BNN

02/2022

QUARTERLY

Digital Magazine for Developments in Sustainable Technology

FOCUS TOPIC:

Industrial Biotechnology

Table of contents

Editorial

CONTEMPORARY ISSUES FROM THE NETWORK

The first half of 2022 is behind us and some exciting achievements have already been possible. It is our pleasure to take part in several initiatives that are tailored to enable "scientific collaboration without borders" (as co-initiator, co-coordinator and/or leader). For more than ten years we have continuously put effort into developing and maintaining communities; this seems to be paying off now during these tricky times of being (physically) separated from each other and lacking opportunities to interact. Some highlights are: on the regional level we manage 3 technology platforms in the fields of nanomedicine, microfluidics and sustainable chemistry, the Austrian project NanoSyn3 which is the collaboration driver for the Austrian nano-community, and initiated the Austrian sustainability platforms community. On the international level, we are co-coordinating the EU NanoSafetyCluster (NSC) as well as INISS-Nano, are partners of the projects NanoCommons (infrastructure), NanoFabNet (nanofabrication hub), and recently started IRISS (global SSbD-network). All these examples involve BNN's community-building efforts and are intended to create synergies through collaboration of stakeholders of different but related disciplines.

Recently, in the frame of the final meeting of the NanoCommons project, so-called NanoWeek2022, the NSC together with the EU-US-Communities of Research (CoRs) held a joint session under the umbrella of "bridging scientific communities". BNN in its role on the NSC-coordination team initiated a specific session to enable participants to (i) get to know the core assets and action areas of each community, (ii) identify ideas, opportunities and contributions for collaboration, and (iii) define common grounds for cross-community collaboration. The thematic areas for this collaboration are Safety-and-Sustainability-by-Design (SSbD); micro- and nanoplastics; environment, health and safety of nanotechnologies/nanomaterials/advanced materials; sustainable materials; chemicals; and processes. If you see yourself and/or your community fitting into these areas AND you are willing to join this global community, please let us know.

You'll notice some differences in the BNN Quarterly (starting with its name) in this edition. We are updating several aspects of our quarterly newsletter in order to improve readability and better serve our members. We hope you enjoy the changes and look forward to hearing your feedback!

Have a nice summer and hope to see you at our Annual Forum back-to-back with the BMT-conference, 27 - 30 September in Tirol.

Sincerely,

Andreas & the BNN–team

BNN News

NEW BNN STAFF

We are happy to welcome our new team member!

Caitlin AHERN

Hello! My name is Caitlin Ahern and I joined the BNN team in April 2022. As I get to know the organization and its members, here is a little bit about me.

A native of Connecticut, I have a B.A. in political science and German from Barnard College, the women's college affiliated with Columbia University in New York City. As editor-in-chief of my college magazine, I was always interested in media and communications and international environments, holding internships ranging from a Madison Avenue newspaper syndicate to the U.S. Department of State.

In 2007 I moved to Austria from the U.S. with the intention of teaching English for one year and then returning to my beloved New York City. I ended up staying permanently! I got an M.A. in International Relations from the Danube University Krems and I got to know many companies in Graz and across Austria teaching business English and freelancing as a translator and proofreader for over a decade.

In 2019 I transitioned to full-time communications work at one of Europe's largest research infrastructures. There I served on the outreach & communications team for the biobanking and biomedical resources community in Europe and led or contributed to work packages for several EU H2020 projects in the life sciences. I especially enjoyed building networks with other science communications professionals and sharing best practices.

At BNN, I am taking over project communications in EU projects DeDNAed, NextGenMicrofluidics, PHOENIX and PRIME, and contributing to DIAGONAL. I look forward to learning more about the project objectives and target audiences to help shape effective communications.

Best,
Caitlin

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2ND MEETING OF THE AUSTRIAN SUSTAINABILITY PLATFORM IN VIENNA

BNN and Dr. Martin Wimmer (Federal Ministry Republic of Austria – Climate Action, Environment, Energy, Mobility, Innovation and Technology - BMK) initiated the 2nd Meeting of the Austrian Sustainability Platform in Vienna on 28 April.

Representatives from the chemical industry, the Austrian natural science sector focusing on sustainability, and representatives from different ministries got to know each other during an intensive exchange. All participants expressed their intention to expand the network and to promote and support the exchange of different areas with the focus on sustainability. Visibility and building up of a strong community in Austria should be raised within the activities of this platform. The community will also link different fields of application, like chemical processes, to the nano-community.

Dr. Wimmer outlined the Environmental Footprint in the European regulatory environment and addressed the European Chemicals Strategy (CSS) in his presentation. He outlined the different SSbD (Safety & Sustainable by Design) criteria and the interrelationships between national and European directives.

The group then articulated the guiding principle that the platform should initiate and accompany the system change in the process industry towards sustainable technological development with a transdisciplinary evaluation.

At the end of the meeting the opportunity was taken and the "SusChem-AT - Executive Summary" from the SusChem-AT strategy paper was handed over to Dr. Wimmer by the three chairs Bettina Mihalyi-Schneider (Technische Universität Wien), Patrick Pammer (Competence Center CHASE GmbH) and Fabian Weinhandl (BDI-BioEnergy International GmbH) and the coordinators of the platfrom Andreas Falk and Melanie Mayr (BNN) in Vienna.

The 3rd meeting of the Austrian Sustainability Platforms is planned for 10 October 2022 in Vienna. The whole network is looking forward to accommodating new members! If you have interest in an Austrian networking platform focused on sustainability, please feel free to contact us!

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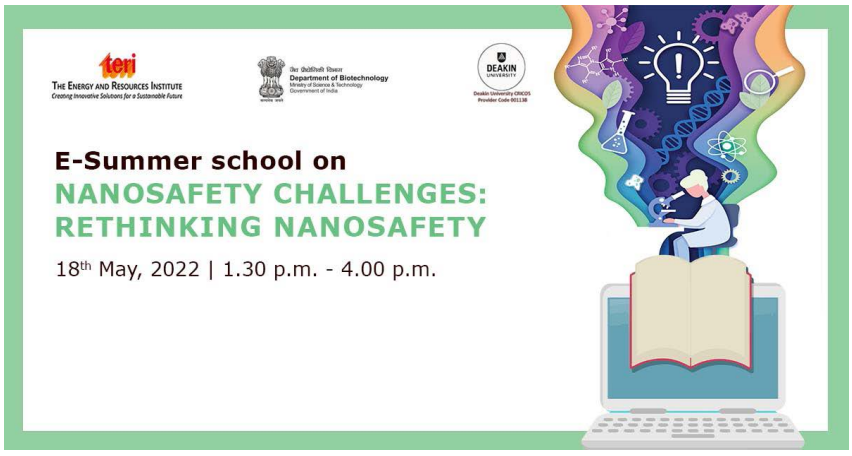
SUSCHEM AT
European Technology Platform
For Sustainable Chemistry
OPERATED BY
BNN

NanoSyn 3
FUNDED BY
Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

→ TABLE OF CONTENTS

BNN @ E–SUMMER SCHOOL ON

"NANOSAFETY CHALLENGES: RETHINKING NANOSAFETY"



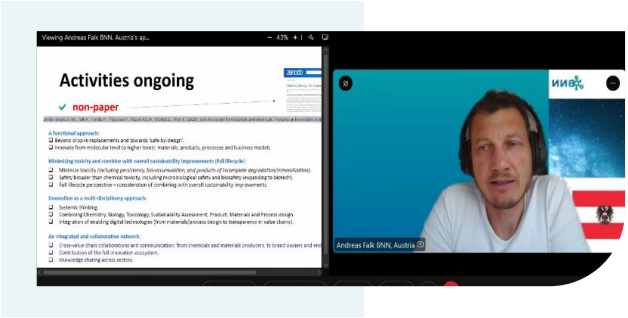
Globally, as multiple nanoproducts are reaching the application and commercial stages, it becomes vital to understand any potential risks associated with their synthesis and application. However, due to unique physicochemical properties these nanoparticles also tend to have complex interactions in environment and interfere with the assays, detection and estimation systems. Factors like these pose great challenge in their overall safety assessments.

The **Teri-Deakin NanoBiotechnology Centre (TDNBC), Gurugram, India**, in association with the Department of Biotechnology, Government of India under "DBT-TDNBC-Deakin-Research Network (DTD-RNA)" for learning and innovation across the continents, organized E-Winter School program on "Nanosafety Challenges: Rethinking Nanosafety" on 18 May 2022.

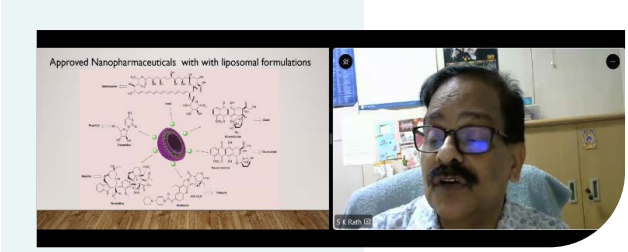
The winter school aimed to spread advanced knowledge about Nanosafety challenges. Young researchers, students, and civil servants participated in this program to gain new insights into the thematic area.

The program began with the welcome address by Dr. Pushplata Singh, Director – Teri Deakin Nanobiotechnology Centre, Gurugram, followed by an introductory virtual tour of TERI and TDNBC nano-research achievements and facilities. The program was moderated by Dr. Palash Kumar Manna, Senior Scientist, TDNBC, TERI.

