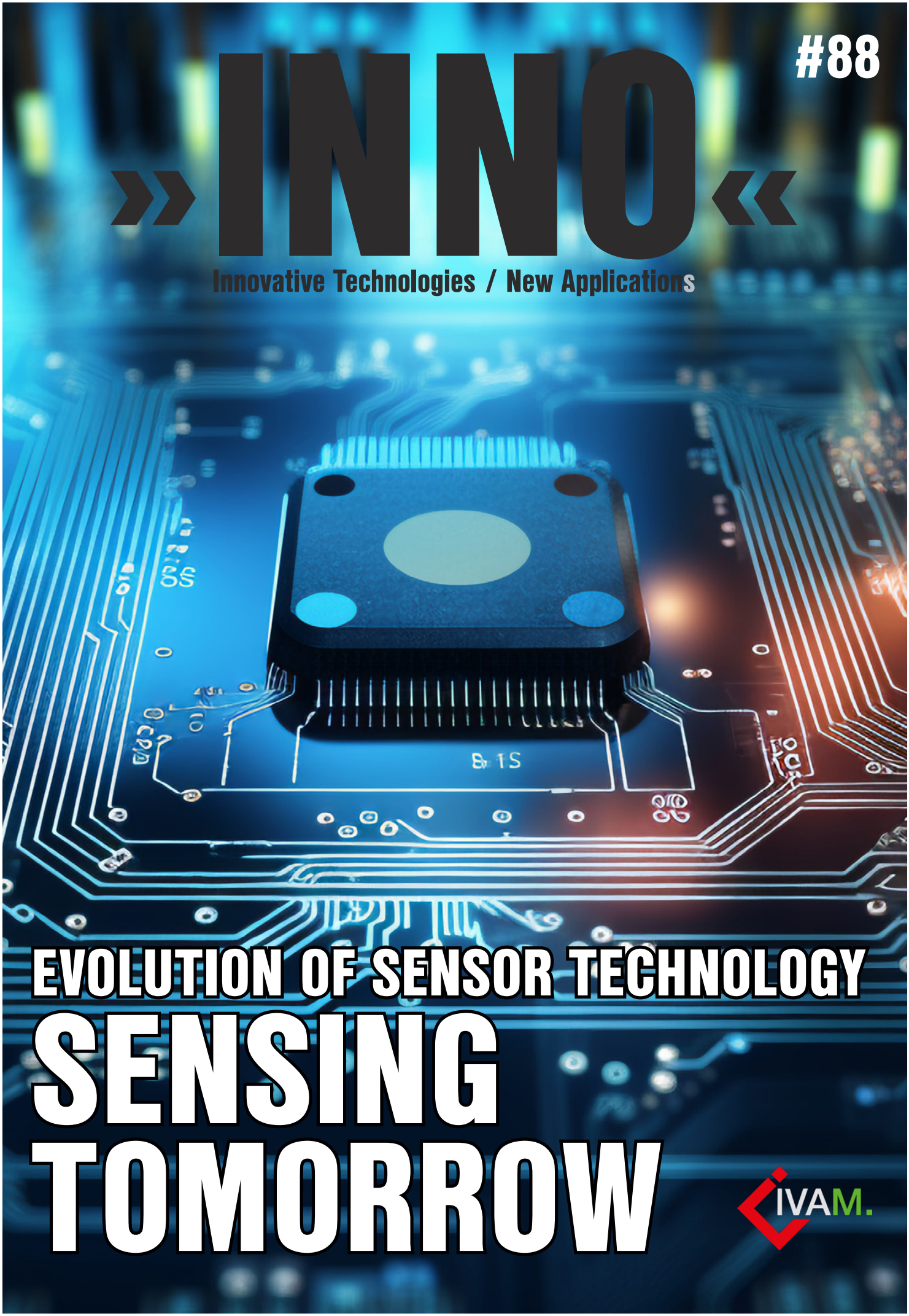
#88

»INNO«

Innovative Technologies / New Applications



EVOLUTION OF SENSOR TECHNOLOGY

SENSING TOMORROW

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CONTENTS

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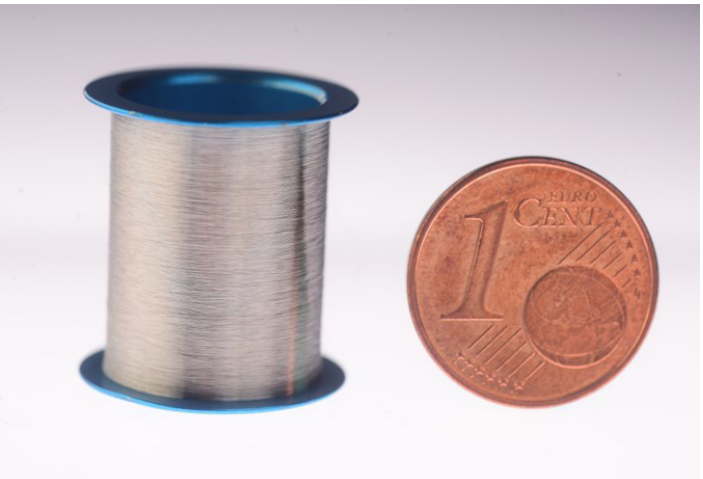


16

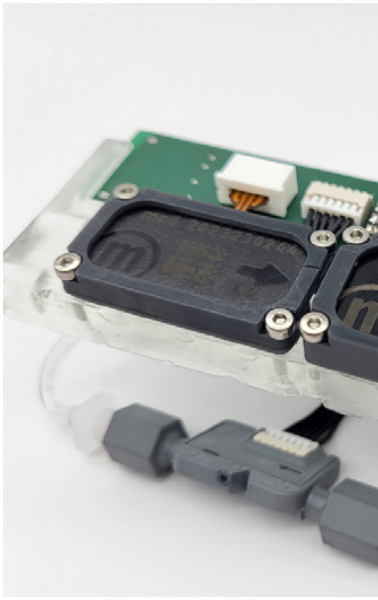
Innovation in Sensors: Functional Fine Wires

Functional fine wires - ultra-thin, specialized wires have emerged as innovative-driven solutions for next-generation sensors.

12

USING EDGE AI - Continuo

Many of our critical infrastruc and utility systems. The tradi infrastructures via fixed mai



24

Ice sensor: World's First of Icefor Food & Pharma

Together with modern AI al allow to optimize the defros

us Monitoring of Critical Infrastructure

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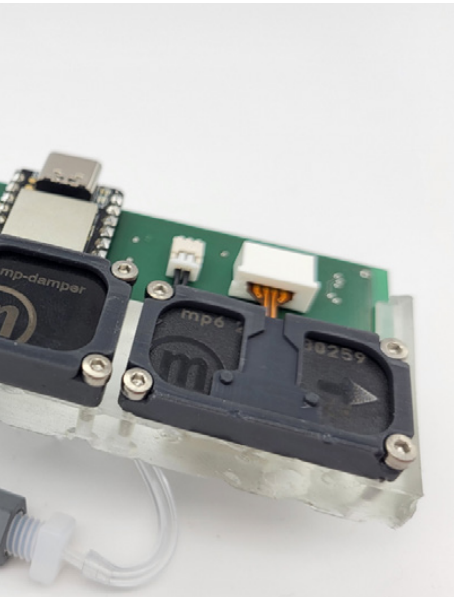

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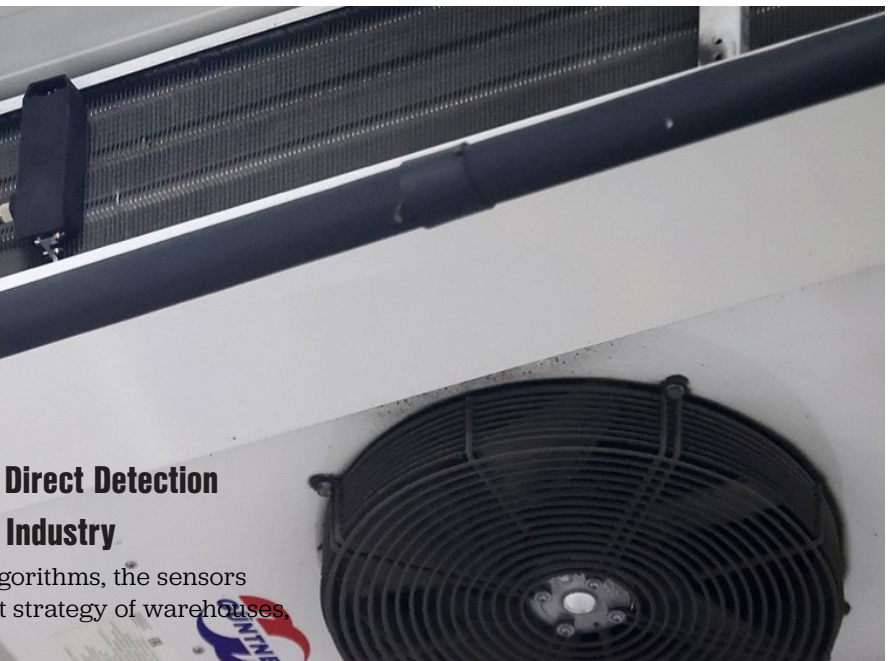
Innovative gas and liquid analysis via microfluidics

Analysis and Sensors play a crucial role in the collection and processing of information that is necessary for optimization, automation, and safety in many areas of our lives and industries.



Direct Detection
Industry

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»INNO 88« Sensing Tomorow

Welcome to the latest edition of INNO! In this issue, we want to explore the transformative world of sensor technology – one of the most dynamic fields in microtechnology today. Sensors have the potential to revolutionize high-tech applications across a wide range of industries, offering innovative solutions to both long-standing and emerging challenges. From healthcare monitoring and environmental analysis to biomolecular detection, the advancements in sensor solutions are reshaping how we understand, measure, and interact with the world around us.

This edition reflects a collaborative effort, drawing on the expertise of two vibrant networks–our own members, as well as contributors from the network DETECT, who share a passion for advancing the future of sensing technology. Together, these experts provide cutting-edge insights into fields as diverse as liquid and gas analysis, single protein and biomolecule sensing, smart sensor components, ice detection systems, and active cantilevers, to name just a few.

We invite you to step into these technical articles, authored by innovators from both networks and discover how sensor technologies are poised to not only meet today's challenges but also unlock new opportunities for tomorrow's innovations. Enjoy your read and be inspired by the possibilities of sensing tomorrow.

Best regards,
Mona Okroy-Hellweg

Aktiia NiBP (non-invasive blood pressure) sensor device

Mathieu Lemay

REVOLUTIONIZING REMOTE PATIENT MONITORING

Optical Cardiovascular Monitoring Technology (oCMT) – developed and owned by CSEM – is revolutionizing mobile patient monitoring. This pioneering innovation bridges the gap between the progress in wearable technologies and patients' evolving needs. oCMT enables clinically validated continuous monitoring of human vital signs such as heart rate, respiratory rate, blood oxygen saturation, and blood pressure, significantly enhancing the quality of patient care.

Hospital wards, ambulatory services, and home care rely on single, intermittent measurements in controlled conditions, which leads to limited diagnostics outcomes and restrains large population screening. But pioneering medical wearables

offer patients, doctors, caregivers, and healthcare providers new solutions that increase the standard of care, provide lifetime continuous access to clinical excellence, and reduce ever-increasing healthcare costs.

The last decade we have witnessed a proliferation of consumer health wearables focusing on wellness and fitness. Today, we do see a steady increase to consumer wearables with medical features, as well as medical devices becoming more wearable. With the urgent quest for the digital transformation of the healthcare system, CSEM's leading innovation hub in wearable technologies evolved into an ISO-13485-certified R&D activity. With its proximity to clinics and patients on the Campus of the University Hospital in Bern CSEM is driving its innovation in remote patient monitoring and clinical research.

oCMT as a driving force of product innovation

oCMT is an assembly of innovations in a reflective optical measurement system set-up, including ultra-low-power opto-electro-mechanical reference designs, software components such as Analogue Front End (AFE) drivers and firmware, as well as embedded algorithms. oCMT puts CSEM at the forefront of medical wearables, leading to clinically validated vital sign monitoring solutions ready to be integrated into commercial products. This includes the monitoring of heart rate and heart rate variability (HRV), respiratory rate, blood oxygen saturation (SpO_2), and continuous blood pressure measurement (ciBP) compliant with ISO standards, including 80601-2-61 (SpO_2 error < 4%) and 81060-2 (BP error < 5±8 mmHg). Thus, oCMT can be deployed in various form factors from standard pulse oximeters to watches, arm- and earpods, patches, and even for smartphones (cameras), and for a large spectrum of applications such as sports and fitness, cardiac arrhythmia monitoring, sleep staging, and sleep apnea detection, as well as the management of hypertension.

Improving user's fitness and patient's quality of life

One of the latest product innovations in the fitness and sports domain leveraging CSEM's two decades of expertise, cumulating in the oCMT platform, is Tissot's latest creation, the T-Touch Connect Sport. The product stands at the intersection of style and fitness tech and deploys significant progress in the realm of connected watches. CSEM's clinically validated PPG optical sensors and algorithms, coupled with the watch's ultra-low-power SwALPS operating system and photovoltaic charging system, contribute to its remarkable three-month battery life in connected-sport mode. The seamless integration of oCMT allows the watch to monitor its wearers' fitness indicators, including heart rate, speed, and energy expenditure, enabling them to track and monitor their performance in real-time.
But oCMT goes well beyond fitness and wellness applications, and which has been realized with the wearable device LEAP from the American company Actigraph. With a product that measures multiple biomarkers and physiological parameters, LEAP aims for better and more precise drug trials, more effective and personalized treatments, and reduced healthcare costs. The wearable enables a holistic and comprehensive understanding of human health by combining multiple sensors in one device. The device collects continuous, multi-sensor data, offering unparalleled insights into participants' real-world functioning. Its design prioritizes participant comfort and adherence and features one of the most comprehensive sensor collections in the industry.

