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inno · Innovative Technologies - New Applications

| Focus: Sustainability|

Sustainability Creates new Opportunities for Electronics Industry

Liisa Hakola
Dr Maria Smolander

Electronics industry can benefit from opportunities from bio-based and abundant materials, from additive manufacturing and from circular economy strategies to decrease its environmental footprint. VTT has used sustainability approach to develop new electronic functionalities with minimal environmental impact. This technical article will highlight the opportunities and challenges for sustainable electronic products.

Bio-based materials, additive manufacturing, and circular economy opportunities for electronics industry

European and Global environmental agendas force electronics industry to rethink its environmental impact, such as the EU's Green Deal, Circular Economy Action Plan, Bioeconomy Strategy, and Industrial Strategy, as well as UN's 17 Sustainable Development Goals that EU is committed to implement. Key aspects for sustainability are more durable products, renewable materials, minimized generation of waste, and efficient circular economy strategies. Since electronic and electric waste (e-waste) is projected to double globally between 2014-2030 with only 20% (40% in the EU) recycled properly, utilization of these principles would be beneficial.

Electronics industry can specifically decrease its environmental burden by shifting from fossil-based materials to bio-based materials, decreasing use of metals, and utilizing printing based additive manufacturing processes, as well as benefiting from circular economy strategies, such as reuse, repair, remanufacture and recycle. Use of materials with less environmental impact, use of fewer materials in manufacturing, use of fewer resources during manufacturing, and generation of less pollution and waste are some examples of suitable eco-design tools. It is estimated that additive manufacturing processes, such as printing, powered by electricity generated from renewable energy, use one tenth of the materials of traditional factory production, resulting in a clear reduction in CO_2 emissions and the use of the earth's resources. With additive methods energy consumption during manufacturing can be even five times less than with conventional methods. Furthermore, the use of environmentally hazardous etching chemicals can be avoided. Although printed electronics is a sustainability opportunity, its main environmental challenges at the moment stem from the fossil-based substrate materials and metals used. Thereby, new materials originating from renewable and bio-based resources should be considered also for printed electronics. Since the global material consumption, including rare and valuable materials for electronics, is going to more than double during the next decades, and availability of many commonly used electronic materials, such as silver and copper, is endangered, bio-based and abundant materials are a clear opportunity.

Compression T-shirt with laminated conductive wiring based on stretchable screen printed graphene

Source: VTT

Sustainable device prototypes from VTT

VTT is developing more sustainable, eco-designed electronics for health and well-being applications. For instance graphene based stretchable conductive wiring for sensors and ➲

Content

Editorial

Focus: Sustainability

Sustainability is on everyone's lips. At least theoretically. Because the biggest problem is already inherent in the topic itself. It seems to be more difficult to implement or change something if one cannot immediately see the success of a measure, if one does not immediately receive a reward for the efforts.

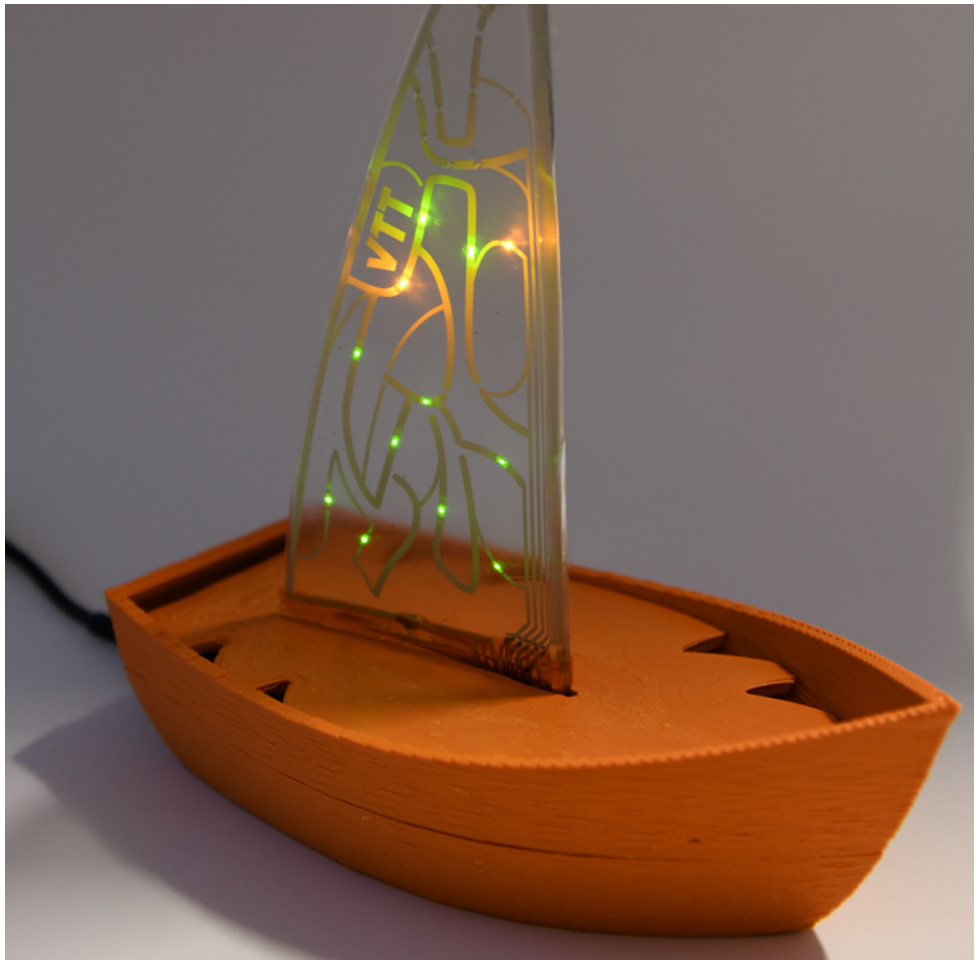
Creating space and freeing up resources in day-to-day business is difficult. Politically, too. The climate targets agreed in the past have - at least in Germany - repeatedly fallen by the wayside and had to take a back seat to pressing day-to-day political decisions.

Technology can be a key to breaking this vicious cycle of procrastination. Innovative, technical processes enable us to find new ways of sustainability. At the IVAM Hightech Summit on May 5, 2022 in Dortmund, for example, the potential of microtechnology and its related key technologies will be discussed. This ranges from nanotechnological solutions to tackle climate change, photonics for a sustainable economy and resource optimization in the life sciences to saving raw materials by miniaturizing components and finding new technological solutions in the area of packaging waste. Read more about the conference on pages 12 and 13.

The other articles in this issue also provide insights into sustainable processes and approaches. For example, new opportunities for the electronics industry, chemical recycling, business models for the circular economy, Inmold Structural Electronics (IMSE), microreactor technology and the fight against microplastics. Enjoy the reading!

Best regards

Mona Okroy-Hellweg



Bio-polymer based structural electronics demonstrator (CO_2 sensor), Source: VTT

dry ECG electrodes have been developed in Graphene Flagship project. The development offers possibilities to use more abundant material alternatives as conducting leads and enhances material saving continuous usage and re-usability. The VTT is currently taking the development further by evaluating the different commercialization paths of its developed and patented electrode concept.

Replacement of fossil-based polymers in structural electronics has also been demonstrated e.g. as a CO_2-indicator device for air-quality sensor. The device comprised a printed circuit with integrated and overmolded signalling LEDs, and a 3D-printed housing for electronics. The LEDs turn from green to red with increasing CO_2 levels due to insufficient indoor ventilation or crowded space. Earlier, Välimäki et al. have shown a higher adhesion in the polymer interface with PLA than with fossil-PET. Also in the demonstrator, all polymer parts could be realized with bio-based polymers without compromising the performance.

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Chemical Recycling: Rebuilding „from Scratch"

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Dr. Kathrin Rübberdt

Building a circular economy is one of the biggest aims to achieve sustainability and fight climate change. But what if cycles cannot be closed easily? Then it's time to apply rougher measures and – literally – smash everything to pieces. Some material cycles can be closed relatively easily, and appropriate systems have been in place for years: Glass, steel, but also certain types of plastics as long as they are homogeneous. But what about the giant amounts of municipal waste containing mixed and often soiled plastics?

Currently, their usual fate is the incineration plant for energy generation – and this applies to more than half of consumer plastic waste. This is where chemical recycling comes into play. While established mechanical recycling technologies are often based on sorting, melting and reshaping, chemical recycling goes one step further: The material is broken down into its monomers or even smaller molecular structures which can then be used to rebuild a broad range of new materials. Thus, chemical recycling is not only flexible with regard to its feedstock, but also in terms of the products that can be made from the intermediates generated by chemical recycling – even up to replacing naphtha or other fossil resources with recycled or bio-based feedstock at the very beginning of the chemical production chain, leading to virgin-grade products.

