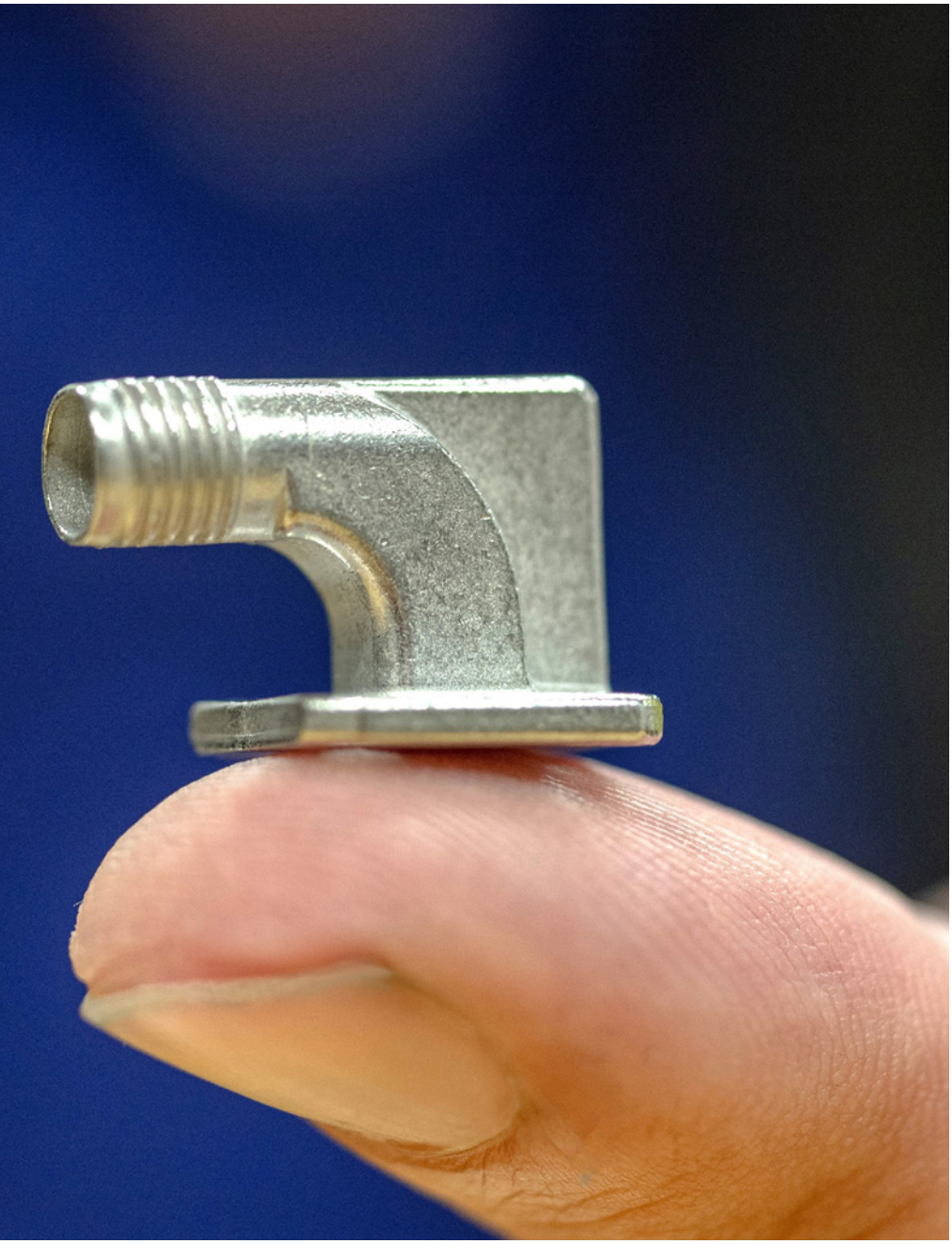
We established a plastic injection molding manufacturer in 1974 in eastern Osaka, Japan, and our MIM business started in 1992. In the 90s, the MIM technology was a new technology that was invented in the US, and it was gradually adopted in Japan. Many metal parts manufacturers and heat treatment manufacturers of metal parts got involved in the MIM industry to enhance their business based on their metal parts manufacturing technology. Since Taisei Kogyo was established in the plastic injection molding industry, we had only an injection molding background, unlike the competitors. We required a huge investment in equipment and gaining the basic knowledge of metal parts manufacturing, especially in the debinding and sintering processes. With vast experience in various types of plastic injection molding, our unique strong points are material knowledge and injection molding know-how. Building on this experience, we started developing our original binder system for the MIM business. Since we had lots of experience in injection molding, we realized there was potential to develop the feedstock for complexly designed parts.

