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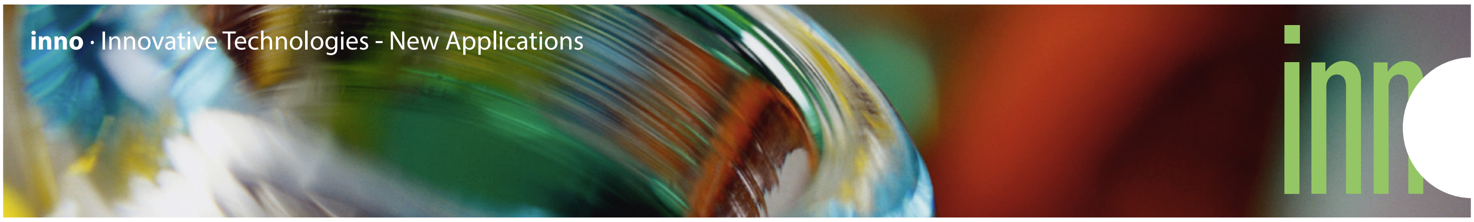


|Focus: Medical Technology|

Dr. Martin Schüttler,
Dr. Jörn Rickert

Neuromodulation goes interactive

Electrical signals are the key elements of brain function – both in health and disease. A new generation of brain-computer interfaces (BCI) seeks to enable bidirectional electrical communication with the brain. The vision: Finding new, effective avenues for treating neurological and psychiatric diseases.

The brain controls a multitude of functions - from movement over perception up to complex cognitive functions. If its activity gets out of control, the consequences are correspondingly serious. Neurological and psychiatric diseases already account for a third of health care costs, with a tendency to rise according to demographic trends.

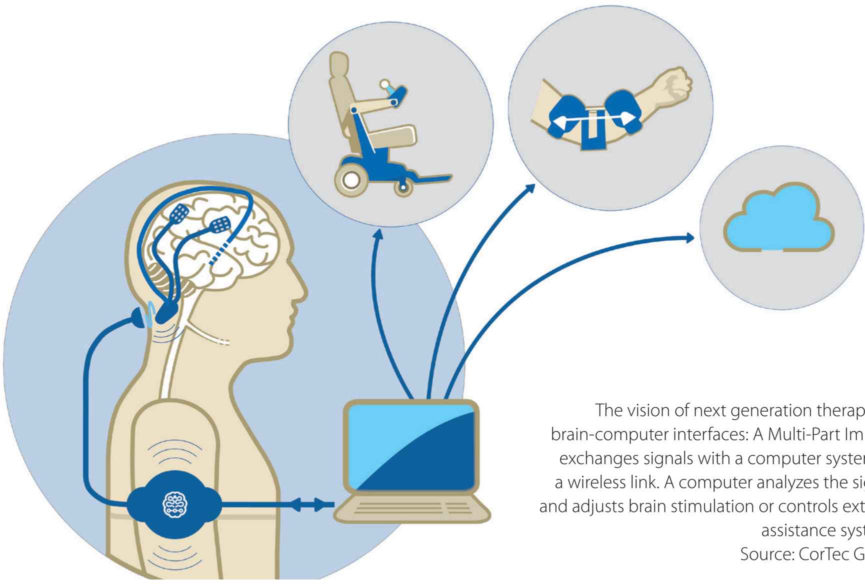
The Status Quo

Present therapeutic approaches to brain diseases often remain inadequate because they do not do justice to the organ's complexity. Pharmacological interventions flood the entire brain with substances that are only needed in certain regions and cause unwanted side effects elsewhere. Electrical neuromodulation therapies, such as deep brain stimulation in Parkinson's disease, more specifically target certain brain areas. As current systems can only stimulate at constant rates, however, they can't accommodate for therapeutic needs that change over time. And while a given stimulation pattern may suppress symptoms in certain situations, the same pattern may fail to do so or may even be harmful in others, for example, by interfering with speech production.

To better meet the changing demands in everyday life, new technical solutions are needed that can adapt to the patient's condition. A particularly smart solution to this problem are systems that could analyze moment-to-moment brain states and deduce the corresponding momentary therapeutic needs. They could also help paralyzed patients by detecting movement intentions and controlling assistive systems. This is the vision of the next generation of therapeutic brain-computer interfaces.

The Challenge

The challenges along the way, however, are manifold. First of all, an interface must be created that can reliably sense and stimulate brain signals. Current electrodes often damage brain tissue and tend to cause growth of scar tissue, rendering them less effective with time in picking up the minute brain signals.



The vision of next generation therapeutic brain-computer interfaces: A Multi-Part Implant exchanges signals with a computer system via a wireless link. A computer analyzes the signals and adjusts brain stimulation or controls external assistance systems.
Source: CorTec GmbH

Content

Second, the brain's complex activity must be made accessible to an electronic signal processing unit that can analyze brain signals, extract patient parameters from the environment and computationally derive therapeutic needs. Thanks to modern microcomputer technology, powerful portable systems are already available at the size of a smartphone. But how to route the signals there? Transcutaneous cables connections aren't an option, as they pose unacceptable risks for infection. A powerful wireless connection would be needed that can securely transmit large amounts of data percutaneously. ➲

Editorial

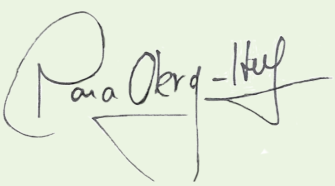
Focus: Medical Technology

At present, hardly any other industry is of such interdisciplinary importance as medical technology. The pressure to innovate triggered by the pandemic spread of the Sars-Cov2 virus is unparalleled. Never before have we needed new solutions in the field of reliable and cost-effective instant diagnostics so quickly. The potential for the development of cost-effective solutions is enormous and ranges from antiviral surface coatings and room air filter systems, protective clothing and disinfection to components for ventilators, sensors for recording vital parameters and complex optical solutions for imaging systems for DNA sequencing to support vaccine development. All this would not be possible without micro- and nanotechnologies.

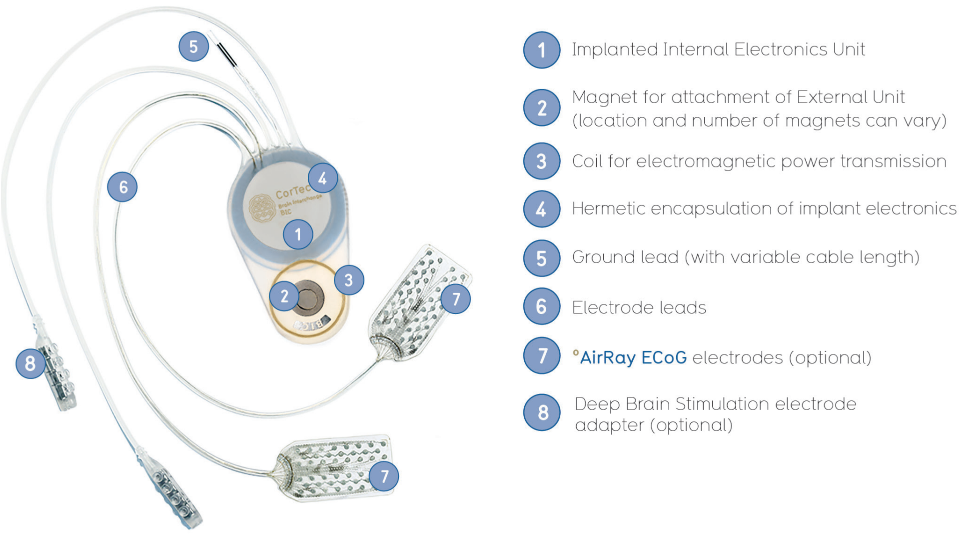
It remains exciting to see which technologies and applications will ultimately "make the running" and what will find its way into diagnostic and medical everyday life in the long term. After all, the situation remains dynamic and is developing almost daily. While at the beginning of the pandemic the focus of interest was mainly on disinfection options and ventilation capacities, many other challenges are now present.

This issue of »inno« presents a wide range of innovative solutions for medical technology - based on micro- and nanotechnology - that go beyond the questions surrounding COVID-19. I hope you enjoy reading this international edition. Stay healthy!

Best regards



Mona Okroy-Hellweg



The CorTec Brain Interchange System. Source: CorTec GmbH

The Implementation

In 10 years of intensive research and development work, CorTec addresses these challenges. The result is the worldwide unique CorTec Brain Interchange System.

Laser-structured AirRay electrode arrays (resulting from research with Prof. Thomas Stieglitz at the IMTEK of the University of Freiburg and a first variation of AirRay electrodes received FDA-clearance) provide a reliable interface for permanent brain recordings. Being very soft and flexible, they allow for easy implantation and gently fit to the curvature of the brain.

A biocompatible ceramic encapsulation hermetically encloses an implanted electronics unit that preprocesses the data. A key component of this system is a custom-made microchip (ASIC) developed in cooperation with the Institute of Microelectronics at the University of Ulm (Prof. Maurits Ortmanns). It amplifies neuronal signals in many independent channels (currently 32) and digitizes them at high sampling rate (currently 1 kHz) while, at the same time, allowing for swift and flexible switching between recording and stimulation mode.

Thanks to an inductive power supply via an external unit, it also works without a battery. This eliminates the need for surgical replacement when battery power decreases (as is still the case in many of today's implantable systems). Via the same external unit, brain signals are transmitted wirelessly to a Computer Unit for processing.

With this series of innovations, the CorTec Brain Interchange platform technology will be soon available for the development of novel, flexible and adaptive therapeutic clinical approaches.

