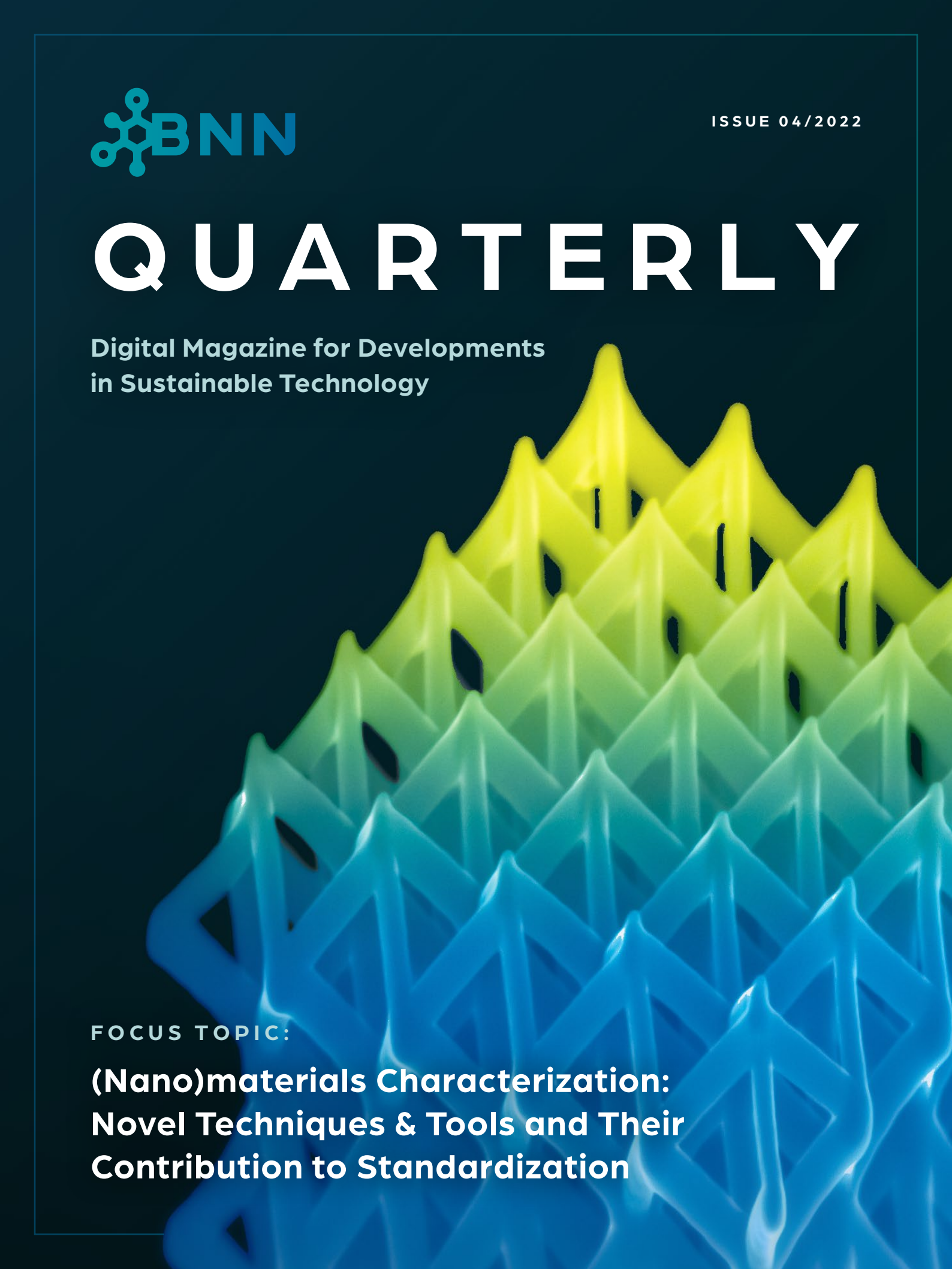
ISSUE 04/2022

QUARTERLY

Digital Magazine for Developments in Sustainable Technology



FOCUS TOPIC:

(Nano)materials Characterization: Novel Techniques & Tools and Their Contribution to Standardization

INNOVATION IS THE KEY.
SUSTAINABILITY LEADS THE WAY.

Cover: Tilted, electron microscopy image of a complex, freestanding 3D nanostructure fabricated via additive, direct-write 3D nanoprinting using focused electron beams. Smallest feature widths are well below 50 nm and composed of nanogranular platinum-carbon materials.

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Editorial

NANO ALL AROUND US

Even if we can't see them, nanomaterials and advanced materials are all around us, and their applications are expanding from sunscreen to medical diagnostics and drug delivery to furniture and beyond. As the use of nanomaterials and advanced materials increases, so does the importance of characterizing them and ensuring their safety and sustainability for humans and the environment.

This month on social media, we celebrated "12 Days of Nanomaterials", to inform a broad public about applications as well as pros/cons of nanomaterials in our everyday lives in a lively, entertaining way.

Fortunately, BNN works with a number of partners who deal with the characterization and analysis of (nano-)materials, using innovative tools and techniques. Several are detailed in this issue, with implications for human health – see FELMI-ZFE and BRAVE ANALYTIC's analysis of nanoplastics in amniotic fluid, IMI's use of NMR spectroscopy to characterize nanoparticles for biomedical research, and Medical University of Graz and UMIT's array of methods for characterizing iron oxide nanoparticles. These methods and techniques are essential for enabling standardized handling of the materials, and thus paving the way towards scientific outcomes.

As I write this, the European Commission has adopted a recommendation to promote research and innovation for safer and more sustainable chemicals and materials to improve the protection of human health and the environment from hazardous substances. Fur-thermore, the Advanced Materials Initiative 2030 (AMI2030) – the focus of our forthcoming Networking Event – progresses well towards an enriched roadmap, guiding the integrative approach of safety expertise paired with sustainability assessment methodologies towards implementation of the SSbD-framework. We are proud to be offering a network for organizations contributing in various ways to the safety and sustainability of chemicals and materials, starting with characterization, but reaching into all aspects of research, development and production.

Be sure to read the updates and recent publications from our members, including the member introductions of new BioNanoNet members, and project reports to stay abreast of recent activities in this space.

Finally, we wish all of our members, project partners, colleagues and friends a safe and invigorating holiday season and a happy new year!

Andreas Falk, CEO

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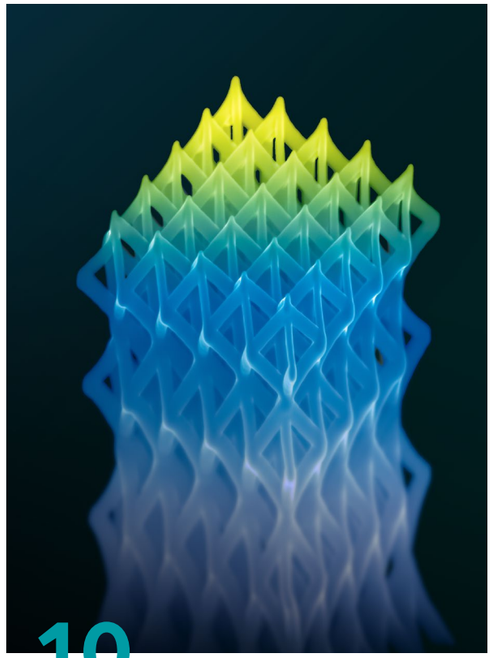

FOCUS TOPIC OF THIS ISSUE:

(Nano)materials Characterization: Novel Techniques & Tools and Their Contribution to Standardization

BNN News

NEW BIONANONET MEMBER

We are happy to welcome our new BioNanoNet member:

Covirabio GmbH

Silver Member, Austria

Covirabio GmbH is an Austrian company aiming to revolutionize infectious disease diagnosis as well as immunity monitoring, thus helping society to move to a "post-covid" normalcy as soon as possible and mitigate or manage future public health threats such as antimicrobial resistance.

Read more

BNN in the gift–giving spirit!