The original MIM feedstock

As we have focused on producing small complex parts, we automatically needed to use fine powders. The fine metal powder market kept expanding - the reason; was the drastic increase in demand for metal 3D printing in the late 2010s. As a result, many metal powder manufacturers heavily invested in enlarging their production capacity. Thanks to the increased production capacity of fine gas atomization powder, powder purchase lead time is becoming shorter than before in standard metal powder. In both metal 3D printing and MIM industry metal powder, the spherical shape with a lower level of contamination is required to achieve the best sintering parts.







Manufacturing process – from mold to sintering and evaluation technology

We have intentionally chosen to outsource our mold production to partners, who are specialized in various types of molds. Together with them, we designed the mold to achieve a net shape with minimal post-processing. This concept is unique in the MIM industry, which helps us to improve our MIM technology and it is beneficial to small parts' stable production, especially in locational tolerance. Our achievement in minimal post-working and stable production is notable in the medical industry, which requires more complex design and tighter tolerance requirements.

We own 40-tonne class injection mold machines as our precise mold size is relatively small. Since we have experience with multi-color injection molding machines in plastic injection molding, we also offer bi-color metal injection molding. Multi-feedstock injection molding decreases the material yield substantially, thus we accept it in limited serial production service only.

For the small metal part size, especially around a few millimeters

size parts, we had to evaluate the micron order tolerances to acquire quality assurance. We realized that there was no applicable standard or well-known technology for micro metal parts measurement when we established our µ-MIM technology about 25 years ago. Therefore, we have developed the measurement technology for our own micro metal parts. And our µ-MIM technology includes measurement technology. We have deployed the following measurement equipment in our quality assurance of µ-MIM technology: optical 3D scanner, ATOS Triple Scan, measurement X-ray CT, MCT225, SEM, and Keyence VR-5000 to name a few.

Future of µ-MIM technology

The demand for MIM components is steadily increasing due to miniaturization of parts in various devices. The µ-MIM technology keeps developing to cater to new and near-future requirements, especially from medical device industries. We have introduced '3.5D Printing' technology which deploys a lithography-based metal manufacturing 3D printer in our prototype process to enforce our µ-MIM technology weak point, the lead time. This LMM-3D printing requires a debinding and sintering process after printing the shape. It is compatible with our MIM debinding and sintering process since we apply the same metal powder for this 3D printing.

Lastly, we are undertaking a debinding and sintering process simulation. When the whole process simulation is accomplished, our µ-MIM technology will be a pioneer in new powder metallurgy markets.

Micro MIM Europe GmbH, Offenburg DE

https://www.micro-mim-europe.com

“The µ-MIM technology keeps developing to cater to new and near-future requirements, especially from medical device industries.“