CorTec GmbH, Freiburg i.Br., DE
http://www.cortec-neuro.com

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Innovative Technologies – New Applications

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MIM production technology for medical devices

Dr. Shigeo Tanaka
Izumi Nakamura
Makiko Tange

The MIM production technology of Micro MIM Japan Holdings Inc. (MMHJ), µ-MIM or 3D-MIM is specially designed for the serial production of small complicated components. With optimized techniques of production, measurement and quality assurance, the company uses their techniques for the serial production of complicated metal components in carefully designed medical devices for over 20 years.

Even with these techniques, the mass production for medical components is still difficult since the requirement of tolerance in size, mechanical properties or applicable material are quite different from other industrial products.

Production for the medical industry

The production technology development has been focusing on small complicated designed metal components for serial production. Since the MIM process uses a mold, it is said the design freedom for the components is higher than machining. As shown in Figure 1, it is capable of mass-production of a nozzle with a 30 µm diameter hole. Additionally, the 3D-MIM technology enhances the design freedom even more such as undercut, inner curved pipe, while satisfying tight tolerance requirements in the serial production.

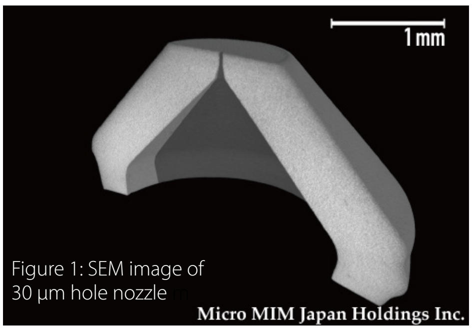


Figure 1: SEM image of 30 µm hole nozzle

The companies' plastic injection molding experience, was the initial business, is supporting the 3D-MIM production. At the beginning of MIM processing history in Japan, most of the MIM manufactures started as powder metallurgy manufacturers or as other metal component manufacturers. While MMJH evolved to be a MIM manufacturer with a plastic injection manufacturer background, the company had quite unique ideas towards the injection molding and feedstock development. After the huge MIM market development in China from the 2000s to early 2010s, the manufacturers of various business type became involved in MIM production, using ready-to-use MIM feedstock.

MMHJ had developed their original feedstock since the MIM manufacturing history was progressed by applying the plastic knowledge, thus have a wide range of material options. Recently, metal additive manufacturing is intensively developed and related technology is also developed fast. One of the benefits is metal powder manufacturing technology development. Most of the metal powder manufacturers have invested in the latest powder production facility to meet the market demand, which the powder property is also applicable to MIM. The finer powder with lower contamination level is well distributed in the market.

Figure 2: Curved internal flow path part made of stainless steel. The top half is graphically merged with the internal structure design.
Source: MMHJ

It is also well known that finer powder is difficult to apply for serial production in MIM since it is required to mix the relatively large volume of binder among PM, thus unnecessary chemical reaction during kneading and/or injection molding step, or increment of the viscosity of the feedstock in the mold are likely to be observed. It is said, these troubles are caused by increasing the powder surface specific area of the powder. On the other hand, there are clear benefits to apply fine powder. It is expected to obtain high reflectivity of mold design and low surface roughness for instance. Since MMHJ have produced small complicated designed components, these two benefits are essential to strengthen Micro MIM component features. With optimized binder systems MMHJ is able to produce small MIM components using fine powders. Especially in medical components' production, more complicated design in smaller size components is frequently deployed than any other industries. The feedstock is beneficial for medical components serial production.

The quality assurance for medical industry components

For example, in the electronics industry, the tolerance requirement is tight but not in many cases applying free curved design. In the medical industry, the metal components design frequently apply the free curve in many directions in a component. It is required a different level of measuring technique to assure the quality. Since it hardly has a flat area, it is required well consideration to set the base plane to compare the measurement data and the drawing data. The probe contacting, non-contacting optical and X-ray 3D measurement systems are deployed in the companies quality assurance. In medical components, complicated internal structure is also frequently deployed thus X-ray CT measurement is applied often. With MMHJ's measurement of X-ray CT, it is possible to measure fine morphology since the maximum resolution is 3 µm. Additionally, to improve size measurement accuracy, it is also deployed FE-SEM in some cases.

It is required either special software or analysis technique to observe the measurement data from the free curved or gear drawing data. In MMHJ's quality assurance, a combined software of a standard one and original one for data analysis is applied, which is ideal to MIM parts data analysis and certified by ISO13485. The data analytical software is also applied for numerical simulation in the assembled state. Recently, MMHJ installed a half automated digital part control system, thus not only the traceability of the component but also the highly controlled components will be delivered to the customer.

Micro MIM Japan Holdings Inc., JP
https://micro-mim.eu

Amorphous metals, a game changer to improve the performance of medical devices

Yves Mathieu

Vulkam is an innovative player within the field of metallurgy, specialized in Amorphous Metallic Alloys (AMA) design and manufacture, based in Grenoble. Its team is completed with high levels Researchers and Engineers specialized in material, mechanical and automatism engineering, to cover all the needs of the company's wide range of expertise. It originally comes from established research centers within the field of Advanced Materials and has been widely awarded for its disruptive technologies and as a DeepTech premium company.

The Vukalloys as Amorphous Metallic Alloys dedicated to medical devices

With its Vulkalloys, Vulkam improves the performance of strategic metal parts that make up micro-mechanical systems, such as in medical and surgical devices. With several significant partnerships within the fields of minimally invasive surgery (surgical instruments), implantology and medical device components, the technology competes in a major way with TA6V, the reference alloy in these fields. Vulkam designs a unique range of Amorphous Metallic Alloys with dedicated mechanical properties in the medical field for surgical instruments, medical device components and miniaturized implants. In addition, the developed process opens the way to the production of innovative and unique geometries. The solution therefore leads to significant improvements in the MD's performance by enabling less invasive procedures, with miniaturized implants, more precise surgeries, with optimized instruments, and innovative components dedicated to medical device technologies.

Zr based alloy with excellent properties specially adapted to the needs of the medical device industry which is:

- two times smaller than TA6V parts for equivalent RESISTANCE
- 10% lighter than titanium parts
- biocompatible and free of CMR and Nickel substances (EN10993, biological evaluation of Medical Devices is in progress)
- two times more elastic than TA6V
- very resistant compared to TA6V
- cytotoxicity rate similar to titanium
- quite accurate: achieve precision levels about one hundredth of a mm.

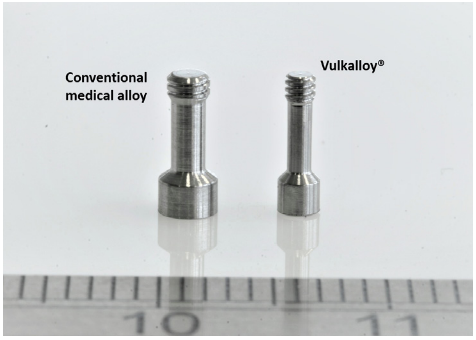
Unique global provider - from material design to parts manufacturing

• 1. Production of the selected Vulkalloys:
More than developing a wide range of materials, the expertise includes a patented amorphous metal preparation process to produce by its own the selected Vulkalloys raw material. Manufacturing from sub-millimetric to centimetric amorphous metal parts with dedicated designed molding tool to provide the right materials samples for further testing procedures and the right selection is possible.

• 2. Parts design:
Vulkam works alongside its customers' teams, to adapt the design according to both customers' needs and process capabilities, dedicated to the parts manufacturing optimization.

• 3. Parts production:
Vulkam offers a unique parts-patented-molding technology adapted to the Vulkalloys with the benefit to get the final dimensions and a high level of surface quality.

What about amorphous metallic alloys?



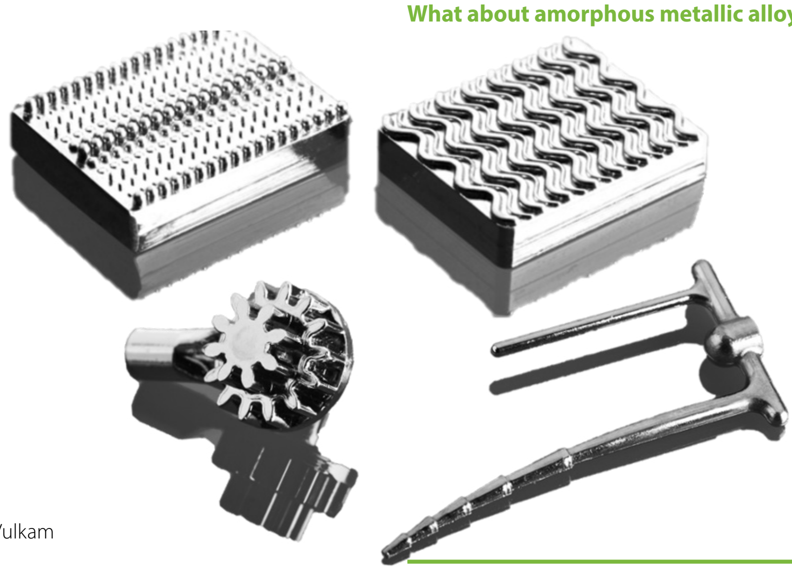
Source: Vulkam

Every industrial metallic Alloy possesses a crystalline structure in which atoms are organized. This crystalline structure may be advantageous for some applications, but also limits possibilities both in terms of final properties and in terms of forming abilities of those alloys. Amorphous metals often referred as "metallic glasses" are suitable alternatives to this crystalline structure. In amorphous metals, the atoms are randomly distributed.