Many people subscribed to our BNN Quarterly by 12 December 2022 and entered into a free conference registration raffle at BioNanoMed or nanoSAFE in 2023. The winner was drawn at random & got to decide which conference to attend, paid for by BNN! **We cordially congratulate Lidia Ferrer who chose a ticket for the BioNanoMed conference 2023.**

PRESENTATIONS & RECORDINGS

BNN hosted a webinar for the Nano-Medicine-Austria platform to inform participants about ways to improve the production of nano-pharmaceutical products.

The webinar took place on 28 November 2022, focussing on **“PHOENIX – The Open Innovation Test Bed for Enabling Nano-pharmaceutical Innovative Products – Presentation of its Open Call & Expertise of the Austrian Partners”**.

After a warm welcome and short introduction, Susanne RESCH, Coordinator of Nano-Medicine-Austria platform, presented the PHOENIX-OITB with its concept and service strategies, workplan and Open Call. This presentation was followed by a talk about “Nanomedicine Austria Digital Process Design” given by Hannes BAUER from the Research Center Pharmaceutical Engineering GmbH and a presentation on "Infrared Raman Spectroscopy for PAT Applications" given by Paul GATTINGER from RECENDT Forschungsgesellschaft mbH. The webinar was rounded off by Susanne RESCH’s presentation "Safe-and-Sustainable-by-Design & its Added Value for Nanopharmaceuticals”.

You can download all presentations here. Watch the recording to learn about the pro bono services along the entire nano-pharmaceutical production chain, and get to know the Austrian PHOENIX partners, who presented their specific expertise.

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Rudolf Heer,
Silicon Austria Labs GmbH © WISTO

2ND NANOSYN3-JOINT MEETING & 21ST NANONET-AUSTRIA MEETING

The 21st nanoNET-Austria Meeting was embedded in the 2022 Millennium Innovation Days on 6 October 2022 and was organized as the 2nd NanoSyn3-Joint Meeting with support of the Smart Textiles platform and BioNanoNet Forschungsgesellschaft mbH through the NanoSyn3 project. This enabled us to reach an audience of the Austrian nano community that went beyond the circle of members and interested parties of nanoNET-Austria.

Rudolf Heer from Silicon Austria Labs GmbH opened and chaired the meeting in his function as president of nanoNET-Austria. He started the SMART TEXTILES & NANO program with a report from the nanoNET-Austria network and an outlook on the planned events, especially the planned presentations at international fairs and delegation trips.

This was followed by the presentation of the activities of the platform Photonics Austria and a presentation on current topics and activities of the Federal Ministry for Climate Protection, Environment, Energy, Mobility, Innovation and Technology (BMK) in the field of production technologies. The scientific and technical session started with the characterization and application of nanoparticles. The first highlight was the presentation of the development process of sensors for the characterization of nanoparticles in exhaust gas streams. The second highlight demonstrated a novel nanoparticle-based method for imaging in biological tissues which was based on the combination of magnetic and plasmonic properties. Finally, the lectures concluded with the presentation of a novel application of nanotechnology for the realization of a copy-proof electronic logic circuits.

In detail the following talks were given in a hybrid format:

- Report on activities of nanoNET-Austria by Rudolf Heer, Silicon Austria Labs GmbH
- Report on activities of Photonics Austria by Heinz Seyringer, V-Research
- Overview of nano-activities from the perspective of the BMK by Alexander Pogany, Bundesministerium für Klimaschutz, Energie, Mobilität, Innovation und Technologie
- Low-cost exhaust nano particle sensing by Tanja Wallner, Silicon Austria Labs GmbH
- Optical imaging using nanoparticle contrast agents with magnetic and plasmonic properties by Stefan Schrittwieser, Austrian Institute of Technology GmbH
- Metal-Semiconductor based Reconfigurable Electronics by Lukas Wind, Technische Universität Wien

The presentations were also live-streamed for an online audience.

The meeting was closed by Rudolf Heer after a Q&A session and a summary of the presented and discussed topics.

We were pleased to hold this meeting after a long time in the form of a face-to-face workshop with great support from the Smart Textiles platform. This gave us the chance to reach an audience of approximately 65 on site plus those joining online.

This event was funded by the BMK project NanoSyn3.

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Talk by Alexander Pogany
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NanoSyn 3
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Federal Ministry
Republic of Austria
Climate Action, Environment,
Energy, Mobility,
Innovation and Technology

FOCUS TOPIC
OF THIS ISSUE:

(Nano)materials Characterization: Novel Techniques & Tools and Their Contribution to Standardization

Image © FELMI at TU Graz & ZFE Graz 2022, Robert Winkler, Harald Plank and Gerald Kothleitner

CONTRIBUTION FROM FELMI–ZFE

Nanoplastic Analysis:

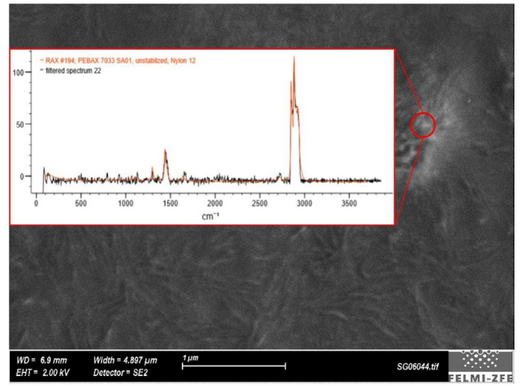
Successes and Future Prospects @ FELMI–ZFE Graz

Nanoplastics are increasingly thought of as dangerous pollutants suspected to be widespread in the environment; thus tools for the detection and analysis of nanoplastics in various environments are critically needed. The challenges to such tools are manifold, such as tiny concentrations, identification of plastics against an organic background and the need to measure a statistically significant number of particles. In recent years, the FELMI-ZFE (Institute of Electron Microscopy and Nanoanalysis – Graz Centre for Electron Microscopy) has been adapting its large variety of microscopic methods to tackle these challenges. A first success was achieved as part of the "HRSM-Project ELMINet Graz" (cooperation of University of Graz, MedUni Graz and Graz University of Technology; financed by Federal Ministry of Education, Science and Research of Austria) by applying correlative SEM-Raman microscopy to detect nanoplastics in amniotic fluid. Now the new interdisciplinary project "Nano-VISION" (FFG-Bridge: 895429 in cooperation with BRAVE® Analytics GmbH and Borkenstein & Borkenstein ophthalmology specialists) is taking things one step further by trying to establish a correlative OF2i®-Raman approach that is more widely applicable.

Correlative SEM–Raman microscopy of nanoplastics in amniotic fluid*

The idea of this proof of principle study was to find nanoparticles, which are too small to be seen by Raman microscopy, with a scanning electron microscope (SEM) and attempt to identify them as nanoplastic by "blindly" aiming the Raman microscope at the suspected particle. The ultimate goal was to screen for nanoplastic particles in amniotic fluid, a challenging but highly relevant environment, provided by our cooperation partners from the Medical University of Vienna.

The suitability of this approach for samples spiked with polystyrene-beads (PS; Ø 200 nm) was shown and even a "native" nylon nanoparticle was detected in the amniotic fluid (see Figure 1). However, a major limitation of correlative SEM-Raman microscopy is that only a limited number of particles can be analyzed. Establishing a new technique that can measure particle statistics is the next logical step.



Nylon nanoparticle found in amniotic fluid by SEM and identified by Raman spectroscopy.

Kick-Off-Meeting of the Nano-VISION project. The project consortium consists of the ZFE Graz, BRAVE® Analytics GmbH und Borkenstein & Borkenstein ophthalmology specialists.

The Nano–VISION Project

As part of the Nano-VISION project, opto-fluidic force induction (OF2i®), a technique that specializes in (nano-)particle statistics, is to be correlated to Raman microscopy. In this approach, a stream of consecutive single particles is trapped by optical forces generated by a strong laser; the size and shape of the particles can be observed from the elastically scattered light and the particle motion (OF2i®). Simultaneously, a microscope observes the inelastically scattered light of each particle, which makes it possible to determine the chemical structure of the particles (Raman microscopy). With this combination it should be possible to measure size, concentration and composition of nanoplastic particles in liquid environments. In addition to developing this method, another case study on medical samples is planned as part of the project.