The backbone of medical wearables

Data-driven personalized medical solutions have the potential to change the way healthcare is managed and delivered for the better. CSEM spin-off Aktiia and its oBPM solution is a perfect example of how oCMT contributes to personalized medicine by improving hypertension management worldwide. oBPM promotes long-term blood pressure monitoring based on a medical wearable and accompanying app that has already captured more than 300 million blood pressure readings, making hypertension diagnosis and treatment easier than ever before. Aktiia's oBPM solution is completely non-invasive, eliminating the need for bulky, expensive, and uncomfortable cuff systems. These long-term data also benefit physicians by giving them more information to use in their diagnostic and treatment plans, ultimately improving patients' medical outcomes.
And the oCMT journey doesn't stop here. In the short future, CSEM is targeting to revolutionize the classification of cardiac arrhythmias, pioneering a calibration-free blood pressure model, and advancing the detection and classification of sleep disorders, including sleep apnea detection. In addition, CSEM is expanding its activities in FemTech applications, a critically underserved area of healthcare. With each stride, CSEM reaffirms its position as a leader in wearable health technology, and its unwavering dedication to improving quality of life.

CSEM Centre Suisse d'Electronique et de Microtechnique SA
https://www.csem.ch/en

Anja Blase

INNOVATIVE GAS AND LIQUID ANALYSIS VIA MICROFLUIDICS

Analysis and Sensors play a crucial role in the collection and processing of information that is necessary for optimization, automation, and safety in many areas of our lives and industries. Thus, the development of microfluidic detection devices represents a significant technological advancemen. These systems combine the advantages of microfluidics with advanced analytical sensors, such as CO_2, VOC, bio-chemical or optical sensors, as well as micropumps, to enable precise, fast, and efficient analysis. These innovations offer diverse applications in environmental monitoring, medical diagnostics, and industrial processes.

Sensor analysis with microfluidics

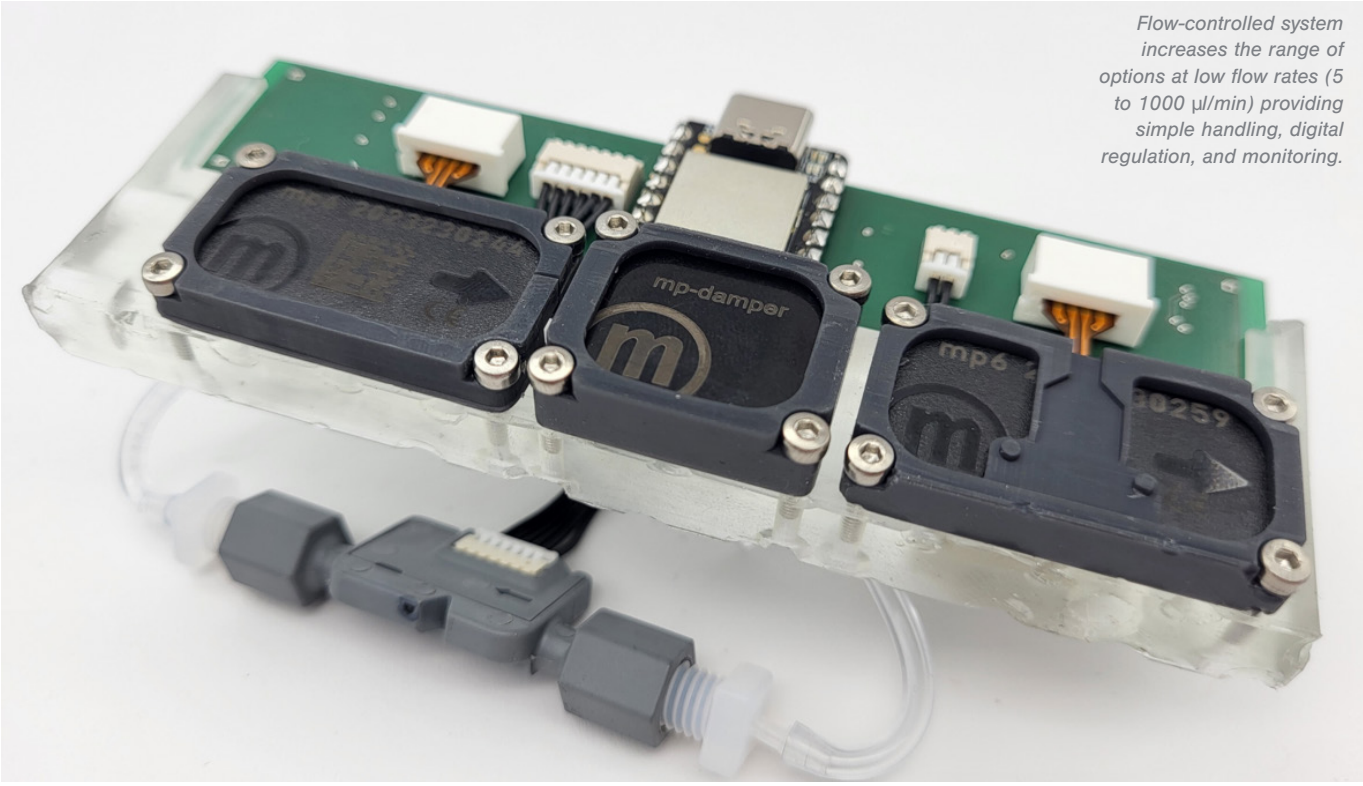
Microfluidics is a technology that enables the control and analysis of liquids and gases in tiny volumes, typically in the microliter or nanoliter range. This technology uses microstructured channels to precisely guide liquids, and gases. By miniaturizing systems, microfluidic devices can operate with very low sample volume and high efficiency.

Gas and liquid analysis are critical for numerous applications, including environmental monitoring, medical diagnostics and industrial processes. Traditional methods of gas analysis are often bulky, time-consuming and expensive. Microfluidic detection devices offer a compact, cost-effective and fast alternative. For example, CO_2 sensors are essential for monitoring carbon dioxide in various applications including climate control, medical monitoring, and industrial processes. These sensors can work very sensitively and detect low CO_2 concentrations, which is particularly important for environmental monitoring and medical diagnostics. Furthermore, identifying and quantifying volatile organic compounds (VOCs) is of great importance in many areas such as indoor air quality, industrial emissions control, and environmental monitoring. Optical sensors play an important role in microfluidics for analyzing liquids regarding their physical and chemical properties. They enable the precise measurement of optical density as well as cell density and sedimentation in microfluidic systems.

Micropumps: Key to Efficiency

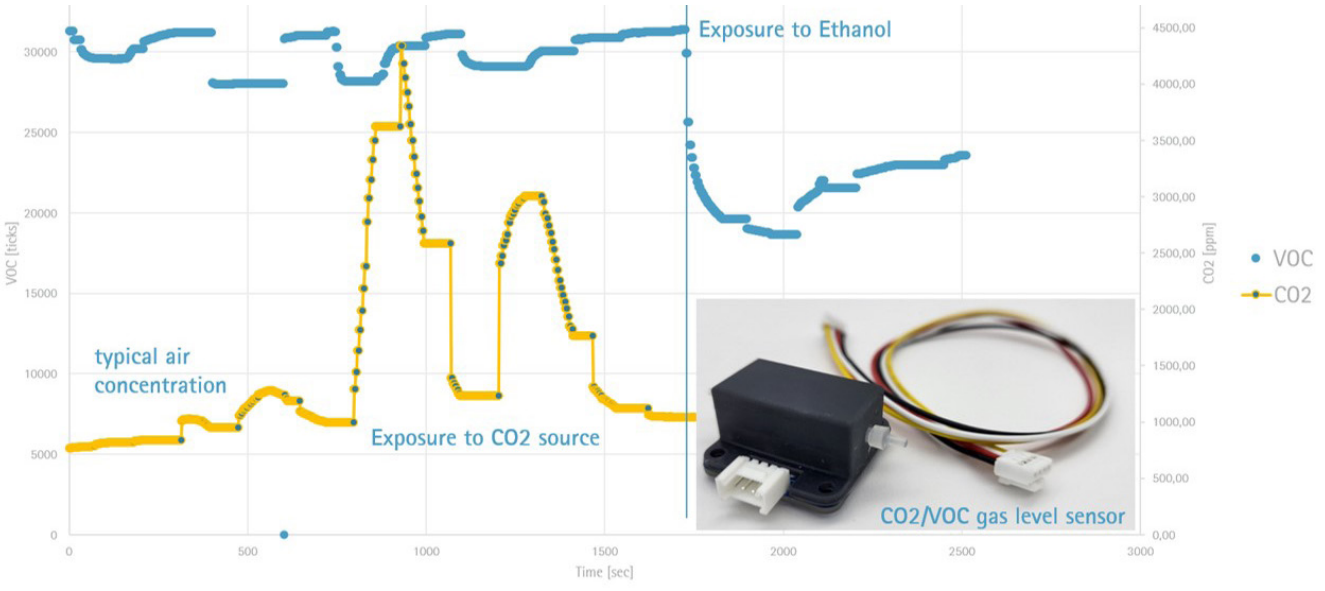
Micropumps are essential components of microfluidic systems. They enable precise control of the movement and distribution of liquids and gases within the microchannels and contribute thus to efficient sample preparation and analysis. The micropumps from Bartels Mikrotechnik are miniaturized double diaphragm pumps. Operated with two piezo actuators each, this space- and energy-saving design is very cost-effective and versatile due to the materials used. In particular, the variably adjustable flow rate is a factor that enables the wide-ranging applications of this micropump.

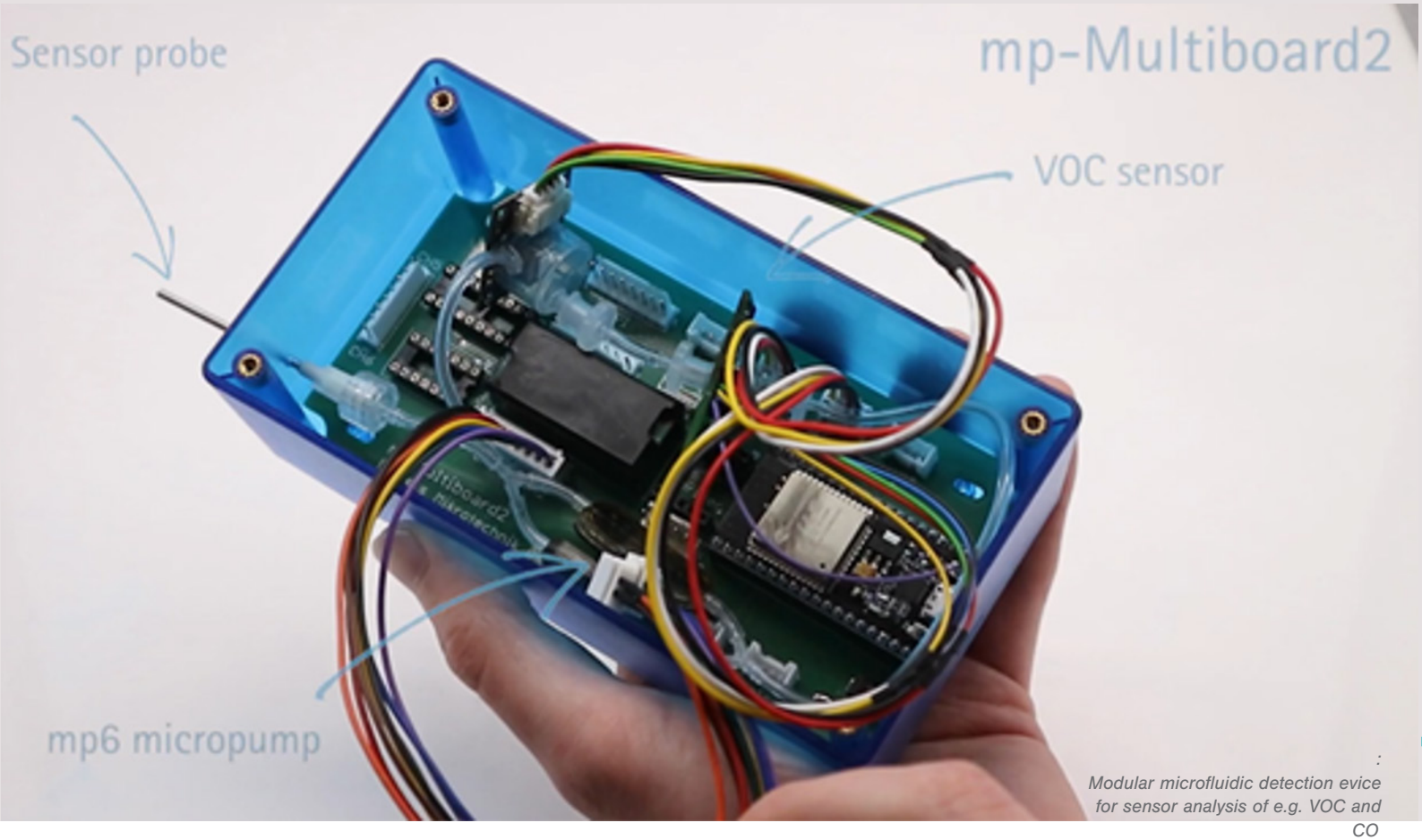
Gas analysis for VOC and CO_2. Utilizing active sensor feeding with our precision micropumps not only increases the accuracy of gas analysis but also provides a faster response time compared to passive methods.



Flow-controlled system increases the range of options at low flow rates (5 to 1000 µl/min) providing simple handling, digital regulation, and monitoring.