In the normal state, every metal has a disordered structure due to the constant motion of atoms. During the fast cooling of the liquid metal, crystallization is avoided, and the amorphous structure is obtained. Consequently, the solid structure is random, and the result is: a metal with a close structure to the one in the liquid state. The lack of crystallization during casting leads to almost no shrinkage upon solidification. The amorphous metal conforms exactly to the expected precise shape and desired dimensional tolerances.

Obviously, the amorphous structure cannot be obtained with any alloy composition nor by using standard manufacturing processes. There are many compositions of amorphous metals with many outstanding, physical, mechanical and chemical properties. In addition, all the final properties are obtained directly after the manufacturing process without post treatment which is another advantage with amorphous metals.

Vulkam, Saint Martin d'Hères, FR
http://www.vulkam.com/en/home



Source: Vulkam

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EXERA wire-based components – a real thing of the future

Gary Davies
Sarah Williams
Lena Wiig Boström

The use of precision medical wire to sense, monitor, guide and stimulate has been the remit of science fiction for hundreds of years and now the future is here. The use of fine-grade medical wire for sensing is not just trapped in a faraway research and development lab – it is being used for practical, everyday preventative and bespoke medical treatment.

Examples of wire-components made by Sandvik and devices they are used in. From left to right: Brain Aneurysm Device, Neurostimulation, Heart Valve Failure monitor, Catheter coil wire FFR (Fractional Flow Reserve), Sacral Nerve stimulation, Deep Brain Stimulation. The matchstick is used to show how small the wire-components are.
Source: Hans Nordlander, BildN

Swedish company Sandvik and its brand of medical wire and wire-base -components, Exera, are at the forefront of development for the latest innovations in this arena – creating bespoke solutions to medical practitioners' challenges as well as leading with its own research. The primary purpose, is to be an active – and many times the lead – part of whatever medical device they're in.

Some twenty years back Sandvik's core business for fine wire was in micro-electronics. However, the word was out there that the company was very good at making high quality precision wire, so a manufacturer of pacemaker leads contacted them, and they succeeded in supporting them with pacemaker leads. The rest is medical history.

The wires that Sandvik makes go into a lot of different applications, and the best way to describe it is that the wires are used to stimulate or send some sort of signal either inside or outside the body. In almost all cases, the wire is an active part of how the sensor works – a continuous glucose monitor wire, for example, is an active chemical sensor for sensing the amount of blood sugar in your interstitial tissue.

One could compare this particular application to the fine-tuning of auto mechanics - a lot of cars now have sensors in them to diagnose how the car is running and once you get the diagnostics from under the bonnet, you can make adjustments to just keep it running smoothly – that thinking is what drives the research and development behind the wires and that's why, in the devices which the wire-components are part of, the primary sensing material is actually an Exera component.

Supporting diabetes patients in everyday life

The remote monitoring so beloved of science fiction writers is actually one of the primary uses of Exera wire-components, a real thing of the future. Most of these are used in Type 1 diabetes cases and you can imagine for younger children especially, the parents' anxiety about whether their child's glucose and insulin levels are right would be quite intense. But the wire-sensor constantly monitors them and flags up when outside intervention is necessary. A real relief for both parents and the young ones who now can go to school, visit a friend's house or even go to summer camps.

Wire-based components used for remote control during Covid-19

Another wonderful, unexpected benefit of the kind of sensing that Exera wire-components can do in their various devices is to keep NHS staff and patients with heart conditions and diabetes safely at home – during the global pandemic of COVID-19.

With this pandemic situation, people who have diabetes are extra susceptible to contracting the disease and having such serious symptoms that must be hospitalized and put on a ventilator. And of course, healthcare workers themselves have higher risk of contracting the disease every time they interact with a patient. So instead of going in for monitoring or to give blood, patients who hadn't thought to use one of these monitors before, they can start using that now, so everything can be done remotely and lower the risk to themselves and their medical professionals.

"Smart wire-components" – for fast track and preventive treatments

But what about the future of precision medical wire? For a company as focused on R&D as Sandvik is – and considering how cutting edge their medical device clients are - can never just be a run-of-the-mill manufacturer or supplier.

A lot of customers are looking at more advancements in their designs – they don't just want a precision wire, they need precise, multifunction wires – they need to be able to incorporate multiple capabilities within the same footprint of machine, if you will. Sandvik has been assisting for the past couple of years in the design of a composite wire that has different elements incorporated into that one wire system. One part of the wire is used to locate the sensing device inside the body, almost like a smart guidewire. Another senses heat, other senses something else.

In addition to the new composite wire, or "smart wires", there is another bit of research that's really set to change the preventative medicine scene. There's a new device Sandvik is getting involved with bringing to the marketplace that will prevent and manage ➲

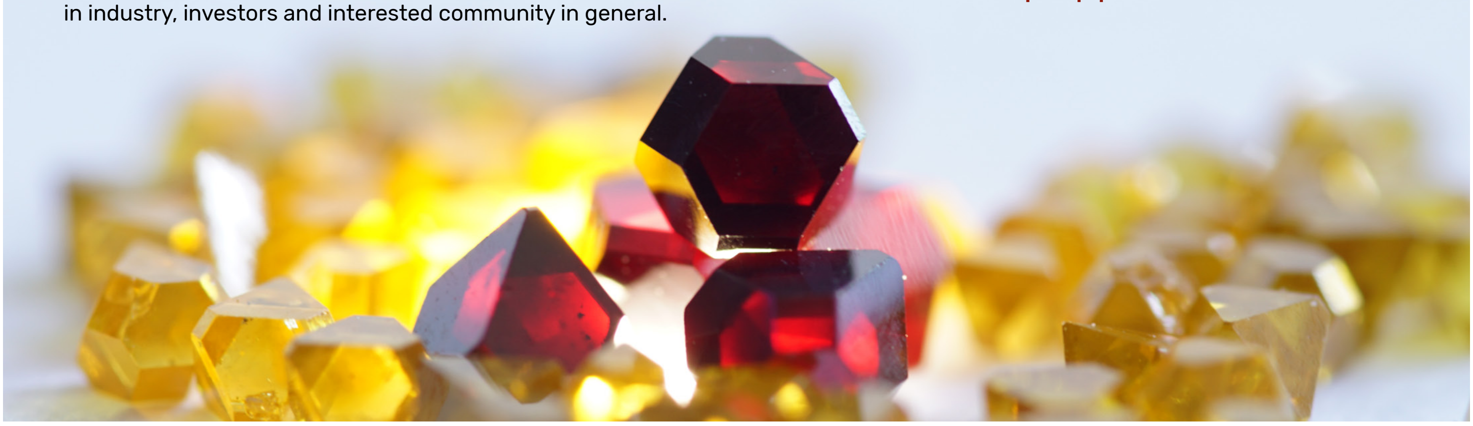
heart failure before it gets to an acute stage.

The wire is inserted into the cardiovascular system and there's an antenna that's attached to this sensor – so the whole system provides a continuous output of blood flow and pressure, that would give the physician an indication that one is starting on the early stages of heart failure and exactly where the problem areas are. They then start the patient on a remedial path long before he or she can ever be considered acute.

The great thing is that you can look at a patient's history, heritage, body type etc. and offer the service to possibly at-risk patients. Because really, what you want to do is prevent these issues before it's too late.

Sandvik Materials Technology
Business Unit Medical, Palm Coast, Florida, US
https://exera.sandvik

Some twenty years back Sandvik's core business for fine wire was in micro-electronics but the word was spread that they were good at making high quality precision wire. The rest is medical history.
Source: Hans Nordlander, BildN



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Photochemical etching solutions for the medical sector

Dr. M. Eesa
S. Williams

The trend towards miniaturization in medical implants places special requirements on the manufacturing methods used to create these implants. Photochemical etching is a versatile technology that can produce metal components with high accuracy, repeatability and the ability to create small features and burr-free edges.

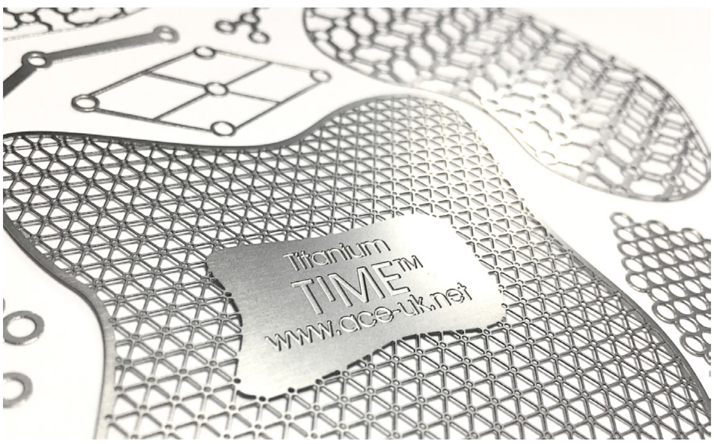
An innovative process for medical implants

The versatility and precision of photochemical etching make this technique ideal for the manufacture of dental, orthopaedic, ostheosynthetic and cardiovascular implant components from biocompatible metals including stainless steel 316L, titanium (grades 1-4) and Nitinol. In particular, the innovative Titanium Molecular Etching (TiME) method, developed by Advanced Chemical Etching Ltd, enables the manufacture of etched titanium components to a high level of quality.