These ambitious goals require an interdisciplinary team that was assembled by the cooperation of the ZFE Graz (Microscopy, Raman), with BRAVE® Analytics GmbH (OF2i®) and Borkenstein & Borkenstein ophthalmology specialists (medical expertise, case study). The project started in August 2022 and, as you can see, the team is eager to tackle the challenges of nanoplastic detection.

Publication:

** Schmidt, R., Nachtnebel, M., Dienstleder, M., Mertschnigg, S., Schroettner, H., Zankel, A., ... & Fitzek, H. (2021). Correlative SEM-Raman microscopy to reveal nanoplastics in complex environments. Micron, 144, 103034.*

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CONTRIBUTION FROM MEDICAL UNIVERSITY OF GRAZ & UMIT

Superparamagnetic Iron Oxide Nanoparticles:

Essential Characterization

Iron oxide nanoparticles (IONs) are of great interest in many research areas ranging from bioseparation, biosensors and catalysis to nanomedicine. IONs have multiple interesting properties like superparamagnetic (non-remanent) behavior, biocompatibility, non-toxicity, and low-cost production. They have a high surface-to-volume ratio (> 100 $m^2 g^{-1}$), with the potential of a high binding capacity. The classic synthesis routes are co-precipitation via the Massart process (Equation 1), hydrothermal synthesis, or microemulsion.

$$Fe^{2+} + 2\,Fe^{3+} + 8\,OH^- \rightarrow Fe(OH)_2 + 2\,Fe(OH)_3 \rightarrow Fe_3O_4 + 4\,H_2O$$

Coatings with organic or inorganic polymers, bioactive molecules, supramolecular structures, or organic surfactants can counteract the common problems of agglomeration or oxidation of nanoscale iron oxides. Particle composition, size and agglomeration, surface properties, and magnetic behavior can be limiting for a specific application. For use in nanomedicine, e.g., drug delivery or imaging, an ideal hydrodynamic diameter between 10-100 nm can prevent rapid clearance, immune system activation, and thrombosis formation.

Therefore, it is crucial to characterize the IONs fully before usage (Figure 1). A complete characterization allows the design of ideal IONs and an improved understanding of experimental data. For a detailed analysis of the surface of the particles, zeta potential measurements can determine the isoelectric point and the stability behavior of the particles depending on the medium. Further, the zeta potential can confirm a coating or analyze adsorption and desorption conditions. The Brunauer-Emmett-Teller method uses the adsorption of gas molecules to measure the specific surface area. Infrared (IR) spectroscopy measurements can be used to analyze the composition and surface functionalities of IONs. IR spectroscopy analysis uses the dipole character of a molecule and can confirm if a coating or binding of a molecule was successful. The thermogravimetric analysis gives a decomposition profile that can determine the coating thickness or amount of bound molecules.

Raman spectrometry indicates a molecule's covalent character, providing information about the particle's composition and oxidation state. X-ray diffraction is a powerful tool to determine the crystallinity and phase purity of the material, giving information about the crystal type of IONs. Changes in the broadening of Bragg reflections can be used to

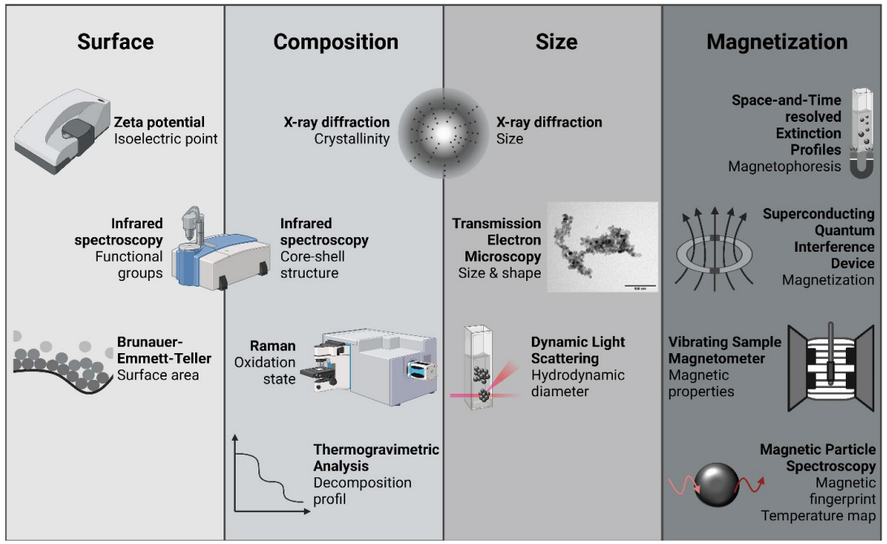

Figure 2: Schematic illustration of different analytical techniques to determine the surface properties, composition, size, and magnetic behavior of IONs. It was created with BioRender.com.

calculate the size of nanoparticles with the Scherrer equation. An alternative tool for size measurements is transmission electron microscopy. It provides additional information about the shape, surface topography, or coating thickness. Dynamic light scattering (DLS) is an optical method based on the Brownian motion of nanoparticles. The Stokes-Einstein law is used to calculate the hydrodynamic diameter based on the scattering of particles dispersed in a fluid. The agglomeration of particles highly depends on their concentration, temperature, pH, and medium composition, making DLS an essential method for generating knowledge of IONs under application terms. Unfortunately, the hydrodynamic diameters of IONs are often only analyzed in water and not under real conditions of use, which can lead to a knowledge gap, missing information, and even misinterpretation of data. Simulated fluids are an excellent alternative to create reliable results if the actual medium is hardly available or expansive. Here, computational fluid dynamic and molecular dynamic modeling are valuable tools for investigating and predicting the particle behavior.

The magnetic properties of superparamagnetic IONs make these materials unique. The term 'superparamagnetic' refers to the behavior of the particle samples showing no hysteresis or remanence magnetization. On the other hand, the particles exhibit a magnetic moment about a thousand times larger than bulk material of the same composition. One important property of concern is the magnetization *M* as a function of an applied field *H*. Several methods can be used to experimentally characterize this relationship. An established technique is direct current magnetometry, e. g. through vibrating-sample magnetometry (VSM), where the magnetic moment of a sample is recorded by measuring a change in voltage when vibrating the sample in a homogeneous applied field by a copper coil or – more sensitively – by superconducting quantum interference devices (SQUIDs).

These sensors are also used in magnetorelaxometry, where the relaxation of the magnetization of a sample is measured after being magnetized by a homogeneous magnetic field. Depending on the size and binding state of the particles, two different relaxation processes from the relaxation signal, the concentration, size distribution and binding states of the IONs in the sample can be obtained. Recently, optically pumped magnetometers have been employed as an alternative sensor concept in MRX. In the last years, Magnetic Particle Spectroscopy (MPS) has evolved as a powerful tool not only quantifying IONS in a sample, but also for their characterization. In MPS, the dynamic magnetic responses of IONs when being exposed to an alternating magnetic drive field is measured.

Due to their nonlinear magnetization behavior, higher odd harmonics occur in the signal measured by a pair of pick-up coils. The MPS spectra, i. e. the higher harmonic amplitude and phase as well as their relationship, are harvested as metrics for different applications. Often the stability and agglomeration behavior of IONs in a specific medium can influence their magnetophoretic behavior stronger than the saturation magnetization itself. The Space-and-Time-resolved-Extinction Profiles (STEP) technology can analyze the sedimentation profile of particles due to magnetophoresis. Although STEP analysis is no standard method to characterize IONs, it is an essential tool to provide knowledge about the usability of IONs in a specific application, for example, nanomedicine. The surface properties and agglomeration behavior of IONs, as well as the composition, pH, and viscosity of a medium, can highly influence their magnetophoretic velocity.