Source: pixabay

Where is the catch?

Although chemical recycling is a very versatile tool, it comes at a price: When closing recycling cycles, the general rule is that the smaller the intermediary fragments into which a molecule is split, the more energy is required. The "softest" version of chemical recycling is the depolymerization of specific plastics fractions by solvolysis. It is often applicable to polyester-based systems and results in monomers such as di-methylterephtalate or polyols. For some polyester factions, recovery of up to 90% of monomers has been reported. If the process includes steps for the removal of impurities e.g. at high vacuum and elevated temperatures, up to 50 % of raw materials can be replaced by recycled material without compromising quality.

Thermochemical processes are more drastic. Pyrolysis of mixed plastics waste of low quality or complex composition is performed at temperatures above 300°C in an inert atmosphere. Polymers are split into shorter chains or fragments. The output - oils and gases of variable composition - can be fed into refineries and chemical plants.

Gasification takes the idea to the extreme: At 1000-1200 °C, the material is broken down into the smallest possible units, resulting in mixtures of carbon monoxide and hydrogen. The so-called "synthesis gas" is a standard feedstock e.g. for the production of methanol.

It may sound as if chemical recycling is a "jack of all trades" for waste, but apart from energy demand, there are some other restrictions that need to be considered and some questions that need to be answered before an economic scale-up of the technologies is possible: Which waste streams should be marked for chemical recycling, and what quality parameters do they need to meet? What purity grade needs to be achieved in solvolysis? Pyrolysis also requires hydrogen to get rid of double bonds or aromatic structures and also to guarantee necessary carbon-hydrogen relations for further processing. This hydrogen needs to be made available on top of the hydrogen required for the transformation to a fossil-free chemical production. Other practical questions include logistics and the necessity of new cooperations: So far, the chemical industry has not been part of the recycling system. Some chemical companies are now leading the way, joining forces with waste collecting and recycling companies to establish new value chains.

Design for recycling

Chemical recycling is an important building block of the circular economy, but it is no universal solution. Keeping the cycles as small as possible should be the aim: Creating water bottles from water bottles with as little energy input as possible is a great solution and should be the method of choice wherever applicable. Which recycling route can finally be taken is decided long before the consumer puts the empty package in the waste bin: Product designers should be aware of recycling options and develop products that are as homogeneous as possible in relation to the material used, avoiding the use of composite materials or additives. Even the color of a plastic product is not only a matter of taste, but may improve or hinder its recyclability: Automatic sorting lines have trouble distinguishing black plastic from the conveyor belt that it lies on, and so the major proportion ends up in the waste streams for incineration instead of the recycling plant. And even the presumably sustainable biobased plastics throw a spanner in the works of the system, requiring more complex collection and sorting systems to ensure recyclable materials streams. ➲

Depending on the waste qualities, mechanical and chemical recycling processes should be applied in cascades, i.e. as complementary processes, in order to optimise recycling as a whole while achieving the highest possible economic efficiency. Chemical recycling can become one pillar that the circular economy and the defossilization of the chemical industry rely on, and it should be developed and exploited further. But in the end, a sustainable future rests on the shoulders of all: producers, consumers, political decision makers and the recycling industry.

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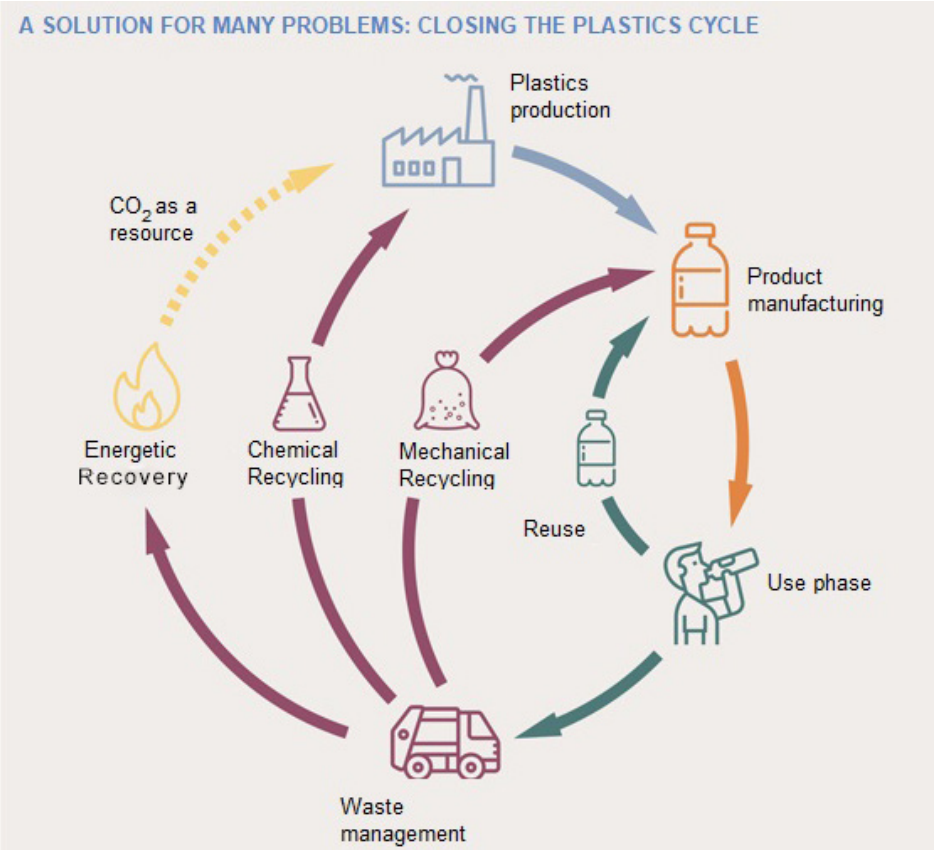


A German overview of of a possible plastic cycle: from production through product manufacturing, use phase and recycling or waste management with subsequent energy recovery (with the use of Co_2 as a raw material), chemical recycling or mechanical recycling.

Source: Adapted from VCI

Circular Economy: Concept and Self-assessment for Companies

Benno Weissner

Triggered by climate change and the associated new requirements for companies to adapt and transform their business models, the Circular Economy approach is increasingly coming to the fore as a concept. The ZENIT Center for Innovation and Technology in North Rhine-Westphalia has developed a Circular Economy Audit to sensitize companies and, in a second step, to support their implementation through sustainability consulting and access to funding.

Circular Economy and New Business models

The basic idea of Circular Economy sounds amazingly simple: instead of disposing of products at the end of their use phase, it aims to preserve the value of the raw materials they contain as much as possible. Circular Economy avoids or recycles "emissions" by dealing with materials, products, systems and business models accordingly. It is therefore about preserving "valuable values"! In addition to the resulting clear monetary advantages, there are further advantages in the recruitment of skilled workers, in new, stricter customer requirements for environmentally friendly production and product standards and, last but not least, in negotiation talks with banks.

There is a whole range of factors that are also important, especially for companies in the high-tech sector. For example, large manufacturers, like in the automotive sector, now require their suppliers to provide proof of compliance with sustainability requirements or of the CO_2 consumption of parts. In addition, further regulations, such as the EU's Eco Design Directive, the Supply Chain Act or the Packaging Waste Directive, place demands on companies. Manufacturers and their suppliers must prepare for this at an early stage and also develop new solutions. The principle of the circular economy aims to conserve resources and increase added value. This is achieved through various approaches:

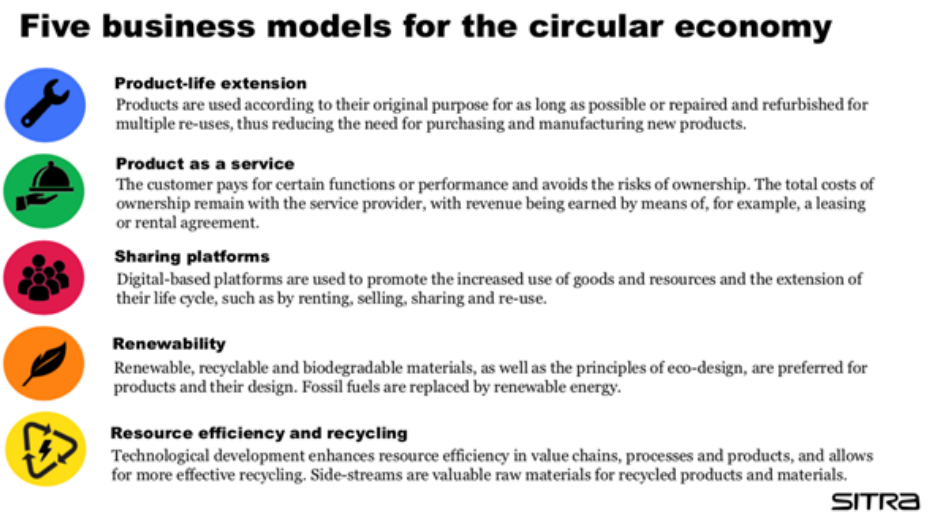
- Does the company use renewable, recyclable and sustainable raw materials?
- Does the company consider recyclability when designing products?
- Does the company reuse products in the use phase?
- Does the company reduce or avoid entering the natural system after the use phase (e.g. microplastics, recyclability)?
- Does it have an efficient material recycling system?