PNX40
NEX30

FILLING OF BATTERY CELLS WITH ELECTROLYTES

HNP Mikrosysteme for the first time at energy fair EES in Munich

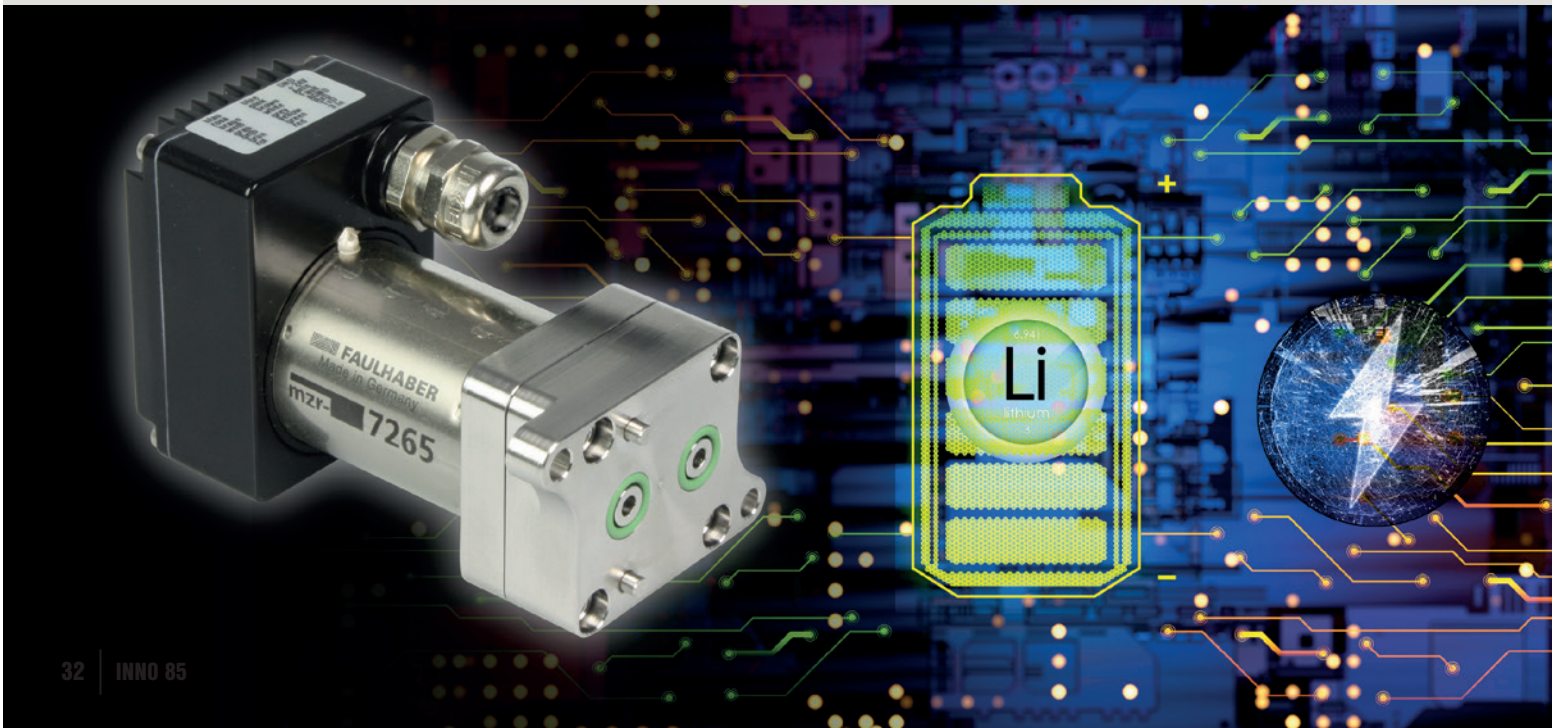
May 2023: Filling electrolytes into battery cells is a critical step in battery manufacturing.
Small dispensing errors cause large variations in battery performance. Hermetic, high-precision dosing pumps are needed for this application. Filling electrolytes into battery cells is a critical step in battery manufacturing. Factors such as electrolyte formulation, pressure and temperature must be considered in the filling process. Critical to battery performance and life are the quality of the electrolyte and the accuracy of the filling process. Small dispensing errors cause large variations in performance. High-precision micro annular gear pumps from HNP Mikrosysteme are used for this application. Lithium-based liquid battery electrolytes are crystallizing and hazardous to health, and require the use of hermetic pumps. The magnetic hermetic pump mzr-7265 doses volumes between 4 and 8 ml in 2 seconds with a deviation of less than 1%.
The process takes place under vacuum conditions. In addition to low-pulsation and precise dosing, the pump realizes very short cycle times. LOHC-based hydrogen storage is another application field for micro annular gear pumps. Pumps of the high performance series, mzr-4605 or mzr-7205 are used to deliver LOHC dibenzyltoluene, also known as Marlotherm, perhydro-dibenzyltoluene and benzyltoluene. For example, the pumps deliver dibenzyltoluene with volume flow rates between 1 ml/min and 240 ml/min into a reactor. Here, the medium is charged with hydrogen by means of hydrogenation. The importance of precision micro pumps in the field of renewable energies will be presented by HNPM for the first time at the trade fair booth at EES – Europe's largest trade fair for batteries and energy storage systems. The EES will take place in June, 14 to 16, 2023 as part of The smarter E Europe in Munich. HNPM exhibits at the Joint Booth Hydrogen, Fuel Cells & Power-to-Gas, hall B2 at booth: B2.450E.