The combination of analytical methods described above provides essential knowledge about the behavior and usability of IONs. A complete characterization allows a better design and understanding of nanoparticles for their specific application and, in the end, successful research. However, practical applications are still hampered in large parts by the lack of standardization of specific characteristics and measurement techniques.

A complete characterization allows a better design and understanding of nanoparticles

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CONTRIBUTION FROM INSTITUTE FOR MEDICAL RESEARCH AND OCCUPATIONAL HEALTH

NMR spectroscopy

Important Tool for Investigation of Processes at the Nanosurface

Widespread biomedical applications of nanoparticles (NPs) prompt the need for mechanistic evaluation of interactions and processes occurring at the nanosurface. These interactions are difficult to monitor by using standard physico-chemical characterization techniques like dynamic light scattering or electron microscopy.

On the contrary, nuclear magnetic resonance (NMR) spectroscopy is a powerful technique for studying weak interactions with NPs and the screening of binding ligands at the nanosurface with atomic resolution.[1,2] Using solution NMR, intermolecular interactions can be monitored with high precision, providing information about structure and dynamics in a range from picoseconds to hours.[1,2] Additionally, this technique can provide information about the structural changes of molecules interacting with nanosurface. This is especially important in the preparation of drug delivery nanoformulations, as drugs may undergo different processes such as oxidation, cyclization, and polymerization when they interact with nanosurfaces. By using NMR technique, Kalčec et al.[3] optimized synthetic protocol for obtaining a stable AuNPs-based drug-delivery system for catechols. Different oxidation products, such as dopaminequinone, may be generated and consequently change the pharmacological properties of such delivery systems. It was observed that molar excess of catechols vs. Au is needed to prevent their oxidation and generation of oxidized products on the AuNP surface (Figure 1).

Intermolecular interactions can be monitored with high precision

Nano-bio interactions need to be explored to understand both the target-specific potential as well as the biocompatibility of such systems. Solution NMR spectroscopy has been successfully employed to characterize the conformation, orientation, and dynamics of the biomolecules involved in corona formation on surfaces of various NPs including those with inorganic (Au, Ag, Si) and organic (polymer, lipid) cores. Pem et al.[4] explored the events occurring in thiol-rich biological media by investigating the interaction of cysteine with small-sized AgNPs and AuNPs. During the interactions of AgNPs and AuNPs with cysteine, oxidative dimerization occurs generating reactive oxygen species (ROS) at the nano–bio interface. NMR experiments revealed that the resulting NPs were coated with cystine and not cysteine. Complementary information on capping ligands can be obtained using solid-state NMR as well.

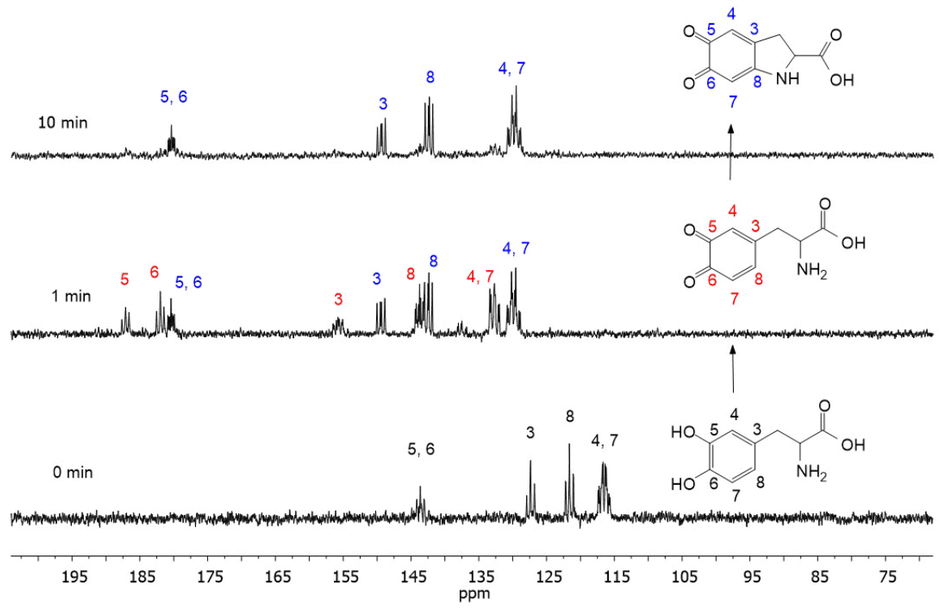

Figure 1. ^{13}C NMR spectra of a) dopamine and b) L-DOPA oxidation processes in D2O (pH ≈ 3; [Au]:[catechol] = 2 : 1)

However, a limited number of solid-state NMR studies can be found in the literature for interactions of NPs with biomolecules. This technique could be useful to understand the interactions of NPs and biological membranes. For this purpose, solid-state NMR measurements can be employed for measuring lateral diffusion in membranes which can be changed due to specific lipid–NPs interactions. Chemical shift perturbations or differential intensity changes for lipid signals may become observable and provide useful information on NPs' interactions with lipid membranes.

In conclusion, NMR should be included as one of the important techniques in characterization of NPs for biomedical applications.

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CONTRIBUTION FROM EMPA –
MATERIALS SCIENCE AND TECHNOLOGY

Empa
Materials Science and Technology

Improving Standardization

through Testing Comparability in Interlaboratory Comparisons

The main goal of standardization is to achieve a better comparability of measurement results over space and time, which is essential to characterize the nanomaterials being developed and produced on a batch-by-batch level. It is important in the process of developing a standard to start early on with testing its performance by interlaboratory comparisons. Empa researchers led by Peter Wick have been focusing on this activity for more than 10 years. In a first study they analyzed the comparability of Dynamic Light Scattering (DLS) measurements[1].

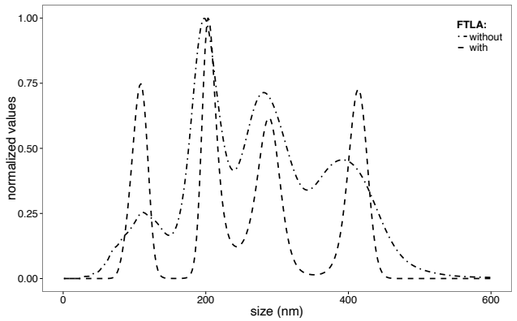

Figure 1: Size distribution of a multimodal sample prior to implementation of finite track length adjustment (FTLA), and following applying FTLA[3]

A considerable effort went subsequently into the development of improved algorithms (FTLA) for the analysis of particle tracks of Particle Tracking Analysis (PTA), which had been initiated by Patrick Hole from Malvern. Consecutive rounds of interlaboratory testing[2,3] together with improvement steps allowed the development of the PTA technique from a rather broad-scale size measurement technique to high-resolution size determination, which allows the adequate separation of complex mixtures (see Figure 1).

As a further step the PTA technology was made fit for the direct measurement of Particle Number Concentrations (PNC), which is compared with other technologies nearly independent of the investigated material types. Figure 2 shows the performance improvement of the result achieved in interlaboratory comparisons due to the applied software correction.

Refinements like this development, which lead to the establishment of new technique-specific standards being released by either ISO or ASTM international, have to be verified by comparing the measurement results of different laboratories, which are using different types of techniques with various instruments and altering operators. A study design measuring different types of particle diameters became a subsequential step. The new investigation[4] included techniques such as scanning electron microscopy (SEM), differential mobility analysis (DMA) and single particle inductively plasma-mass spectrometry (spICP-MS) beside the PTA and DLS. The two techniques spICP-MS and SEM measure the NP core size, as opposed to the larger hydrodynamic diameter determined by PTA and DLS. Monodisperse gold nanoparticles (AuNPs) with varying sizes (30 nm or 60 nm) and surface coatings (citrate, polyvinylpyrrolidone, or branched polyethyleneimine) were investigated and used for the comparison of particle sizes and of PNC. The study demonstrated some of the limitations of direct comparisons between techniques, which are based on different physical principles. Still, such investigations are important due to the requirements of regulatory bodies, which demand complementary information for the (nano)particle characterization. (FDA - Final guidance: Drug Products, Including Biological Products, that Contain Nanomaterials Guidance for Industry, April 2022).