In summary, there are the following pushes and pulls for circular business models:

- Circular Economy will receive numerous regulatory and financial pushes from government levels (Green Deal, etc.) in the coming years.
- Social and political climate
- Consumer demand (assessment of products and services, LCA)
- Opportunities for new business models (green start-ups)

New Opportunities for Innovation

This results in future tasks for the transformation from a linear to a circular economy and presupposes the emergence and diffusion of a multitude of innovations - technological (recycling tools), organizational (business models), institutional (recycling rates and social concepts). Digitalization can accelerate the efficiency of secondary raw material production and the emergence of new business models. However, incentives and spaces are also needed for companies to try out and develop models and technologies.



The concept of the circular economy offers good opportunities to develop new business models and solutions for industry. Here, opportunities arise above all, for example, through

- the design of products for better recyclability
- the substitution of materials
- recycling of products and materials
- reparability

For example, a 2018 survey of companies on the topic by EuPC shows that the main barriers to the use of recyclates in the industry are product specifications, recyclate quality and regulations, in addition to prices and security of supply. This one example shows that there is a high need for new innovations and research here. High-tech solutions should also work on solutions to trace the product life cycle, to improve resource and energy efficiency in processes, and to improve the quality of recycled materials.

Anyone looking for funding for an innovative idea in the future needs to know that a third of the investments from the NextGenerationEU construction package and the EU's seven-year budget, totalling 1.8 trillion euros, will flow into the EU Green Deal. There are many opportunities for companies to participate in the EU's research programs, but also at national level.

Sustainability management

However, the advantages of the Circular Economy approach do not only include new opportunities in competition, the saving of expensive resources, compliance with laws and the chance to attract subsidies. The "image" of a company is also becoming increasingly important. Especially against the background of the shortage of skilled workers, companies that make an effort to protect the environment have a clear advantage over others when it comes to young people. But customers' demands for environmentally sound production and product standards and climate protection are also increasing. The same applies to the company in "negotiations" with investors, insurance companies, authorities and neighbours in the vicinity of production. This is not meant here in the sense of "greenwashing", but rather the question of how the company presents itself as sustainable in order to remain competitive. Sustainability management helps with internal implementation and external presentation.

There are some instruments available, such as DIN ISO 2600. This International Standard is not a management system standard. It is not intended or appropriate for certification purposes or regulatory or contractual use. Any offer to certify, or claims to be certified, to ISO 26000 would be a misrepresentation of the intent and purpose and a misuse of this International Standard. This standard could be a first starting point to deal with sustainability management in the company in more depth and, if necessary, to use further instruments of environmental management (EMAS, Ecological Footprint, Life Cycle Assessment, Sustainability Report, Eco Label, etc.). Depending on the goals and orientation of the company, these instruments can be used.

Circular Economy Audit Tool

In order to make it easier for interested companies to get started, ZENIT has developed a Circular Economy Audit as an online tool with which one can independently go into the most diverse company areas and question and reflect their processes with the most diverse aspects of the Circular Economy approach. The audit is industry-independent and can be used by almost all manufacturing companies. In the first step, company areas such as management, purchasing and procurement, development/technology, production, storage, warehousing, sales/marketing and others are addressed.

Netzwerk ZENIT

For small and medium-sized entrepreneurs, there are basically only three guiding questions (independent of the sector) for a decision-making process on the "introduction" of new topic areas - such as Circular Economy - into their own company:

- Do I have to do this?
  (legal requirements?)
- Can I do it?
  (If so, how? And connected to this is....)
- What is the benefit for me?
  (Not only monetarily but also.....)

The tool and also the coaching take place within the framework of the Enterprise Europe Network (EEN). The network has regional contact points in all EU countries to which SMEs and research institutions can turn with topics such as EU funding, internationalization, digitization, sustainability and the EU Single Market, and where they can receive EU-funded support on these issues. You can find your regional contact via the website https://een.ec.europa.eu/.

Netzwerk ZENIT e.V.
https://www.zenit.de/netzwerk-zenit

The concept is as follows, in order to make it as easy as possible to get started with the topic:

1. The guiding questions in the audit are intended to sensitize you to where adjustments in your processes could make sense by means of the circular economy approach. The menu navigation is simple and the time required is manageable (approx. 10 min).

2. In the second step, we offer a personal exchange (workshop and coaching) to discuss the possibilities of the Circular Economy for your company and to work out solutions together. The result is an action plan tailored to your company for a wide range of project and company goals.

3. The third step is the actual implementation of the action plan, which you can work on alone or together with us, depending on the task area and solution path. Here we also look at various tools of sustainability management.

4. In addition, services such as technology scouting and assistance in accessing EU funding are offered.

You can access the tool via the link: https://cea.zenit.de/

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Enviromental Performance of Inmold Structural Electronics (IMSE) Across The Lifecycle

Markus Thamm,
Janne Jääska

Sustainability in applications and industries has been steadily increasing in importance over the last decade, and this growth will only accelerate in the foreseeable future. Sustainable packaging, locomotion, construction, manufacturing, and food, to name a few, is a value in itself for a large portion of consumers in any market segment.

Source: TactoTek®

Salcon International has been working with TactoTek in Finland since 2015 to change the world of electronic production in a very disruptive way. TactoTek focuses on reducing the environmental impact of its IMSE technology and thereby improving its sustainability - from the initial design of its products through their endof-life. Striving for continuous improvement, TactoTek partners with different organizations to conduct studies on the topic and get reliable results.

Assesing enviromental performance

As per best practice, TactoTek works with external experts and institutions to provide objective views on environmental performance. This is to ensure to work with the latest methods and analysis techniques to find out the real data and facts on environmental performance. Most recently, they worked with a company called '2.-0 LCA Consultants', a well-known actor in the field with a proven track record for LCA studies. Their methodology, 'Consequential LCA', or cLCA for short, answers what the different drivers for the environmental impacts are, for example, the production of consumer electronics. This method is particularly appropriate for TactoTek's technologies.

Comparing IMSE to conventional solutions

In practice, this means to compare two different digital twin IMSE solutions against a conventional solution to see how IMSE fares against product components in the current market and get further information about the environmental performance of IMSE parts contrasted to conventional solutions. As objects to the study, a conventional Human-Machine-Interface (HMI) panel, a panel made with IMSE technologies, and a panel with an IMSE System in Package (SiP) were chosen. SiP means bringing the control electronic components inside part, further minimizing the size of the PCB.

The study was designed in cooperation with Dr. Ivan Muñoz from 2.-0 LCA Consultants to get accurate, robust, and reliable results of the environmental impacts of IMSE. For the input information on the parts, the team at TactoTek gathered the required data on the conventional part and created comparable IMSE designs. After the input data, certain aspects of the study have been agreed on, such as amounts produced annually, geographical locations of materials, components, manufacturing, use, etc. The rest is subject to the LCA modeling done by 2.-0 LCA Consultants.

Reducing greenhouse gas emissions

The chosen reference part was deliberately close to an IMSE solution regarding its technical features and technologies to achieve realistic results. The aim was to see the differences between the environmental performance of IMSE head to head with other modern capacitive touch devices. For example, the reference part had capacitive touch buttons instead of mechanical switches.

Comparing the reference device with the ones using IMSE technology showed that IMSE helps lower lifetime greenhouse gas (GHG) emissions by up to 56% for an IMSE solution with external electronics and 62% for an IMSE System in Package (SiP) solution. Considering the similarity of the devices, the circa 60% reduction in GHG emissions was a positive surprise and proves that IMSE lowers the environmental impact significantly. Another outcome was the unexpectedly high impact of the printed circuit board on GHG emissions. As already known from a previous LCA study, the printed circuit board (PCB) affects GHG emissions, but when the relative mass of the PCB to the total mass of the control panel was higher, the impact was remarkable.