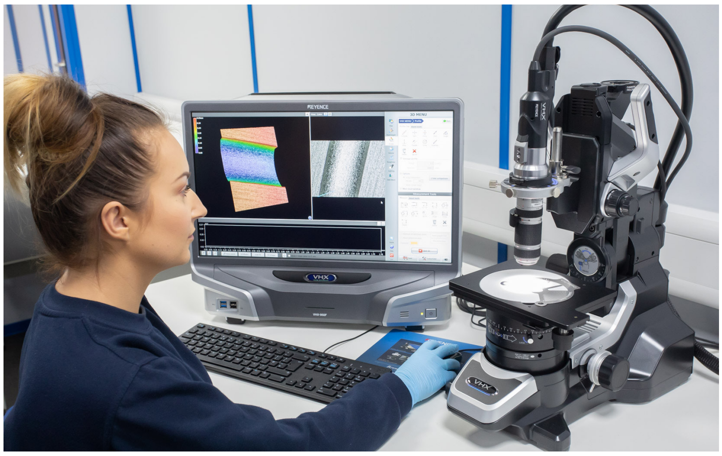
Photochemical etching is a subtractive metal processing technique in which metal is removed selectively from a flat metal surface using a chemical reagent to create specific shapes or patterns. The process uses CAD drawings transferred onto transparent photo-tools and used to create a negative image on a photosensitive polymeric film (photoresist) applied to the metal surface. This process produces high resolution parts, often with complex geometries or with arrays of variable aperture profiles in relatively thin flat metal sheets from several tens of microns to ~2 mm in thickness. The process has technical and economic advantages over other techniques such as traditional metal cutting and stamping.

While other techniques may produce a directional surface finish, photochemical etching yields a non-directional surface finish. In addition, profiled apertures can be etched to enable a perfect fit for countersunk screws used in ostheosynthetic applications.

Source: Advanced Chemical Etching Ltd.



Source: Advanced Chemical Etching Ltd.



To produce the required dimensions of the etched features on the final etched product, the CAD drawing must account for a phenomenon known as ‘undercut’ – the lateral etching taking place under the edge of the photoresist. The photo-tool drawing compensates for this by including an etch allowance applied to all dimensions affected by undercut. The process yields high dimensional accuracy and precision and is able to achieve tight tolerances.

Importantly, etching does not alter the mechanical and chemical properties of titanium and Nitinol, namely, their super-elasticity, shape memory and biocompatibility.

Titanium and Nitinol for medical applications

ACE routinely etch titanium implants for osteosynthesis and orthopaedic applications, e.g. bone meshes, bone plates, support components for hip implants, dental implants, stents, battery grids for pacemakers and hearing aid components. Superior results are achieved on mesh components compared to parts manufactured using laser cutting/ machining methods.

Nitinol is especially useful for medical applications, where it is used for implants in orthopaedics and orthodontics. It is also becoming widely used in devices for minimally invasive interventional procedures, such as stents, graft support systems and filters. Super-elastic stents are guided into the body while they are tightly compressed, and, when released, spring back to their original larger shape, thus holding open the blood vessel to improve blood flow. Moreover, the corrosion resistance of Nitinol contributes to its biocompatibility. After passivation treatment, Nitinol surfaces become covered by a titanium-rich oxide layer that is both stable and uniform. This oxide layer protects the alloy from bio-corrosion and creates physical and chemical barriers against nickel oxidation. Research has also shown that this oxide film is able to sustain large deformations induced by the shape memory effect, and that it is more resistant to chemical breakdown compared to the oxide film on passivated 316L stainless steel.

Efficient manufacture of precision-etched parts

Complementing the TiME etching capabilities for miniature and precision etched medical components in titanium and titanium alloys, ACE offer project and technical support also in cooperation with ‚hjm-technic‘. Ongoing R&D, state-of-the-art material and process control and quality inspection offer a high degree of reliability and repeatability which is essential in the medical industry. Through R&D, ACE will continue to push the boundaries of the photochemical etching technology in order to meet the evolving demands of the medical sector.

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Permanent non-invasive in-ear blood pressure measurement

Kai Werum,
Jürgen Keck

Cardiovascular diseases are the leading cause of death in industrialized countries. By treating patients with high blood pressure in time, almost half of all heart attacks and strokes could be avoided. In the BMBF funded project "MikroBo" continuous recording of the absolute blood pressure in the ear is to be developed.

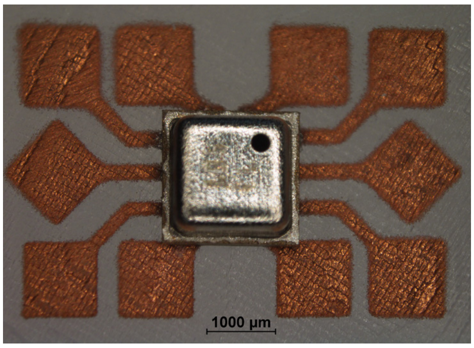
Motivation and challenges

The human ear appears to be a unique place for blood pressure measurement: With each heartbeat a certain amount of blood is pumped into the ear expanding its arteries. Upon temporarily sealing the auditory canal airtight the changes in artery dimensions result in pressure fluctuations where the blood pressure can be derived from.

The challenge lies in the narrow and protected ear space, as well as in the measurement requirements of medical applications, which sensors and actuators available on the market do not meet. Therefore, miniaturized sensors with improved resolution and noise reduction are required. In addition, more effective micro pumps and valves for an active applied reference pressure are needed. Here, the accuracy is a key factor. For this purpose, new concepts in micromechanics, an evaluation circuit, and also the substrate and interconnection technology must be developed. This is exactly where the MikroBo project comes into play: In the scope of this project, new microsystem sensor and actuator components that are necessary for the implementation of a permanent and non-invasive blood pressure measurement are developed. Their integrative interaction in a miniaturized overall system is optimized.

Miniaturization and system integration

Printing technologies enable resource-friendly and cost-effective build-up of functional structures, such as conductive traces and printed sensors, for use in industrial or medical applications. Therefore, Hahn-Schickard focused on the digital printing of circuit layers for the implementation and functionalization of 3D printed ear molds.



Pressure sensor soldered on 3D printed ear mold with printed tracks that were electrolessly copper-plated.
Source: Hahn-Schickard

With the digital aerosol jet printing technology Hahn-Schickard achieved this goal. The digitally printed circuit tracks, obtained by using silver nano ink and subsequent photonic curing by means of pulsed UV-Vis irradiation, passed the adhesion and electrical tests. In order to connect the printed structures with e.g. the Bosch pressure sensor, different strategies such as soldering (Figure 2) and usage of conductive adhesives (ICA) were investigated.

Results and Conclusion

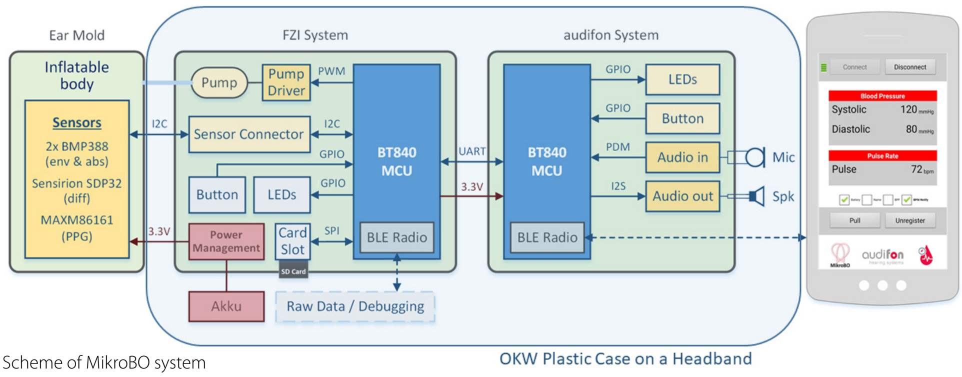
It has been shown that the solderability of the printed structures depends on many factors such as the wettability and the diffusion rate between solder and the printed metal layer. Whereas direct soldering on printed silver tracks does not work out well because of the solubility of silver in the solder material, electroless copper plating of the printed silver structures enables the soldering process. Another option to connect the printed silver tracks directly is by means of conductive adhesive (ICA).

The measurement results based on clinical studies demonstrate the viability of the assumed concept of in-ear blood pressure measurement.

In summary, promising results have been achieved towards the development of the desired in-ear blood pressure measurement system. The key to success lies in the integration of different technologies and knowledge represented by the different companies and research institutes involved in the project.

The consortium of MikroBo consists of various companies and research institutes and fulfills the following tasks in the project:

- **Bosch Sensortec GmbH**: Development of a high precision pressure sensor based on proven MEMS (micro electro mechanical system) technology which enables a small footprint of the sensor to be able to integrate the sensor into the hearable. The custom developed ASIC for conversion of the MEMS signal to the digital domain allows to reach low noise requirements and precise measurement of barometric pressure.
- At the **CiS Forschungsinstitut für Mikrosensorik GmbH** a compact, optical sensor system for continuous blood pressure monitoring is under development, which is worn on the inside of the tragus (part of the auricle) via an ear mould. The photoplethysmographic (PPG) sensor also enables the determination of further vital parameters such as the heart rate, its variability and blood oxygen saturation.
- **Bartels Mikrotechnik GmbH** develops the microactuator for active, fine-tuned pressurization in the ear. For this, the miniaturized, bidirectional micropump can function as a valve in addition.
- The **FZI Research Center for Information Technology** is concentrating on the development of high-performance algorithms for actuator control and blood pressure analysis. Thereby, classical modelling approaches as well as methods of artificial intelligence are applied.
- **Herz- und Diabeteszentrum NRW** (HDZ) is responsible for clinical studies using the developed technology.
- **Hahn-Schickard** is responsible for printing solutions and performs evaluation of digital printing, interconnection technology, and assembly processes.
- **Audifon GmbH & Co. KG** is contributing by designing and producing an inflatable ear mold equipped with pressure and PPG sensors. Furthermore, Audifon is managing the design and construction of a demonstrator for the project.