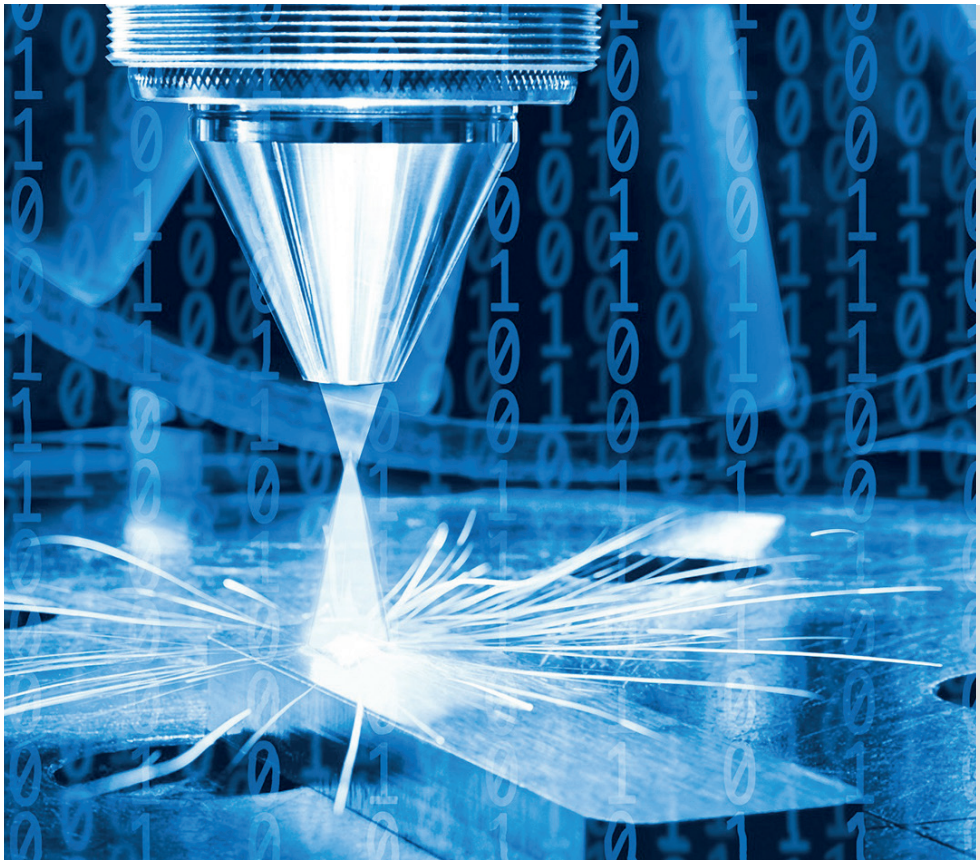
Mikrosysteme GmbH, located in Germany, develops, manufactures, markets pumps and systems worldwide which deliver small amounts of liquids fast and accurately. Beside several applications in plant engineering, chemical and pharmaceutical processing, mzr-pumps are used in the field of life science and analytical instrumentation.