Better performance of IMSE among the other impact categories

The study results also showed that IMSE performs better not only in greenhouse gas emissions but in all of the 14 measured impact categories. The results were monetized to rank their environmental impact according to their perceived damage to the environment. This enables the comparison of different impact categories, even if the actual units are different per category. The list contains a few examples from the impact categories with percentages for the relative impact of IMSE and IMSE SiP against the reference part:

- Respiratory inorganics: IMSE 62% reduction, IMSE SiP 68% reduction
- Greenhouse gas emissions: IMSE 56% reduction, IMSE SiP 62% reduction
- Human toxicity, carcinogens: IMSE 58% reduction, IMSE SiP 65% reduction
- Nature occupation: IMSE 39% reduction, IMSE SiP 48% reduction
- Acidification: IMSE 54% reduction, IMSE SiP 63% reduction

A similar trend is visible in all impact categories. ➲

Developing sustainability of IMSE further

TactoTek is dedicated to investigating more ways to improve the environmental performance of its technology. One main effort is researching replacement materials for the IMSE production that are more sustainable and still ready for mass production. The company already has some in use that are industry-standard, but is working on verifying more. Replacement materials have identical technical properties as conventional materials but with biobased materials mixed in.

Another promising approach is the recyclability of IMSE. TactoTek cooperates with recycling companies and research facilities in developing knowledge on the recyclability of IMSE. Initial results state that recycling is a no-brainer for materials created during manufacturing. For IMSE parts, pyrolysis looks to be a promising approach; circular material loops can be made for metals and plastics, as well. Currently, the company is placing a big emphasis on generating sufficient knowledge and gathering a group of recycling companies to recycle IMSE, and then providing these contacts to license partners.

An Outlook to the future

TactoTek is still a young company but has been focused on sustainability from the beginning. LCA and recycling studies have proven that IMSE provides substantial benefits to the environmental performance of electronics manufacturing with possibilities to enable circular material loops. TactoTek is committed to developing and enabling eco-design principles through IMSE technologies for all industries. In addition to the continuous efforts in terms of materials and recyclability, we have already commissioned 2.-0 LCA Consultants to conduct another LCA study. This time, the focus is on automotive interior parts and comparing a new center console control panel to an IMSE part that can produce the same or similar features and functionalities. These results will help to create a holistic picture of IMSE environmental impacts during the total lifecycle of any product using IMSE technologies. There will also be a focus on further development of the IMSE recycling and circular economy knowledge. With the right partners it is possible to find a way to enable material loops for not only metals but also plastics, making IMSE the most sustainable technology for producing smart surfaces across industries. For more information on the LCA study and upcoming activities a webinar on the Environmental Performance of IMSE can be downloaded.


Source: TactoTek®

Salcon International, Heidelberg, DE
https://www.salconinternational.de
TactoTek, Oulu, Finnland
https://www.tactotek.com

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Dynamically Tuned Microreactors on a Chip

Dr. Claus Fütterer,
Katja Prasol

Microfluidics got very popular within the last decade and is utilized for a vast number of biological, medical, (bio-)physical, (bio-)chemical or pharmaceutical applications. In this field the term "microreactor" is increasingly encountered. What is a microreactor, what is it good for? For instance, when talking about synthesis of nanomaterials, it can refer to the whole microfluidic device, i. e. the microfluidic chip.

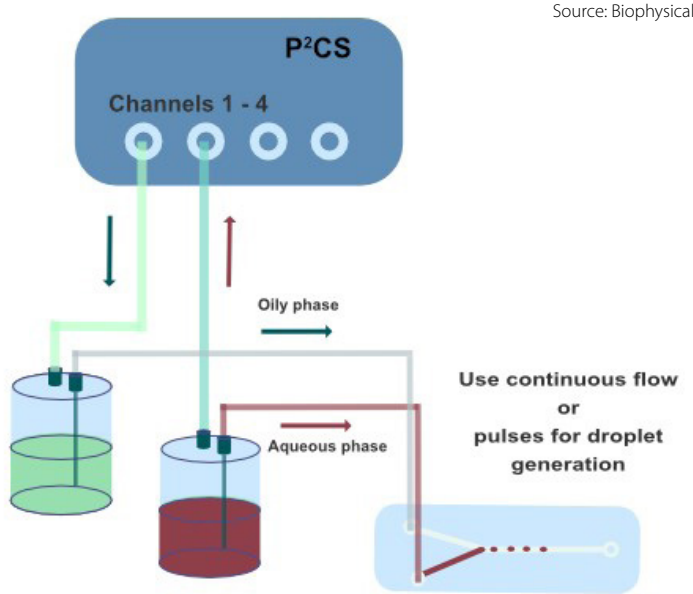
In the field of droplet microfluidics, also called "discrete microfluidics" or "digital microfluidics", the droplet itself is understood as a microreactor, e.g. for growing cells, tissues or cultivating and observing bigger objects such as unicellular protist "Paramecium caudatum". Vesicles and capsules are also deployed as vessels for all kinds of assays and are qualified as microreactors, though they are not discussed here.

Pros and Cons of Confined Miniaturized Reaction Volumes

The application of droplet microreactors is advantageous regarding sustainability, since consumption of liquids, gasses and recipients (mostly disposable plastics) and energy (e.g. heating of PCR machines and incubators) can be strongly reduced. Many applications in their conventional form – e.g. synthesis of nanomaterials and nanoparticles, lipids for mRNA-based vaccines, encapsulation of substances, production of different nanoparticles, including magnetic nanoparticles or biological applications – can take advantage of this approach. Conventional cell or bacteria cultures need a lot of heat energy and gasses and can noticeably benefit from miniaturization. If working with toxic or hazardous substances or reactions, generating such substances, contamination risks and safety concerns can be significantly lowered by this approach as well. Further, the use of closed microreactors can substantially reduce the risk of inadvertent spilling of dangerous substances.

Other problems of conventional methods concern controllability and repeatability of reaction conditions. Here the parasitic flow is poorly controlled. For particle production this factor causes higher size and other property dispersion of droplets. The use of microfluidic devices provides much better controlled hydrodynamic conditions for mixing, adding substances, and controlling the reaction speed. However, disadvantageous is that the surface properties in microchannels have to be controlled more thoroughly as surface/volume ratio is much higher than in conventional systems. Sensors are more difficult to deploy as the droplets are not in direct contact with the channel walls with integrated electrodes. So, high frequency impedance signals are degraded. Optical read-outs suffer from the smaller optical density because of the thinness of the liquid layer. Refraction at curved interfaces and surfaces may present a problem as well.

Source: Biophysical Tools GmbH



Materials in Microfluidics

In microfluidics it is essential to choose (bio-) compatible sustainable materials, which can withstand the reaction or incubation conditions and which do not release interfering substances. Nevertheless, biodegradable materials are still an exception in this field. For biological organisms the biocompatibility and prevention of contamination of the culture are critical. The compatibility of materials in the field of synthesis is even more to be considered, since many materials used for microfluidic chips such as PMMA, PC, PS are not suitable for organic solvents or high temperatures. Dimensioning of microchannels according to the conditions, reagents and objects used require great care, so that agglomeration and clogging risk is reduced. Optical quality and auto-fluorescence may also be considered. Further, electric, magnetic, acoustic or high-frequency properties can impact good wave transmission or insulation for impedance measurements. Here, new biodegradable materials are urgently needed for future microreactor developments.