Scheme of MikroBO system
Source: audifon

Hahn-Schickard, Stuttgart, DE
https://www.hahn-schickard.de

Daniel Förster
Dr. Christian Freitag

Precise processing of additively manufactured medical components

Additively manufactured components such as medical implants offer new potentials in patient care by allowing individual adaptation. One significant drawback is the surface quality and precision of 3D printed components. The ultra-short pulsed laser is the ideal tool for precise manufacturing and post-processing.

Precision manufacturing with ultra-short pulsed lasers

Ultra-short pulsed lasers, sometimes referred to as ultrafast lasers, can be used for a precise removal of material in the order of several atomic layers. Typical removal depths per laser pulse lie between several 100 nm and several microns, but can be lower than 10 nm. Such precision is required in a variety of technological processes such as drilling of micro holes, 2.5 D structuring of surfaces, defined layer removal of multi-layer work pieces and precision cutting of thin films. Since the energy of a laser pulse is coupled into the material within a time of 1 picosecond (one trillionth of a second) or shorter, the material directly evaporates or sublimates, offering the possibility to process almost every material with the highest precision. Not only metals or semiconductors, but also transparent materials such as glass or diamond as well as ceramics and plastics can be processed. Another possibility is to process additively manufactured materials such as AlSi10Mg or Ti6Al4V. In this article, the emphasis lies on potential applications that are enabled by using the ultra-short pulsed (USP) laser: precision drilling and surface finishing as a post-process for additively manufactured components.

Drilling of micro holes into additively manufactured material

By using specialized optical systems, the laser beam can be moved along a circular beam path, leading to a rotation and also inclination of the beam. This allows for different shapes of blind and through holes such as conical, cylindrical or negatively conical geometries. Furthermore, free forms can be drilled when moving the work piece while rotating and inclining the laser beam. As an example, a star-shaped hole is given in Figure 1. The width of the arms and the thickness of the sample amount to 20 µm and 600 µm, respectively, resulting in an aspect ratio of 1:30. The inner hole walls are smooth and show a surface roughness of only a few 100 nm. The hole outlet is characterized by a clean and sharp cutting edge. To show the possibilities offered by the USP laser, a sample with an increased porosity was used. Pores of different sizes between 1 and 10 µm are cleanly cut through by this laser, showing no influence of the cut geometry (find also more information in the IVAM INNO No. 75, Volume 25, Spring edition 2020, in German). Such holes can be used for defined fluid transport in additively manufactured implants or medical instruments.

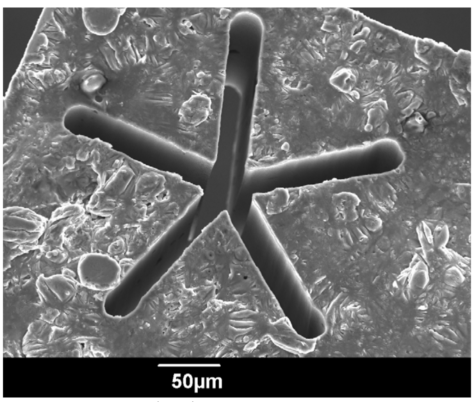


Figure 1, Source: LightPulse

Surface finishing of additively manufactured components

Due to layer-by-layer removal, the USP laser also can be used for precise surface structuring of additively manufactured components. In figure 2, a macroscopic view of surface finishes with different processing strategies is shown. With the same tool, different stages of polishing as well as 2.5 D Structuring, e.g. the milling of pockets or notches, can be obtained. This offers new possibilities in the manipulation of surface structures of additively manufactured devices such as implants.

In figure 3, SEM-pictures of different surface structures are shown. The original structure of the sample surface is given in figure 3a). Residual powder particles in the size of several microns cover the irregular surface, leading to a non-uniform roughness. Laser structuring of the surface with an USP laser allows a uniform adaption of the roughness to the requirements of the application. A laser-polished surface with a roughness of less than 1 µm is shown in figure 3b). One possible application could be the surface structuring of additive printed hip joints. In the future, such artificial hip joints will be individually adapted to each patient through additive manufacturing, whereby the surface is not smooth enough for a direct use as a hip joint after 3D printing. The ultrashort pulsed laser is a versatile tool for post-processing. Not only for the spherical hip joint itself, where a smooth surface is required, but also for the connection to the femur (thighbone) a defined surface structure can be achieved with the same laser system. Figures 3c) and 3d) show defined porosity of varying degrees that could enable better coalescence of bone and tissue. While the surface structure of additive-printed material itself enables a better connection of bone and implant, a defined surface porosity could lead to a significantly increased bonding and healing process, generating added value by USP laser post-processing. These application examples show that the innovation potential of the ultra-short pulse laser is far from being entirely exploited.

Figure 2, Source: LightPulse

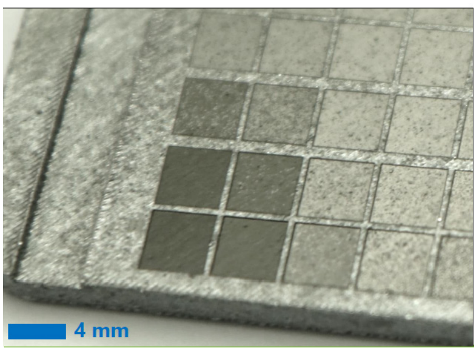
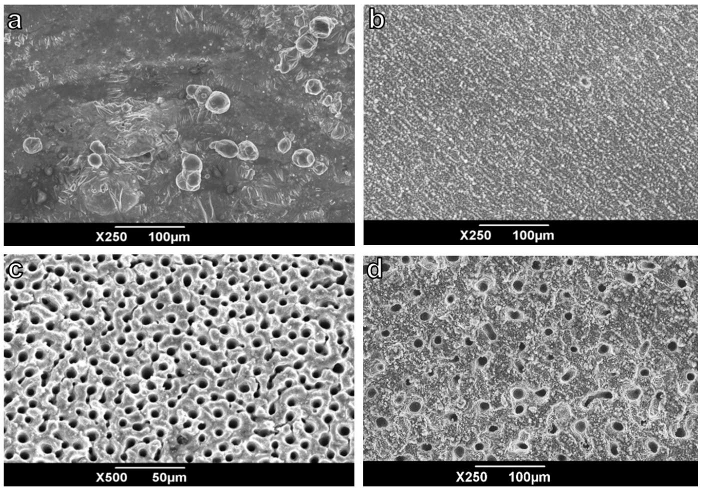


Figure 3, Source: LightPulse



LightPulse LASER PRECISION, Stuttgart, DE
www.light-pulse.de

Volume 25, No. 76, Summer 2020

Identification and measurement value acquisition using passive RFID technology

Reinhard Jurisch
Peter Peitsch

The use of RFID technologies enables innovative solutions both in medical technology and in other industrial sectors. This technology helps to clarify spare parts and accessories for high-quality devices and special applications in surgery, artificial respiration technology or therapeutic treatment and to track their use. The automatic recording and storage enable efficient operation at the same time.

With a wide range of miniaturized passive transponders and sensor transponders, microsensys offers a versatile basis for different applications of RFID technology. These passive transponders are batteryless, which guaranteed a maintenance free life for such systems over several years and makes them geometrically very small. In customer-specific solutions, implants for monitoring various physical parameters such as temperature, pressure, movement and tension in the human body are realizable.

Thanks to the combination of contactless RFID technology and low power sensors, a wide variety of sensor applications for telemetric measurement of temperature, pressure, humidity and other measured variables can be implemented in practice.

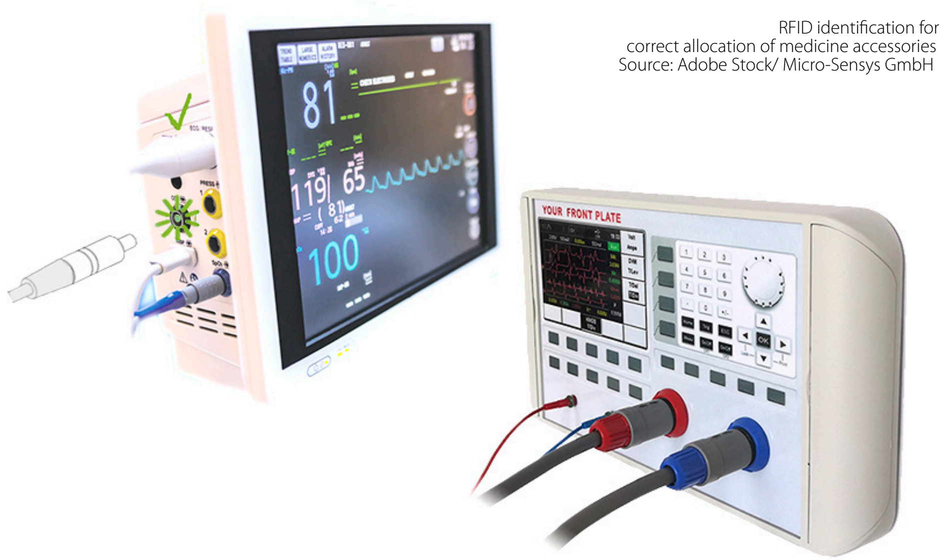
The user receives not only an objective measured value but can also clearly identify the object in question at the same time. Because of the sensor transponders remain on the measurement object, they simultaneously provide clear identification of the measuring point. In addition to storing identification data, the implemented memory also allows calibration values and other information about the measuring point to be stored. Due to the high-quality materials from which the transponders are made, they can also be used under harsh environmental conditions.