HNP Mikrosysteme GmbH, Schwerin DE

https://www.hnp-mikrosysteme.de/en/

Figure 1: Micro pump for battery cell filling



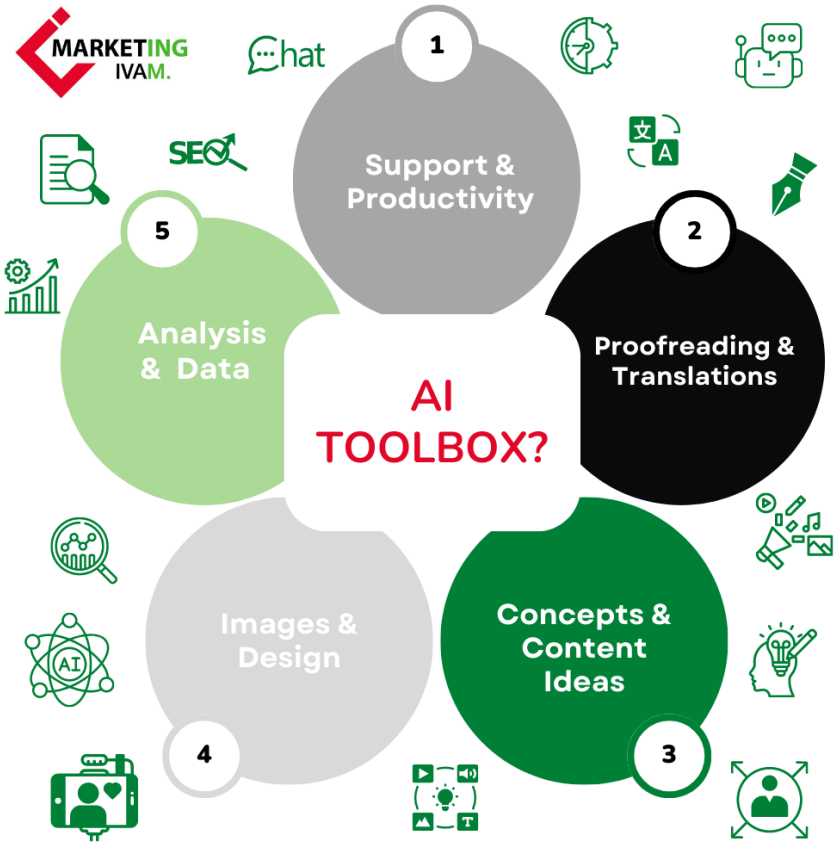


WHAT CAN AI DO IN LASER MATERIALS PROCESSING?

Automation and zero-defect production are important trends in machine construction. Artificial Intelligence (AI) plays a major role in advancing both of them.
At the third “AI for Laser Technology Conference”, organized by the Fraunhofer ILT on November 23 and 24, 2023, these and other trends in the application of AI in materials processing will be discussed.

https://www.ilt.fraunhofer.de

“HOW TO EQUIP YOUR AI TOOLBOX FOR MARKETING?”



At the next virtual meeting of the IVAM Focus Group Marketing, we want to deepen the topic of AI applications for marketing, sales, and corporate communications and discuss best practice presentations.

During the session, we want to evaluate who is successfully using which tools and prioritize their use. We would like to include the cost-benefit ratio but also the risk assessment regarding IP security for high-tech companies.