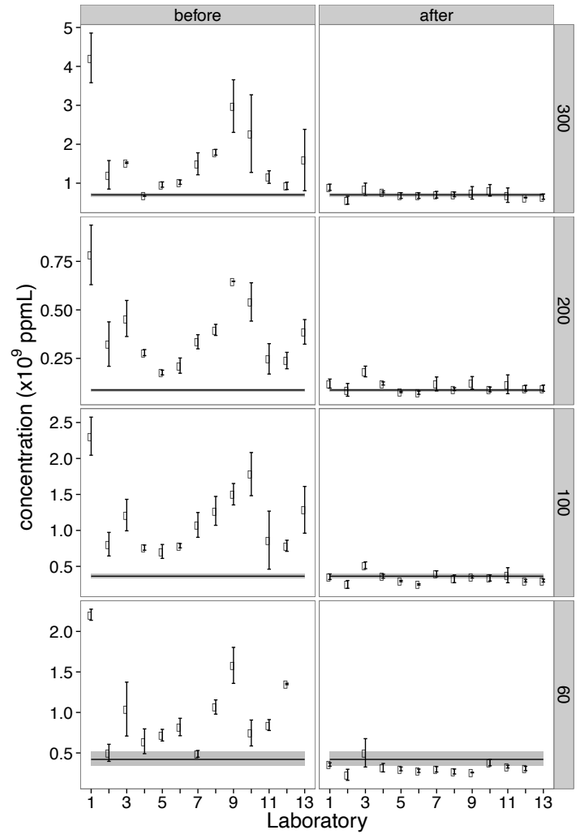

Figure 2: Concentration measurements: statistical analysis of 60, 100, 200, and 300 nm PSL particles before and after software correction for all participant laboratories. [3]

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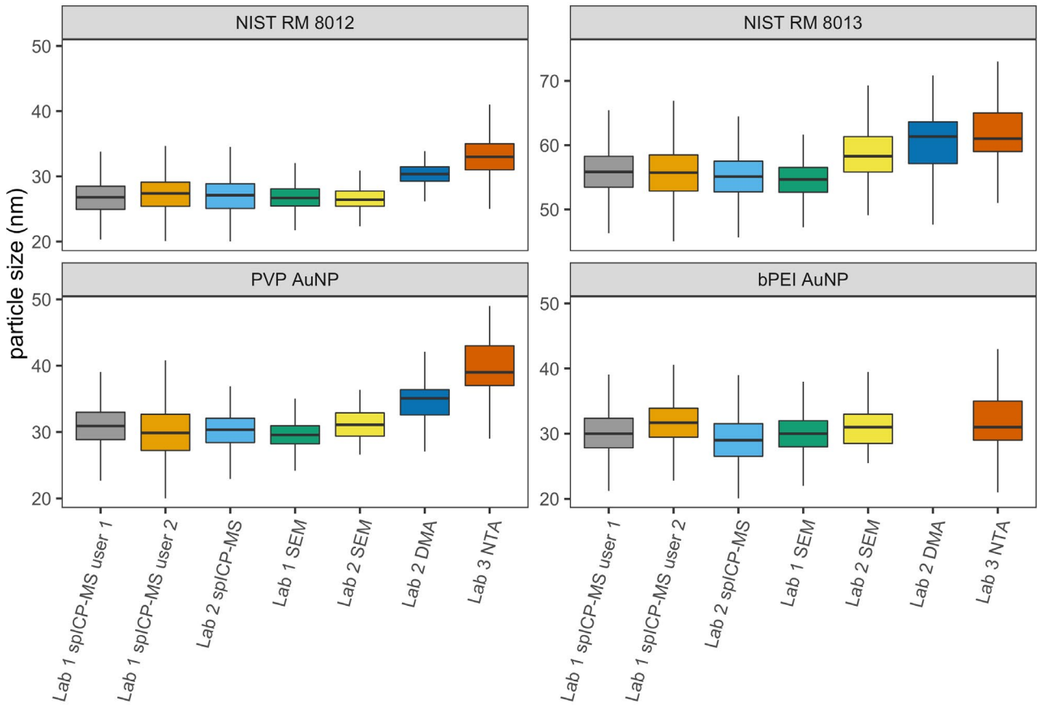

Figure 3: Boxplots for the NIST RM 8012, NIST RM 8013, PVP AuNP, and bPEI AuNP samples. Based on the broad distribution determined by DLS their boxplots are not included. [3]

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How to Achieve Effective Release Rate Testing of Nano–Medicines Using the NanoDis

NanoDis system

CONTRIBUTION FROM MYBIOTECH

MyBiotech

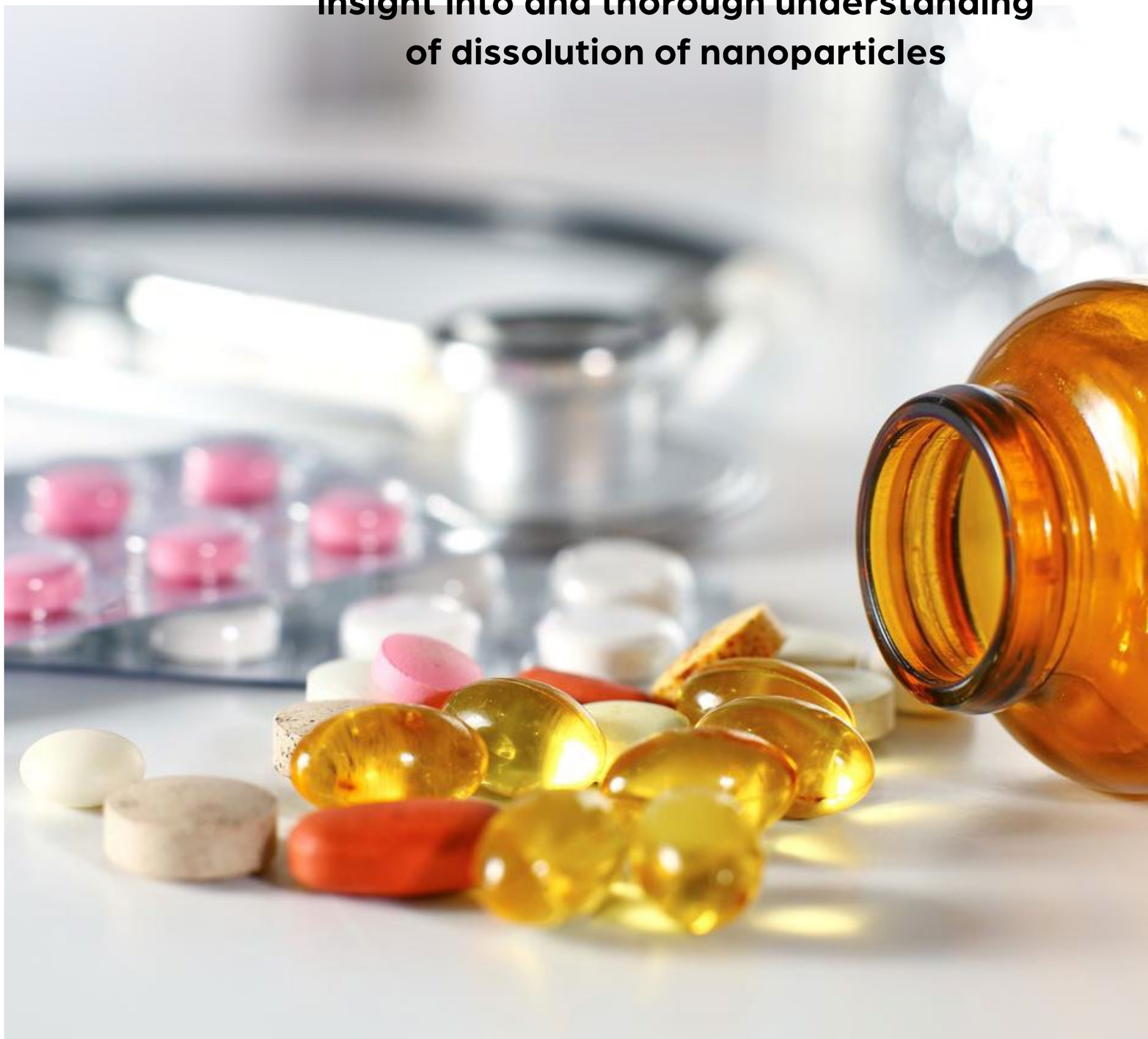
Reliable nano-formulation release rate testing is a frustrating challenge to overcome for many formulation chemists. This idea, discussed at a recent conference, was the beginning of the cooperation between Dr. Emre Türeli from nanoparticle manufacturer MyBiotech GmbH and Agilent Technologies.