In addition, the HF technology based on the ISO 14443 standard has proven to be very suitable, as it has high energy transmission and optimal data rates for operating the sensors with low consumption.

The advantages of passive sensor transponders compared to conventional wired technology or active, battery-supported loggers and radio transmitters are primarily the low mass and the small size of the actual measuring device as well as the independence of charge battery status or the accumulator.

As a highlight, the TELID 251 from microsensys enables to connect external of contactless measurement sensor elements, which can be contacted via four gold-plated contact surfaces on the back of the component. The integrated analog-to-digital converter (ADC) enables the potential-free measurement of input voltages with high resolution and low power requirements. The contactless transmission of sensor signals using RFID technology is very interesting for many sensor applications because these advantages enable the opening up of completely new market segments.

The passive ADC transponder opens up a variety of interesting, wireless, solutions. The possible applications ranged from temperature control in a processes for checking transports to an individual sensor transponder.



RFID identification for correct allocation of medicine accessories
Source: Adobe Stock/ Micro-Sensys GmbH

Risk minimization and data management

Thanks to contactless communication between the RFID reader module built into the medical device and the transponder on the accessories, RFID has proven to be a very reliable technology for contactless, unambiguous detection and data transmission. This technology features through the following advantages over other identification technology:

- Contactless, bidirectional data transmission
- Possibility of data communication even without visual contact
- Read and write any data in the data memory of the transponder
- Possibility of data encryption, also cryptographic
- Hermetic encapsulation in a plastic housing allows the transponder to be used even in harsh environmental conditions

The integrated reader module allowed the successfully identified equipment to be able to be connected with one another (e.g. plugs, hoses, etc.). This minimizes the human error rate. Due to integrated storage space and the intended unit data, such as the last data, the duration of use or limitation of usability are stored on the transponders. Automatically generated usage reports can then provide information about accessories requiring repair or wear.

Brand protection and certifications using RFID technology

For the approval of a medical device, it is very important that these components of the medical device are clearly recognized and the instantaneous state can be correctly assessed. It must be ensured that the component really belongs to the approved medical device and does not come from another manufacturer. From the risk management perspective, this requirement is particularly important for the components of the medical device.

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https://microsensys.de

Volume 25, No. 76, Summer 2020

Dr. Andreas Alt

Flow measurement in smart Inhalers for connected drug delivery

Inhalers are among the most commonly used devices for treating respiratory diseases such as asthma and chronic obstructive pulmonary disease (COPD). With each inhalation through the inhaler, the device delivers a specific amount of medication to the lungs. However, when it comes to proper inhaler use, misuse is the norm.

It is well documented that patients often have problems adopting the correct inhaler technique and thus receive insufficient medication. This applies equally to both metered dose inhalers (MDIs) and dry powder inhalers (DPIs) and leads to poor disease control and increased healthcare costs, either as a result of uncontrolled disease, increased drug utilization for relief medication, preventative therapy or emergency department visits. This remains a common problem in both asthma and COPD. Global annual costs associated with asthma and COPD management is substantial from both the healthcare payer and the societal perspective. Research findings show that healthcare spending for an uncontrolled patient is more than double that of a controlled patient. Studies have also found that patients make at least one mistake during inhaler drug intake as often as 70% to 90% of the time, resulting in only 7% to 40% of the drug being delivered to the lungs. The two biggest and most serious errors when using an MDI are both related to patient inhalation. The first error is related to the coordination between inhalation and triggering the dose release of the inhaler. Even a short delay can result in only 20% of the medication being delivered to the lungs. The second most significant error is not breathing deeply enough, which can cause another 10% less medication to reach the lungs. The opportunity for technological innovation to reduce these common errors by measuring patient inhalation airflow through the inhaler device is already available today and allows for increased drug delivery efficacy, improved medication adherence, reduced healthcare costs and, ultimately, improved patient outcomes.

Why measure the inhalation flow profile?

As discussed above, the two biggest and most serious errors in using inhalers are related to patient inhalation. By measuring the inhaled airflow through the inhaler, and additionally registering the point in time when the drug is dispensed for MDIs, allows information on whether the drug was released within the optimal window of the inhalation cycle to be accurately determined (see Figure 1). This dose-trigger timing versus flow correlation is one critical parameter to understanding if the drug carrying flow reached deep into the bronchia and achieved the desired high lung deposition.

Figure 2. Schematic illustration of drug deposition when the drug is released in the optimal timing window (left side) and when the drug is released too late (right side).Source: Sensirion.

The second critical parameter is the inhaled airflow profile. Borrowing from spirometry, several parameters can be derived from the inhalation airflow profile that provide insights into each patient's inhalation:

- depth and length of inhalation
- entire exhalation before inhaling
- slow inhalation according to instructions
- lung function and its development

Accurate and calibrated real-time recordings of the inhalation flow profile provide the information above, from which it can be determined whether the patient carried out the inhalation correctly and achieved a high lung deposition. Other parameters of interest include the inspired vital capacity (IVC) and peak inspired flow rate (PIF), along with the full inhalation airflow characteristic as shown in Figure 3. Subsets of parameters such as forced inspired volume during the first second of inhalation (FIV1) or the airway resistance (RAW) can also be determined from the inhalation airflow profile. The derivation of the latter is shown in Figure 4.

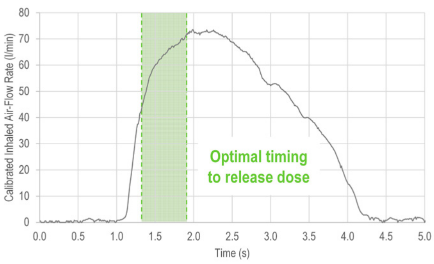

Figure 1. Inhalation flow profile showing the calibrated flow rate in standard liters per minute (l/min) versus the inhalation time in seconds (s). Source: Sensirion.

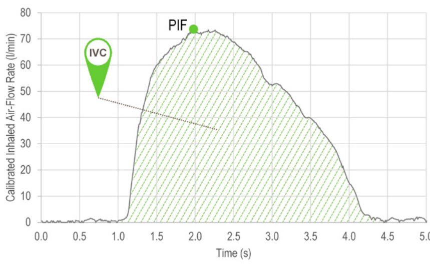

Figure 3. Parameters derived from the inhalation airflow characteristic: inspired vital capacity (IVC) and peak inspired flow rate (PIF). Source: Sensirion.

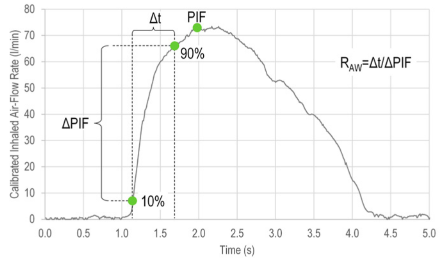

Figure 4. Besides the peak inspired airflow (PIF), the airway resistance (RAW) can be determined from calibrated inhalation airflow characteristics recorded with a sufficient high temporal and flow resolution. Source: Sensirion.

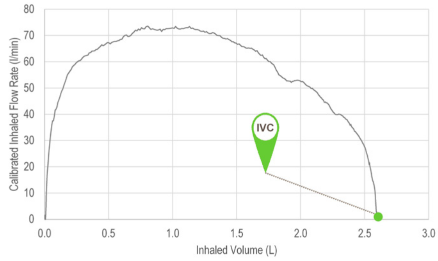

Figure 5. Typical spirometer plot of flow rate versus inhaled volume. The inspired vital capacity (IVC) is the total inhaled volume as the flow rate returns to zero at the end of the inhalation. Source: Sensirion.

Some parameters such as airway resistance (RAW) can be of special interest for patients with chronic obstructive pulmonary diseases (COPD) as it may relate directly to the condition of the disease. As the inhaler is now being utilized as a spirometer-like device, all parameters are derived upon use of the inhaler without any additional effort or time-related burden to the patient. Besides monitoring every inhalation through the inhaler for its quality and the correct use of the inhaler, the above parameters monitored over time can additionally provide feedback on the effectiveness of the medication, the course of the disease and alert the healthcare professional or be motivational for the patient and increase adherence.

Cohero Health already provides patients with an additional spirometer for exactly this reason, i.e. to allow the patients to routinely measure their lung function over the course of the treatment. The benefit of providing direct disease management and sharing this data with medical professionals helps patients and clinicians to assess treatment progress and also enables payment-by-results rather than pay-per-dose. This same development can ➲

be observed in the insulin or sleep apnea industry where it has led to growing market shares for companies offering connected devices in recent years and simultaneously brought down treatment costs and improved patient outcomes. Most importantly, this combination of drug delivery and diagnostic unit in a single device is a powerful tool in improving patient outcomes.

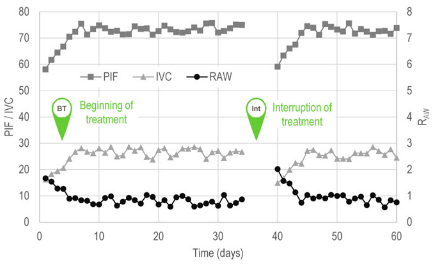

Figure 6. Peak inspired airflow (PIF), inspired vital capacity (IVC) and airway resistance (RAW) monitored over time, providing valuable feedback to the healthcare professional and the patient. Source: Sensirion.