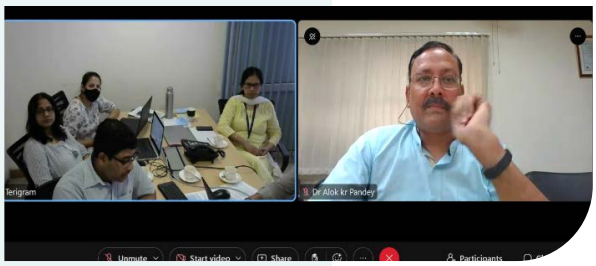
The scientific session started with a keynote by Andreas Falk, CEO of BNN, on Nano-Safety Challenges and the Way Ahead for Global Collaboration. He briefly explained the challenges and focused on leading the way in global research nanosafety partnerships and tackling scientific and societal challenges in various areas.



Dr. Srikanta K Rath, Chief Scientist, Division of Toxicology & Experimental Medicine CSIR-Central Research Drug Institute, India, delivered a perceptive talk on the Safety of Nano Pharmaceuticals. He explained the basics of the safety challenges involved.



The last lecture was presented by Dr. Alok K Pandey, Senior Scientist, Systems Toxicology & Health Risk Assessment CSIR-Indian Institute of Toxicology Research, India, who delivered an insightful talk on Nanomaterial Toxicology: Methods and Challenges. He explained the methods and challenges one may face during the synthesis and characterization of nanomaterials.



After each session, an interactive Q & A session was held. The E-Winter School platform was attended by more than 70 participants across the globe.

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BIONANONET GOLD MEMBER WEBINAR

On 31 May 2022 our BioNanoNet Gold Member Webinar took place with interesting project presentations. The following projects were presented by our gold members:

- FastNanoTox presented by Peter ERTL, Technische Universität Wien
- NanoPAT presented by Christian HILL, Medical University of Graz
- SIXTHSENSE presented by Lucas PALETTA, JOANNEUM RESEARCH
- BreadCell presented by Stefan SPIRK, Graz University of Technology
- SABATLE presented by Claudia MAIR-BAUERNFEIND, University of Graz

We have recorded the presentations for you. You can watch them on our YouTube channel. To download the presentations, visit our website.

Browse our website to find out about the benefits of a BioNanoNet membership. If you are interested in becoming a member, feel free to contact us. We would be happy to have you as member in our association.

These projects have received funding from the European Union's Horizon 2020 Research & Innovation Programme under grant agreement n° 862583, n° 964430 & n° 883315.

Focus topic of this issue:

Industrial Biotechnology

CONTRIBUTION FROM ACIB

Converting CO_2 into High–Quality Protein

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Global CO_2-emissions are rising continuously. At the same time, the world population is growing and with it the production of food. In particular, the demand for high-quality proteins will almost double by 2050. Alternative, sustainable sources for protein production are therefore in high demand. The Austrian Centre of Industrial Biotechnology (acib) and the start-up Econutri are using a special microorganism called Cupriavidus necator to convert the harmful greenhouse gas CO_2 into high-quality protein. The process does not pollute the oceans or land areas and, as an alternative source of food and feed, thus prevents overfishing of the oceans. Furthermore, it is a sustainable answer to factory farming, which is widely regarded as a climate killer.

The global agricultural industry is confronted by numerous challenges: On the one hand, sufficient feed and food must be produced, and on the other hand, this production must be designed to be as resource- and climate-friendly as possible. After all, agriculture is the

third largest CO_2 emitter after the energy and transport sectors and industry. In addition, the security of supply of protein, for example, is not guaranteed across the board in many places - especially in developing countries and conflict areas.

Another challenge is that protein is not only used for human nutrition, but also in large quantities in animal breeding - and is in turn lacking for the food industry. Currently, the main sources used for animal feed are fish meal or protein-rich plant products such as soy. The increasing demand for agricultural land for the production of plant proteins causes the destruction of primeval forest areas. An important CO_2 reservoir is thus lost and climate change is further advanced. Not only that, the production of fishmeal is highly controversial with regard to the already overfished oceans: the biodiversity and subsequently the resilience of the sensitive marine ecosystems are massively disrupted as a result - making the world's oceans even more vulnerable to the climate crisis.

Transforming harmful greenhouse gases into high–quality protein

The Austrian Centre of Industrial Biotechnology (acib) is aiming to develop solutions to climate change and supply insecurity for food and feed. A novel carbon utilization technology is now causing a stir: 'This is a new type of process in which the harmful greenhouse gas CO_2 is converted into high-quality protein,' explains Helmut Schwab, former head of the Institute of Molecular Biotechnology at Graz University of Technology and founding father of acib.

Based on his years of research in this field, the process was developed together with acib and TU Graz researcher Petra Heidinger and her team. Petra Heidinger explains the process: "It is generally known that plants can use CO_2 as a raw material. However, they need sunlight and a lot of space to do so. What is less well known is that there are microorganisms that can also use CO_2 as a raw material. These are called chemolithotrophic organisms. A typical representative is a bacterium called Cupriavidus necator. These bacteria are able to use CO_2 as their sole carbon source, thus completely eliminating the need for sugar or other organic substances from agricultural production as a carbon source." The bacterium requires only hydrogen to implement the process. "At the end of the process, C. necator can store up to 80% of high-quality protein in its biomass– and it does so in an environmentally friendly and space-saving way," adds Helmut Schwab.

Large–scale industrial production planned

The researchers plan to implement concrete applications on an industrial scale very soon. To this end, the Styrian company Econutri- with equity capital of 1 million euros - was founded in 2021. The start-up emerges from acib and the Graz University of Technology. Econutri's goal is to couple bioreactors with large-scale industrial plants as early as in the next few years in order to use CO_2 from waste gases from industrial plants, for example. "Currently, we are building a pilot bioreactor in order to create the necessary basis for an economical bioprocess. Subsequently, the findings will be used in the planning of a large-scale plant to be able to produce proteins on a multi-ton scale in the next few years," ex-

plains Econutri Managing Director Verena Schwab. As a processed, protein-rich biomass, for example, the product can be fed directly to animals, including fish, chickens or pigs. The process helps to avoid polluting the oceans and land: "Biotechnologically produced protein could prevent fish mortality in several ways: by producing feed, numerous species can be protected and fishing can be reduced globally. It could also create an additional, alternative form of food production that does not require cultivation or grazing land and uses fewer resources," explains Econutri co-founder and CSO Helmut Schwab. Currently, agriculture releases up to 37% of all man-made greenhouse gases. In particular, factory farming and the methane it produces, which is 25 times more harmful than CO_2, are considered climate killers. Helmut Schwab: "We are therefore also thinking about producing different protein products for human nutrition, for example protein supplements but also special foods for people with special nutritional needs." The basic technology could also be used to produce environmentally friendly bioplastics.

Greater awareness of environmentally friendly developments

The prerequisite for this, however, is that the population's acceptance of novel, industrially produced foods increases. Industry would also have to make an even stronger structural change toward more environmentally friendly developments "so that our technology can benefit large sections of the population and, not least, prevent climate change," Verena Schwab points out.

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→ TABLE OF CONTENTS

CONTRIBUTION FROM ACIB

Alternative Meat Products for the Reduction of Factory Farming

Current crises and a growing population are causing the demand for meat to rise sharply worldwide. Traditional meat production, especially factory farming, consumes too many of the increasingly scarce resources available, requires too much land and produces the same amount of greenhouse gases as the entire transport sector. Graz-based researchers from the Austrian Centre of Industrial Biotechnology (acib) are researching a new, more environmentally friendly meat alternative. Produced using biotechnological methods, this could be on supermarket shelves in the next few years. With a 95% reduction in space requirements, a tenfold reduction in CO_2 emissions and the avoidance of animal suffering, this new, alternative type of meat has above all climate-relevant and ethical advantages compared to traditional animal husbandry - and market potential worth billions: according to surveys, in 15 years 20% of the meat consumed worldwide will already come from environmentally friendly alternative production processes.

There will be almost nine billion people living on earth in 2050 which will also lead to a massive increase in demand for meat. However, traditional meat production, above all facto-

ry farming, is anything but ecological and is increasingly reaching its limits; the current crises show this particularly clearly: in 2019, 4.8 billion hectares of land, equivalent to more than a third of the Earth's total available land mass, were used for agricultural purposes. Two-thirds of this was used for livestock farming alone. Furthermore, meat production causes about the same amount of greenhouse gases as the entire transportation sector worldwide.

The alternative – meat production with new biological processes

Graz-based researchers at the Austrian Centre of Industrial Biotechnology (acib) and the Institute of Molecular Biotechnology at Graz University of Technology are working on bringing an alternative to our plates in the next few years: Cultivated meat. "The technology of producing animal tissue in the laboratory was originally developed by applied medical research and has already found its way into food production. We are currently focusing on two applications: On the one hand, on the production of alternative meat products and, on the other hand, on the production of animal proteins such as the important iron carriers myoglobin and hemoglobin, which are equally needed for alternative meat products," reveals acib employee Viktorija Vidimce-Risteski. The process relies on the production of "real" meat from tiny, gently obtained meat samples. The natural tissue is propagated in a biological process without animals having to suffer. "Optimally, up to 2 tons of meat can be obtained in this way from a sample just a few millimeters in size" reports acib researcher Aleksandra Fuchs. "The biological process replicates the natural growth of fat and muscle cells. The cells then grow together to form muscle fibers. However, to produce larger amounts of meat, the muscle fibers need special natural factors to stimulate proper growth."