Conventional and Novel Droplet Generation Techniques

Droplets employed as microreactors can be generated in different ways. Usually multiphase systems are employed. Those can be systems with immiscible liquid-liquid-phases or gas-liquid-phases. In biological applications the aqueous phase is employed for cultivating cells or organisms on a chip. In this case suitable oils serve as a carrier fluid in the microchannel. In the chemical field also other immiscible or miscible liquids are widely utilized. In order to prevent coalescence of droplets in tight microchannels, when it is difficult to keep droplets apart, small amounts of surfactants help to stabilize the generated droplets and provide reproducible quality. Some of pre-processed oils containing surfactants can even be used at high temperatures, e.g. for PCR or extremophiles. It is also conceivable to use gas-liquid-systems to produce droplets. Here surfactants play an essential role to get better results. However, the compressibility of gas is a particular property adding challenges,

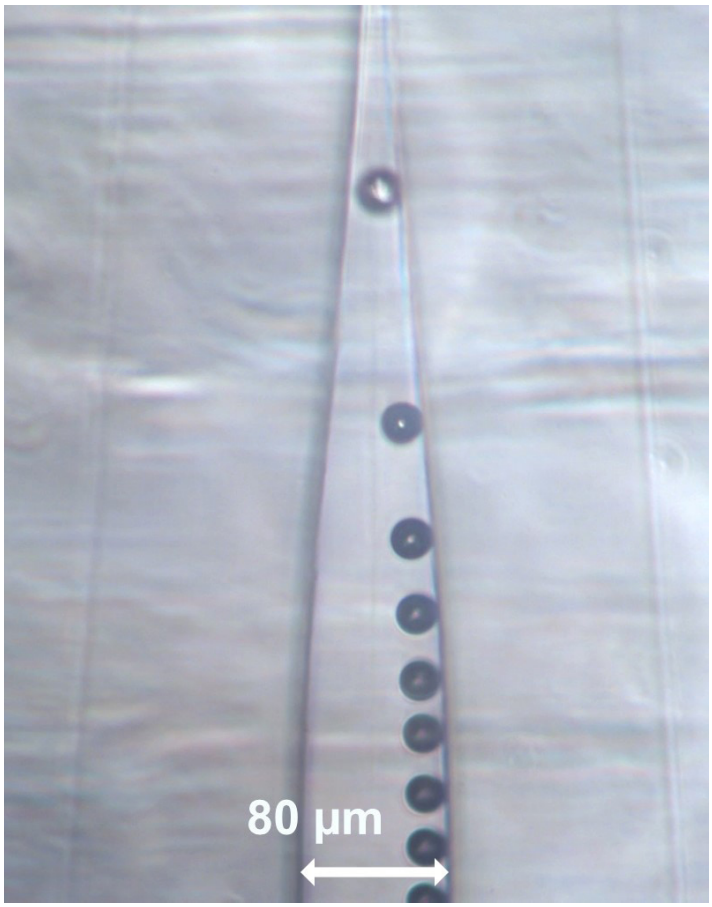
but also new possibilities. Two mechanisms for droplet generation are possible – spontaneous and forced droplet generation. Which mechanism to choose depends on the number, size and monodispersity of the droplets to be produced.

Spontaneous Droplet Generation (SDG):

It depends on the competition between surface tension at the interface between the immiscible liquids, the line tension at the contact line at the channel orifice and the hydrodynamic friction of the droplet in the flow field of the carrier fluid. The side-channel pressure must be increased, until it exceeds the counter pressure of the meniscus between the two liquids at the orifice – the experiment gets super-critical now. The droplet grows into the main channel non-linearly in time and concurrently the friction of this droplet increases. Eventually the friction overpower the line tension, droplet then detaches and is advected away by the flow in the main channel. The disadvantage of this approach is the robustness of the critical point, i.e. the droplet size depends strongly on material and fluid properties as well as the flawless preparation of the channel walls and geometry. The advantage is that pressures can be kept constant and droplets form spontaneously. The generation frequency can become quite high up to the 5-digit range.

Dynamic Droplet Generation (DDG):

The second mechanism is based on an experiment kept sub-critical. The pressure is increased to a level where droplets just do not (!) form spontaneously. A fast pressure pulse, e.g. by the pressure pulse function of the microfluidic flow controller P²CS, drives the experiment super-critical for a short period of time. If the pressure pulse is sufficient, a droplet builds up and gets carried away by the drag force of the flow in the main channel. As the pulse function is real-time, the droplet size does not depend on the ponderabilities of operating systems or the critical point of hydrodynamic instabilities. By this means droplet size is much more reliable and reproducible, however, the generation frequency is limited by the speed of the pulse generator. In the case of the Precision Pressure Control System P²CS 20Hz could be achieved. An advantage of this approach is the possibility to tune the droplet size dynamically, i.e. during one single experiment larger or smaller droplets can be generated at will and in one go. This unique feature has not been exploited so far by the scientific community. It may be used to enable droplet labeling by size. Further, dilution series in one microfluidic channel become feasible.



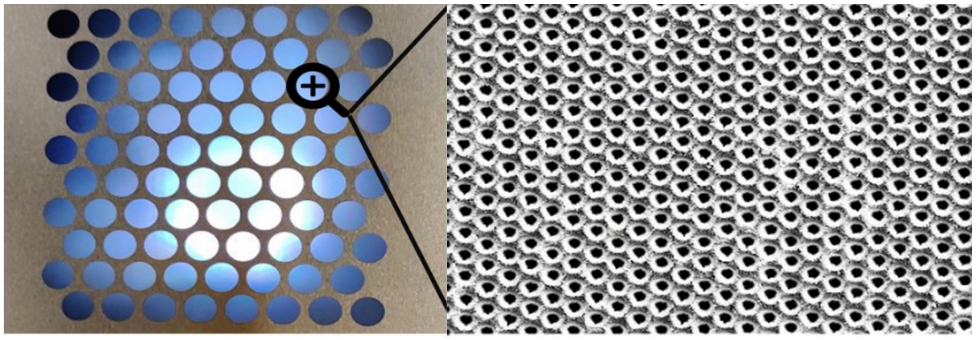
Source: Biophysical Tools GmbH

Biophysical Tools GmbH, Leipzig, DE
Labor für Biophysik
https://biophysical-tools.de

Taking the Fight to Microplastics with Lasers

Until now, wastewater treatment plants have not been able to sufficiently filter out tiny microplastics in wastewater, but this could soon change: The first laser-drilled microplastic filter is being tested in a wastewater treatment plant. It contains sheets with extremely small holes just 10 micrometers in diameter. The technology to efficiently drill millions of such holes was developed at the Fraunhofer Institute for Laser Technology ILT, and now the institute's engineers are scaling up ultrashort-pulse (USP) laser technology in the kW range.

Today, sustainability is not an option, but much more an obligation no matter what technology is under development. Accordingly, the laser industry is increasingly using USP technology to improve sustainability in many projects. Lasers are already being utilized to boost the efficiency of hydrogen technology and to generate absolutely tight battery housings in electromobility applications. In the BMBF-funded "SimConDrill" project, Fraunhofer ILT has joined forces with industrial partners to build a filter that – for the first time – can remove microplastics from wastewater. "At its core, our challenge was to drill as many holes as possible, as small as possible, in a steel foil in the shortest time possible," explains Andrea Lanfermann, project manager at Fraunhofer ILT.



In the microplastic filter, the films with the microholes are fixed on a coarser grid so that they do not tear under the water pressure. Source: Fraunhofer ILT.

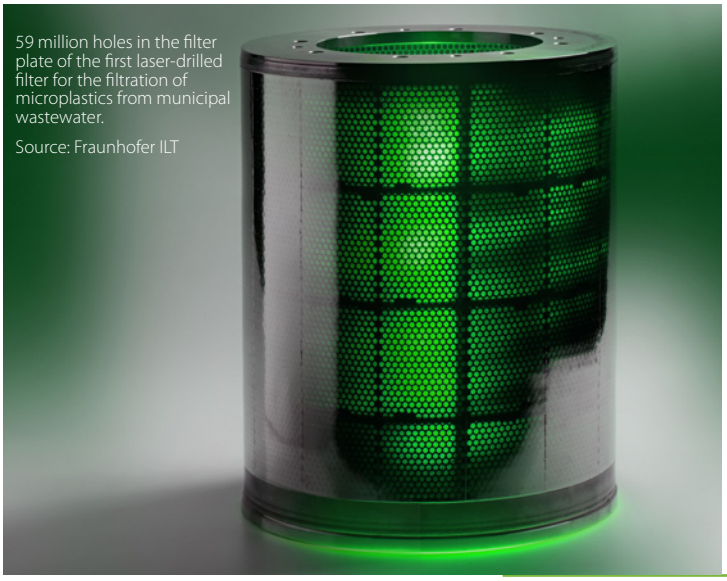
Mobile filter plant in wastewater treatment plant

This has been achieved. After the process was developed at Fraunhofer ILT, experts from LaserJob GmbH drilled 59 million holes with a diameter 10 micrometers into a filter sheet, thus creating a filter prototype. The Fraunhofer researchers are also collaborating with three other companies on this ambitious project. In addition to the project coordinator KLASS Filter GmbH, LUNOVU GmbH and OptiY GmbH are also involved.

In the meantime, the laser-drilled metal foils have been installed in KLASS Filter GmbH's patented cyclone filter and subjected to extensive testing. In the first test, the fine powder from 3D printers was filtered from contaminated water. The setup is now being tested under real conditions in a wastewater treatment plant.