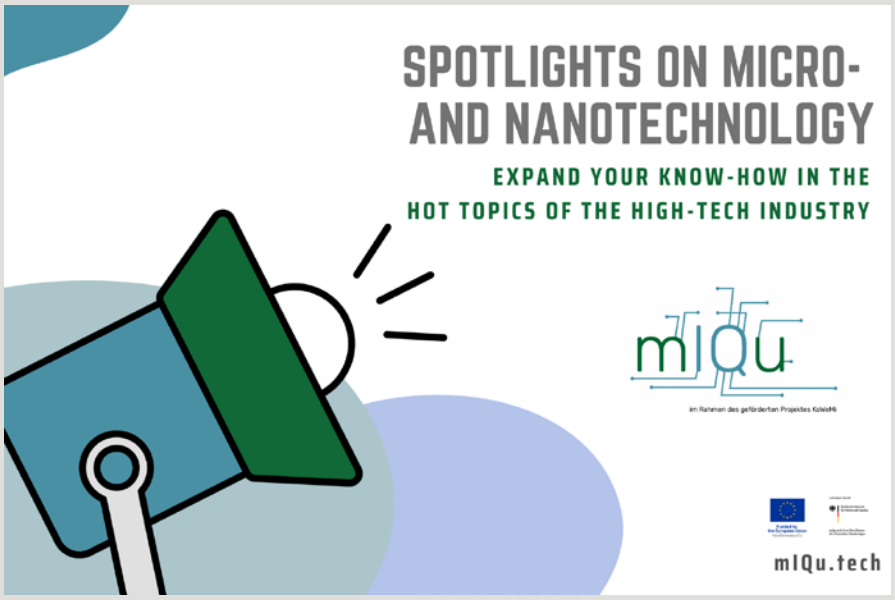
- Best practice experience report: campaign planning with ChatGPT
- Which AI tools are currently most widely used in the industry?
- Sharing experiences and recommendations
- What are current challenges in this regard?

We ask all participants to email us before the session at marketing@ivam.de to let us know which tools they are already using and which they would like to use, or which need discussion.

Attendance at Focus Group meetings is free of charge for IVAM members

October 18, 2023, from 2:00 pm - 4:00 pm (CEST), Zoom Meeting.

https://www.ivam.de/events/ivam_focus_group_photonics



SPOTLIGHTS ON MICRO- AND NANOTECHNOLOGY

The digital event series Spotlights of Micro and Nanotechnology will provide insights into the recent state of the art on various topics and aspects of micro and nanotechnologies. The event series will focus on innovative developments, but also on cross-disciplinary relevant topics of the high-tech industry.

https://www.ivam.de/events/spotlights_12

CONSCIENCE DELIVERS FIRST QUANTUM CHIPS TO CLIENTS

Quantum devices have been developed at Chalmers University of Technology in Gothenburg Sweden through the last 20 years, but until now, the translation of the world class research into commercial devices has not been possible due to challenges with production and quality control. ConScience AB is a company specialized in cleanroom production and has spent the last year on developing methods for production of quantum computing devices of sufficiently high quality and reproducible characteristics to be used by clients.

“Quantum device manufacturing is very complex, and we have been pushing ourselves and spent a severe amount of time in the cleanroom to achieve the stringent requirements in terms of performance variations set out by our client.” says Joachim Fritzsche, CEO of ConScience. Large academic and industrial efforts are being made towards quantum computers worldwide, with major companies like Google, IBM and Microsoft leading development. In Sweden, the Quantum research efforts have been leveraged around the Wallenberg Center for Quantum Technology (WACQT) located at Chalmers University of Technology in Gothenburg.

While ConScience have now shipped the first devices, there are still some way to go before we will see quantum computers solve daily real-world problems.. “We still need to improve the production methods, but we are happy to do our small part in the second quantum revolution by working on robust cleanroom fabrication methods,” says Fritzsche.

The work on quantum computer components is financed by ConScience and a Smart Electronics grant from the Swedish Research Agency Vinnova.