Muscle soreness for meat production

Here, the researchers have once again borrowed from nature - especially from athletes. Muscle soreness after too much athletic stimulus has the effect of increasing muscle fiber volume. Since meat consists largely of muscle fibers composed of individual muscle cells, this process is also interesting for biotechnological meat production: "Growing muscle cells in the laboratory at the highest possible density is extremely complex. In muscle, cells divide only with difficulty if they have too little space," Fuchs explains. The reason for this limitation is the so-called Hippo pathway, which regulates cell division processes and is responsible for ensuring that muscles, for example, do not grow too large too quickly. In meat production, the opposite is required - sustained growth. That's why the researchers are adjusting the signaling pathway to enable the efficient buildup of meat fibers. "With increased muscle load, the body also releases more of certain myokines. These messenger substances stimulate cell division," says Fuchs. A combination of Hippo pathway inhibitors and myokines is therefore used for the new production form. The signal molecules mimic athletic training and stimulate meat production naturally.

More efficient and cost–effective process conditions

"The biggest challenge to date in the production process of natural meat alternatives is the medium in which the fibers are grown. In the bioprocess, this virtually takes over the function of blood: it supplies all the cells with vital molecules, including amino acids, minerals, and other nutrients - and thus enables their growth," explains Vidimce-Risteski. Here, too, the company is working on biological and ethical optimizations: "In the meantime, we have succeeded in completely dispensing with bovine serum - previously necessary and obtained from calves - in alternative production - a milestone in the direction of sustainable, ethical meat production," says the researcher. The new, gentle process is clearly superior not only in ethical but also in economic terms: The cost of bovine serum accounts for up to 95% of the price. By foregoing bovine serum - and thus animal suffering at the same time - the meat alternatives become cheaper and thus more competitive. For media optimization, the researchers are relying on organic producers such as yeast. "By "educating" these yeast strains to produce different components for our growth medium, we significantly reduce production costs," Fuchs explains and continues: "Two years ago, the price per kilo was about $5,000, and the big goal is to bring the price down to about $5 per kilo."

Hemoproteins provide smell and taste

Avoiding animal suffering and low-cost production are only one side of the coin, however, as Vidimce-Risteski explains: "Without the right taste, color, and natural smell, the acceptance of such products is low. These characteristics are directly related to the concentration of two proteins that occur naturally in meat, namely myoglobin in muscle tissues and hemoglobin in the blood. As sources of iron, both also represent important nutrients for humans and make meat a valuable food," says Vidimce-Risteski. Until now, these substances could only be obtained from animals. As one of the first research teams worldwide, the Graz researchers have now also been able to produce animal myoglobins and hemoglobins gently in yeast, "with the aim of producing large quantities of them in the future," says Vidimce-Risteski.

Wider acceptance for alternative meat among the population

For meat products from alternative production to land on our plates in the near future, however, they must be accepted - and eaten - by the population as food. "A more nuanced view of these foods is needed," says Vidimce-Risteski: "A healthy distrust of new things is understandable. But new things also arouse curiosity and, as in this case, have many advantages," she says. Neither rearing nor fattening is required and there is no slaughter of animals, which is why the technology could also be another option for vegetarians to eat ethically. The new products also have a number of health benefits. Considering that over 70% of all antibiotics produced are used in animal breeding, the production of alternative meat is almost entirely antibiotic-free and takes place under controlled, organic conditions. Last but not least, the production requires up to 95% less space and helps to poten-

tially save ten times more CO_2. A key aspect for the triumph of alternative production methods will be their approval as Novel Food by the EU authority: "This involves comprehensive studies to ensure that the consumption of these products has no side effects. And this approval process in turn creates greater confidence," Fuchs is convinced.

Change toward new meat production inevitable

The researchers indicate that - in the long term and once established on the market - the technology should offer an environmentally friendly alternative to factory farming, for example. Small quantities have already been successfully produced on a laboratory scale. However, consumers still have a long way to go before they can buy a gently produced steak in the supermarket. Nonetheless, the Good Food Institute, an international non-profit organization and acib partner in the project, which is looking at new ways of producing meat, believes that the new methods have great market potential: in a good fifteen years, 20% of the meat offered worldwide is expected to come from alternative production methods. In view of the environmental and resource problems caused by the global increase in meat consumption, change is inevitable.

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→ TABLE OF CONTENTS

European Summit of Industrial Biotechnology

When? 14 – 16 November 2022

Where? Graz, Austria

Are you active in industrial biotechnology and looking for something special? Have you always wanted to attend an event that not only covers science but also deals with industrial needs and hopes, economic demands, funding resources or political aspirations and still leaves space for networking and recreation? The European Summit of Industrial Biotechnology (esib) is the European communication platform for industrial biotechnology. Stay tuned!

The Austrian Centre of Industrial Biotechnology (acib) is again organizing ESIB2022 from 14 – 16 November 2022 in Graz.

The previous 3x ESIBs were very successful with each attracting approx. 500 international participants from research and industry. ESIB2022 will have several highly interesting scientific parallel sessions in addition to extensive networking opportunities, pitches and a matchmaking event.

We offer you the opportunity to present your organization and connect to new potential partners and/or customers.

Please find several opportunities for being an exhibitor or sponsor HERE!

More information

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→ TABLE OF CONTENTS

CONTRIBUTION FROM BDI

Styrian Plant Manufacturer BDI–BioEnergy International Opens California's Largest Biodiesel Plant – a valuable contribution to minimizing the ecological footprint

Ribbon cutting of Crimson-BioDiesel plant in Bakersfield; BDI-BioDiesel-plant with patented RepCAT-technology

A valuable contribution to minimizing the ecological footprint

BDI-BioEnergy International has opened a next-generation biodiesel production plant in Bakersfield, California helping make Crimson Renewable Energy the largest producer of ultra-low carbon biodiesel in the western United States. The key innovation: the patented RepCAT technology with a recyclable catalyst. BDI-BioEnergy International is a specialist in technology development and plant construction for biodiesel from Styria, Austria.

Following successful projects in Vienna, Hong Kong and London, BDI-BioEnergy International GmbH has now brought its new RepCAT technology to the US. In partnership with Crimson Renewable Energy Holdings, LLC – the largest low-carbon biodiesel producer in the western United States, including California – BDI has built a new biodiesel plant in Bakersfield featuring the RepCAT technology. The plant will mainly operate with waste oils and fats collected in the local region, especially from central and southern California metro areas. The feedstock comes from restaurants, industrial kitchens and food processors, and rendering facilities.

Developed in Styria, used all over the world: BDI RepCAT technology

To ensure that the biodiesel plant meets the highest standards, BDI-BioEnergy International implemented the latest technology – including the RepCAT process, which was developed and patented by BDI itself. RepCAT stands for "REPeatable CATalyst".

Innovative technologies cut the environmental burden

In the US, California has led the nation in climate change policy and strongly advocates CO_2 neutrality – not least because of the untiring efforts of former governor Arnold Schwarzenegger. Now BDI has helped advance this transition with trailblazing technology for recycling waste. "As a builder of special processing plants, it's our mission to use our innovative technologies for a better environment. We are not just developing processes for safe utilization of waste oils and fats, we are helping the world get closer to the climate targets", says Markus Dielacher, CEO of BDI-BioEnergy International GmbH.

Maximizing feedstock flexibility with a retrofit program

BDI's RepCAT technology makes biodiesel production more efficient and more sustainable. Compared to conventional processes, it is exceptionally flexible in terms of the kinds of feedstocks the process can accept. This makes production more economical, because a great variety of lowest-value waste can be fully exploited. "With this newest generation of biodiesel plant, we can respond to any changes in raw material availability and achieve the maximum possible flexibility," said Harry Simpson, Crimson's CEO. "BDI has been a terrific partner and its RepCAT technology is on track to produce a bit over 13 million new gallons for us per year, removing an additional 135,000 metric tons of carbon dioxide annually." This wasn't the first project BDI did in partnership with Crimson Renewable Energy: it is a sequel to a retrofit project completed in 2016 at the first Crimson biodiesel plant. BDI supplied the technology, the key equipment and the necessary engineering services. With the second plant, Crimson's total annual production capacity in Bakersfield is now more than 37 million gallons.

Markus Dielacher (BDI) & Harry Simpson (Crimson)

To be continued

Currently, BDI is working at full speed on further biodiesel plants using the innovative Rep-

CAT technology for environmentally friendly disposal and upcycling of waste fats to produce high-quality biodiesel. Hermann Stockinger, CSO at BDI: "Our RepCAT technology is already being used successfully in the largest biodiesel plant in Hungary and will soon also be used in Belgium to produce sustainable fuel. The highly efficient use of local resources is an important argument for technology from Styria in this context."

About BDI–BioEnergy International GmbH

BDI-BioEnergy International GmbH is the market leader in the construction of biodiesel plants. The patented BDI Multi-Feedstock process enables maximum waste material flexibility and guarantees highly efficient economic production. The company thus makes a valuable contribution to minimizing the ecological footprint on the part of each individual customer. The range of services extends from contract research and process development to engineering and scale-up services and customer service. Currently, BDI-BioEnergy International GmbH has around 100 employees.

About Crimson Renewable Energy Holdings, LLC

Crimson Renewable Energy Holdings, LLC and its subsidiaries are the largest producers of ultra-low carbon biodiesel in the western United States and one the largest used cooking oil and grease trap collection companies on the West Coast. Crimson biodiesel customers ranging from major oil companies to truck fleet operators and national truck stop chains count on Crimson as a highly reliable supply partner for ultra-low carbon biodiesel to achieve their carbon reduction and sustainability goals. Food service establishments ranging from restaurants and food processors to hotels and entertainment venues all rely on Crimson's SeQuential Environmental Services subsidiary for very dependable, professional waste oil management services. Today, Crimson is one of only a handful companies in the U.S. handling on a large-scale the process from beginning to end: collecting used cooking oil and other waste oils, refining it into biodiesel and refueling fleets, fuel stations and various equipment in our local and regional communities. Thus, Crimson and its SeQuential subsidiaries help deliver critical environmental and economic benefits to the communities and regions where they operate.