The award winning NanoDis is an innovation born out of the frustration of using conventional dissolution techniques for assessing nanoparticle-based drug formulations. For example, incorrect pore size (too large) or ruptured filters allow undissolved nanoparticles to pass into the collection vial, effectively stopping the dissolution process. Clumping of particles within dialysis membranes also contributes to inconsistent results, while unsuccessful separation of nanoparticles from the dissolution medium has a negative impact on the ability to accurately develop the true active pharmaceutical ingredient (API) dissolution profile. Ultimately, these issues hinder the effective selection of the best lead formulation.

The NanoDis is an exciting breakthrough as nanoparticle formulations have such great potential for pharmaceutical development, especially for poorly soluble substances. By utilizing conventional dissolution apparatus, formulation scientists can attain accurate release profiles of APIs. The NanoDis incorporates United States Pharmacopeia (USP) dissolution apparatus 1 and 2 instrumentation (Agilent 708-DS dissolution apparatus) with automated sample collection. Equally, the sample flow dynamics use an exclusive dual-pumping sample flow sequence in the closed-loop system. The flow maintains surface-area exposure of nanoparticles for consistent dissolution release-rate profiling. Because individual samples flow to either the fraction collector (filtrate) or back to the dissolution vessel (unfiltered), fill-volumes are automatically maintained and consistent during analysis.

Dr. Türeli explained that “The new NanoDis gives us far better insight into and thorough understanding of dissolution of nanoparticles, enabling a truly efficient formulation development where we can rely on in-vitro data for the lead formulation selection.” His team’s publication[1] explains how NanoDis shows clear superiority over the dialysis method and accurately characterizes the burst release from capsules. Three new application notes have been released that describe the Dissolution of a PLGA Nanoparticle Formulation Using the NanoDis, the Dissolution of an Immediate Release Nanoparticle Formulation, and Dissolution of a Propofol Liposomal Formulation. The scientific partnership between MyBiotech GmbH and Agilent to release the NanoDis highlights their long-term commitment to supporting the pharmaceutical industry.

The new NanoDis gives us far better insight into and thorough understanding of dissolution of nanoparticles



Reference:

S.M. Lombardo, N. Günday Türeli, M. Koch, M. Schneider, A.E. Türeli, Reliable release testing for nanoparticles with the NanoDis, an innovative sample and separate technique, International Journal of Pharmaceutics (2021), doi: https://doi.org/10.1016/j.ijpharm.2021.121215

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CONTRIBUTION FROM
UNIVERSIDAD DE BURGOS

Toxicological Evaluation

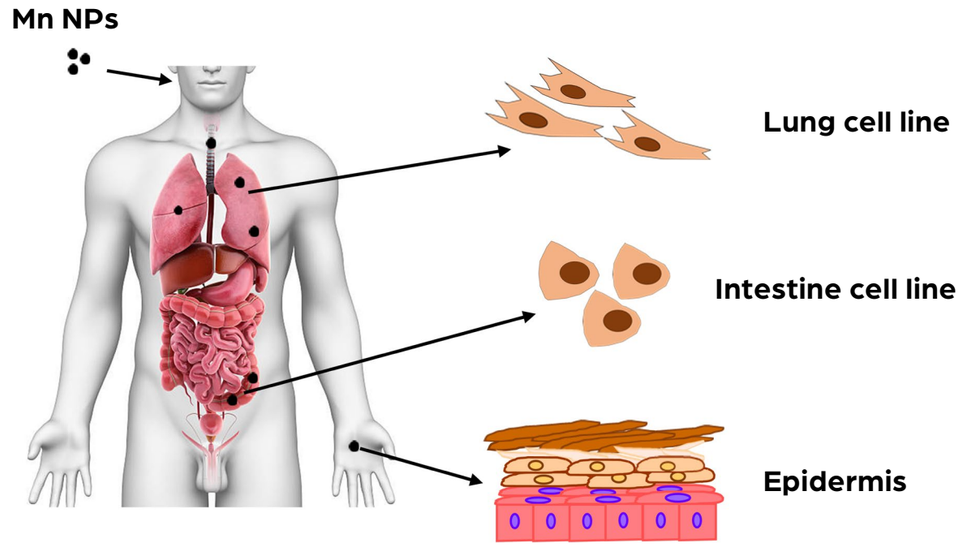
of Manganese Oxide Nanomaterials in Different Human in vitro Models

In the last two decades, the use of manganese oxide nanomaterials in several applications such as the development of energy storage devices, biomedical applications, catalysis, etc., has increased due to their excellent physico-chemical properties, including their morphology, crystalline structure, and surface nanoarchitectures.

Consequently, it may lead to a rise in human exposure, posing a risk due to their potential toxicity. It has been demonstrated that the main source of manganese intoxication is the working environment. Taking all of this into account, the provision of data about the possible associated hazards of novel nanomaterials containing manganese and considering different exposure routes is crucial, since it will provide information about their potential effects on human health.

Our work focuses on the evaluation of the potential toxicity of a novel engineered Mn_3O_4 nanomaterial with enhanced electrochemical properties, which was developed for their use in the manufacture of energy storage devices, and its precursor material (Mn_3O_4). First, the physico-chemical properties of these materials were analyzed through different methodologies. Subsequently, toxicological studies were performed employing human in vitro models resembling the main systems of the human body and organs associated with the routes of nanomaterials exposure: respiratory system, gastrointestinal system, and skin.

The obtained results showed both nanomaterials produce similar toxicological effects in the tested conditions. Thus, adverse effects were observed in lung and intestine cell lines when exposed to these nanoparticles. On the other hand, dermal exposure showed to be harmless. These results provide new insights related to the potential adverse effects of Mn nanomaterials. In addition, this information is relevant for the implementation of safe-by-design strategies associated to the production and handling of these nanoparticles.



Reference

Fernández-Pampín, N., González Plaza, J.J., García-Gómez, A. et al. Toxicology assessment of manganese oxide nanomaterials with enhanced electrochemical properties using human in vitro models representing different exposure routes. Sci Rep 12, 20991 (2022).

https://doi.org/10.1038/s41598-022-25483-w

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Acknowledgements

This work was supported by the Junta de Castilla y Leon-FEDER grant n° BU058P20 (NANOCOMP), and by the European Union's H2020 research and innovation program, under the grant agreements n° 952379 (SURFBIO), and n° 953152 (DIAGONAL).

CONTRIBUTION FROM NANOMOL TECHNOLOGIES

Characterization of Nanomedicines

to Ensure Pharmaceutical Quality, Speeding their Translation to the Clinics

"Nanotechnology is the intentional design, characterization, production, and applications of materials, structures, devices, and systems by controlling their size and shape in the nanoscale range."[1]

Therefore, when we work in the nanoscale range, we can work with new domains that do not apply to any other scale and so reshape the world around us.