Figure 6 shows the schematic behavior of PIF, IVC and RAW versus time. It visualizes the positive effect of starting the treatment, the stable treatment phase during regular dosage and the negative effect of interrupting the treatment.

By adding the capability of measuring flow to the drug delivery inhaler device, not only can patient compliance and correct use of the inhaler be monitored, but also the effectiveness of the medication and course of the disease over time can be observed by utilizing the spirometer-like lung function recordings. Next generation inhalers – natively incorporating airflow measurements in their design – will facilitate automatic dose release at the optimal point in time, individually tailored to the patient and their specific condition.

How to measure the inhalation flow profile?

Before inhalers natively include electronics and connectivity features by design, existing inhalers and inhaler platforms can be enhanced with the required electronics to achieve connectivity and the required sensing functionality. This is already being done today by companies such as Propeller Health, Adherium and others that have designed a variety of clip-ons for existing inhalers to add connectivity by monitoring parameters such as date and time of usage as well as evaluating signals from additional sensors such as accelerometers, GPS and many more. In the past, accurate measurement of the flow through the inhaler was challenging due to the lack of sufficiently robust and yet sensitive devices capable of measuring the smallest flows.

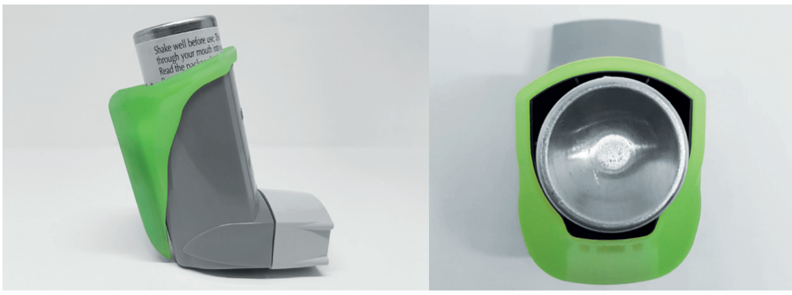

Figure 7. 3D-printed inhaler clip-on containing the Sensirion flow sensor SDP3x in the side view (left) and top view (right) showing the unobstructed flow path of the inhaler.

Source: Sensirion

In order to avoid revalidation of the inhaler with the FDA and maintain approval, the key regulatory requirement for all inhaler clip-ons demands that the flow path of the inhaler remains unaltered in order to ensure that it does not interfere with the existing inhaler device function. In order to demonstrate how accurate flow measurement through an inhaler can be realized without interfering with the flow path, a functional inhaler clip-on has been developed by Sensirion. Figure 7 shows the 3D-printed inhaler clip-on containing the Sensirion flow sensor SDP3x as well as a Bluetooth low energy communications chip and a battery power source. It is notable that the inhaler housing has not been altered in any way and the flow measurement principle relies solely on the Venturi/Bernoulli principle at the inhaler inlet. The calibrated inhaler airflow shows excellent agreement to an external flow reference and was used for obtaining the flow profiles depicted in this article.

The unaltered and unobstructed inhaler flow path design is enabled by the extreme sensitivity of the Sensirion MEMS-based (micro electro mechanical system) flow chip solution utilized in the SDP3x flow sensor series. This technology is based on the microthermal flow-through principle, the next generation hotwire flow sensor technology that has been successfully used in medical ventilators for decades. In clip-ons for existing inhalers as well as newly developed inhalers, the key advantages of Sensirion's CMOSens flow chip technology can be summarized as:

- highest sensitivity down to hundredths of a Pascal
- high temporal and pressure/flow accuracy
- proven device in the medical and automotive industry
- robust against being dropped and ultra-sonic welding process steps
- inherently robust against external disturbances by the two-port design
- low power consumption for portable and battery operation
- world's smallest commercially available flow sensor

Outlook of flow measurement in smart inhalers

Adding a diagnostic unit to the drug delivery device that the patient is already familiar with is a powerful tool in asthma and COPD disease management. Improper inhalation technique leads to decreased efficacy through reduced deposition of drug in the lungs, which in turn leads to increasing disease severity and thus a worse patient outcome and an increase in healthcare costs. The solution of guiding the patient and providing direct feedback as well as supporting the patient in controlling the disease and increasing adherence have already been shown to improve patient outcomes by current connected drug delivery devices.

Thus, robust and accurate flow measurement is an important feature towards better disease management and patient outcomes and is already realizable today. The high percentage of patients suffering from asthma or COPD and misusing their inhaler when a life free of complaints would generally be possible with proper disease management will continue to drive innovation for connected drug delivery. An increasing number of companies are implementing digital technologies in their products already today to provide an enhanced method of managing asthma and COPD as well as improving the effectiveness of medication. Supporting the patient with the optimal treatment of their disease, not solely as a simple medical tool but as a companion device to remind, coach and provide relevant insight into the treatment and the course of the disease, is the direction in which the industry is advancing.

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Volume 25, No. 76, Summer 2020

Cell separation for innovative drug development

Richard Lensing
Dr. Nadine Nottrodt

In today's world, environmental and resource protection are more important than ever. At the same time we wish for a good quality of life and to avoid or quickly shake off illnesses. With new tools for cell separation, we can reduce the time and resources required for the development of innovative drugs and thus achieve both goals simultaneously.

The development of innovative drugs is essential for progress in the prevention and treatment of diseases, but high costs in the research and production of new drugs lead to high market prices and limited availability of medicines for patients. In addition, the high costs and long time to commercialization prohibit smaller companies to fully participate in research and development processes. In order to ensure a high quality of life, free from disease, and at the same time conserve resources, innovative drugs must be developed and produced more efficiently. Today, many drugs, so-called biopharmaceuticals, are produced in biotechnological processes from living cells, bacteria or yeast. However, these production processes react strongly to deviations in the cell lines, hence a high-quality monoclonal cell line is needed. Such monoclonal cell lines always start with a single cell that is genetically modified and selected to produce the desired active component. The complete process from the idea of a new biopharmaceutical to a cell line ready for production can take up to twelve months, is expensive and risky.

Automated cell analysis and isolation

In order to develop cells for new biopharmaceuticals, the first step is to be able to analyze the cells individually and in detail. To do so, scientists need tools that enable them to efficiently isolate the most promising transfected candidates from numerous cells for further analysis. Researchers at the Fraunhofer Institute for Laser Technology, ILT in Aachen, Germany are investigating laser based processes to separate, isolate and analyze biomaterials. The center of this research is the so-called Laser Induced Forward Transfer (LIFT), a process for contact-free transfer of cells and biomaterials.

Source: Fraunhofer ILT/Biofabrication

The process utilizes the dynamics of a laser induced cavitation bubble to propel a liquid jet with which one or multiple cells are transferred. Since no nozzles or orifices are needed only the internal friction of the liquid jet acts on the cells, resulting in a very gentle transfer. Additionally, the LIFT process can be combined with other contact-free, optical processes such as microscopy and Raman spectroscopy to add cell detection and analysis capabilities to the transfer process.

Implementation of the process combination in the "OptisCell" platform

Based on this process combination, a platform was developed in a joint project with the Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB and the Fraunhofer Institute for Applied Information Technology FIT to quickly identify promising cells for biopharmaceutical production and verify their production capability. In this so called OptisCell platform cells are initially identified using an integrated microscopy setup and image recognition algorithms. In a second step the Raman spectrum of each cell is recorded and examined using a machine learning algorithm. The algorithm can qualitatively identify promising cells for protein production due to their characteristic spectrum. Each promising candidate is isolated and transferred in a well of a 96 well microtiter plate using the LIFT process. After a short cultivation phase, cells are analyzed with Surface Enhanced Raman Spectroscopy (SERS) to enable a very early quantitatively measurement of the production capabilities of each isolated cell. This way only cells that are verified to be good producer cells for the desired protein are chosen for cultivation and biopharmaceutical production. The cell isolation has an 85% transfer rate with a cell survival of 95% and higher. Nearly all the promising cell in the cell culture are correctly identified and separated. The quantitative protein measurement ensures that every cell chosen for starting a cell line meets the high production requirements. So far, the functionality of all individual steps of the platform was demonstrated. In Future this platform technology can possibly reduce the time required for the production of the cell line by three quarters and to drastically reduce costs due to the reduced cultivation and examination time of each single clone. Thus speeding up the patient access to innovative drugs and enable research into more efficient and effective medicines while reducing the consumption of resources.

Source: Fraunhofer ILT / Biofabrication

Fraunhofer Institute for Laser Technology ILT,
Biofabrication, Aachen, DE,
https://www.ilt.fraunhofer.de

Volume 25, No. 76, Summer 2020

High-precision micro-optics in medical technology

Bernd Bresseler

Medical photonics play an increasing importance in modern medicine. When thinking about optical applications in medicine, a first association is diagnostic image processing. In biomedical research, modern optical and photonic techniques enable monitoring and manipulating life processes in cells and even molecules.

But techniques using light go much further than that. In clinical practice, optical and photonic techniques are well established in many fields of specialized medicine like in endoscopy. As an interface between medicine and optics, the specialist discipline of medical photonics offers modern examination and operation procedures. The particularly gentle and effective performance of medical areas characterized by optical methods is much valuable in treating living organisms. The highly precise methods of diagnosis can provide beneficial information on the early stage of illnesses and often enable the direct treating a medical problem. Depending on the respective implementation, there are different types of safe devices in common use: Rigid endoscopes as well as semi-rigid endoscopes, flexible glass fiber endoscopes and video endoscopes supplying moving pictures.