Its integration into microfluidic detection devices for gas and liquid analysis offers several advantages. The precise control of the flowrate of gases and liquids results in precise and repeatable measurements. This is particularly important for detecting low gas concentrations and performing complex analytical procedures. Due to the compact design of the micropumps, they can be easily integrated into microfluidic systems. This results in a reduction in the size and weight of the entire devices, making them ideal for portable and mobile applications. In addition, automated systems improve efficiency and usability. Nevertheless, by using very small volumes, microfluidic systems reduce the need for expensive reagents and sample materials. This reduces operating costs and minimizes waste. To prevent the weaknesses of the micropumps about independent suction and the filling process, Bartels has developed a Flow Controlled System for liquid flowrates between 5 to 1000µl/min, which is tailored to the requirements and needs of the life science market and its applications, such as the point-of-care diagnostics, next gen-sequencing or droplet generation. The dosing system resembles a monolithic structure, consisting of two micropumps BP7, a pulsation damper, a 2/2 valve, and the electronic control beside the flowsensor from Sensirion. Due to the low power consumption of 230mW, it is suitable for a battery application such as would be conceivable in an incubator. In addition, Bartels developed an adaptable device for gas and liquid analysis, maintaining the micropump, different sensors, and the controlling. For example, a CO_2 and VOC measurement is shown in the figure below. Also, it can be used for monitoring special chemical procedures such as contamination or for





Modular microfluidic detection evice for sensor analysis of e.g. VOC and CO

“Microfluidic detection devices are expected to play an increasingly important role in various industries, opening new opportunities for precise and efficient sensor analysis.”

controlling the target concentrations of gases or liquids. Due to the advantages described above, samples can be taken directly from a bioreactor and fed to the sensor. Therefore Bartels plans to integrate biochemical sensors to detect e.g. hemoglobin or lactate. The wide variety of sensor solutions available on the market together with the modular construction of our developed device opens an amazing number of possibilities for analysis, continuously growing by the availability of new kinds of sensors.
These microfluidic detection devices represent a significant technological advance and provide accurate, rapid, and cost-effective analysis that can be used in a variety of applications, from environmental monitoring to medical diagnostics to industrial process control. As research and development advances, they are expected to play an increasingly important role in various industries, opening new opportunities for precise and efficient sensor analysis.

Bartels Mikrotechnik GmbH, DE
https://bartels-mikrotechnik.de

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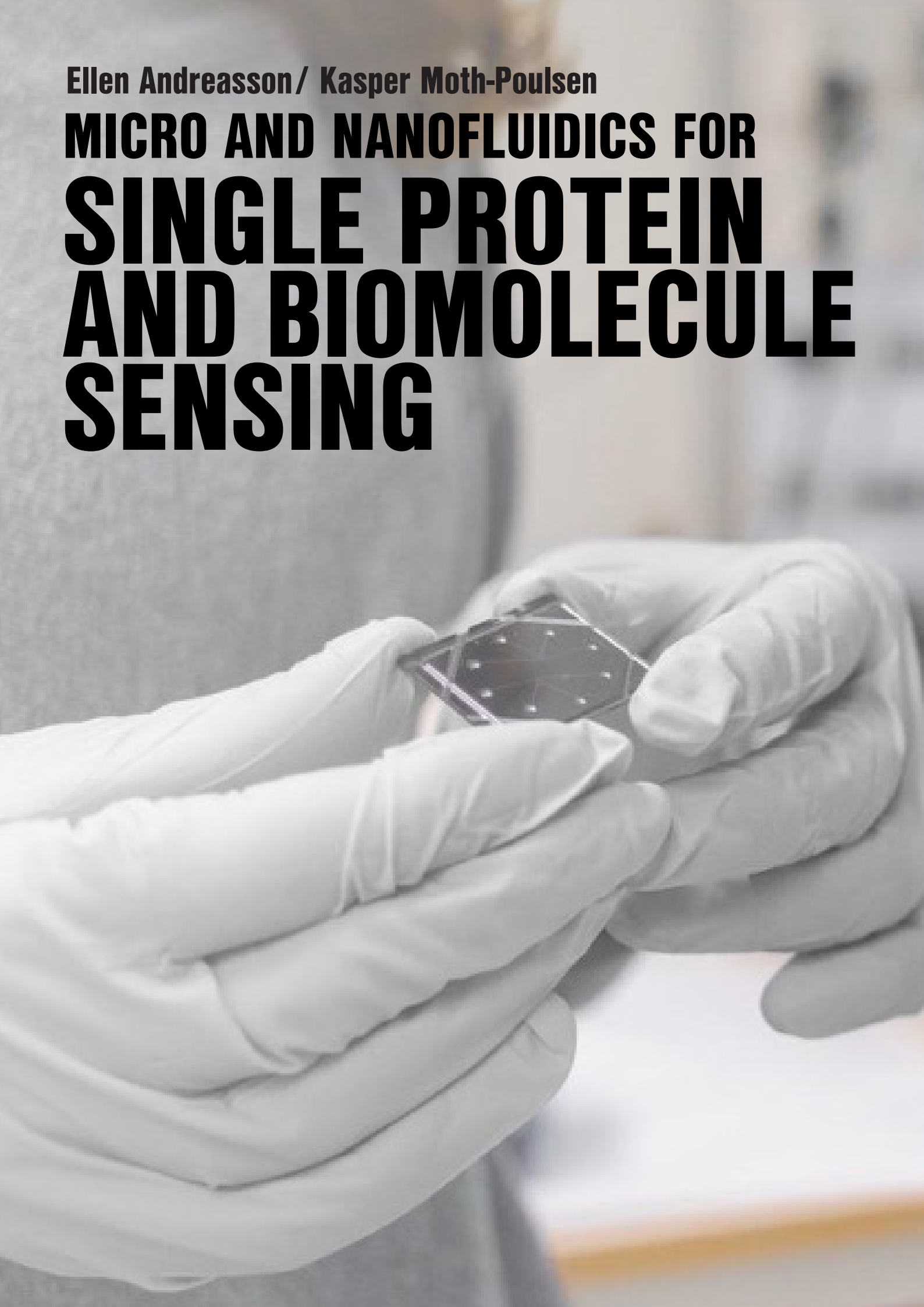
MICRO AND NANOFLUIDICS FOR SINGLE PROTEIN AND BIOMOLECULE SENSING

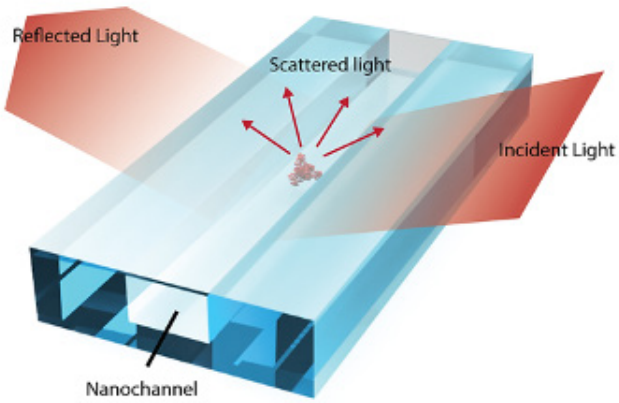


The function of cells, proteins, and enzymes has been known and studied for decades. From the food industry to pharma - proteins and their function are ubiquitous. Protein structure is important for the texture and taste of what we eat and drink, e.g., yogurt and cheese. The microscopic factories of cells - the enzymes are functional proteins and are applied in a broader range of industries such as Pharma, Chemicals production, Washing Detergents, Synthetic Biology, and more. When scientists and researchers study the function of enzymes, due to the microscopic size of proteins and other biomolecules, traditionally they have to resort to methods that study the systems on the macroscopic scale, involving ensemble measurements on thousands, millions, or even billions of items at the same time. The problem with this is that the individual biomolecules change shape and thereby function over time, and the exact effective structure and function of the individual molecule is lost when studying many.

Studies of Individual Cells in Microfluidic Systems

Bacterial cultures have been studied and used for thousands of years; the fermenting of cheese and the production of wine are examples of classical use. Sometimes, unwanted bacterial cultures may interfere with the systems that we are trying to create, and Escherichia Coli is one of the critical bacterial strands to study. ConScience AB in Sweden has through the last 12 years developed capabilities for high-precision microsystems that enable researchers to study the growth and dynamics of individual living cells located in channels with specific control of growth conditions and cell dynamics. These systems have been used by scientists from all around the world, employing the so-called "mother-machine" concept to gain deeper insight into how these bacterial systems work.

> **"From the food industry to pharma – proteins and their function are ubiquitous.**



Pushing the limits of nanofabrication to study single molecules

In recent years, ConScience has refined the limits of their fabrication methods so that the channels now have dimensions down to the order of magnitude of individual biomolecules (100 nm) several orders of magnitude smaller than the cells studied previously. This capability has allowed researchers to study larger DNA molecules through rapid imaging concepts.5 The original works involved complex impregnation of the biomolecules with synthetic fluorescent labels that facilitated imaging through conventional fluorescence microscopy.

To push the limits of biosensing even further, and to avoid the use of synthetic labels, the Gothenburg-based Envue Technologies AB, has developed a patented cutting-edge solution for bioanalysis within life science applications to quantitative characterize nanoparticles and biomolecules. Envue's patented core technology, Nanofluidic Scattering Microscopy (NSM), uses ConScience's fabricated nanofluidic devices as tiny optical sensors in combination with light illumination and advanced data analysis to measure single nanoobjects and biomolecules in solution. The NSM platform technology provides a label-free method that offers two quantitative key parameters – mass and size – in a single measurement. With a resolution down to approximately 50 kDa and 1.5 nm, and a mass resolution about ten times higher than alternative solutions, the company envisions potential for applications in early nanomedicine research, as well as in the development and manufacturing of next-generation drug delivery systems.

In collaboration with the University of Gothenburg and the Research Institutes of Sweden AB (RISE), ConScience and Envue Technologies, have secured a project with a total budget of 8 million SEK from the Swedish Innovation agency Vinnova. This project, titled "Nanofluidic Scattering Microscopy - Optical Biosensing System for Increased Efficacy in Drug Development", aims to accelerate and enhance the development of advanced nanofluidics and biosensing technologies.

ConScience AB

https://www.con-science.se
https://www.envue-technologies.com

Samuel Klein I Julia Emge I Dirk Koster

USING EDGE AI

CONTINUOUS MONITORING OF CRITICAL INFRASTRUCTURE

Many of our critical infrastructures are old and heavily used, including bridges, roads, and utility systems. The traditional approach of inspecting and maintaining these infrastructures via fixed maintenance intervals is often outdated. Predictive maintenance, which is based on the evaluation of raw data, can increase maintenance efficiency, as continuous monitoring enables a faster response to changes in structures. There is a significant discrepancy between the current state of technological knowledge and the actual technological equipment of such structures. The project presented here aims to close this gap by using modern measurement technology, edge AI processing, and autonomous data evaluation. This should offer significant benefit to inspectors and operators by providing them with additional information and resources to save labor and costs while increasing safety. waste streams.

Sensor data fusion for predictive maintenance

In the collaborative project “ImaB-Edge”, Fraunhofer IZFP, along with infrastructure construction

companies, research partners and infrastructure operators are developing a modular, configurable electronic system designed to facilitate the on-site assessment of engineering structures.
Our efforts in infrastructure monitoring and data security leverage edge AI concepts to conduct data processing proximal to the data source. This offline edge computing, executed directly at the site, obviates the need to transmit raw data over the internet, thereby safeguarding sensitive information against various attack vectors. The decentralized fusion of sensor data integrates multiple data sources to deliver a comprehensive load measurement directly at the monitored structure.

A series of highly sensitive vibration sensors continuously monitor road vibrations. This data is integrated into a local database alongside other sensor values, such as asphalt temperature, environmental data, and camera images. Using advanced AI processes, a load measure per vehicle is determined. This information is stored in the database and made available to the operator. The concept demonstrated here aims to provide maintenance-relevant information about the structural condition in the future. By integrating multimodal inspection methods into a single inspection system in conjunction with the BIM model, a unique evaluation basis is created, enabling inspectors and operators to identify necessary actions more quickly, by providing highly localized information about load and building state.
A living laboratory at Fraunhofer IZFP in Saarbrücken is utilized to evaluate and advance the technology to transfer the system and the acquired knowledge to both new and existing infrastructure frameworks.

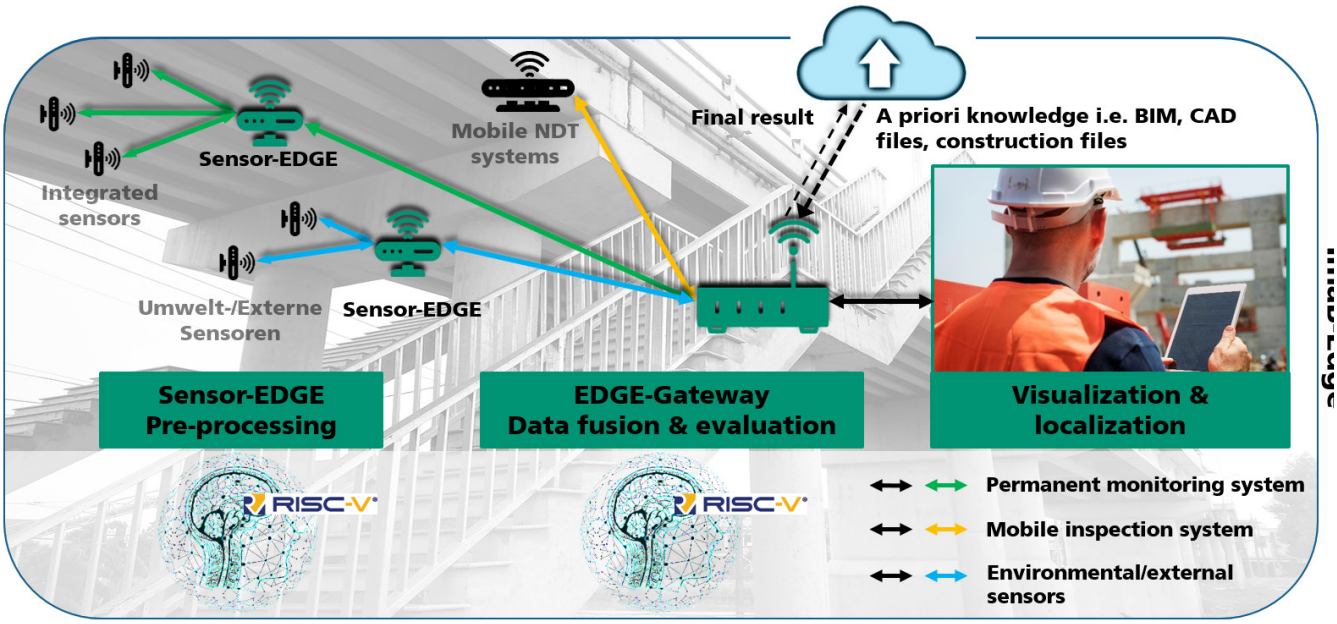
Enhancing Infrastructure Safety

Operators can achieve long-term cost savings through early fault detection and the implementation of preventive maintenance measures. Users benefit from increased infrastructure safety, as the likelihood of catastrophic failures is mitigated. Furthermore, this technology can serve as a paradigm for other domains where continuous monitoring is essential. Lastly, the deployment of such technologies fosters innovation and competitiveness by enhancing system reliability and efficiency. Additionally, the development of a modular system adaptable to various testing scenarios allows for flexible and application-specific use. With very few constraints on performance or sensor technology, versatile and scalable deployment is ensured.