Process knowledge is the key

Drilling millions of holes one after the other takes time, but can be done faster with the multibeam process, in which a matrix of identical beams is generated from a laser beam via a special optical system. Fraunhofer ILT used this process with an ultrashort-pulse laser (TruMicro 5280 Femto Edition) to drill holes simultaneously with 144 beams. The basis for such applications is detailed process knowledge, which has been collected at Fraunhofer ILT over decades and implemented in corresponding models and software. Thanks to this expertise, parameters can be varied on the computer and optimum process parameters found quickly. The robustness of the process can also be analyzed before the application is tested.



59 million holes in the filter plate of the first laser-drilled filter for the filtration of microplastics from municipal wastewater.

Source: Fraunhofer ILT

In parallel to this drilling application, a consortium of six partners is working on how to best integrate a multi-beam processing system into an industrial machine. In the EU project "Multiflex", researchers along with the industry are increasing the productivity of scanner-based laser material processing using multi-beam processes. The special feature of this project is that all partial beams can be individually controlled and, thus, used to produce any kind of surface structure. The project partners aim to increase the speed of the process by a factor of twenty to fifty, thus making the entire process significantly more cost-effective.

CAPS: Scaling into the kW range

Process knowledge is also a critical factor in further scaling up materials processing with ultrashort laser pulses with or without multibeam optics. When power is increased into the kilowatt range, thermal damage to the workpiece can occur. Such effects are explored through complex simulations, and processes can be adapted accordingly. The lasr systems for such experiments are available in the application laboratory at Fraunhofer ILT in Aachen. They are part of the Fraunhofer Cluster of Excellence Advanced Photon Sources CAPS, where 13 Fraunhofer institutes jointly develop laser beam sources, process technology and applications for USP laser powers up to 20 kW. A second CAPS laboratory is operated at Fraunhofer IOF in Jena.

Fraunhofer Institute for Laser Technology ILT
https://www.ilt.fraunhofer.de

IVAM Hightech Summit shows range of technological solutions for sustainability

Climate change and the increasing shortage of raw materials require urgent adjustments to society's way of working and living. Micro- and nanotechnology and technologies based on this, such as microfluidics, photonics or sensor technology, offer enormous potential in the development of solutions to these global problems.

Since 2017, the IVAM Hightech Summit has been a central point in the year where companies from micro and nanotechnology come together and present the latest developments and products as well as discuss the challenges in the future. Probably the greatest challenges at present, but also in the future, are, for example, coping with climate change and the shortage of raw materials and the resulting necessary adaptation of the way people are working and living. Microtechnology is a key player in developing solutions to these global problems. That's why the topic of this year's Hightech Summit is sustainability.

Microtechnology conference: sustainability in various areas

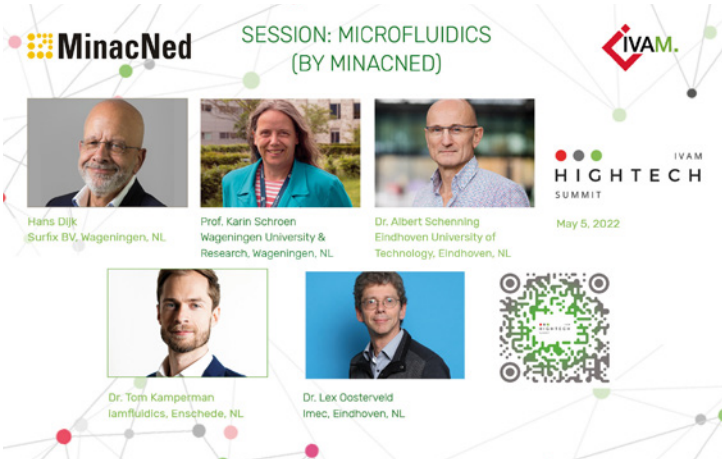
The IVAM High-Tech Summit 2022 will feature eight sessions on hot topics in micro- and nanotechnology. The sessions are organized and conducted together with partner associations and focus group leaders.

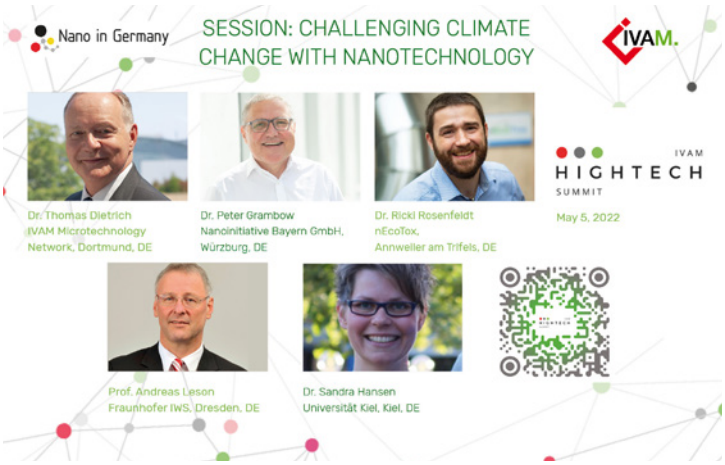
Different technologies that have the potential to solve many of today's challenges will be presented at this event. The eight sessions will address different aspects and diverse applications of microtechnological solutions for greater sustainability. Each session includes three to five expert presentations and offers sufficient space for questions and technical discussions. The topics range from „microfluidics", „photonics for a sustainable economy", „challenging climate change with nanotechnology" or „new approaches for a sustainable sensortechnology" over „sustainable approaches in medical technology", „sustainability in flexible and hybrid electronics" up to „focusing sustainability in photonics". Renowned and high-ranking experts are guests of the sesssions, which have been organized with partner associations and the chairs of the IVAM Focus Groups.

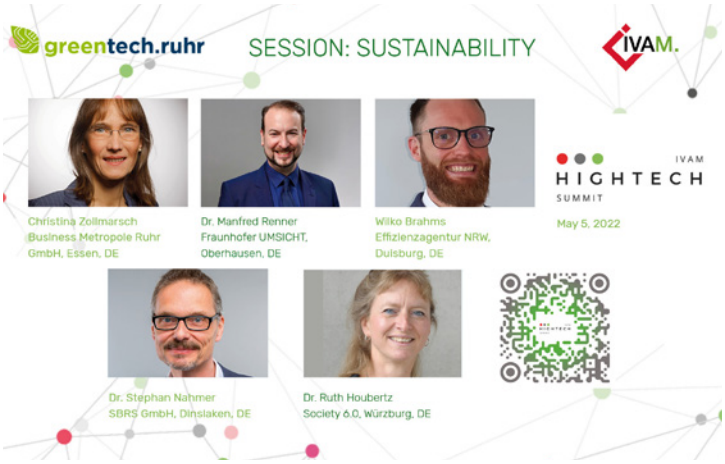
The central aim of the event is to establish efficient contacts. IVAM members and members of partner networks will have the opportunity to present their products, find customers, suppliers and research partners and talk about upcoming projects. During a Get-Together, which will take place on the evening before the conference, participants will have the opportunity to make contacts and network in a relaxed atmosphere.

The venue is the Dortmunder U. Formerly the basement high-rise of the Dortmunder Union Brewery and production site for beer, the building was put to a new use as a center for art and creativity in 2010 after 82 years of its existence. It was handed over to the public as part of the European Capital of Culture RUHR.2010 and is thus also a symbol of sustainable use of formerly industrial buildings.

IVAM Microtechnology Network
https://www.ivam-hightech-summit.com



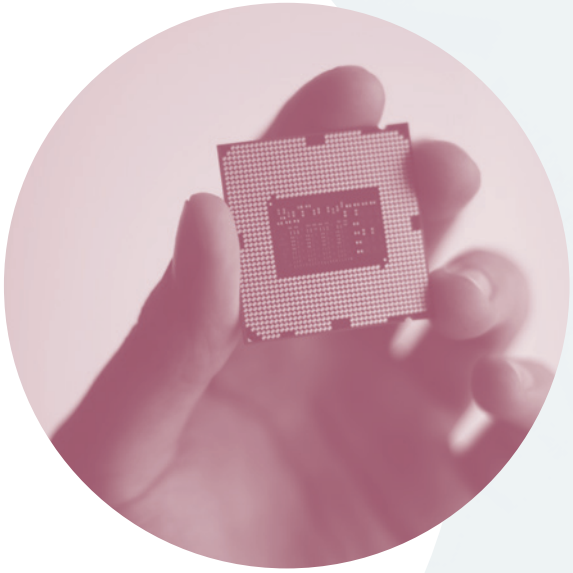




Sources: 2021 PhotonicLEAP

miqu

Passgenaue Weiterbildungen im Mikrotechnikbereich und Stärkung der Wettbewerbsfähigkeit durch Zusammenarbeit.