Complex micro aspheres for applications in endoscopy

In minimally invasive surgery, special specifications such as biocompatibility are required. With solutions competence for challenging demands and reliable availability, INGENERIC serves customers worldwide. Even complex micro-optics in volume production can be proceeded in clean environment and are subject of 100% inspections. Using aspheres offers substantial advantages: The minimization of aberrations and distortions lead to brilliant views. Imaging in high resolution of e.g. 4K is obtainable. The characteristics of the lenses are single or double-sided aspherical shape, all-surface molding in optical glass (high index material). The lens diameter range from 1.0 mm up to 5.0 mm, with a diameter tolerance of < 0.05 mm. With a numerical aperture < 0.8 and a round or rectangular lens aperture, an EFL between 0.3 mm and 20.0 mm can be achieved at a center thickness of 0.25 mm to 2.0 mm (tolerance < 0,2%). Form accuracy is almost <100 nm PV Irr.

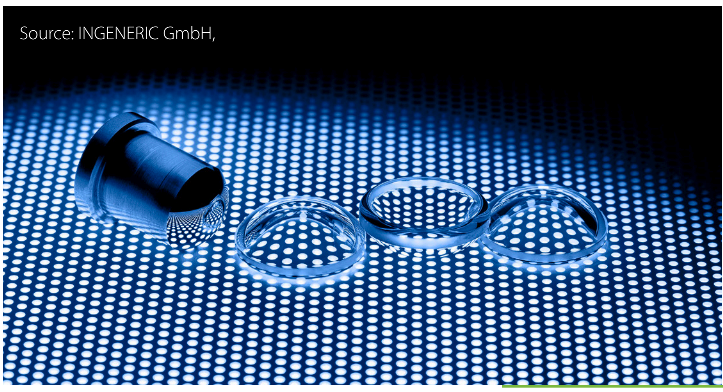
Precision Glass Molding

The replication of a high-precision tool surface through iso-thermal glass forming used by INGENERIC is particularly suitable for complex optical components such as aspheres, microlens arrays or free-form optics. The technology features of precision glass molding are isothermal molding conditions, 1:1 replication of mold on glass part while the precision of mold is crucial for achievable accuracy of optics. Molding of double-sided optics with guiding or mounting faces are suitability for high-index glass and chalcogenide IR-types. A special cost efficiency is possible due to flexibility determined by different machine concepts and the scalability by multi-cavity as well as wafer-level manufacturing. As an additional service, INGENERIC is able to simplify the customers' mounting process by pre-assembled optical modules. Many products are already mounted automatically and thus give benefit from the highest precision and reproducibility, assembly and packaging in clean environment as well as 100% measurement of dimension.

Precision and versality due to long-term competence and equipment

Micro-optics is considered one of the most important pacemaker technologies of the 21st century with considerable growth rates and are now an integral component in many products – whenever light needs to be shaped, focused, collimated or directed. In many cases mobile applications, including the miniaturization of products, require highly complex optical surfaces that can save space and weight in the optical system. INGENERIC is an established supplier of high-precision micro-optics and optical systems for a wide range of industries and leading manufacturer of tooling systems for precision molding of glass optics. Relocated to a new

Source: INGENERIC GmbH,



Source: INGENERIC GmbH,

production site in Baesweiler (near Aachen, DE), the newly constructed company building, with its significantly expanded capacities and competencies, enables further growth on an area of over 10,000 m². The modern production hall covers a gross area of around 2,700 m² and provides around 800 m² of clean room for the production and refinement of optical elements and the assembly of optical modules as well as around 600 m² of air-conditioned production areas for ultra-precision machining. The sensitive production processes require an environment in which the temperature is controlled to +/-0.5 °C. With its infrastructure, the new company headquarters exactly meets the requirements for efficient production of high-precision optics. Precision Glass Molding offers an economical production option in modern high-tech applications. The technology platform developed at INGENERIC, consisting of hot forming, refining and, if needed, automated assembly of micro-optical components, serves application fields that demand extremely high precision. Firmly anchored in the Aachen region with other drivers of innovation, the basis for an optics center was created almost 20 years ago, as scientific expertise is combined with industrial practice. Established in 2001, the company counts around 100 employees as its trusted key for success. Since 2013, INGENERIC is part of the TRUMPF Group. Another major step was the acquisition of the Aixtooling GmbH in 2019.

INGENERIC GmbH, Baesweiler, DE
www.ingeneric.com

Company and product news

Question and answer online session on 3D lithography

Following the successful first edition of the online #QandAThursday Session end of July, Multiphoton Optics invite the interested community in optics/ photonics and biomedical engineering, but also the next generation of technical experts to join the forthcoming Online #QandAThursday „Beyond Lithography", scheduled for August 27, 2020. This open platform provides to a deeper insight into 3D lithography.

Participants will learn more about the technological advances offered by 3D Direct Laser Writing. Multiphoton Optics will demonstrate experience in nano and microsystems and packaging technology, and deep know-how of along the value chain, from materials, prototyping and engineering via process technologies to industrial scale production. The experts will answer questions and discuss with all participants. Individual questions arising during the session will be answered in B2B-meetings following the session.

Multiphoton Optics GmbH, Sonja Pfeuffer, Email: sonja.pfeuffer@multiphoton.de, https://www.multiphoton.de

Source: Multiphoton Optics GmbH

International conference QuApps shows status quo of quantum technology

Quantum technology offers unprecedented potential for industry and science. The technology covers the fields of quantum computers, cryptography and quantum sensors and is currently developing rapidly. The QuApps conference deals with the state of the art and the development of quantum technology. The international event will take place at Düsseldorf Airport from March 1 to 3, 2021.

Experts provide information about research progress and existing fields of application: The participants will gain deep insights into current research progress and expected milestones. The conference focuses on the exchange with renowned experts in quantum technology, e.g. from IBM Research, Volkswagen Data:Lab, Bosch Research, the University of Stuttgart or Forschungszentrum Jülich. In more than 30 lectures, technologies and applications in the fields of telecommunications, healthcare, security, automotive and others will be discussed. An accompanying exhibition shows possible application examples.

The event is aimed at quantum engineers and researchers, business development strategists and trend scouts in industry, at investors and the interested public. Interested experts are welcome to apply for a lecture or poster presentation as part of the Call for Presentations and to present their current products, developments or projects at the QuApps conference.For more information, go to https://quapps-conference.com. There you will also find the program and the options for registration and application.

IVAM Microtechnology Network, Ramon Förster, Email: rf@ivam.de, www.ivam.com

Source: Prof. Jan Meijer

Live Web-Seminar: Like a PCB – but 3D. Unlimited possibilities with 3D-MID technology.

3D-MID (Mechatronic Integrated Device) offers the unique possibility of combining and integrating electronic and mechanical functions on a three-dimensional body. The advantages of the technology, freedom of design, miniaturization and weight reduction, are more than ever in demand in areas such as the automotive, medical as well as industrial and consumer electronics.

Interested participants are invited to learn more about the technology and its application possibilities in the web seminar on August 25, 2020 at 10 – 10:30 am CET.

Content

- Short introduction 3D-MID process
- Comparison PCB - MID: advantages and chances of the technology
- Target markets with application examples
- 3D-MID in-house development at HARTING - one component for different applications

For those who are unable to attend the live web seminar, the seminar will be fully available on-demand after the registration and after the broadcast. Information & registration here:

HARTING AG Mitronics, https://www.harting.com/3D-MID/en-gb/web-seminar

Source: Harting

Volume 25, No. 76, Summer 2020

IVAM trade shows and events

Digital 'Unternehmertreffen Medizintechnik NRW-Japan'
September 28, 2020, Zoom-Meeting
Innovative production technologies for high-tech medical devices
www.ivam.com

CMEF 2020
October 19-22, 2020, Shanghai, CN
IVAM presents a joint pavilion at Asia Pacific's leading medical industry platform
www.ivam.com

COMPAMED
November 16-19, 2020, Dusseldorf, DE
International leading trade fair for suppliers of medical manufacturing. IVAM will present the Product Market "High-tech for Medical Devices" as well as the "COMPAMED HIGH-TECH FORUM".
www.ivam.com

Medical Fair Asia
December 9-11, 2020, Marina Bay Sands, Singapore, SG
Leading medical and healthcare exhibition in Southeast Asia.
IVAM presents a joint pavilion.
www.ivam.com

MD&M West
February 09-11, 2021, Anaheim CA, USA
IVAM organizes a joint pavilion at the focus area MicroNanotech
www.ivam.com

W3 Fair+Convention
February 24-25, 2021, Wetzlar, DE
Networking fair for the optics, electronics and mechanics sectors
IVAM organizes a joint pavilion and trade fair forum at the special exhibition area "Microtechnologies for Optical Devices"
www.ivam.com

QuApps2021 & QT2030
March 1-3, 2021, Dusseldorf, DE
International Conference on Applications of Quantum Technologies and Quantum Technology Roadmap Europe 2030
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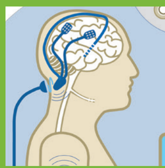

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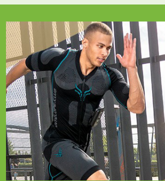

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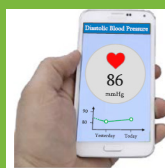

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