> **“Operators can achieve long-term cost savings through early fault detection”**

Fraunhofer Institute for Non-Destructive Testing IZFP, Saabrücken, Germany

https://www.izfp.fraunhofer.de



Stefanie Loracher

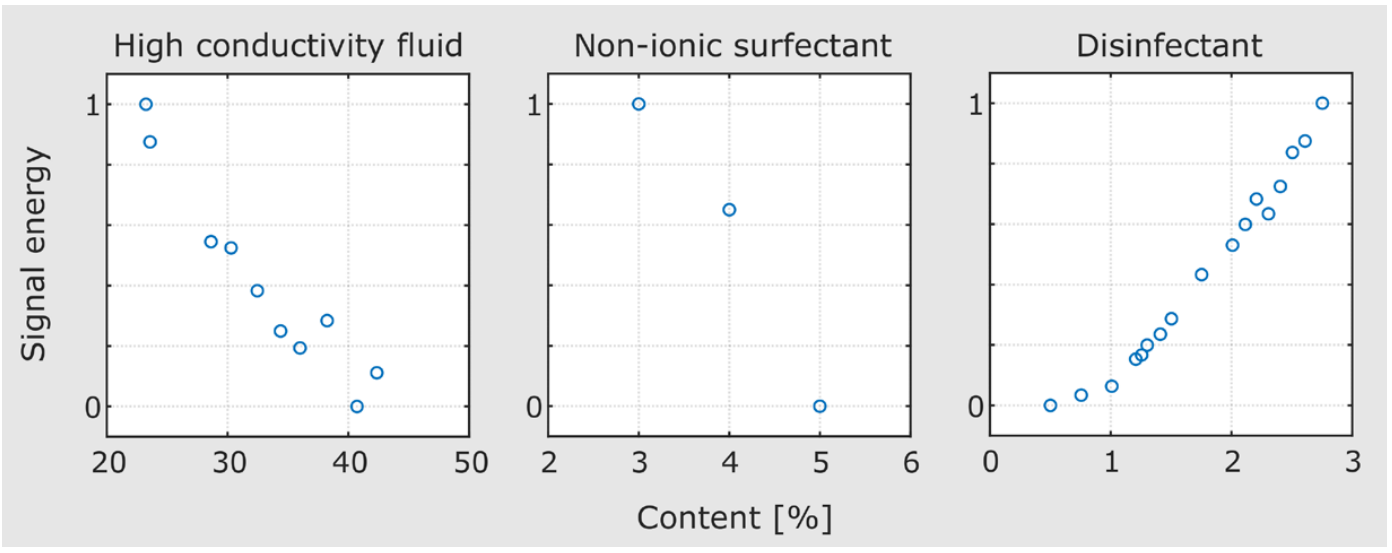
IN-LINE SPECTRAL ANALYSIS OF CHALLENGING PRODUCTION LIQUIDS

> **“Ressource management, process flow and the availability of information about the liquids in operation at all stages of the process can be improved.”**

Industry 4.0 promotes digital eco-systems and autonomous decision-making for strengthened production operation, improved sustainability, and early error detection. To train and continuously update the machine learning algorithms necessary for this, large amounts of process parameters are needed. A solution for efficient data collection is therefore essential.

The measurement device “m:explore.eis” uses a patented impedance spectroscopy which collects data over a hyper wideband spectrum. The unmatched width of the measured spectrum is accompanied by a greater amount of quantifiable process information. This closes the gap found in conventional resonant measuring devices. The m:explore.eis can be easily incorporated in the process line and enables automated information gathering and real-time data evaluation. Subsequently, resource management, process flow, and the availability of information about the liquids in operation at all stages of the process can be improved.

Industrial liquid analysis can happen either in the laboratory or in the processes. However, lengthy measurements, complex sample handling or space limitations can make lab technology unsuitable for the production space. On the other hand, conservative in-line production sensors may not be able to sufficiently represent the complex dependencies of a process to the customer’s satisfaction.
The hyper wideband spectral measurement of the m:explore.eis addresses this gap with real-time and in-line liquid analysis to detect concentrations, contaminations, or compositions. The technology has been successfully demonstrated even for challenging liquids, such as non-ionic surfactants or saline liquids of very high conductivity.



Challenging liquids across the industries

The information required for the process optimization of those liquids could not be provided by conventional in-line sensors:

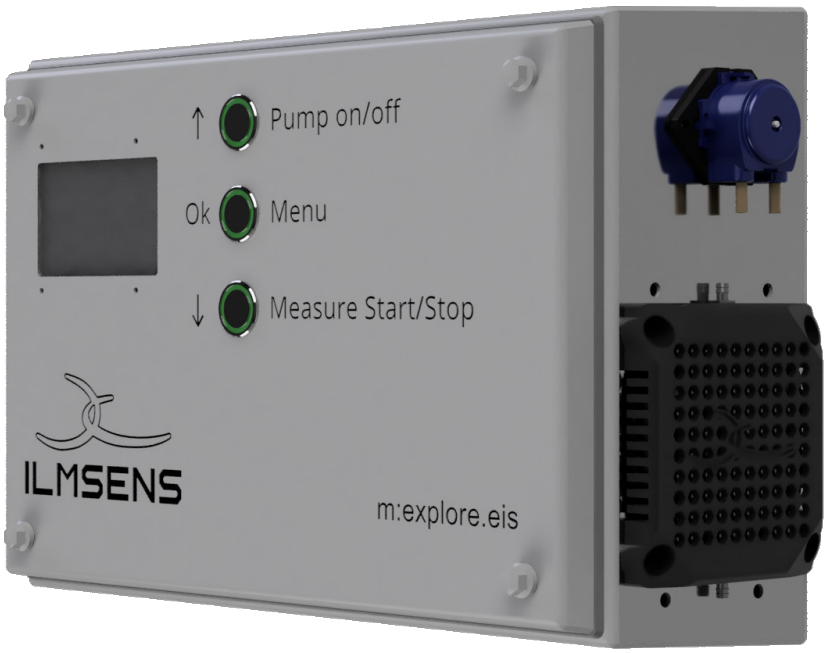
- Non-ionic surfactants in industrial cleaning could not be measured with sufficient accuracy by either conductivity probes or bubble pressure tensiometry.
- The concentration of a disinfectant must be precisely determined using time-consuming and time-delayed titration.
- Liquids with a high salt content have a particularly high conductivity, which exceeds the measuring range of conventional conductivity probes.

These are examples of process liquids that have benefited from spectral measurements. However, many liquids present in other industries have not been investigated yet, which could benefit from the information gained through broadband spectroscopy as well, e.g. pharmaceutical, construction material, or chemical industry.

Liquid processes may concern not only the monitoring of mixing (liquid-in-liquid or solids-in-liquid) or condition monitoring but also incoming supply control or outgoing product documentation. Due to the many possible applications, a versatile solution for efficient data collection is essential.

Gain access to hidden process information with wideband measurements

The m:explore.eis is a standalone hyper wideband impedance spectroscopy device designed for straightforward handling and inclusion at different points of the production line. In order to facilitate these various application scenarios, the device is built to be attached to the process and transfer liquid into its measurement chamber with a built-in pump.



The chamber contains coaxial probes which emit a hyper wideband measurement signal (0.8 kHz - 1.2 MHz, 3 MHz - 3 GHz). The amount of the transmitted and reflected signal gives insight into the material properties of the substance. Just as a fingerprint can be assigned to a specific human being, a certain substance component can also be assigned to an impedance spectrum. Two substances might be similar in a limited frequency range, but the wider the measured frequency range, the more likely it is to find differences in a specific frequency range.

A wideband measurement directly records the frequency-dependent impedances and allows the indirect determination of other deducible physical quantities, such as the composition of a multi-component substance. Thus, a single wideband measurement corresponds to several parallel, narrowband resonator measurements at different single frequencies. The simultaneous measurement of thousands of frequencies instead of sequential measurements reduces the measurement time considerably and enables the investigation of changing scenarios, inhomogeneous materials or samples with high flow velocity.

Aside from composition detection, variation from normal behavior can be detected to alert the user. With a sufficiently large database, changes in the process can be predicted and even prescriptions for a process are possible. Such information, e.g. the necessity to re-dose a substance in a specified time, can either be shown to the user or used for quality control of incoming supplies or documentation of outbound wares.

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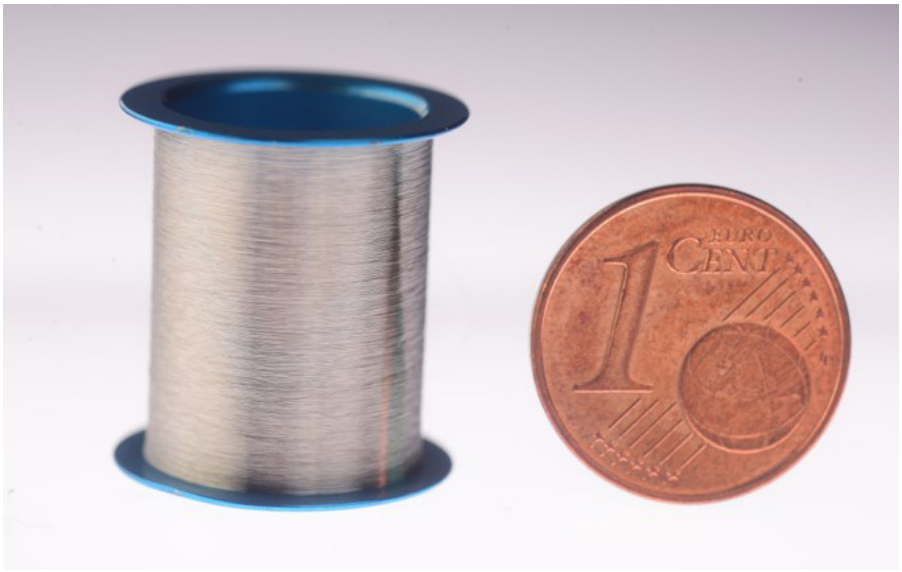
Dominic Thauer

INNOVATION IN SENSORS

FUNCTIONAL FINE WIRES

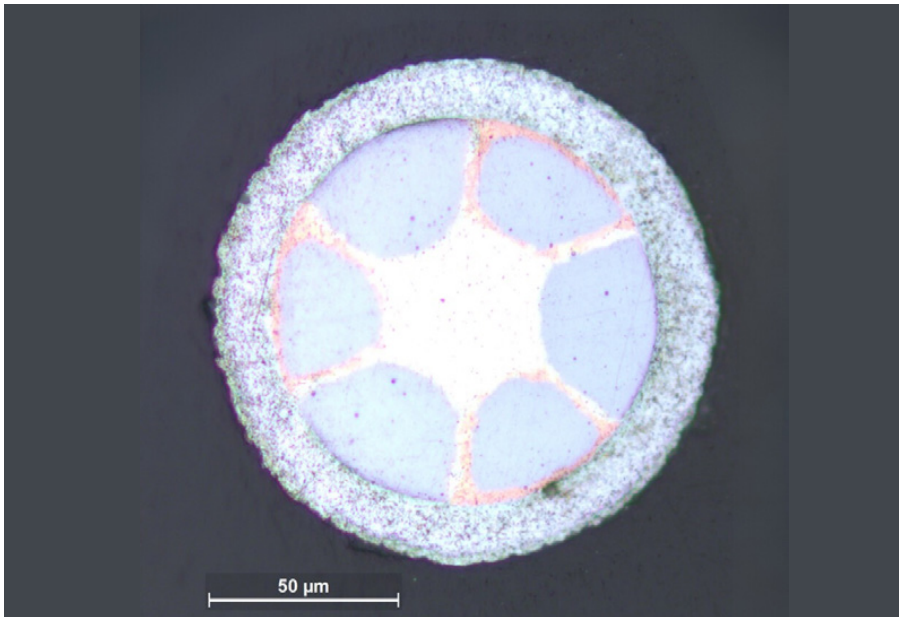
In the field of sensor technology, innovation is often based on special materials and components that make up complex devices. Functional fine wires - ultra-thin, specialized wires, designed with precise electrical, thermal, or mechanical properties - have emerged as innovative-driven solutions for next-generation sensors. These kinds of fine wires, often measured in micrometers with diameters of just one-tenth of a human hair, are pushing the boundaries of existing sensors, by improving sensitivity, miniaturization, and functionality, across a wide range of applications. This article explores the role of functional fine wires in modern sensor technology and their potential to revolutionize various industries.