Koordinierungsstelle für Weiterbildungsverbünde in der Mikrotechnik

aus dem Projekt KoWeMi
(Laufzeit April 2021 - März 2024)

Weitere Informationen unter
www.miqu.tech

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IVAM.

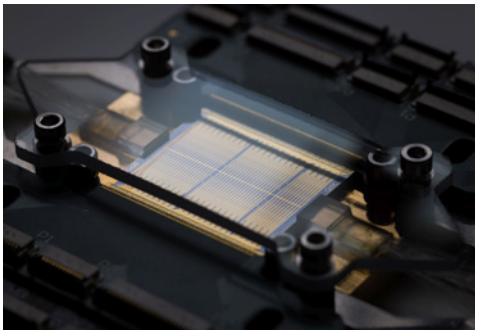
COMPAMED Innovation Forum 2022: High-tech medical technology as hope for neurological diseases

Source: pixabay

According to WHO estimates, one billion people worldwide suffer from diseases that affect the brain or the entire central nervous system. Including for example depression, dementia, epilepsy, Parkinson's disease or the consequences of a stroke. The COMPAMED Innovation Forum this year will therefore focus on innovative high-tech therapy approaches for neurological applications: Innovative medical technology can help improve the quality of life of those affected. Unlike drugs, which help regulate the chemical system in the human body, neuroimplants target the electrical nerve pathways of the spinal cord and brain. The international expert forum will take place as a digital event on „Innovative Technologies for Neurological Applications" on June 2, 2022. At this year's COMPAMED Innovation Forum, leading international experts from the field of neurology will present innovative technologies and therapeutic approaches such as advanced brain-computer interfaces and neuroimplants, mind-controlled assistance systems or novel systems for the detection and diagnosis of neurological disorders. Furthermore, topics such as optimized material properties for the use of medical technology components in neurology will also be addressed. Following the presentations, there will be the opportunity to discuss the new developments, research results and further needs. The COMPAMED Innovation Forum addresses current medical technology challenges once a year. The focus is always on the dialog between research, industry and medical practice. The presentations also provide an outlook on the trend topics of COMPAMED, which takes place annually in Düsseldorf in the fall. The IVAM Microtechnology Network organizes the digital forum in cooperation with Messe Düsseldorf.

IVAM Microtechnology Network, Orkide Karasu, Email: ok@ivam.de

QuiX Quantum launches new quantum photonic processor



Source: PHIX bv

QuiX Quantum, the market leader in photonic quantum computing hardware, announced the commercial launch of the world's largest photonic quantum processor. The processor, which was developed at QuiX' facility in Enschede, the Netherlands, outperforms the current generation of processors by almost a factor of 2. The new quantum photonic processor has a record number of qumodes (20), and the highest operating specifications on the market. With this new product, QuiX Quantum continues to push the envelope of photonic quantum computing.

Quantum computing will revolutionize the way we process information, in fields such as machine learning, chemistry and finance, because of its ability to outperform supercomputers at certain computational tasks. A quantum photonic processor is a device that can be used to manipulate light for computations. Such processors are the heart of a photonic quantum computer – a quantum computer that uses particles of light as the basic information-carrying units. There are two things that matter for a photonic processor – quantity and quality. Quantity here means the number of qumodes that the processor can support. Qumodes are the optical equivalent of qubits, the basic information carrying units in the computer – this number should be as high as possible. The quality of the processor is set by the amount of light which is lost when traversing over the processor – the less the better. QuiX Quantum has succeeded in producing a processor which has simultaneously very low optical losses and the largest number of qumodes. With this product launch, QuiX Quantum solidifies its position as the global market leader in photonic quantum computing hardware. QuiX' products distinguish themselves from the competition not just due to their excellent specifications, but also due to their commercial maturity: the system is plug-and-play, and compatible with a large number of other pieces of quantum photonic hardware including all photon sources and detectors currently on the market. For these reasons, QuiX' products have become the de-facto standard for photonic quantum computing across Europe, including the French, German, British, and Hungarian quantum ecosystems. QuiX Quantum is a quantum technology firm located in Enschede, the Netherlands, and is a spinout of the University of Twente, with the main investors being Forward One and Oost NL.

Quix Quantum B.V., Email: info@quix.nl, https://www.quixquantum.com/

Apply now for IVAM Marketing Prize Asia @MMA in Singapore

The participation is open to exhibitors of MMA 2022 only. All finalists will be required to conduct a presentation on-site. All applications must be completed and submitted before April 30, 2022. Criteria of the jury for evaluation are made up of three main components marketing concept (strategic approach, authenticity, target group orientation, marketing tools and activities,) scientific/Technological Contents (topicality, information content, applications), visual Appearance (structure, creativity, originality, entertainment, aesthetics, technical quality).

The winner of the IVAM Marketing Prize Asia @ MMA will receive one year of free membership with the international IVAM Microtechnology Network as well as one full-page full-color advertisement in MEDICAL MANUFACTURING ASIA 2024 Show Update (worth SGD 1,200) with circulation to 45,000 industry professionals. Additionally the winner gets a prize trophy and certification sponsored by MMA and is featured on IVAM's communications channel across the world.

Marketing-Award@IVAM.com,
https://www.medmanufacturing-asia.com/pdf/IVAM-Marketing-Prize-Asia-Nomination-Form.pdf

Company and product news

Bartels Conference 2022: Bringing together the Life Science industry

The Life Science industry is moving and transforming rapidly. So, it can be hard to keep up. The "Bartels Conference – Next up in Life Science" wants to offer a focused and condensed outlook into the near future of Life Science. The virtual conference will feature industry experts and key opinion leaders. The event will be held on May 12, 2022, from 1 pm to 5 pm CET. To make it easy to join, the conference is online, free of charge and completely in English. In addition to the thought-provoking presentations, there is room for interactive discussions and to connect with the speakers and other participants. Participants can share their experiences and get a look at new technologies.

With the Bartels Conference, Bartels Mikrotechnik is launching a very own online format to bring together experts, professionals and newcomers of the Life Science community. The goal is to create a platform to share experiences and to take a look at what is to come. "Next up in Life Science" means figuring out the best steps to ensure successful future in this fascinating industry. Agenda and registstration are available at https://www.bartels-mikrotechnik.de/en/bartels-conference

Bartels Mikrotechnik, Alicia Thiehoff, Email: thiehoff@bartels-mikrotechnik.de, https://www.bartels-mikrotechnik.de/en/bartels-conference

Eco-friendly new extension building

In July 2020, AEMtec GmbH located in Berlin, began the construction of its new extension building in order to accommodate its growth in its microelectronic and micro optical assembly businesses. Despite the challenges of a pandemic, the building was completed on time. Meanwhile employees from administration, development and production have moved into the new premises. The switch of the existing production equipment, as well as the addition of new equipment runs according to the scheduled timeline and the first production processes in the new building have already begun. With the new extension building, AEMtec achieved the doubling of its office and production space and is in a good position to meet increasing customer inquiries and demands for state-of-the-art technologies. AEMtec continues to invest into modern high precision manufacturing equipment so that their services can be further be expanded. With the addition, the entire building now comprises around 9,000 sqm, which includes 3,000 sqm of cleanroom area.

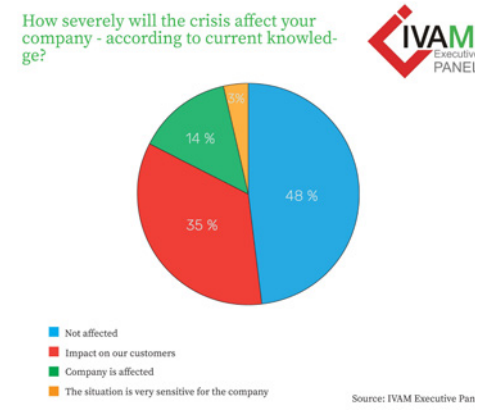
Source: AEMtec

To contribute to a positive working atmosphere, AEMtec offers well-appointed meeting lounges for exchange between colleagues while drinking a cup of coffee. Furthermore, a multifunctional room to be used for company events has also been established. AEMtec already attached great importance to sustainability in the past. Consequently, for the extension building eco-friendly materials were used and an internal heat recovery system was installed. AEMtec strives for CO_2 neutrality and its certification.