BDI also contributes to minimizing carbon footprint and opened the largest waste-based biodiesel plant in Belgium. Read more about it here.

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→ TABLE OF CONTENTS

CONTRIBUTION FROM RECENDT

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RESEARCH CENTER NON DESTRUCTIVE TESTING

MOEMS–Near–Infrared–Spectrometer Technology for Non–Invasive Monitoring of Industrial Bioprocesses

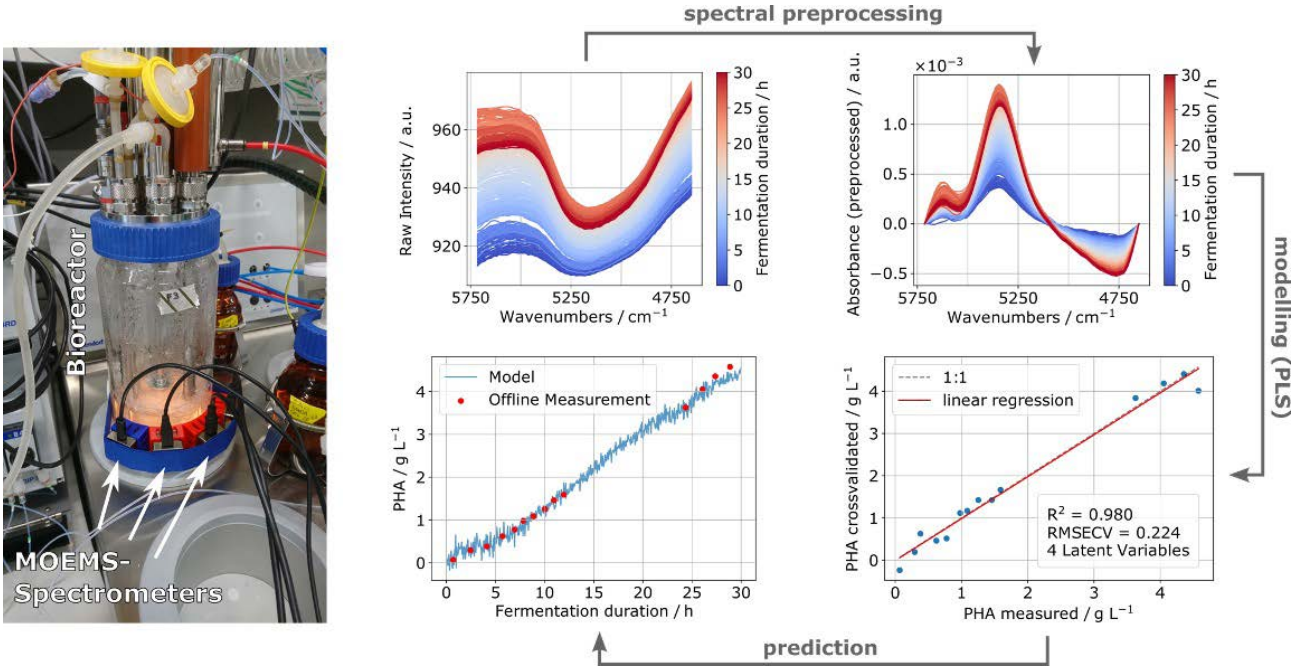

Figure 1: Left – Photograph of the monitored bioreactor with the MOEMS-based NIR-spectrometers attached outside the glass wall. Right – Establishment of a PLS regression model to predict the total concentration of Polyhydroxyalkanoates during the fermentation process.

The Austrian Research Center for Non-Destructive Testing (RECENDT) is solving challenges of the modern biotech industry by developing next-generation spectroscopic measurement solutions using ultra-compact near-infrared sensors.

In industrial biotechnology processes, it is important to precisely monitor the biological, physical, and chemical conditions to guarantee the required product quality and yield. Off line and at line measurements require manual or automatic sampling, often followed by a sample preparation step before the final analysis. These steps can be time consuming and are often unwanted sources of measurement errors. Therefore, the ability of real time in-line monitoring is crucial to increase the efficiency, productivity, and reproducibility of bioprocesses (Lourenço et al., 2012). RECENDT is using modern spectrometer technology based on micro-optomechanical system (MOEMS) technology, with an integrated light source to measure inline data in a non-invasive fashion. The spectrometer is attached to the outside of the bioreactor and near-infrared (NIR) spectra are acquired through the glass wall. This met-

hod allows for real-time monitoring of critical process parameters while also eliminating the risk of contamination.

After already being successfully used for non-invasive inline-monitoring of biomass, penicillin, and phenoxyacetic acid in a *Penicillium chrysogenum* fed-batch fermentation process (Zimmerleiter et al., 2020), this novel approach was recently applied to the production of Polyhydroxyalkanoates (PHA). PHAs are polyesters with increasing importance because they can be produced from renewable resources and are biodegradable. Their mechanical properties are comparable to common petrochemical polymers like polyethylene or polypropylene. Therefore, they have enormous potential to be used as an environmentally friendly packaging and coating material, but high production costs are currently still limiting their applicability. To produce PHAs, the bacterium *Cupriavidus necator* is fed with levulinic and acetic acid to form poly(3-hydroxybutyrate-co-3-hydroxyvalerate) as a storage compound. During this process, we used a MOEMS-based spectrometer to obtain NIR absorption spectra in a completely non invasive way. The acquired raw spectra are preprocessed and subsequently, a partial least squares (PLS) regression model was trained using reference values to extract the relevant information. This PLS regression model allows to predict the total concentration of PHA in the bioreactor from the measured NIR-spectra (Figure 1).

Acknowledgements

This work has been supported by the project "circular economy using selected biopolymers as an example" (BIOCYCLE-UA) by the federal government of Upper Austria and the European Regional Development Fund (EFRE) in the framework of the EU-program IWB2020 with additional funds from the REACT-EU initiative.

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→ TABLE OF CONTENTS

BioNanoNet Member Updates

MEMBER PRESENTATION OF IVL

SWEDISH ENVIRONMENTAL RESEARCH INSTITUTE

IVL Swedish Environmental Research Institute – working for environment and sustainability since 1966

IVL was formed after an initiative from the forest industry and the Confederation of Swedish industry in a period where environmental problems caused by industrial emissions were becoming increasingly apparent in Sweden, especially in connection with the pulp and paper industries. In a unique arrangement, industry and government joined forces and formed a joint state and industry research institute with specific focus on solving the most notable environmental issues of the time such as industrial emissions of pollutants from the pulp and paper industry and severe contamination of both air and water. With this early start, the development of IVL largely coincides with the development of environmental legislation and an increased awareness of the importance of environmental protection in both authorities and industry in Sweden and many other countries.

Today, IVL has broadened into an organization that works with applied research and consulting on environment and sustainability with all major industrial sectors and with the public sphere. The topics of research have also broadened to become more interdisciplinary including the interactions between ecological, economic and social perspectives and with a strong base in system thinking. IVL currently employs more than 350 engineers, behavioural scientists, chemists, marine biologists, biologists, political scientists, journalists, business developers and economists. IVL has extensive collaboration with academia, industries and government agencies, which provides an excellent framework for both development of research directions and implementation of results.

Hazardous substances at IVL

IVL is active in research and consulting on hazardous substances and chemicals in a variety of areas including environmental chemistry, chemicals in products and materials value chains, mitigation of hazardous substance releases as well as regulatory development and support. The transition to a green and sustainable use production and use of chemicals is a focus area and, together with IKEM (Innovation and Chemical Industry in Sweden), IVL leads the SusChem Sweden platform for a sustainable chemical industry.

Research on hazardous substances at IVL is funded via national or EU-grants as well as co-funded projects with industry.

MISTRA SAFECHEM

The Mistra SafeChem Program

IVL leads the Mistra SafeChem program that aims to create a sustainable chemical industry and reduce exposure to hazardous substances. It is financed by Mistra, The Swedish Foundation for Strategic Environmental Research, was granted in 2019 and runs from 2020 to 2024. The Mistra SafeChem consortium consists of two institutes, three universities, one NGO and 13 companies representing the full value chain of chemical production and use.

The vision and overarching aim of the Mistra SafeChem program will be fulfilled by a broad research program focusing on the development of tools, processes and methods with the specific objectives to:

- Develop, test and evaluate innovative industrial production processes for non-hazardous molecules involving enzyme catalysis, and minimal waste processes.
- Develop and apply a robust framework for early prediction and verification of hazardous properties of new molecules or materials using in-silico predictive models, in-vitro tools and advanced chemical/biological analytical methods.
- Develop and apply improved methods for life cycle assessment incorporating hazardous properties of molecules and materials and risks for exposure along the full value chain.
- Conduct a series of case studies where specific design, production and recycling processes, in different levels of the value chain and representing a range of applications, will be evaluated.
- Develop a vision and agenda for expansion and implementation of the Mistra SafeChem concepts into the Swedish chemical industry.
- Initiate the establishment of a permanent platform for Green Chemistry Sweden – where research, innovations and collaborative efforts on safe and sustainable chemical industry can be further developed involving industry, authorities, academia and institutes.

Click here for more information about MistraSafeChem: www.mistrasafechem.se

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AUSTRIAN ACADEMY OF SCIENCES – ITA

Nano–safety Through Standards

Nanomaterials such as nanoplastics or nanosilver are used in many products. For years, tons of particles have spread in the environment. In a new ITA Dossier on nano-safety André Gazsó and his team explain why early risk assessment is crucial.