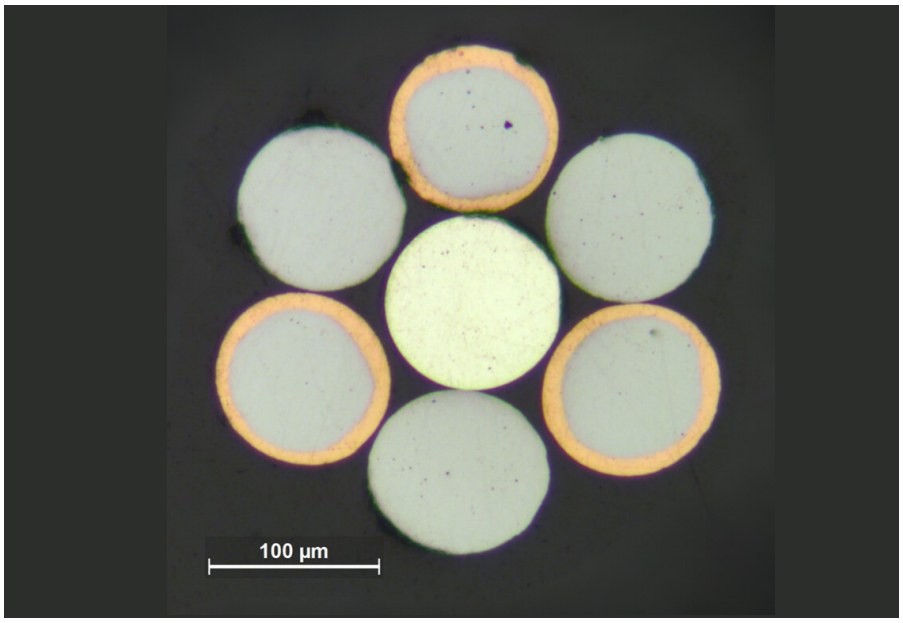


The role of functional fine wires in „sensor technology“

Functional fine wires are more than just simple „conductive threads“, they are carefully engineered components, that interact with other materials and their environment to achieve specific sensor capabilities. These wires are often made of materials like platinum, gold, nickel, copper, or their alloys and can be additionally coated with polymers, ceramics, or other metals to enhance their properties.

One of the key advantages of using functional fine wires in sensors is their ability to improve sensitivity. For instance, in resistive sensors fine wires can be designed to exhibit changes in electrical resistance when subjected to external stimuli such as temperature, pressure, or chemical exposure. The smaller diameter of these wires





increases their surface area relative to their volume, allowing for more significant interactions with the surrounding environment and thereby enhancing the sensor's ability to detect the smallest changes or variations.
Furthermore, functional fine wires support the miniaturization of sensors and individual designs or even flexible shapes and geometries. As industries demand smaller, more efficient devices, these wires are an integral part of reducing the size of sensors without compromising performance.

Applications and prospects

The impact of functional fine wires extends across multiple industries, while each area benefits from high variety of materials combined with smallest dimensions and individual designs.
In the automotive sector, fine wires are used in advanced driver assistance systems (ADAS) and autonomous vehicles. Therefore, sensors must be highly reliable, responsive, and capable of operating in harsh environments.

Special wires, with their tailored properties, ensure that sensors can maintain accuracy and performance under varying conditions, contributing safety and efficiency of modern vehicles. In consumer electronics, they are key components in the development of wearables and smart devices that require compact, yet highly sensitive, detecting elements.

In medical devices functional fine wires are used as microelectrodes, where they are part of revolutionizing diagnostics and patient monitoring systems. Their use in implantable devices, such as glucose monitors or cardiac pacemakers clarifies their importance in developing next-generation medical technologies that are both - effective and minimally invasive.
Looking ahead, the continued development of functional fine wires will unlock new possibilities in sensor technology. As research progresses, we may see the development of multi-functional fine wires that combine electrical conductivity with other attributes such as biocompatibility or self-healing properties. These innovations could lead to sensors that are not only more powerful but also more durable and adaptable to various environments.

Significant innovation in sensor technology

Functional fine wires represent a significant innovation in sensor technology, offering enhanced sensitivity, miniaturization, and versatility. Their wide range of applications across different industries, from automotive to healthcare, highlights their transformative potential. As these wires continue to evolve, driven by materials science and new manufacturing technologies, they are set to play an increasingly vital role in the future of sensors, enabling the development of devices that are more efficient, reliable, and functional than ever before.

The journey of functional fine wires has just begun and its impact on sensor technology will be profound and far-reaching.

ELSCHUKOM gmbh, Veilsdorf. DE
https://elschukom.com

Fabian Dietrich I Aditya Suryadi Tan I Hans-Georg Pietscher I Katia Ivanova I Mirosław Woszczyna I Ivo W. Rangelow

ACTIVE CANTILEVER: FROM BIRTH TO ITS FORTHCOMING PROSPECTS

Conventional scanning probe microscopy (SPM) systems incorporate the optical beam detection (OBD) method, which requires optical components, their alignment, and access for alignment. Such optical components take up a large portion of the instrument's physical size. Due to the optical read-out, the dimensional downscaling of conventional scanning probes reaches its limits. Moreover, the shortcomings of optical detection, associated with diffraction and reduced sensitivity, necessitate the development of novel measurement methods to quantify probe-sample interactions.

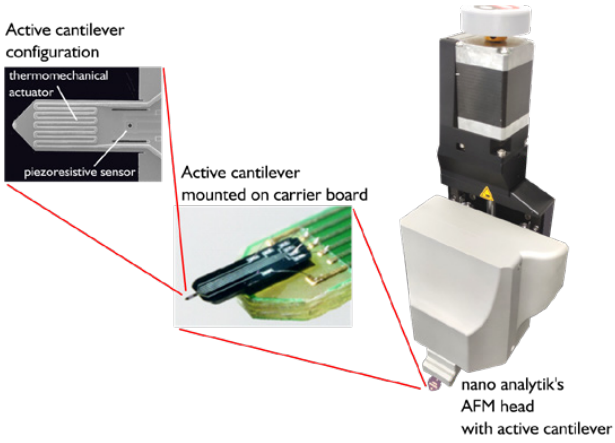


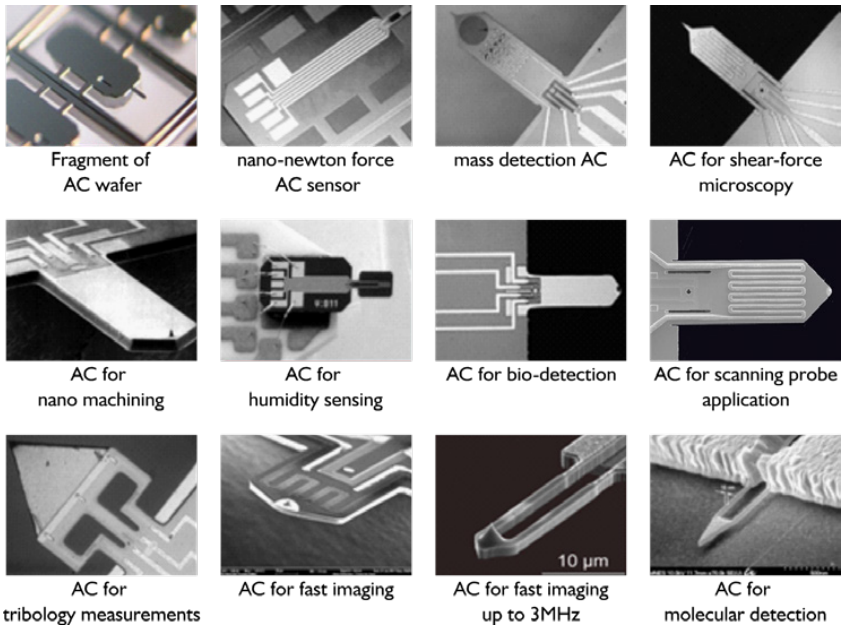
Fig. 1. The SPM-System using the active cantilever technology, where no OBD is required, and detailed pictures of the active cantilever.

In 2010 nano analytik GmbH in Ilmenau gave birth to the active cantilever technology, a cantilever with embedded sensors and actuators. This technology results in an on-chip cantilever technology platform that combines high measurement bandwidth and very low displacement noise floor with compactness, robustness, small size, and potential for low-cost batch fabrication inherent in micro-electro-mechanical- systems (MEMS). SPMs with active cantilevers require no more OBD (Fig. 1) and offer new capabilities and simplified user operation compared to conventional passive cantilevers SPMs. Because of that, SPM with active cantilevers finds applications beyond imaging, such as in single-ion implantation or gas molecule sensing. This technology has been mature enough to offer sensing resolution and noise performance comparable to the conventional OBD sensor and offers many additional advantages.

Active cantilever

The active cantilever technology integrates both read-out and actuation capability, whose configuration is displayed in Fig. 1. The actuation of the active cantilever is done thermomechanically via an integrated bimorph structure at the cantilever. When subjected to a change in temperature, the cantilever begins to deflect with the deflection proportional to the temperature change. The cantilever deflection is then sensed via a piezoresistivity-based sensor, which is also integrated into the cantilever beam. It usually uses thin p-doped resistors positioned at high-stress locations lengthwise on the bending beam. Due to the piezoresistive effect, the induced mechanical stress within the resistors leads to changes in their specific resistance. These changes are converted

Fig. 2. Various types of active cantilevers (AC) for different types of applications.



into an electrical voltage signal by biasing a fixed current, whose stress sensitivity depends linearly on the operating current. In this way, the self-actuating and the self-sensing features are integrated into the cantilever.
Fig. 2 depicts the different types and forms of active cantilevers. Since the active cantilever can be operated without any OBD, its mechanical form can easily be varied and adapted based on the application requirement. This is one of the strong virtues of the active cantilever technology.
Regarding the technological development of SPM systems, the cantilever evolved from a simple passive deflection element to a complex microelectromechanical system by integrating functional groups, such as piezoresistive detection sensors and thermomechanical actuators. By doing so, the active cantilever technology has the potential to overcome optical read-out limitations.

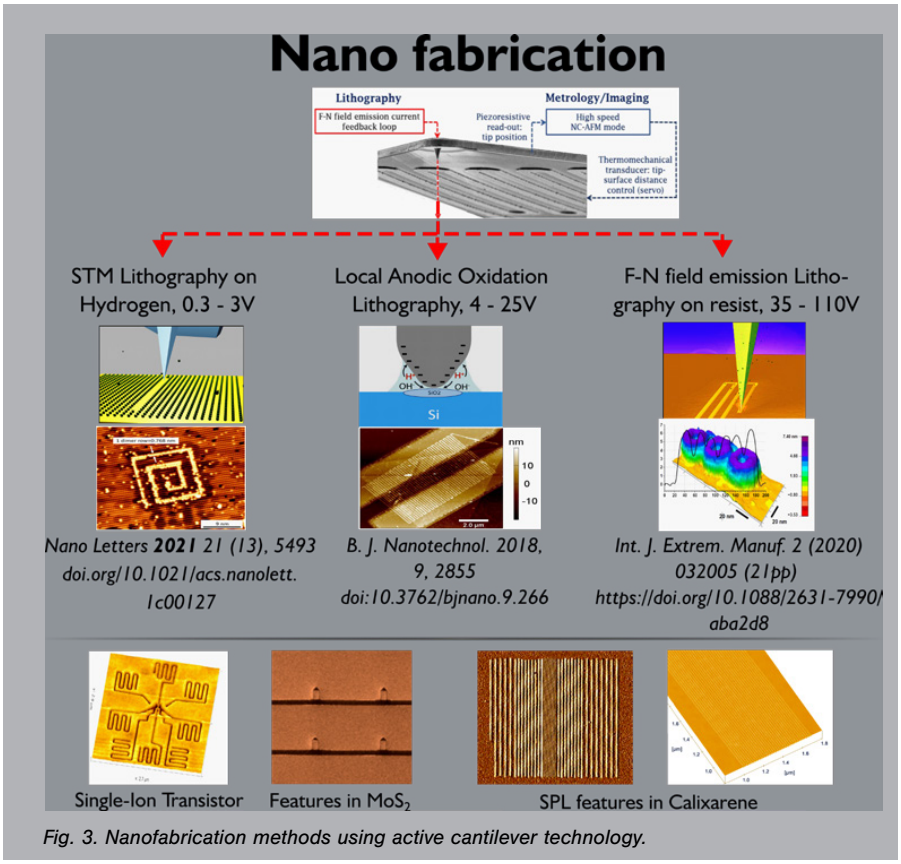


Fig. 3. Nanofabrication methods using active cantilever technology.

Nanofabrication Methods

The SPM with active cantilever can be used not only for imaging but also for nanofabrication methods like field-emission scanning probe lithography, tip-based electron beam-induced deposition, or nanomachining and provides a new tool for correlative nanofabrication and microscopy (Fig. 3).

Application and the future of active cantilever technology

The integration of the active cantilevers into SPM systems makes traceable dimensional measurements with sub-nanometer resolution possible. It also makes SPM systems more compact, easier to operate and automate, and offers straightforward integration into industrial systems.