AEMtec GmbH, Rena Vignold-Heinze, Email: rena.vignold@aemtec.com, https://www.aemtec.com/

War in Ukraine also affects the high-tech industry:

The Russian attack on Ukraine does not remain without consequences for the high-tech industry in Europe. In an executive panel survey, the IVAM Microtechnology Network has obtained the current sentiment regarding the Ukraine crisis among selected executives of the micro and nanotechnology industry. When asked whether the company or institution is affected by the war in Ukraine, 48% answered that the crisis does not currently affect them. In the other answers, 35% said that their customers are directly affected and thus they are indirectly confronted with the consequences of the crisis, 14% said that their business is directly affected and 3% said that the current situation is even highly critical for their own company.



When asked whether the response in the form of sanctions by the EU and the German government can be judged as appropriate, a clear picture of opinion emerged: None of the respondents answered that the sanctions were felt to be too drastic or that no sanctions should be imposed. All respondents judged the measures adopted to be appropriate or wished for even tougher sanctions against Russia. The industry experts surveyed expect the crisis to have a significant impact on Europe's high-tech industries in the medium to long term: 52% of those surveyed expect the crisis to have a significant impact on the technology scene. 3% even said they expected devastating effects. While 14% are still unsure whether there will be noticeable effects in the industry, 31% are confident that there will be no impact for them. IVAM CEO Dr. Thomas Dietrich on the impact of the crisis on the European high-tech industry: „Our full solidarity is with Ukraine, its people and its companies. We and the organizations in our network strongly condemn Russia's invasion and are fully behind the sanctions imposed. The crisis is massively affecting the high-tech industry in Europe and we hope for a ceasefire and a return to resolving conflicts through diplomatic channels. Peace in Europe is an essential prerequisite for international trade, interdisciplinary research and innovation culture, and thus for the well-being of all people." The IVAM Executive Panel is a group of selected executives in small and medium-sized high-tech companies in the micro- and nanotechnology industry. Within the panel, the IVAM Microtechnology Network conducts short surveys on current topics in the fields of business, politics or society.

IVAM Microtechnology Network, Dr. Thomas Dietrich, Email: td@ivam.de

IVAM trade shows and events

Mid-Week Coffee Break - April 2022
April 20, 2022, Zoom-Meeting
Virtual technology talk between IVAM Members:
Sandvik Materials Technology
https://www.ivam.de/events/mid_week_coffee_break_april

IVAM Hightech Summit 2022
May 5, 2022, Dortmund, DE
Solutions for Sustainabilty
https://www.ivam.de/events/ivam_hightech_summit_2022

Business Growth Solutions: Organize Growth Community - Insights - Exchange
May 11, 2022, Zoom-Meeting
Online-workshop on „Organize Growth“ together with our partner Metaplan
https://www.ivam.de/events/business_growth_solutions_organize_growth

Mid-Week Coffee Break - May 2022
May 18, 2022, Zoom-Meeting
Virtual technology talk between IVAM Members:
Hahn-Schickard
https://www.ivam.de/events/mid_week_coffee_break_may_2022

COMPAMED Innovation Forum 2022
June 2, 2022, Zoom-Meeting
Innovative Technologies for Neurological Applications
https://www.ivam.de/events/compamed_innovation_forum_2022

IVAM Focus Group Photonics
June 13, 2022, Zoom-Meeting
Photonic in the automotive industry
https://www.ivam.de/events/ivam_focus_group_photonics_4

Europe meets USA 2022
June 30, 2022, Zoom-Meeting
Microtechnologies as a Key Enabler for Life Science Applications
https://www.ivam.de/events/europe_meets_usa_2022_digital_

W3 Fair+Convention
July 6-7, 2022, 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”
https://www.ivam.de/events/w3_fair_convention_2022

CMEF 2022
August 21-24, 2022, Shanghai, CN
Asia Pacific‘s leading medical industry platform.
IVAM will organize a joint pavilion.
https://www.ivam.de/events/cmef_2022

Medical Manufacturing Asia 2022
August 31 -September 2, 2022, Singapore, SG
Manufacturing Processes for Medical Technology Exhibition and Conference
https://www.ivam.de/events/medical_manufacturing_asia_2022

COMPAMED
November 14-17, 2022, 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“.
https://www.ivam.de/events/compamed_2022

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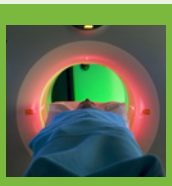
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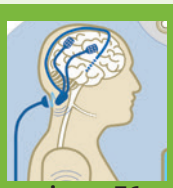
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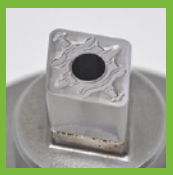
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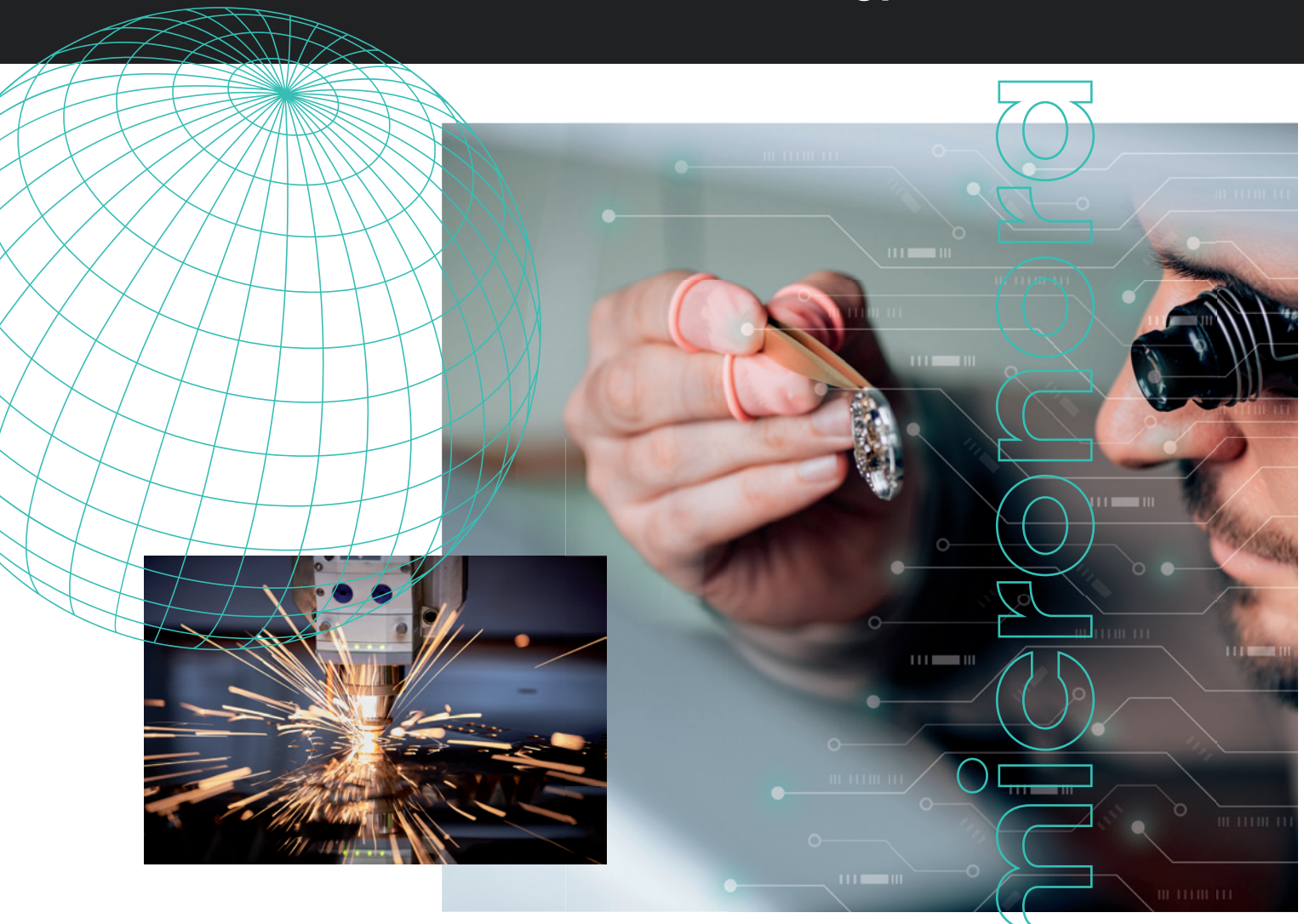
international microtechnology trade fair



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