ConScience AB, Gothenburg, SE
https://www.con-science.se

EUROPE meets USA - Part IV

HIGH-TECH FOR MEDICAL DEVICES

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EVENTS

10 Oct 23

SPOTLIGHTS ON MICRO- AND NANOTECHNOLOGY @

Part 12: Nanotechnology in Medicine

18 Oct 23

MID-WEEK COFFEE BREAK – SUSS MICROOPTICS SA @

Virtual technology talk between IVAM Members

18 Oct 23

IVAM FOCUS GROUP MARKETING @

How to equip your AI toolbox for marketing?

13-18 Nov 23

COMPAMED 2023

Product Market "High-tech for Medical Devices" and "COMPAMED HIGH-TECH FORUM" in Hall 8a, F29 (IVAM Lounge)

22 Nov 23

MID-WEEK COFFEE BREAK – CHIPS 4 LIGHT GMBH @

Virtual technology talk between IVAM Members

29-30 Nov 23

W3+ FAIR JENA 2023

Networking Fair for Optics, Photonics, Electronics and Mechanics

30 Nov 23

IVAM FOCUS GROUP PHOTONICS

Focus Group Session and Networking at W3 in Jena

07 Dec 23

GET TO KNOW IVAM

Information event about the network and the benefits of membership

20 Dec 23

MID-WEEK COFFEE BREAK – DEXTER MAGNETIC TECHNOLOGIES GMBH @

Virtual technology talk between IVAM Members

06-08 Feb 24

MD&M WEST 2024

Medical Design & Manufacturing - IVAM presents Micro Nanotech Area in Hall C

15 Nov 23

ASIA PHOTONICS EXPO 2024

Discover the Future of Photonics with IVAM

https://www.ivam.de/events

IVAM Microtechnology at COMPAMED/MEDICA

COMPAMED, the leading international marketplace for medical manufacturing suppliers, which takes place parallel to MEDICA in Duesseldorf from November 13-16, 2023. In hall 8a, the IVAM area showcases solutions for medical technology on more than 600 sqm of space.

https://www.ivam.de/events/compamed_2023

EUROPE MEETS USA - PART 4 AT COMPAMED

International expert meeting of European and U.S. high-tech companies. The event is aimed to medical technology companies and research institutes along the entire value chain: from technology developers, component manufacturers, software, testing and analytics companies to medical device manufacturers and consumers. Trade show visitors can participate at the event "Europe meets USA" free of charge. November 14, 2023 as part of the annual COMPAMED/ MEDICA

https://www.ivam.de/events/europe_meets_usa_session_2023

EASY ACCESS TO THE ASIAN PHOTONICS MARKET - EUROPEAN JOINT BOOTH AT THE NEW APE 2024

Together with EPIC and W3+ Fair, IVAM is organizing a joint booth at the new Asia Photonics Expo in Singapore. The partners thus provide interested companies from the European photonics industry with easy access to the Asian market.

APE 2024 - the Asia Photonics Expo trade show will be held for the first time at the Marina Bay Sands in Singapore from March 6 - 8, 2024. The event sees itself as a new photonics platform that aims to provide awareness and access to new business contacts in the Asian market. Thematic focal points are e.g., optical communication, innovative manufacturing, semiconductor technology, sensor technology, metrology, and medical technology. To facilitate the move to Asia and the development of new business areas for companies from Europe, the network fair W3+ Fair has joined forces with its partners IVAM and EPIC. Together, they are organizing the Photonics+ Europe powered by IVAM, EPIC & W3+ area, which offers exhibitors a range of services and networking opportunities in addition to stand presentation.

APE 2024 focuses on the latest innovative technologies and emerging user markets in Asia. The event aims to promote collaboration among experts along the entire photonics value chain. Companies will benefit from the strong business location of Singapore, which is considered an international hub for Asian trade, as well as from the ease of communication in English. Registrations for the joint stand are now open.