Read the whole article here.

All About Nano – New ITA Webpage Goes Online

Do nanoparticles endanger the environment? Can nanomaterials in solar panels promote sustainability? All about the ITA's ongoing nano research, important events and current news can now be found on the new NanoTrust webpage.

Read the whole article here.

HUMAN TECHNOLOGY STYRIA

Lejla Pock Becomes Managing Director of the Styrian Human Technology Cluster

On October 1st 2022, Lejla Pock will take over the management of "Human.Technology Styria". She succeeds Johann Harer, who is going into a well-deserved retirement after eight years at the helm of the cluster.

Read the whole article here.

MEDICAL UNIVERSITY OF GRAZ

Immune Cells in the Skin: Protector and Problem

A study in cooperation with Med Uni Graz clarifies their origin

Our immune system is influenced/controlled by a variety of complex and interconnected processes. Mechanical barriers such as the skin or biochemical mechanisms such as enzymes in tears or saliva and immune cells such as killer cells or T cells are only parts of a gigantic system that ensures that our body can protect itself from foreign substances and pathogens. Different parts of this system often work together seamlessly to protect us as best as they can. This cooperation becomes obvious in the case of tissue-resident memory T cells, which are located in the skin and other barrier tissues. These T cells that have a memory were examined in a paper authored by international colleagues and Theresa Benezeder. In the paper, which recently appeared in the prestigious *Science Immunology* journal, the young Med Uni Graz researcher described how cells enter into the skin (or other barrier tissue) and differentiate.

Read the whole article here.

PROFACTOR GMBH

Success Story: INKplant

Customized 3D printed implants promise a new era of regenerative medicine

With a first Open Call launched on April 1st on INKplant.eu, INKplant invites everyone to be part of ushering this era by submitting a new use case idea until 30th of June and obtaining the possibility to freely use INKplant's expertise to realize the new ideas.

Implants made from biomaterials that are precisely customized to individual needs using state-of-the-art 3D printing manufacturing methods: That's the goal of the European research project INKplant, to take regenerative medicine to a new level. The project is funded by Horizon 2020 and coordinated by the production research institute Profactor in Steyr.

Read the whole article here.

RECENT SCIENTIFIC PUBLICATIONS OF BIONANONET ASSOCIATION MEMBERS

View the BioNanoNet members' publications sent to us in 2022 here: BioNanoNet member publications.

All BioNanoNet members are invited to send us their recent publications to info@bnn.at to promote them in our network.

Project presentations & updates

DEDNAED PROJECT UPDATE

DeDNAed Hybrid Meeting - April 2022, San Sebastian, Spain

DeDNAed partners show great progress during their 1st annual meeting held in hybrid format in April 2022

The H2020 FET-OPEN project DeDNAed held a review of their progress after the first 14 months in San Sebastian (Spain); the consortium meeting was hosted by TECNALIA and CIC-BiomaGUNE in hybrid format. Partners were able to join online or to visit TECNALIA's facilities in San Sebastian and meet face-to-face. Discussions on the design of the sensing elements, the design and surface integration of the DNA origami (hybrids) as well as safety aspects were discussed.

DeDNAed project

DeDNAed intends to develop a novel, innovative biosensing platform whose advantages and benefits are in terms of sensitivity, versatility and being ultrafast by an optical approach. The platform will be based on the assembly and integration of sensing elements (trans-

ducer and biological recognition element) by DNA origami. The DNA origami will serve as a "nano-breadboard" in order to precisely control the position of these elements and thus the sensor architecture at the nanometer scale.

How it works

The biological recognition element will be based on metallic nanoclusters and a sensing element (DNA or antibody), which will be assembled on a DNA origami template that will serve as "nano-breadboard" to control the sensor architecture at the nanometer scale. The precise positioning of the biological recognition element in a surrounding nanoparticle array will lead to a significant increase in Raman signal. In this way, Surface Enhanced Raman Spectroscopy (SERS) can detect the signal shift between free and occupied (bound target molecule) recognition elements. This sensor method can be transferred to different biomarker molecules resulting in a high degree of flexibility in the area of application, from medical technology to food monitoring. In addition, the transfer of the DNA origami-based sensor platform to flexible (and/or textile) substrates will be carried out using lipid bi-layers and the Langmuir-Blodgett method for later use as a wipe test or medical wearable.

The DeDNAed interdisciplinary team:

The DeDNAed project consortium includes high-level experts from 7 institutions in Austria, France, Germany and Spain, including research organizations that ensure the implementation of cutting-edge research.

The consortium also enjoyed the team dinner

Their specific expertise fields are:

- Technical University of Chemnitz (Project Coordinator, Germany): Wafer processing, thin-film nanostructuring, surface immobilization/integration
- CIC BiomaGUNE (Spain): Nanotechnology, nanoparticles design, synthesis and characterization
- TECNALIA - Biomaterials group (Spain): Antibodies, surface functionalization
- KSI Meinsberg (Germany): DNA origami design, synthesis and characterization
- University Le Mans (France): Surface Enhanced Raman Spectroscopy
- University Potsdam (Germany): Biomolecular coupling and biosensors
- BioNanoNet Forschungsgesellschaft mbH (Austria): Safe-by-design assessment and communication & dissemination

Julia Hann at the General Assembly

Role of BNN

BNN contributes with two distinct activities. BNN is Work Package Leader in Communication, Dissemination and Exploitation activities. In addition, BNN contributes to the safety assessments of the developed DeDNAed biosensor technology. We will evaluate safety aspects regarding the materials and manufacturing process of the resulting biosensor.

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DEDNAED

This project has received funding from the European Union's HORIZON 2020 research and innovation programme under grant agreement n° 964248.

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→ TABLE OF CONTENTS

HARMLESS PROJECT VIDEO RELEASED

HARMLESS is pleased to introduce a project overview video presenting the main concepts and ideas behind the project.

Advanced materials with improved properties are being developed which should be safe for ecosystems and humans and protect our natural resources. These advanced materials are often complex mixtures of multiple components for which routine approaches towards clarifying their safety are of limited use. HARMLESS provides new and integrated tools, which assess the safety of advanced materials during their entire life cycle.

One particular challenge to safety assessment is the use of nanostructures and matrix-embedded small particles, which are becoming more widely used in various products such as paints. When paints are exposed to harsh weather, they degrade over time and small particles, potentially including sizes of less than 100nm, or 100 times smaller than a strand of hair, can be released into the air, soil or water. Similarly, small particles can be released from certain plant protection products when bags are transferred, or when the product is sprayed onto fields.

In both cases, the release of small particles can be harmful to human health, particularly when particles are inhaled, and to the environment, especially since small particles often react

stronger and may be transported differently throughout air, soil, water and organisms than large particles. HARMLESS provides new and integrated tools for safety assessment of products containing advanced materials throughout their entire lifetime.

This Safe-by-Design approach refines the components of newly developed products with respect to shape, composition and many other parameters, during the various stages of product development until an adequate balance of safety and functionality is reached. HARMLESS supports industry in making the right decisions on the most sustainable and harmless materials to choose for making functional and safe consumer products for a wide range of different sectors from construction, to catalysis, manufacturing, and agriculture.

Role of BNN

Safe Innovation Approach, Stakeholder engagement, Graphic Design, Communication & Dissemination

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HARMLESS

This project has received funding from the European Union's HORIZON 2020 research and innovation programme under grant agreement n° 953183.

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→ TABLE OF CONTENTS

HI-ACCURACY CONSORTIUM

M26 MEETING GRAZ, AUSTRIA

Hi-Accuracy consortium team, Graz, Austria, May 2022

The Hi-Accuracy project co-ordinators, Joanneum Research, hosted the latest consortium meeting in Graz, Austria. Fortunately, many partners were able to travel and attend the meeting in person, while others opted to join remotely.

Alexander Blümel, Andreas Rudorfer and Herbert Gold, all of Joanneum Research, welcomed the team and led the two-day programme of meetings. The consortium was able to discuss the progress of Hi-Accuracy to date and develop a strategy for the remainder of the project's duration - the aim being to catapult the project forward, towards completion and commercialization in 2023.

Much of the discussion centred around how the team would overcome the technical challenges still facing the consortium, specifically the development of test structures that will be the foundation of Hi-Accuracy's final demonstrator screen devices. There was excellent input from the work package leaders and contributors that stimulated debate among the whole project team.

We were grateful to Susanne Resch, of BNN, who facilitated a second sustainability workshop, challenging the consortium members to consider the wider environmental impact of their project workstreams. The team were asked how they could incorporate the principles of 'Safe and Sustainable by Design' (SSbD) in their on-going activities, particularly considering the project's use of nano-particle inks. More detail about SSbD is covered in an accompanying article that can be accessed via the Hi-Accuracy website's repository page.

The team, led by Alexander Blümel, concluded this invaluable face to face, opportunity to discuss the project, with plans agreed for a further 'in person' consortium meeting later in 2022.

Role of BNN

Safe Innovation Approach, Stakeholder engagement, Graphic Design, Communication & Dissemination.