Applying nanotechnology to health sciences, around 100 nanomedicines currently exist that are approved by various regulatory agencies worldwide, with others are under advanced pre-clinical and clinical evaluation.[2]

Control of Critical Quality Attributes at the nanoscale is key in meeting regulatory requirements

To translate nanomedicine candidates into the clinics and the pharmaceutical market, it is mandatory to obtain nanoformulations with high quality and to use the appropriate physicochemical techniques to control their critical quality attributes (CQAs) at nanoscale. Compared to conventional small molecule drugs, the characterization of nanomedicines demands an assessment of subgroup-dependent physicochemical properties that influence the quality, safety and efficacy profiles. However, chemical composition, average particle size, size polydispersity, particle shape and morphology, and physical and chemical stability represent common critical parameters that should be described for any nanomedicine according to regulatory agency guidelines[2]. As first-line characterization tools required for nanoparticle analysis in liquid suspension, dynamic light scattering (DLS), multi-angle dynamic light scattering (MADLS), electrophoretic light scattering (ELS) and cryo-Transmission Electron Microscopy (cryoTEM) are proposed as the most suitable. DLS is the most common size determination method, and it is relevant to control average particle size and size polydispersity.

MADLS is an enhanced approach to DLS particle sizing with less noise, improved resolution, and improved size accuracy. ELS is a technique used to measure the electrophoretic mobility of particles in dispersion related with the stability of particles in suspension (read on zeta-potential). And the cryoTEM technique allows the transformation of a liquid sample into a vitreous specimen by rapid cooling and permits one to directly visualize and analyse particle morphology of colloids in aqueous solution, preserving its colloidal stability and particle typology.

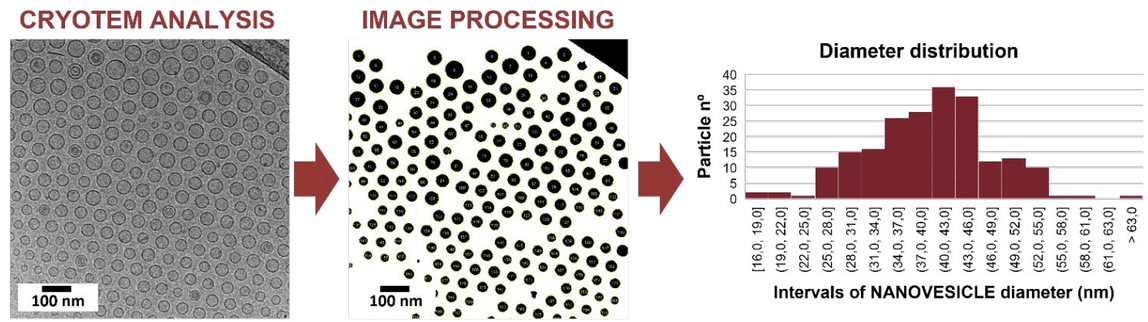
Nanomol Technologies offers expert characterization of Nanomedicine Critical Quality Attributes

The SME Nanomol Technologies SL (Bellaterra, Spain), founded in 2010, is one of the few cGMP specialized particle analysis suppliers in the world. Their team delivers expert characterization of CQAs such as particle size, morphology and structural properties of drug substances, raw materials and drug products at the nano- and microscale. Regarding physicochemical characterization of nanomedicines, Nanomol Technologies is a recognized expert in the application of DLS, MADLS, ELS and cryoTEM, with a track record in measuring size and concentration of colloidal systems containing nanoparticles by DLS and MADLS, and in the determination of Z-Potential with the ELS technique, including pH titration studies (determination of isoelectric point).

The particle analysis unit develops, optimizes, validates, transfers methods, and puts them into routine under cGMP, for more than 60 clients of the pharmaceutical, biotech and chemical sector. In addition, the team provides experience in characterization of biologicals and nanoconjugates – protein aggregation, stability, isoelectric point, globule size. Regarding cryoTEM, Nanomol Technologies can carry out appropriate combination of microscopy techniques with image processing software; thus nanoparticles in colloidal formulations are visualized in their native state, and further analyzed by image analysis software to lead to quantitative analysis of their morphological parameters.

Similarity and Sameness Studies

Particle similarity and sameness studies on drug products under development, such as nanosimilars (generic nanomedicines) by comparison to the Reference Listed Drug (RLD) product properties, are effectively carried out following specific regulatory guidelines.



Characterization of nanomedicines with PHOENIX–OITB

In the framework of the EU project PHOENIX-OITB, a service portfolio is being established, including physicochemical characterization, in vitro testing, in vivo testing and manufacturing services for nanomedicines. Through the PHOENIX Single Entry Point, physicochemical characterization services are offered to research groups from both public and private entities, all along the value chain, from early preclinical development to more advanced stages. Nanomol Technologies, partner of PHOENIX-OITB, offers expert particle size and morphology characterization of APIs, raw materials, intermediates and drug products, from method development to cGMP routine analysis or tailored services, such as particle similarity analysis.

Role of BNN in PHOENIX–OITB

BNN contributes to tasks in business development and overall sustainability of the project and the future OITB. These activities are performed in close collaboration with the "marketing" (communication & dissemination) work package, in which BNN has the lead role, dedicated to dissemination and exploitation activities for marketing purposes and establishing connections with stakeholders during the project.

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References:

1 J. Jeevanandam et al. Beilstein J.Nanotechnol 2018 https://doi.org/10.3762/bjnano.9.98

2 S. Đorđević et al. Drug Delivery and Translational Research 2022 https://doi.org/10.1007/s13346-021-01024-2; Reflection paper EMA/CHMP/806058/2009/Rev.02 (February 2013); FDA Final Guidance for Industry: Considering Whether an FDA-Regulated Product Involves the Application of Nanotechnology (June 2014); FDA Final Guidance for Liposome Drug Products (April 2018);

FDA Final Guidance for Industry – Drug Products, Including Biological Products, that Contain Nanomaterials (April 2022).

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

SEE WEBSITE

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Member Updates

MEMBER PRESENTATION OF GREEN TECH VALLEY CLUSTER GMBH

Situated in the south of Austria, the Green Tech Valley is the #1 Technology-Hotspot for Climate Protection & Circular Economy. This unique location is a hive of industry for 300 active green tech pioneers and technology leaders. Their focus is on green innovation.

Green Tech Valley

Today, the Green Tech Valley combines the expertise of over 800 entrepreneurs in one location. 20 global leaders in technology all lie within one hour's drive. This established network is robust and ready to launch into a greener future. More than 60 start-ups and therefore a large number of founding innovators are successfully investing their heart and soul into the development of new technologies for the green transition. With an above average R&D ratio, you can hear the buzz of research in the south of Austria. The top flight, cutting-edge research activities, devoted to the green solutions of the future, are here in the Valley, including 14 out of a total of 18 COMET Competence Centres in Austria. This unique combination of industrial expertise and dedicated research form the cornerstones of the region.

The call for new ways of thinking is getting louder and louder. That is why innovators in the Green Tech Valley constantly invest their deep know-how in further development of sustainable technologies for renewable energy and the circular economy and are continuously breaking new ground.

The Green Tech Valley has an impact

On the ECO Innovation Index Austria registers amongst the top three leaders in innovation in Europe. Above all, the country is noted for its above-average level of employment and high profit ratios in the green tech sector. The south of Austria is considered to be a particularly fertile breeding ground for eco-driven economic growth.

Companies in the Valley have doubled the number of employees within the space of 10 years. Over and above this, they have tripled their sales turnover. With a research ratio of over 5% and investment in the development of new green technologies running in the billions, the Green Tech Valley is the dynamo of Austria as an innovation leader.

> **"The companies in the Green Tech Valley have already generated CO_2 savings of 550 mega tonnes."**
>
> **Bernhard Puttinger,**
> CEO Green Tech Cluster

Green Tech Valley Cluster

With great pioneering spirit, the Green Tech Valley Cluster was established in 2005. The 11-strong team committed itself to the Vision 100: One World. Zero Carbon. Zero Waste. And it supports its 300 partners with industry expertise and a wide range of services. The aim is to sustain and continuously strengthen the position of southern Austrian companies and research institutions and to grow their leading, international technology and market position in the field of energy and environmental technology. Through active match-making and knowledge transfer, the cluster team facilitates and drives forward the development of green innovation in the Green Tech Valley, the #1 technology hotspot for climate protection and the circular economy. We are your access point to 800 business and export contacts and 18 international energy and environmental technology clusters.