The progress of active cantilever development has resulted in a significant downscaling of the cantilever system. Further development is to extend the self-sensing and self-actuating probe capabilities to achieve the requirements of high-speed imaging. The active cantilevers require higher resonance frequency, higher bandwidth, and lower spring constant. In other words, we aimed to fabricate softer and smaller probes with a bigger resonance frequency to spring constant. This allows bigger imaging dynamics and reduced probe-sample interaction forces while maintaining a high sensitivity. Last but not least, the simplicity of the cantilever structures opens the possibility of operating multiple cantilevers at once by mounting them parallel to each other. This will manifold the scanning field and therefore the scanning speed. For more information, please feel free to contact nano analytik GmbH, Ilmenau, the birthplace of the active cantilever technology.

nano analytik GmbH Ilmenau, DE
https://www.nanoanalytik.net

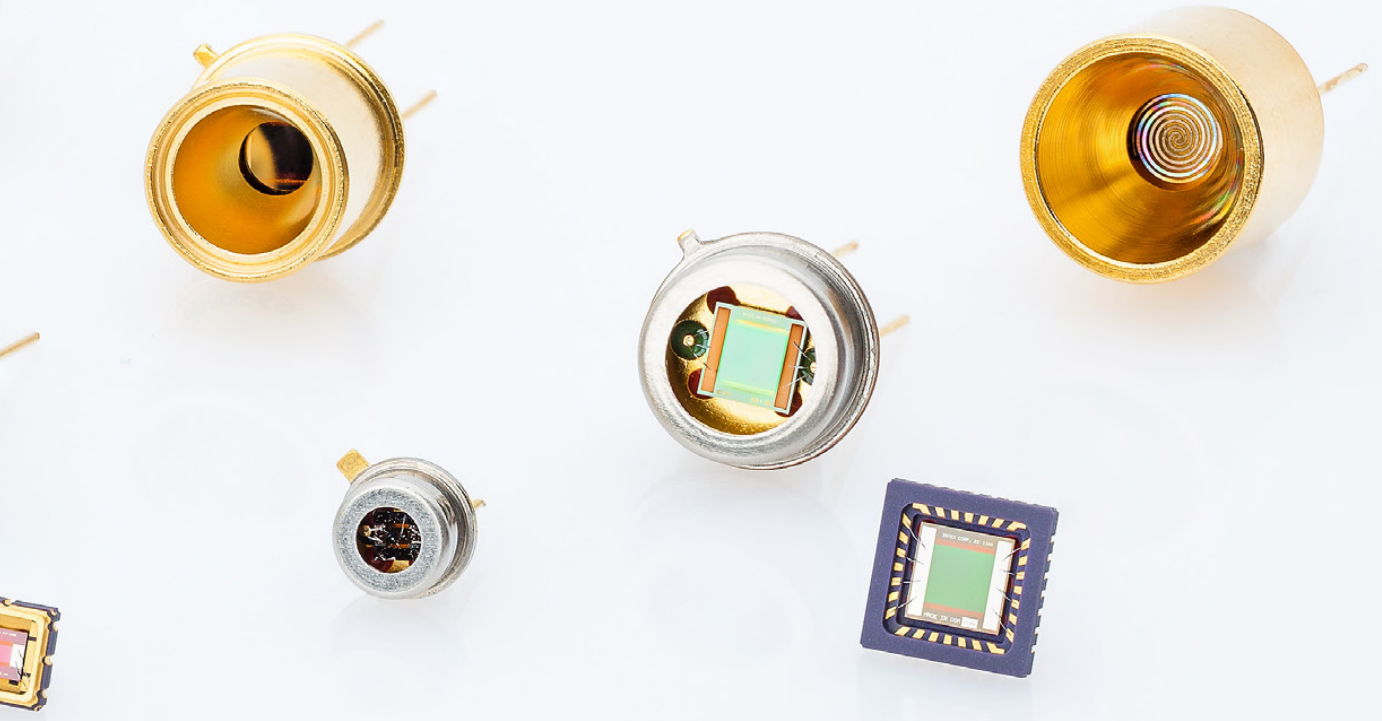
Steffen Biermann I Dr. Julius Komma I Annett Isserstedt-Trinke

IR-COMPONENTS FOR NDIR-GAS ANALYSIS & EVALUATION

Micro-Hybrid Electronic GmbH is one of the founding members of the Sensor Network „DETECT“

The product portfolio ranges from ceramic substrates and housings for miniaturized electronic modules for sensor control to infrared (IR) components and sensors for contactless temperature measurement and gas analysis as well as inertial measurement applications. We develop high-quality and accurate NDIR gas sensor modules for measuring different gas concentrations in industry, medicine, environment and labor technic. Nondispersive infrared (NDIR) gas analysis can be used to measure different concentrations of known gases in gas mixtures. These are recorded and analyzed in a gas-measuring cell, which consists of an IR radiation source, a sample cell, and an IR detector. Micro-Hybrid is a single source supplier of all needed IR components.

> IR components – different packaging versions – SMD, TO (transistor outline), reflector, open and hermetically sealed



IR-COMPONENTS

Micro-Hybrid provides a wide range of MEMS-based radiation sources for IR light. Silicon as the base material acts as a carrier element for an active heating membrane. The thermodynamic and -mechanical properties of the layer stack have been optimized for low time constants and high mechanical stress stability. This enables a modulated operation without an additional mechanical chopper. The up to 750 °C high-temperature stable active metal system is optimized in its long-term properties for resistance and migration via specific process treatments, and a resistance change of less than 5 % can be expected over the 10-year operating period in the field. A novel Nano-amorphous-carbon (NAC)-emitter with optimized performance in terms of optical power output at longer wavelengths between 7-12 µm was developed and maintained a robust and long-term stable design. The extended spectrum improves measurements of gases with absorption maxima at those wavelengths, for example, anesthesia gases, ammonia, alcohol and sulfur hexafluoride. Additionally this modification reduces the emission between 4-5 µm to obtain a more homogenous

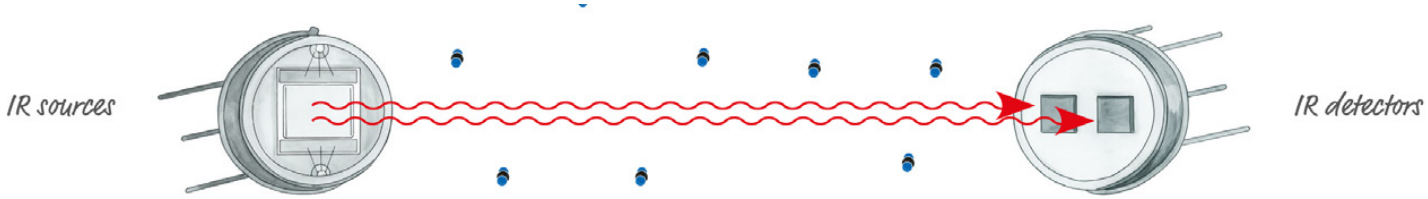
Micro-Hybrid Evaluation Kit "eNDIRi²" for IR components

optical power output over the whole IR spectrum which reduces the required electrical input power. This is beneficial for handheld applications.

"Nondispersive infrared gas analysis can be used to measure different concentrations of known gases in gas mixtures.."

For the detection of IR radiation commonly two types of thermoelectric detectors are used, thermopiles and pyroelectric detectors. The basis of thermopile detectors is formed by the so-called thermocouples. A material combination of bismuth and antimony, which enables very high sensitivity and an optimal signal-to-noise ratio even at very high temperatures up to 180°C. Thermal diffusion currents of two different metals (Seebeck effect) generate an electrical voltage which is transmitted and processed as a measurement signal. The sensitivity of the detector significantly influences the quality of the measurement result. Thermopiles are a good choice for achieving higher sensitivities in less time-critical applications.

Pyroelectric detectors are much faster in their measurement response. They are based on the pyroelectric effect, in which the polarization in certain materials such as lead zirconate titanate (PZT) varies with temperature changes. This change leads to a measurable charge shift, which can be read as an electrical signal. Pyroelectric sensors require pulsed IR radiation, which can achieved by direct modulation of the IR source.
The patented hermetic packaging technology makes it possible to optimize the opto-electrical performance of the IR components by backfilling inert gases with specific physical properties into the housing. High-purity backfill gases also enable operation at low ambient temperatures down to -40°C. The power consumption of the emitter can be significantly reduced by using a gas with low thermal conductivity. On the other hand, the sensitivity of the thermopiles can be increased by using a low thermally conductive gas.

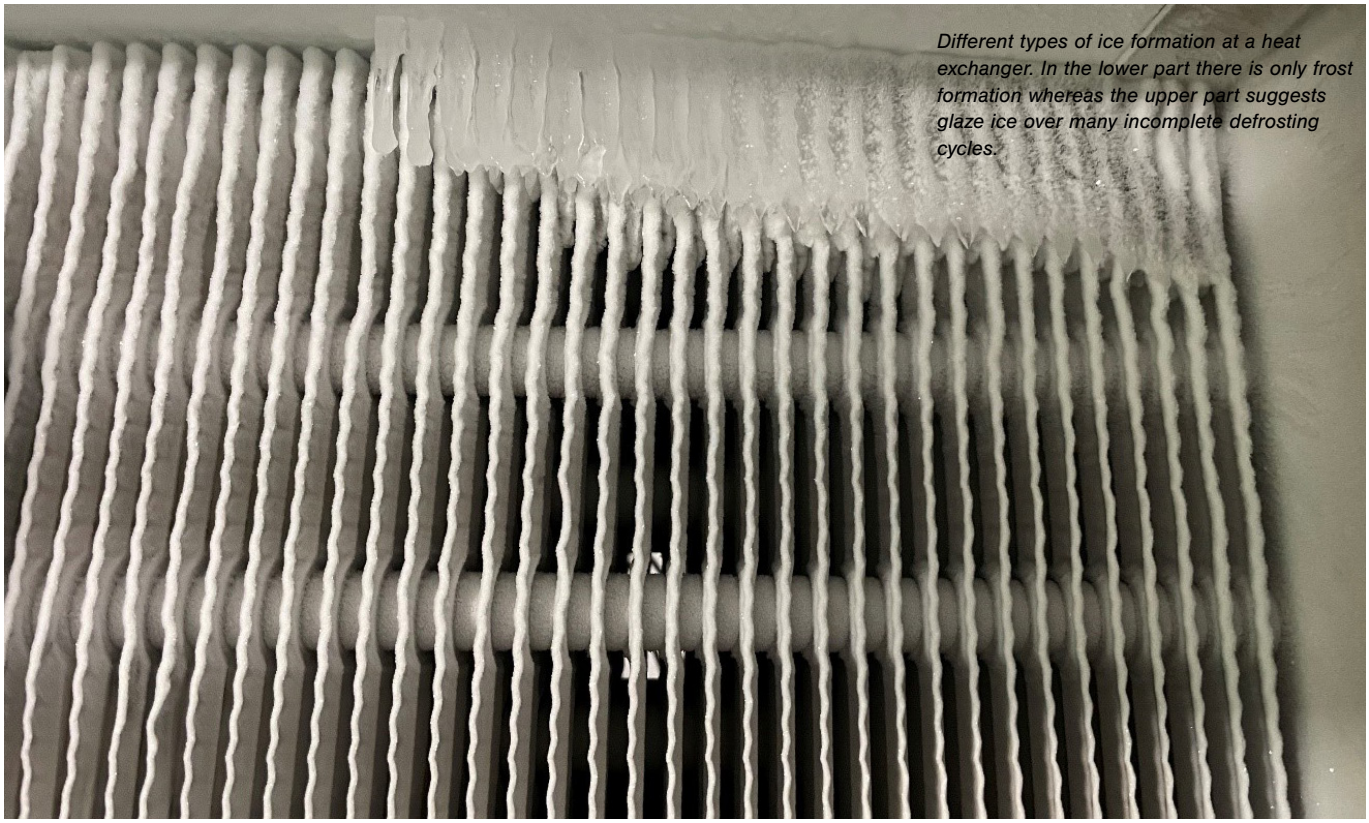


System sketch NDIR gas measuring cell, using a two channel detector including reference channel

NDIR GAS ANALYSIS

The evaluation kit "eNDIRi²" enables quick access to NDIR gas analysis and can be used to evaluate thermopile or pyroelectric detectors together with IR emitters in the customer's application. The components can be optimally matched to each other in terms of time behavior, radiation intensity, and sensitivity for cycle frequencies between 1-100 Hz for specific applications. The IR source in the gas sensors is operated periodically, adapted to the specific detector elements used, to avoid interfering offset voltages when using thermopile detectors and to display the signal functionality with pyroelectric detectors. The IR detector unit consists of a multi-channel system. One channel is used for a reference measurement to filter out influencing factors from the signal during processing, such as aging phenomena of the optical surfaces etc. The second channel is set to the wavelength of the gas to be analyzed, e.g. CO_2. An optical IR filter with a center wavelength of 4260 nm is typically used to determine the absorption of the CO_2 gas concentration. For doing some first test measurements eNDIRi² includes software for evaluating and exporting these data.

Micro-Hybrid Electronic GmbH
www.microhybrid.com



Different types of ice formation at a heat exchanger. In the lower part there is only frost formation whereas the upper part suggests glaze ice over many incomplete defrosting cycles.

ICE SENSOR

WORLD'S FIRST DIRECT DETECTION OF ICE FOR FOOD & PHARMA INDUSTRY

Do you remember when you last time scratched away the ice from the freezer compartment of your fridge at home? Cooling rooms in the food and pharma sector are essentially facing a similar challenge, only that their logistics centers are more than 100.000 larger than your freezer. The method of removing the ice at the heat exchangers of these large cooling rooms is called "defrosting" and is typically performed three times a day. To automate and optimize the defrosting strategy, Coldsense developed an ice sensor that can measure ice thickness and phase state (solid/liquid water).

Sensor principles

Frost formation and ice accretion on heat exchanges have been a challenge since the early beginnings of refrigeration technology. It is frequently caused by the condensing air humidity that settles at the surface of the cold heat exchangers and finally freezes. It is estimated by the Machinery and Equipment Manufacturers Association (VDMA) that around 5% of the 123 million refrigeration systems already in operation are affected by icing.

Temperature sensors were state-of-the-art for many years to indirectly estimate ice accretion on the heat

"Together with modern AI algorithms, the sensors allow to optimize the defrost strategy of warehouses,"

exchanges. This is because the growing ice thermally insulates the lamellas of the heat exchanger and thus reduces its capability to cool down the surrounding air. However, there are two major shortcomings with this principle. First, the correct placement of the temperature sensor is crucial to the success of the measurement. And second, the sensor's inability to distinguish between ice accumulation and warm air arriving from open warehouse doors yields a large measurement uncertainty.