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SEE WEBSITE

→ TABLE OF CONTENTS

GUIDING INDUSTRY IN THE NANOFORM REGISTRATION PROCESS

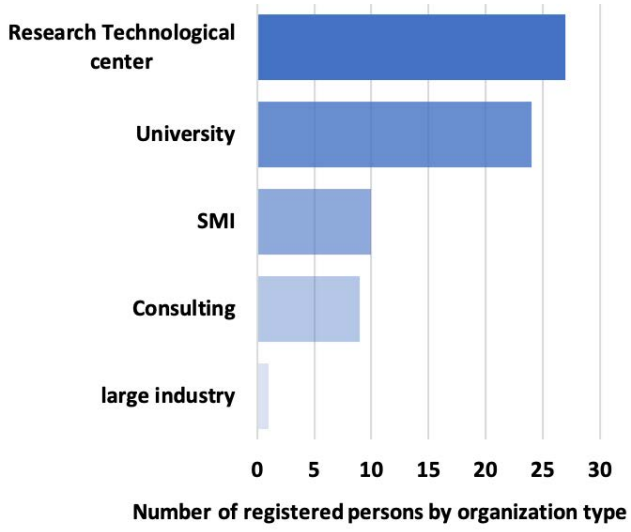
An overview of the requirements by the different regulatory bodies & available infrastructure for safety assessment

On 2 June 2022, the EU H2020 project NanoCommons held an online workshop to increase understanding of the Nanoform Registration Process and support for safety assessments.

The workshop provided an overview of current and future regulations, during a crucial time in which we are seeing many new directives coming into force. The first session provided an overview of the different steps to be implemented in a regulatory framework. The second session provided insight on data to comply with regulations and on the methodology to use. Furthermore, the organizers presented guidance, tools and models available within the NanoCommons Knowledge Base for the different actors of the nanotechnology sector.

Seventy-four participants registered for the workshop and 50 attended - the vast majority coming from Europe, with Spain the most represented country followed by Portugal and Austria. Notably, 5 participants were located outside Europe, namely from Brazil, Argentina, and South Korea.

A breakdown of the participants can be shown here:



See the full agenda on the NanoCommons website here.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 731032.

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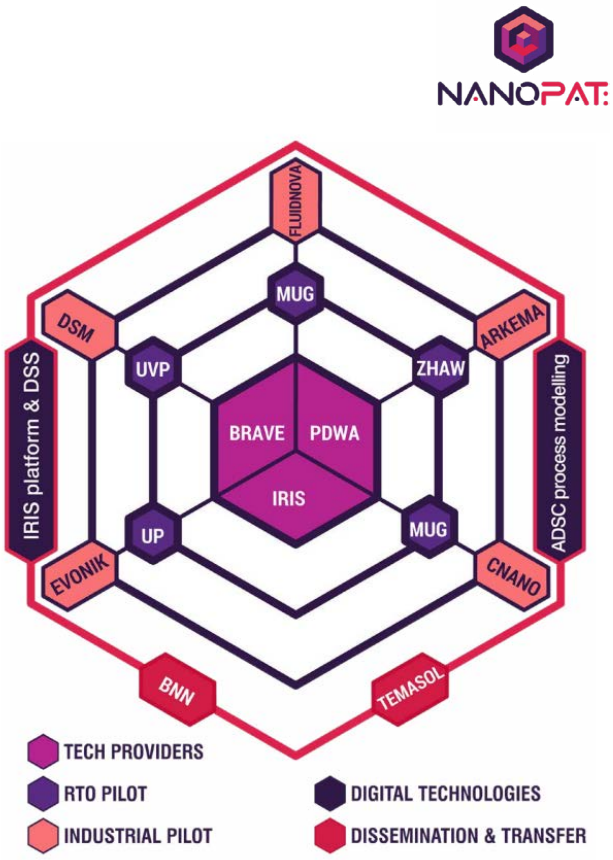
NANOPAT'S STATUS REPORT

The project has finished its second year and many advances have been made so far.

In January 2022, NanoPAT had its first Review Meeting where we showed our Project Officer, and our external expert the progress on the developments within the project, the achievements during the first reporting period, as well as our upcoming plans. They gave us great feedback that will guide us in the upcoming months. During the last six months, NanoPAT has finalized the descriptions of the 5 Case Studies (the nanoparticles to be monitored are polymers, silica, hydroxyapatite, zeolite and ceramic) for the integration of the monitoring technologies and the CFD simulation. The validation process at lab scale of the three monitoring technologies (BRAVE, PDWA, IRIS) has/is taking place in the three RTO pilots (UP, ZHAW and UPV), and the scale-up suggestions on where the different nanomaterial monitoring devices will be placed for the scale-up tests in the industrial pilot plants have been done.

Furthermore, relevant work is being performed between Analisis-DSC and the PAT technology providers for the integration of the three technologies and to prepare the future installation of the sensors/prototypes in the facilities of the end users (Fluidinova, Cnano, Evonik, Arkema, DSM) for the industrial pilot scale validation of the technologies. Once the pilot scale validation is successful and the end users prepare their pilot lines for hosting the prototypes, we will head into the industrial pilot plant demonstration of the technologies.



Overview of the roles of NanoPAT partners

At the same time, a lot of activities are being organized by BNN and TEMASOL towards collaboration with other EU funded projects with similar or supplementary activity. Additionally, the project partners have been very active with the organization and/or participation in conferences and other events to promote their research, as well as external and internal knowledge transfer activities for exchanging ideas internally and with professionals of the industry that are eager to integrate tools that can help us fulfil the common goal. Over the next period, BNN is also involved in the organization of very interesting events for the

dissemination of our results. NanoPAT will be very active in workshops and events in the upcoming months, so stay tuned for more information on this aspect.

Find out more in the NanoPAT Newsletter.

Role of BNN

Training, Graphic Design, Communication & Dissemination

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This project has received funding from the European Union's HORIZON 2020 research and innovation programme under grant agreement n° 862583.

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→ TABLE OF CONTENTS

IMPLEMENTATION OF PDW TECHNOLOGY AT THE INDUSTRIAL NANOPAT PARTNERS

UP/innoFSPEC team at Evonik (left) and Covesto (right)

NanoPAT is being very active this spring as the work on the implementation of the PDW technology at the industrial NanoPAT partners is ongoing.

The fist activity took place on 11 May 2022, when the UP/innoFSPEC team visited the industrial site of NanoPAT partner Evonik in Wesseling (Germany), within the framework of the Case Study 2 of the project, real-time in-situ monitoring of the genesis of nanostructured silica under different precipitation conditions.

On 24 May, the UP/innoFSPEC team visited the facilities of Covestro in Waalwijk (Netherlands), within the framework of Case Study 1 of the project, monitoring particle formation of polyurethane dispersions and polyacrylate emulsions.

During their visits, the UP/innoFSPEC team visited Evonik's and Covestro's R&D labs as well as their pilot and production plants and together with the industrial partners' colleagues they planned the technical implementation of PDW technology at Evonik's & Covestro's labs to explore the full potential of PDW spectroscopy as a potential new PAT in the production process of silica and polymers.

This project has received funding from the European Union's HORIZON 2020 research and innovation programme under grant agreement n° 862583.

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1ST NANOSYN³ JOINT MEETING &

20TH NANONET–AUSTRIA MEETING

Right-hand photo, from left: Alexander Pogany, BMK, Federal Ministry of Climate Action, Enivironment, Energy, Mobility, Innovation and Technology, and Rudolf Heer, Silicon Austria Labs.

It was a great pleasure to have the 20th nanoNET-Austria Meeting on the premises of our nanoNET member Anton Paar GmbH in Graz on 22 April 2022. Due to the invitation of Anton Paar GmbH and support of BioNanoNet Forschungsgesellschaft mbH with the project NanoSyn³ we were able to organize the meeting as the 1st NanoSyn³-Joint Meeting. This enabled us to reach an audience of the Austrian nano-community beyond the circle of members and interested parties of nanoNET-Austria.

During the meeting, we focused on standardization and characterization of nanoparticles and nanostructures in different media. Challenges in surface and pore size determination with gas sorption were highlighted as well. Furthermore, current topics and activities of the Federal Ministry for Climate Protection, Environment, Energy, Mobility, Innovation and Technology (BMK) in the field of production technologies were presented and discussed. The lecture block was rounded off with a report from the nanoNET-Austria network and

an outlook on the planned events, in particular the planned presentations at international trade fairs and delegation trips.

In detail the following invited talks have been given in a hybrid format:

- Welcome Message
  Anton Paar – DI. Gerhard Murer
  nanoNET – SAL – Dr. Rudolf Heer
- Standardisierung als Teil der Risikogovernance emergenter Technologien. Bericht aus dem Normenkomitee 052.73, Nanotechnologie
  ÖAW – Prof. André Gazsó
- Surface Area and Pore Size Determination by Gas Sorption
  Anton Paar – Dr. Elisabeth Turrini
- Feel and measure at nanoscale - in air, vacuum and liquids
  SCL-Sensor – Dr. Ernest J. Fantner
- A BRAVE new way in realtime and continuous particle characterization with OptoFluidic Force Induction (OF2i)
  Brave Analytics – Dr. Christian Hill
- Nanoparticle Analysis with Light Scattering Methods and its use in Biomedical Research
  Anton Paar – Dr. Christian Moitzi
- Overview of nano-activities from the perspective of the BMK
  BMK – Mag. Alexander Pogany
- Report on activities of nanoNET-Austria
  nanoNET-Austria – SAL – Dr. Rudolf Heer

Seven presentations were held in-person and one online.

The presentation block was ended with a very impressive presentation of the Anton Paar product portfolio in the laboratories and a guided tour through the production lines.

We were pleased to hold this meeting after a long time in the form of a face-to-face workshop with great support from Anton Paar GmbH. This gave us the chance to reach an audience of over 30 people in-person and online.

This event was funded by the project Nano-Syn^3.

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→ TABLE OF CONTENTS

LAUNCH OF THE EUROPEAN RESEARCH AND INNOVATION PARC PROGRAMME TO IMPROVE CHEMICAL RISK ASSESSMENT

Group picture of all in-person participants at the Cité des Sciences et de l'Industrie, Paris.