APE Asia Photonics Expo
Photonics+ Europe powered by IVAM, EPIC & W3+

SENSIRION AND AIRTEQ COLLABORATE FOR THE LAUNCH OF A NEW BEST IN CLASS INDOOR AIR QUALITY MONITOR

Sensirion and AirTeq announcend a partnership for the launch of the indoor air quality monitor AirCheq Pro Series. This collaboration combines the precision and quality of Sensirion's Swiss-made sensors with AirTeq's commitment to delivering exceptional indoor air quality solutions for commercial and residential environments.

The AirCheq Pro Series is designed to provide comprehensive insights into indoor environments, ensuring that users can enjoy healthier, more comfortable living and working spaces, empowering them to identify areas for improvement and make informed decisions to optimize air quality. It is a versatile solution that puts the comfort and health of users first and the sensors included in the device offer an array of benefits.

Sensirion's SHT4x series are highly accurate and reliable humidity and temperature sensors. They build on an optimized CMOSens chip that offers reduced power consumption and improved accuracy specifications. Tape and reel packaging combined with its suitability for standard SMD assembly processes make it ideal for high-volume applications.

Particulate matter sensor: The SEN55 environmental node from Sensirion is a straightforward sensor platform for the accurate measurement of particulate matter. Thanks to proprietary algorithms, it can be easily integrated into various applications and allows device manufacturers to save valuable project time and personnel resources.

Volatile organic compounds (VOC) and nitrogen oxide (NOx) sensor: Sensirion's VOC and NOx sensor offer a solution for two sensors on a single chip, facilitating design-in and saving design costs. The two sensor signals can be used to automatically trigger the removal of indoor air gas pollutants.
Carbon Dioxide (CO_2) sensor: The SCD4x is Sensirion's miniature CO_2 sensor and offers high accuracy. The SMD assembly allows cost and space effective integration with maximum design freedom.

"This partnership underlines our shared commitment to delivering high-quality indoor air quality solutions. Sensirion's reputation for producing some of the most advanced and reliable sensors aligns seamlessly with AirTeq's dedication to ensuring user comfort and health. By integrating Sensirion's sensors into the AirCheq Pro Series, we aim to provide users with a dependable and user-friendly tool for understanding and enhancing their indoor air quality" says Arie den Hartog, CEO at AirTeq.

Sensirion AG, Stäfa, CH
https://www.sensirion.com

DEBUT AT MEDICAL FAIR THAILAND WAS A HUGE SUCCESS

IVAM made its debut appearance at the Medical Fair Thailand (MFT) in Bangkok, and it was nothing short of triumphant. As a leading international hub for micro and nanotechnology, IVAM showcased its expertise at a joint booth within the 'Medical Manufacturing' special exhibition area. This inaugural event in Southeast Asia featured the participation of three international companies and took place from September 13 to 15, 2023.

Dr. Thomas Dietrich, CEO of IVAM, highlighted the event's significance: "Participating in the Medical Fair Thailand is incredibly appealing for medtech companies. The international audience displayed immense interest in the innovative products and services on display. Notably, the startup sector saw the presence of numerous IT firms presenting intelligent, cutting-edge products. For medtech suppliers looking to tap into the ASEAN markets, the Medical Fair Thailand stands as the ideal platform to unveil groundbreaking medical innovations."

In the lead-up to the event, a visit to hakkai precision Thailand facilitated knowledge exchange and highlighted the exceptional local production capabilities. The upbeat atmosphere at the fair, along with the successful IVAM session, "High-tech for Medical Devices," during the accompanying forum, underscored the event's triumph. IVAM's participation at MFT underscores the ASEAN market's appeal to international medtech firms, and they are already planning their return in 2025. Interested companies can now express their interest in participating with IVAM.

https://www.ivam.de/events

GET TO KNOW IVAM MICROTECHNOLOGY NETWORK - JOIN A Q&A SESSION

Have you ever thought about whether your company could benefit from a membership in a network? Perhaps an IVAM membership may be the right solution for current challenges in your microtech-, biotech- oder deeptech-company! We cordially invite you to get to know the network better. You are welcome to bring specific questions, which we will then answer personally. Additionally you have the possibility to arrange an individual appointment.

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