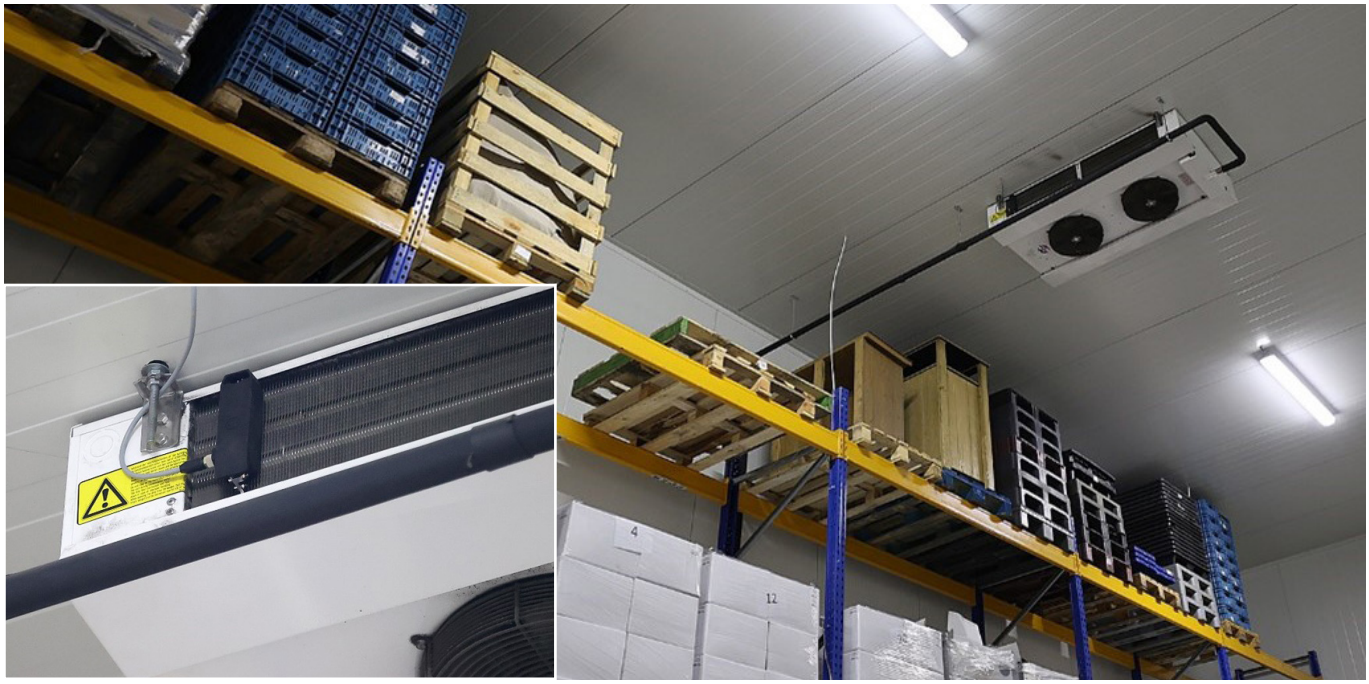
Coldsense has developed an industrial ice sensor that combines several measurement principles foraccurate measurement of ice on heat exchanges. Many principles have been analyzed in the past, e.g., ultrasonic waves, visible and infrared imagery and Bragg-scattering. Ice, however, is a very complicated material. Because it exists close to its melting point, many physical mechanisms can influence its properties. Even by eye observation, we can distinguish between glaze and rime ice. This renders it nearly impossible for only one measurement principle to detect all the appearing ice forms. In the end, a combination of analyzing the electromagnetic field, temperature and heat-flux gave high success rates for ice detection, while at the same time providing cost-effectiveness and industrial robustness.

From lab to field

First tests were performed under controlled conditions inside an icing wind tunnel, which allows for adjusting different air flow rates, temperatures, and icing scenarios. Thereafter the first adaptation to industrial heat exchangers took place. Challenges were the mechanical interfacing and particularly the choice of materials. Finally, field tests in selected cold-store warehouses took place, which contributed to the maturation of electromagnetic compatibility and industrial standardization.
After more than three years in service, our ice sensors have contributed to increasing the energy efficiency of up to 20% in cold-store warehouses of food, beverage and pharma producers and distributors, logistics companies, large canteens and cafeterias.
Together with modern AI algorithms, the sensors allow to optimize the defrost strategy of these warehouses, so that heat exchanges and refrigeration systems can work efficiently and reliably.

Coldsense Technologies GmbH
https://www.cold-sense.com/

Coldsense Ice Sensor



Inside a logistics center. The heat exchanger is mounted at the ceiling. The Coldsense ice sensor is visible in the zoomed image.

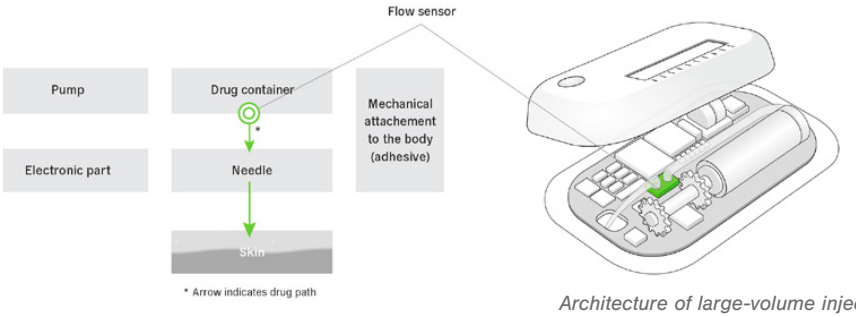
SUBCUTANEOUS DRUG DELIVERY

In recent years, the healthcare industry has seen a significant transformation, increasingly favoring outpatient and home-based care. This shift has been mirrored in the realm of drug administration, with a decrease in hospital stays for certain treatments. The transition from intravenous to subcutaneous injections has been a key facilitator of this change.

The main driver of this shift is cost reduction in hospital settings. Intravenous injections need skilled medical staff and sometimes expensive devices like infusion pumps. In contrast, subcutaneous drug delivery is more cost-effective, allowing patients to self-administer at home with training on devices such as pens or large-volume injectors. This saves healthcare workers' time and reduces hospital costs, potentially cutting expenses by 30 to 50% compared to intravenous infusion, excluding medication costs.

> **"In contrast to intravenous injections, subcutaneous drug delivery is more cost-effective, allowing patients to self-administer at home with training on devices.**

Additionally, subcutaneous drug administration lets patients continue their work and leisure activities, as it is discreet and minimally disruptive. Administering medication at home also lowers the risk of hospital-acquired infections, and avoids complications associated with intravenous catheters. Regulatory support for



Architecture of large-volume injectors

this approach is increasing, with payers demanding proof that expensive treatments are administered as prescribed.

Pharmacologically, subcutaneous delivery is preferred for drugs unstable in the stomach's acidic environment. Innovative formulations allow for the subcutaneous administration of larger molecules and higher concentrations directly into the bloodstream, ensuring medication stability.

Malfunctions of large-volume injectors

The range of therapies using large-volume injectors is extensive, including pain management medications, antibiotics, insulin, and biological treatments in oncology, immunology, and neurology. Accurate dosing is crucial to ensure efficacy and safety, especially with pain medications, where stringent dosing guidelines are necessary to prevent addiction. However, pumps may sometimes fail to administer the correct dosage. For instance, a complete or partial blockage can cause the pump to increase pressure without delivering the proper flow of medication.

Enhancing large-volume injectors with flow-sensing

Incorporating a flow sensor into the device enables monitoring and potential control of the pump's function. Positioned within the fluid's pathway near the needle, the flow sensor is crucial.

Sensirion has developed a platform of liquid flow sensors tailored for use in large-volume injectors. They are designed for various maximum flow rates up to 5 ml/min and are compatible with a wide range of pharmaceuticals, all in a compact form factor of 12 × 14 × 3.2 mm (the form factor may slightly vary depending on the flow rate). Additionally, they are designed to be energy- and cost-efficient, making them well-suited for portable devices and single-use applications.

SLD3x sensors are based on a micro thermal measurement principle implemented underneath a channel through which the drug passes. In this channel, a small heater is flanked by temperature sensors. As the drug flows, it carries a thermal signal past the heater, detectable by the downstream sensor. The temperature difference between the two sensors provides a precise flow rate measurement. The heater operates at low power, ensuring minimal temperature rise in the fluid.

Example of sensor performance

The utility of a flow sensor is intrinsically linked to the pump type in use. Passive pumps and those that circulate air rather than dispensing liquid directly cannot provide information on medication flow to the patient, making a flow sensor essential for monitoring the flow rate. For pumps that offer their own flow feedback (e.g., tracking rotation counts), the flow sensor serves a critical diagnostic function.

Even with an ideally loaded pump and minimal operational noise, flow readings might appear steady but fail to detect blockages, such as those caused by cannula obstructions at the needle's exit. Despite continuous operation and increasing pressure, the pump may fail to deliver medication under such circumstances (see Figure 1).

In cases of complete or partial blockage, the pressure might eventually dislodge the obstruction, emphasizing the importance of monitoring flow to ensure consistent drug delivery and patient safety (see Figure 2).

In some cases, however, the pressure build-up can cause an internal leakage inside the device. If the leakage occurs upstream of the sensor, the sensor will typically register a negative flow, as the pressure in the line dissipates (see Figure 3).

Moreover, integrating a flow sensor provides a critical safety feature by identifying air bubbles. Unlike a pump, which cannot differentiate between air and liquid, the sensor detects the absence of drug flow if air is present due to the difference in thermal conductivity between air and liquid-based drugs. Continuous monitoring of the medium's thermal conductivity allows the sensor to promptly alert to the presence of air (see Figure 4).

The flow sensor serves multiple roles beyond indicating flow. It provides diagnostic insight and verifies that the prescribed drug volume is administered accurately and timely. Additionally, certain regulatory environments require an independent flow measurement source to meet compliance standards, ensuring precise adherence to therapeutic protocols and enhancing patient safety and efficiency.

Sensirion AG
https://sensirion.com

Figure 1. Forming of occlusion in the device.

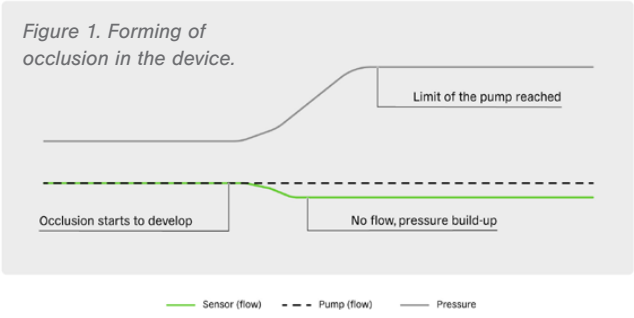


Figure 2. Clearing of occlusion followed by spike in flow.

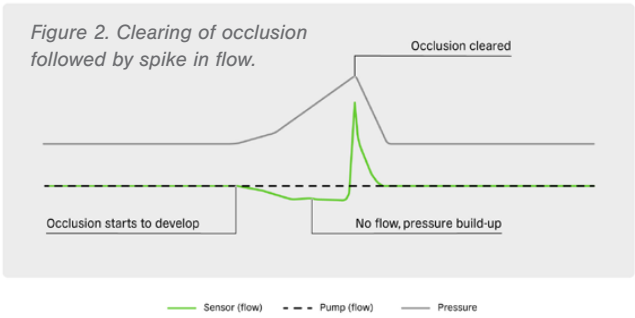


Figure 3. Internal leakage due to pressure buildup.

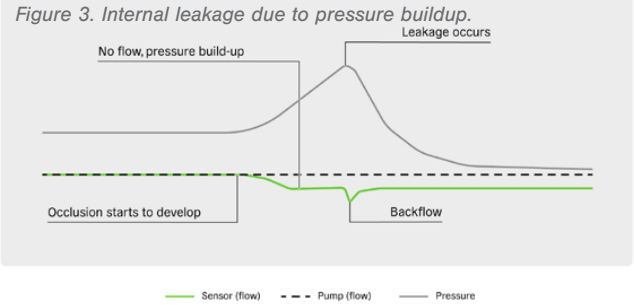
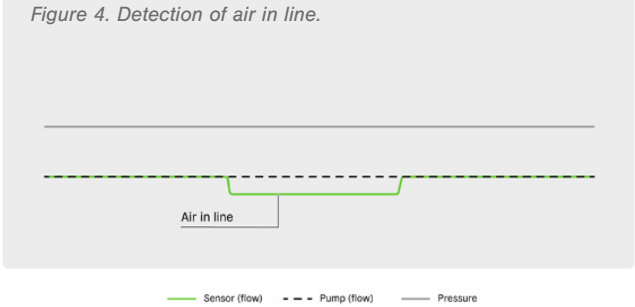


Figure 4. Detection of air in line.

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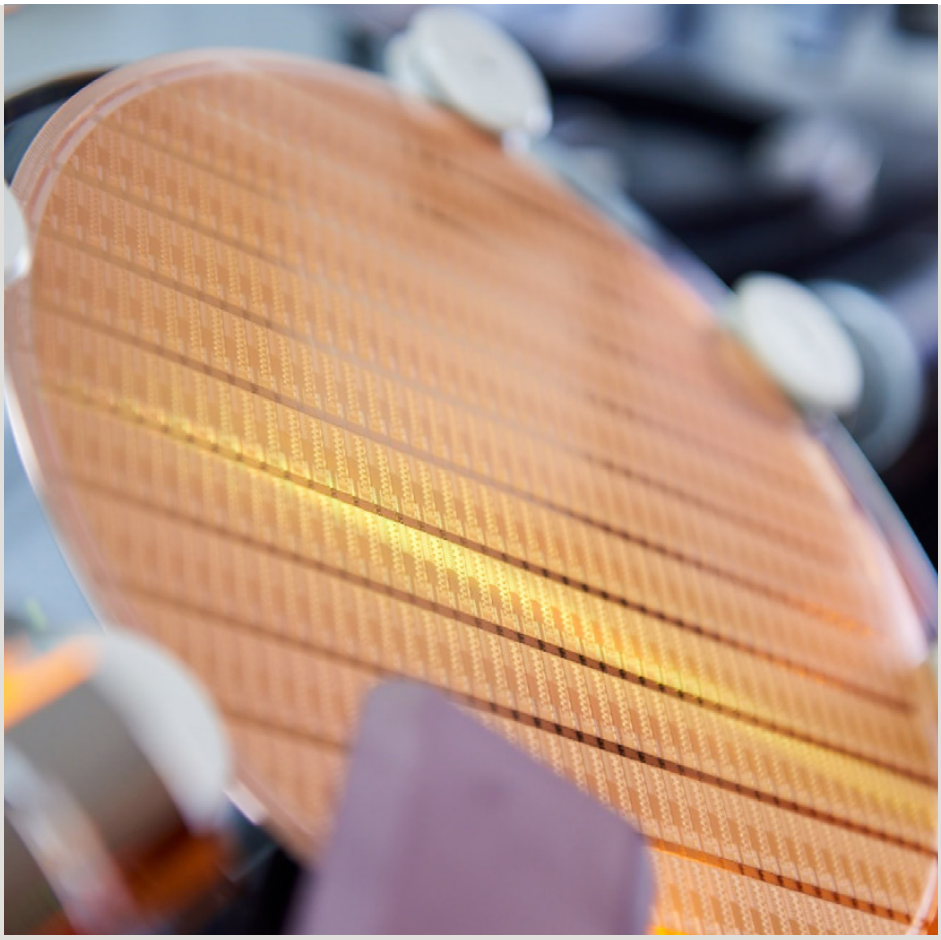

SENSORNETWORK³ SYMPOSIUM

SENSORS, TECHNOLOGIES AND INNOVATIONS BETWEEN HYDROGEN AND MOBILITY

The challenges of energy transition and mobility change are becoming ever more pressing. The rapid developments in these areas are confronting industry and society with major tasks - and at the same time offer enormous opportunities. At the SensorNetwork³ Symposium, you will learn how innovative sensors and cutting-edge technologies can provide decisive impetus to actively shape these changes and secure the future in the long term. IVAM organizes this event in cooperation with the network partners detect and AMA on January 22, 2025 in Dortmund, Germany.

https://www.ivam.de/SensorSymposium2025

UNIQUE EXPERTISE IN NITINOL PROCESSING AND ELECTROPLATING SERVICES TO THE MEDTECH INDUSTRY

Alleima offers unique expertise in processing the “smart” material nitinol, an alloy which is attractive to the Medtech industry for its unique properties such as shape memory, super elasticity, biocompatibility, and fatigue resistance. At its location in Karlsruhe, Germany, recognized nitinol expert Dr. Bernd Vogel and his team have built up unique capabilities in developing and manufacturing innovative nitinol instruments and implants for minimally invasive surgery. Due to its specific characteristics, nitinol will also play a key role in surgical robots of the future. In close collaboration with its customers, Alleima innovates and develops state-of-the art medical solutions. Alleima also offers unique competence and expertise in electroplating wire and micro-parts, another process valuable to the Medtech industry. By applying one or several metallic coatings you can enhance material characteristics such as electrical properties, acid resistance, biocompatibility, or aesthetic appearance depending on your requirements. Electroplating is a cost-effective way to add a thin layer of metal to a component built from another material. Alleima offers barrel and rack plating for parts and reel-to-reel plating of wire.