In May 2022, the European Partnership for the Assessment of Risks from Chemicals (PARC) was successfully kicked-off. PARC seeks to develop next-generation chemical risk assessment, incorporating both human health and the environment in a "One Health" approach. It will help support the European Union's Chemicals Strategy for Sustainability and the European Green Deal's "zero pollution" ambition. Bringing together nearly 200 partners from 28 countries as well as EU agencies, PARC is coordinated by ANSES, with funding from the European Commission's Horizon Europe research and innovation framework programme and the partnership's participants.

Launched on 12 May 2022, under the French Presidency of the Council of the European Union, PARC aims to bring together a broad community of research establishments and health agencies to advance research, share knowledge and improve skills in chemical risk assessment. The results of this partnership will be used to support new European and national strategies to reduce exposure to hazardous chemicals and their impact on health and the environment.

The goal will be to generate new, easily accessible and usable data, along with new assessment methods and tools. In particular, PARC will help with the development of tools to identify new, less hazardous substances that are keeping with sustainable development approaches.

PARC has strong ambitions for scientific collaboration, and will provide a unique opportunity for the different risk assessment players to work together above and beyond the schemes and timetables associated with the different sector-specific regulations. By identifying opportunities for pooling efforts at national and European level, it will optimize the resources dedicated to chemical risk assessment and monitoring, and accelerate progress in these areas.

The partnership will build on previous work, in particular the actions undertaken as part of the European Joint Programme HBM4EU (Human Biomonitoring for Europe), which will end in summer 2022. The partnership will build on previous work from different European projects and programmes, like the EURION and ASPIS clusters, EU-ToxRisk and EuroMix.

To date, PARC involves nearly 200 partners from 28 countries, as well as three EU agencies (the European Environment Agency – EEA, the European Chemicals Agency – ECHA and the European Food Safety Authority – EFSA). It is bringing into play public partners across the continent, including European and national risk assessment agencies, universities and public research organizations. Five Directorates-General of the European Commission (DG-RTD, DG-GROW, DG-ENV, DG-SANTE and JRC) and the ministries of the countries involved are contributing to the governance of PARC and will monitor its activities. Fifteen organizations in France are partners in this major project.

The partnership will run for seven years and is scheduled to end in spring 2029. PARC has an estimated budget of €400 million, half of which is being funded by the European Commission and the rest by the partner countries.

BNN will contribute to PARC with operationalization of Safe-and-Sustainable-by-Design (SSbD) criteria and methodologies.

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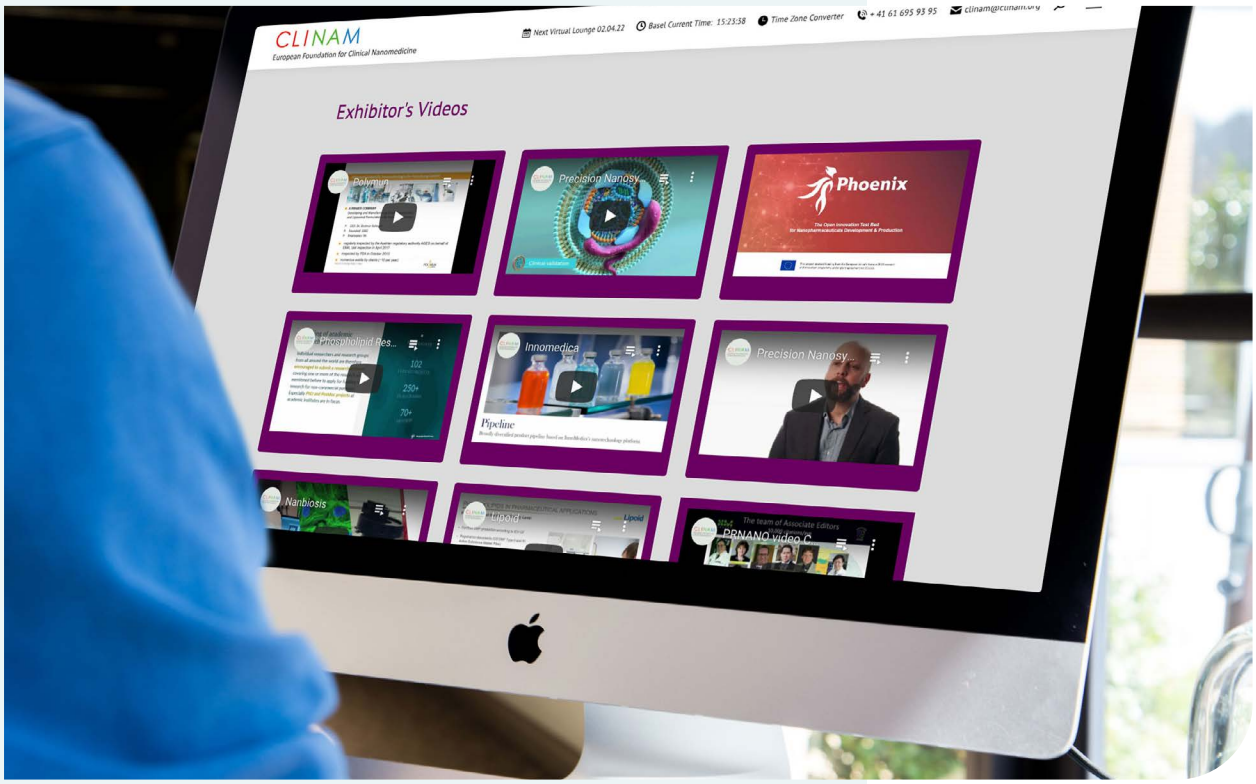
→ TABLE OF CONTENTS

PHOENIX OITB PRESENTED WITH A BOOTH AT CLINAM 2022 CONFERENCE



PHOENIX project was presented within the BNN virtual booth at CLINAM, 2 - 4 May 2022

The European Foundation for Clinical Nanomedicine – CLINAM – celebrated from 2 - 4 May 2022 its 13th European and Global Summit for Nanomedicine, with the subject From Hope to Product – The Brilliant Prospect in Nanomedicine and Related Fields. What was achieved? What are the future horizons for nanomedicine? The conference took place in live stream.

BNN participated with its own virtual booth at the CLINAM's Virtual Exhibition. Attendees of the conference could learn how BNN supports its members through its different Working Areas (i.e. Innovation, Design of Technology Development, Alliances & Clustering and Complementary Business Support).

BNN's virtual booth also presented how BNN contributes to the development of health & safety issues in the nanomedicine field, i.e. through the participation in the PHOENIX OITB that is the sole Open Innovation Test Bed for Enabling Nano-pharmaceutical Innovative Products, granted by the EU Commission in 2021.

Capabilities, partners and specific Demo Cases of the PHOENIX OITB were featured in a showcase video during the breaks of the program and advertisement available live streams, showing the work, research and outlook to future nano-pharmaceuticals.

More information about the CLINAM conference and BNN's virtual booth can be consulted at:

- conference.clinam22.clinam.org/index.php/programm-22
- conference.clinam22.clinam.org/index.php/virtual-exhibition
- www.phoenix-oitb.eu

Role of BNN

Business development and overall sustainability of the project and the future OITB, dissemination and exploitation activities for marketing purposes and establishing the connections with stakeholders during the project.

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→ TABLE OF CONTENTS

PHOENIX OITB – LEAN, SMART AND COST–EFFECTIVE BIOPRODUCTION IN THE BIOPHARMACEUTICAL INDUSTRY

Meet PHOENIX project partner Leanbio–Pro

© Leanbio-Pro

Biotherapeutics were introduced as pharmaceutical products a few decades ago by means of extraction from either animals or humans, for example coagulation factors, insulin or growth hormone. Manufacture processes yielding these proteins used variable raw materials coming from blood and organs of animals or humans which had extremely variable content of target product as well as of impurities; these were a burden for human health and raised ethical questions.

In the early 1980s, the first wave of recombinant protein pharmaceuticals were approved by regulatory bodies, namely insulin and growth hormone. At that time, molecular biology using E.coli model for the recombinant manufacture of proteins was more a work of art than a standardized tool, and scientists were even considered artists who wrote manuscripts on how to build modified strains.

During the last four decades, tools evolved and knowledge increased exponentially so that skilled scientists could generate hundreds or even thousands of codon-optimized gene sequences, combine them with different leader peptides, use different promoters and test

them across a set of well-known expression systems, like E.coli, Pichia, CHO, etc., to obtain the best combination for protein expression.

Evolution of the technology, however, does not necessarily ensure that a specific protein can be manufactured with high quality and yield in any expression system. As an example, in the best-case scenario for an IgG1, CHO cells might produce up to 10g/L in a fed-batch bioreactor whereas same cells produce a few milligram/L of a coagulation factor. It is also well known that certain enzymes can be produced up to 20g/L in Pichia, whereas the same cells might not even reach a few micrograms for other proteins. In E.coli, titers between 5-8g/L for antibody fragments or certain peptides might not be reproduced with certain enzymes which yield clearly below 1g/L.

An important aspect which has to be taken into account is the manufacture feasibility with regards to quality. This aspect is strongly related to the understanding of the mechanism of action of the target protein in the human body as well as the capacity of the expression system to produce certain post-translational modifications and other aspects such as route of administration of the drug.

Biopharmaceuticals have been in the top sales for the last decade and with the influence of pandemics the sector is currently booming. Most products registered in EMA and FDA are Biologics and top sales pharmaceutical products are mainly Biologics.

It is important to mention though that although huge investment is done and tools are evolving to facilitate manufacturability of products, it is still a complex matter from a science and technology perspective and there is a cost barrier for a big part of companies, meaning that only a limited number of companies have resources to successfully execute programs from research to market and create a pipeline of products.

The open innovation approach for New Biological entities and Biosimilar opportunities has enabled many pharmaceutical companies, traditionally focused on small molecules, either new products or generics, to take the wave of Biopharmaceuticals.

Leanbiopro is a CDMO specialized in the development and manufacture of recombinant proteins with more than 20 years of track record being able to provide service to third parties across all the value chain of research, development and manufacture to support from POC, preclinical supply, clinical supply and market supply using either microbial or mammalian systems.

Leanbiopro and PHOENIX

Leanbiopro participates in the PHOENIX project as a continuation of previous national and European framework programs which funded the development of a nanoencapsulated form of GLA enzyme. GLA corresponds to the drug substance of Fabrazyme, a product used for the treatment of lysosomal disease identified as Fabry disease. This indication has a market of 1.3 billion dollars/year and is currently covered with a variety of treatments, where the most important correspond to Fabrazyme and Replagal.

Leanbiopro tasks in the project relate to the generation of CHO cell line, development of a

manufacturing process at Bench scale, scale up to industrial scale and supply for nanoencapsulation development, pilot and industrial scale manufacture.

Leanbiopro CHO platform provides excellent expression level for this extremely complex molecule and is benchmarked in terms of quality to reference product providing a highly comparable product batch to batch and versus reference standard. Current tasks are related to the routine supply of several grams of the highly pure drug substance for its nanoencapsulation for non-clinical and clinical programs.

Leanbio is a privately owned company located in Barcelona with a mission to facilitate access of expensive drugs to society. The main values of the company are related to sustainability, both from a social and environmental perspective, enabling sustainable public healthcare systems in the era of climate change. Please contact them by email, LinkedIn or their website for any request for proposal or licensing opportunity.

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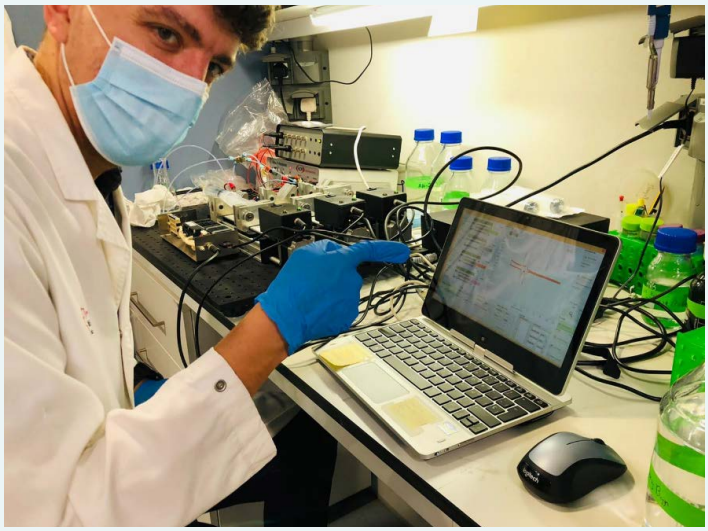
This project has received funding from the European Union's HORIZON 2020 research and innovation programme under grant agreement n° 953110.

SEE WEBSITE

→ TABLE OF CONTENTS

SABYDOMA'S TECHNOLOGY TRANSFER ACTIVITY



Martí using the control software to form a lipid monolayen (left), Martí preparing a mercury sensing element (right)

As the project advances and the technologies are being developed in the different organizations, the technology transfer between universities/RTOs and industrial partners starts.

From 17 – 20 May 2022, Will Stokes from University of Leeds (UNIVLEEDS) travelled to the facilities of Applied Nanoparticles (APPNPS) in Barcelona for commissioning the Biomembrane Sensor, i.e., transfer the biomembrane sensing equipment, developed by UNIVLEEDS, to APPNPS as part of Case Study 1.

During this visit, Martí Busquets Fité (APPNPS) received training on various tasks required to operate the system, include the formation of a Mercury sensing element and lipid membrane required for performing cytotoxicity assays. Both partners, UNIVLEEDS and APPNPS verified that the duplicated equipment gave a similar response to the original system, by performing a sweep of assays on Silver Nanoparticles fabricated by APPNPS. APPNPS will now demonstrate the use of the biomembrane sensing equipment in their industrial setting.

Role of BNN

Safety-by-Design, Graphic Design, Dissemination & Exploitation, Stakeholder engagement

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This project has received funding from the European Union's HORIZON 2020 research and innovation programme under grant agreement n° 862296.

Get connected with SABYDOMA on:

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NANOSAFETY TRAINING SCHOOL

Reflections from the NanoSafety Training School in Venice, Italy

From 15 – 20 May 2022, around 120 scientists from the European Nanosafety Cluster (NSC) represented by 15 projects met in Venice to offer the annual Nanosafety Training School – this year, as a hybrid event and under the subtitle "Towards Safe and Sustainable by Design Advanced (Nano)Materials". With around 70 participants gathering on-site (plus 49 who joined online), 22 interactive educational sessions were performed covering the whole variety of current nanosafety research: The overarching motto of the training school was "Transition from Safe-by-Design to Safe-and-Sustainable-by-Design of advanced (nano)materials", as we currently have arrived at the point were the knowledge on genuine nanomaterials that has been achieved during the past two decades within the nanosciences community is now infiltrating emerging research fields beyond (advanced materials, nanomedicine, microplastics, sustainable chemistry, etc.). In line with the above-mentioned motto, the subjects "What they (nanoparticles) are", "Where they go" and "What they do" were investigated from

different perspectives, including also the views of important stakeholders such as industry, regulators and society. These guiding questions are derived from the GRACIOUS framework for grouping of nanomaterials and include topics such as similarity assessment (grouping) and read-across approaches, but also extend to risk assessment and management as well as risk governance or FAIR (Findable, Accessible, Interoperable, and Reusable) data management and data quality assessment. The topics were presented by 50 renowned researchers from the nanosafety community of Europe and the US in an interactive manner.

The speakers and participants had the chance for lively discussions inside the beautiful and traditional Auditorium Santa Margherita of the Università Ca' Foscari Venezia. Thanks to a professional technical team, participants joining online could be integrated well in the sessions. The ones attending live in Venice additionally could enjoy plenty of networking opportunities under the Italian sun in the coffee and lunch breaks. One evening, the attendees moved away from nano topics and instead learned about the history of Venice on a guided city tour. Overall, the participants were very happy with school. Some of their highlights included:

- Getting different perspectives on nanosafety
- "Organization was excellent", "Quality and organization"
- "Venue is exceptional"
- "The community"
- "Networking", "Meeting other young scientists"
- "Food, location and social activities"

This year's main organizer was the SUNSHINE project, together with partners from ASINA, CHARISMA, DIAGONAL, HARMLESS, NanoInformaTIX, SABYDOMA, SAbyNA and SbD4Nano.

However, the school would not have been possible without further support and contributions from CEINT, Gov4Nano, NanoCommons, NANORIGO, NanoSolveIT, RISKGONE, and the EU NanoSafety Cluster.

The scientific and organising committees thank everyone for their support and hope to meet again for the next Nanosafety Training School on the islands of Venice in 2023.

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For a full list of the scientific and organizing committees and further information about the School, please refer to the event page here. The full programme including all details on the presenters, trainers and the content of the session is available here. Educational resources can be found here:

- ✔ The presentation slides are linked under the titles of the full event programme here.
- ✔ Once available in July, the session recordings can be found on the project pages (e.g. SUNSHINE's e-learning page).

These projects have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement n° 952924 (SUNSHINE), n° 862444 (ASINA), n° 952921 (CHARISMA), n° 953152 (DIAGONAL), n° 953183 (HARMLESS), n° 814426 (NanoInformaTIX), n° 862296 (SABYDOMA,), n° 862419 (SAbyNA), n° 862195 (SbD4Nano), n° 814401 (Gov4Nano), n° 731032 (NanoCommons), n° 814530 (NANORIGO), n° 814572 (NanoSolveIT), n° 814425 (RISKGONE).

→ TABLE OF CONTENTS

Outlook

BNN EVENTS & EVENTS SUPPORTED BY BNN

BioNanoNet Member Welcome Webinar

When? 7 July 2022, 13:00 – 14:30 CEST

Where? online

More information

General Assembly & Strategy of BioNanoNet Association

When? 16 September 2022, 11:00-12:30 CEST

Where? online

More information

BioNanoNet Annual Forum & BNN Networking Session (including Call Matchmaking) as part of the pre-event of the BMT conference (on-site event)

When? 27 - 28 September 2022

Where? Hall in Tirol, Austria

More information

→ TABLE OF CONTENTS

Horizon Europe–Matchmaking @BMT2022 (on–site–event)

When? 27 - 28 September 2022

Where? Hall in Tirol & Innsbruck, Austria

More information

BNN's focus session "Nanotechnologies for Safe & Sustainable Biomedical Applications" @BMT2022 (on-site event)

When? 28 September 2022

Where? Innsbruck, Austria

More information

Click here to view all events on our website.

→ TABLE OF CONTENTS

FINALLY

We hope you enjoyed reading the BNN QUARTERLY! Please don't hesitate to contact us if you have any suggestions or feedback.

Our next BNN QUARTERLY will be published in October 2022 and will focus on the topic **Nanomedicine**. BioNanoNet members are welcome to send their contributions regarding this focus topic and also articles about their scientific research by 23 September 2022. Articles on other topics can be published any time on the BNN website.

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→ TABLE OF CONTENTS

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