Alleima - Business Unit Medical
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QUIX QUANTUM WELCOMES BASIL GARABET TO THE SUPERVISORY BOARD

QuiX Quantum, European leader in photonic quantum computing hardware, is pleased to announce the appointment of Basil Garabet to its Supervisory Board. With over four decades in the photonics industry, Basil brings a wealth of experience and expertise to QuiX Quantum.

Basil Garabet has served as President and CEO of NKT Photonics since 2015. Under his leadership, NKT Photonics achieved significant growth and was acquired by Hamamatsu Photonics, a global leader in photonic technologies, earlier in 2024. Basil remains in his role at NKT Photonics post completion. In addition to his role at NKT Photonics, Basil is active in the photonics and quantum ecosystem. He has been on the board of the Danish Quantum Community from 2021 to 2024, and is currently the president and board member of the European Photonics Industry Consortium and a board member of Bifrost Communications. His educational background includes an MSc in Lasers from the University of Essex, obtained in 1983. He has held executive positions at several leading photonics companies, including JK Lasers, EM4, Altitun, Melles Griot, and Lasertron, and has been involved in numerous transactions.

Commenting on his appointment, Basil Garabet said, "I am thrilled to join QuiX Quantum's Supervisory Board at such a pivotal time. The company is making remarkable strides in photonic quantum computing, and I look forward to contributing to their continued success." As a board member at QuiX Quantum, Basil will bridge connections with the Danish ecosystem, as well as helping to guide the board's role in strategic technology decisions, scaling up, and commercial strategies. His appointment marks a significant step forward in QuiX Quantum's mission to lead the development and commercialization of photonic quantum computing technologies in Europe and beyond.

QuiX Quantum
https://www.quixquantum.com

BOOST YOUR SUCCESS IN THE MEDTECH MARKET!

IVAM offers the opportunity to showcase your company at COMPAMED 2024 and connect with valuable industry contacts. Only a few exclusive booth spaces are still available on exclusive joint area– this is a unique chance to present your innovations to a broad international audience of high-tech professionals. Our full-service package ensures that every aspect of your participation is taken care of, allowing you to focus on what matters most: your business.

https://www.ivam.de/events/compamed_2024

“NEW DIMENSIONS” – RAITH LAUNCHES NEW BRAND IDENTITY

RAITH, the global market and technology leader in maskless nanofabrication systems and characterization solutions, presents its new brand identity and website to the general public. The company’s brand evolution is an important step, supporting RAITH’s continuous growth strategy and progress within a market environment driven by diverse megatrends.

The new advanced positioning and progressive design strengthens the brand and secures its future viability. In addition to redefining RAITH’s corporate identity, the brand architecture was also redesigned and simplified to establish new RAITH solution and technology brands.

New dimensions are opened up to customers as innovations are enabled through a wide range of applications in connectivity, mobility, green energy, and healthcare. The market leader now covers the entire spectrum from micro- to nanofabrication, including outstanding characterization solutions.

RAITH has evolved as a technology solution provider, guiding customers in industry and science through their field of application to their specific solution with combined or connected products. A unique and versatile portfolio of high-precision writing and imaging tools based on electron beam, ion beam, and laser beam technology is offered.

The aim of the new website is to communicate effectively with new stakeholders, interest and customer groups worldwide and to form the centerpiece of brand communication.

“As part of our strategy process and the vision and mission we published last year, the next logical step was to further develop RAITH as a brand. As a company that is constantly evolving, we are very proud to be able to visually and emotionally communicate the progress expressed in our core brand value to the outside world. The new customer experience and the new website are two important milestones on our way to presenting RAITH as the innovative high-tech brand that it is,“ says Dr. Michael Steigerwald, CEO of RAITH Group.

https://raith.com

IVAM PHOTONICS FOCUS GROUP SESSION AT W3+FAIR IN JENA

As part of W3+Fair in Jena, there will be an IVAM Session on Photonics & Optics in Microtechnology on September 26, 2024 from 11:30 am - 12:30 pm. Speakers will be Philipp Wartenberg (Fraunhofer IPMS), Petter Karlow Herzog (TC TECH), Dr. Kahraman Keskinbora (Raith) and David Ilioae (Diamond). More information about the program can also be found on the W3+ air website.

To attend the fair, you are welcome to secure a free visitor ticket via the W3+Fair ticket store. Please use the free ticket code W3+IVAM2024.

Participants of the Focus Group can also attend the Aperó on September 25 from 17:15 pm free of charge. Exhibitors, speakers and guests will meet here for networking at the end of the first day of the fair.

https://www.ivam.de/events/w3jena24

PRECISION ETCHED COMPONENTS DRIVING AUTOMOTIVE SAFETY AND PERFORMANCE

As the automotive industry rapidly advances, the demand for precision, reliability, and safety in components has never been greater. micrometal Group, a leader in photo-chemical etching (PCE), plays a critical role in supporting this evolution. Its components, from filters to interior grilles, enhance vehicle safety and performance.

Jochen Kern, Head of Sales and Marketing at micrometal Group, explains, "As vehicles become more advanced, parts need to be more precise and durable. Our PCE processes ensure components meet the high standards of today's manufacturers, improving safety and performance."

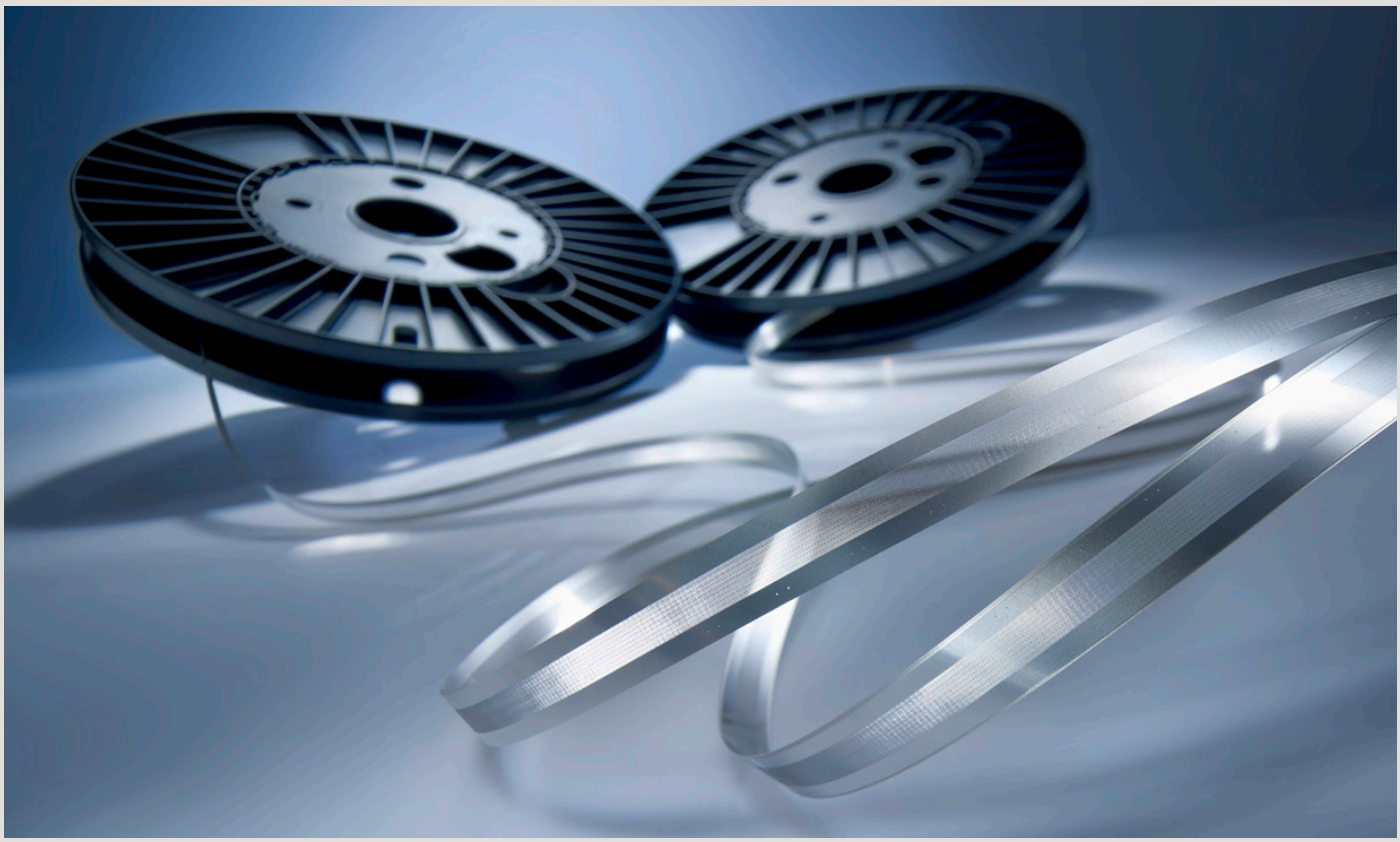
PCE offers unmatched precision for automotive parts like filters, which help maintain engine performance by keeping fuel and air systems clean. Even minor imperfections can reduce efficiency and increase wear. micrometal's filters are designed to last, ensuring reliability and better engine life.

Additionally, micrometal's interior grilles manage airflow and support vehicle comfort and electronic systems. The flexibility of PCE allows for intricate, burr-free designs, offering superior form and function over traditional methods.

micrometal Group excels in scalability and cost-efficiency, enabling rapid prototyping and high-volume production without costly retooling, helping manufacturers innovate quickly while maintaining quality. Certified to ISO 9001 and IATF 16949, the company ensures every part meets the highest standards, contributing to the safety and performance of vehicles on the road.

"We continuously push the limits of PCE to meet the automotive industry's demands and improve vehicle safety," concludes Kern.

micrometal GmbH
https://www.micrometal.de/



THIS EDITION WAS EDITORIALLY SUPPORTED BY DETECT!

DETECT

We detect it.

detect is a dedicated network that focuses on sensors and their importance for modern technology. As a hub and voice for the high-tech sector in the heart of Germany, detect promotes cooperation between industrial companies and research institutions and represents their interests. The network is based in Erfurt and aims to promote research, development and production of sensors, sensor components and sensor systems. With a strong basis in the regional cooperation of Thuringian partners and a focus on modern, digital structures, detect is committed to building a forward-looking sensor technology cluster that bundles the expertise of its members and positions Thuringia as a leading international location for sensor technology.

detect provides a comprehensive platform for players in the sensor industry who specialize in the development and production of sensors, sensor components and sensor systems. The network supports the activities of its members through targeted cluster management in the areas of networked business development, recruitment of specialists, application-oriented technology transfer, visibility and external presentation as well as networking and training events. In addition, detect offers its members the opportunity to participate in (international) partner networks and to increase the reach and visibility of the Thuringian sensor industry in global competition.

detect addresses all players in the sensor industry who are active in the various markets and application fields. The focus is on supporting companies that develop sensors for monitoring physical, biological and chemical parameters and integrate these technologies into manufacturing processes, automation technology and digital everyday applications. The international orientation of the cluster management addresses not only regional but also global markets in order to make the strengths and innovations of the Thuringian sensor industry known worldwide and to open up new user markets and technology cooperations.

https://we-detect-it.de/

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.

membership@ivam.de

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EVENTS

11-13 Sep 24

MEDICAL MANUFACTURING ASIA 2024

Manufacturing Processes for Medical Technology, Singapore, SG

18 Sep 24

MID-WEEK COFFEE BREAK – VELIXX GMBH@

Virtual technology talk between IVAM Members

26 Sep 24

IVAM FOCUS GROUP PHOTONICS

Focus Group Session at W3+ Fair in Jena, DE

11-14 Nov 24

COMPAMED

Product Market “High-tech for Medical Devices” and “COMPAMED HIGH-TECH FORUM” Düsseldorf, Germany, DE

13 Nov 24

EUROPE MEETS USA - PART 5 AT COMPAMED

High-tech for Medical Devices, Düsseldorf, Germany, DE

26 Nov 24

GET TO KNOW IVAM@

Learn about the network and the benefits of membership!

9+10 Dec 24

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22 Jan 25

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