Contact

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Microfluidics InnovationHub

The single–entry point of the NextGenMicrofluidics project

Consortium members of the European project NextGenMicrofluidics have established the Microfluidics Innovation Hub as a non-profit association designed to act as a single-entry point for customers to access all NGM-related services. This includes access to the combined competencies and the wide range of microfluidic technologies collectively offered by the partners.

We cover the entire value chain

The MIH brings together technologies along the entire value chain in the creation and advancement of customized microfluidic lab-on-a-foil systems, from assay development to manufacturing and quality control. We offer services for the development and production of these systems to companies — from start-ups to large-scale industry.

We offer project funding to Accelerate your Microfluidic Innovation

In addition to this, the Microfluidics Innovation Hub also manages the NGM Open Call initiative, which offers multiple funding opportunities and provides development support services to groundbreaking projects in the field of microfluidics.

Applicants can enjoy up to 92% project funding to help accelerate the development and commercialization of their innovative solutions. The Open Call welcomes applications on a rolling basis until September 2023 and is open for start-ups, SMEs & large enterprises in the EU, UK, and Switzerland.

Apply to our Open Call at
www.microfluidicshub.eu/open-call

Who we are

We combine the competencies of 21 companies and research organizations along the entire value chain in the development of microfluidic lab-on-a-foil systems and offer services for the development and production of these systems for companies – from start-ups to large-scale industry.

Microfluidics Innovation Hub - Value Chain

Assays & Materials | Design & Simulation | Patterning | Surface Functionalization | Electrodes & Sensors | Backend Services | Read-out Devices | Quality Control

Molecular & Biochemical Assay Development
We develop molecular assays and adapt existing assays to suit Roll-to-Roll processes.

Material Development
We develop and modify UV resins and thermoplastic polymers, functional inks or selective membranes.

Design & Simulation
We simulate and design the optimal structures for your microfluidic chip, light guiding structure and cell culture plates.

Toolmaking
We manufacture large-scale replication tools with customized micro- and nanopatterns for polymer forming processes.

Replication
We offer a portfolio of industrial high-throughput replication processes such as embossing, injection molding and R2R replication.

Functionalization
We offer chemical modification,deposition and immobilization of customized (bio)functional materials on a wide range of polymer substrates.

Electrode Printing
We print customized electrode designs and arrays on large area substrates. We offer post functionalization of printed electrodes through chemical treatment or spotting processes for sensor applications.

Backend Services
We offer multi-material assembly, foil-to-foil bonding, inlet cutting and chip singulation. We assemble multi-material lab-on-a-chip devices containing foils, rigid parts and complex microfluidic chip cartridges.

Read-out Devices
We offer detection and acquisition device development as well as complete system integration services.

Quality Control
We are establishing an "MIH–Certified" label to ensure design & production according to application-specific standards.

- ✔ **Single Entry Point**
- ✔ **Most Comprehensive Service Portfolio**
- ✔ **Fast Prototyping & Scale up**
- ✔ **Multiple Funding Opportunities**
- ✔ **Quality Assurance**

Role of BNN

Safety-by-Design, Quality management, Project management, Graphic Design, Communication & Dissemination

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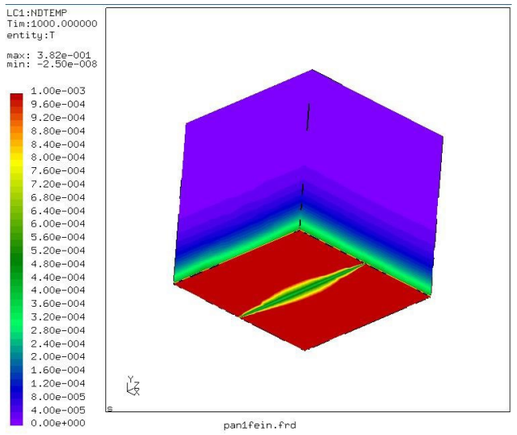
Microfluidics Innovation Hub is the single-entry point of the European project NextGenMicrofluidics which has received funding from the European Union's HORIZON 2020 research & innovation programme under grant agreement n° 862092.

MEMBER PRESENTATION OF TECHNICAL OFFICE FOR CHEMISTRY – DR. KARL DOBIANER

The Technical Office for Chemistry - Dr. Karl Dobianer, established 2005, is a technical consultancy company run by a graduated toxicologist, chemist and biochemist with registrations and/or certificates as Austrian court expert for toxicology, pharmacology, general applied chemistry, general analytical chemistry and adhesion technology and as technical expert for the toxicological risk assessment of products of the group LMSVG C Z8, C Z9 and C Z10 (food contact materials, cosmetics and food additives) of the Austrian Ministry of Health. Professional functions include chairmanship in a chemistry-related association, representation in Austrian and European standardization committees dealing with construction products, advisory boards and NGO representation at UNIDO.

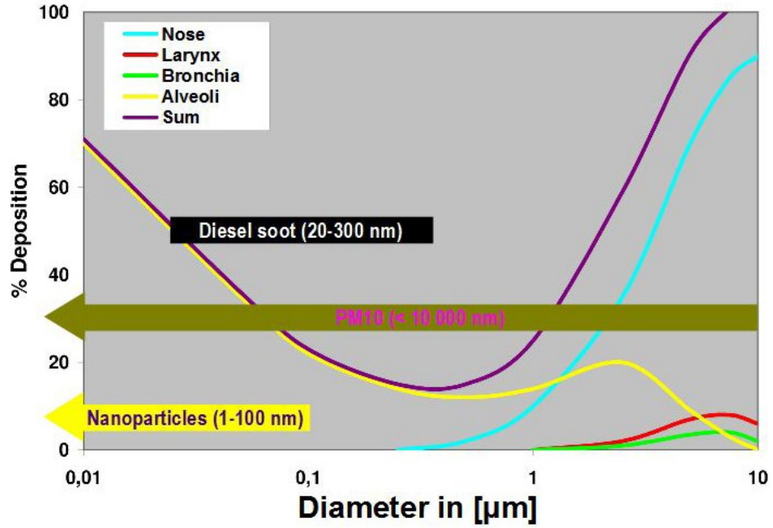
Services are offered worldwide to industry, public authorities and lawyers but also to private customers in the fields of toxicology and pharmacology, general chemistry, adhesion technology and materials. These services include but are not limited to R&D, expert opinions and other projects (mainly risk assessment, damage prevention and analysis, product development). Statistical analyses, modelling and FE analyses are frequently offered as additional services. Testing is usually performed by a cooperating network of qualified testing institutes.



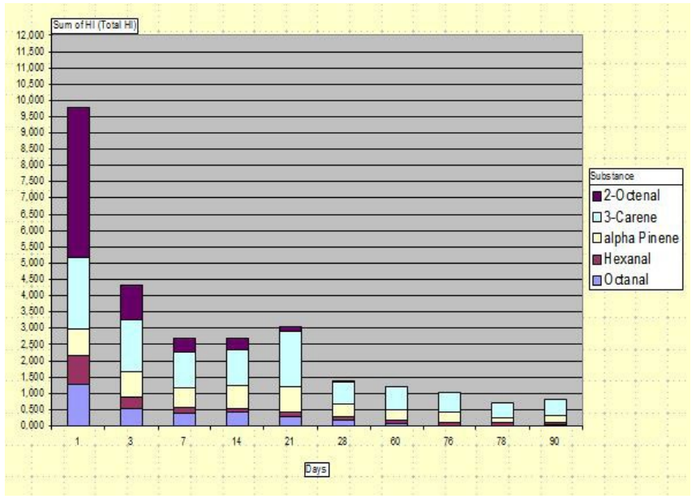
Diffusion modelling of emissions of toxic gases from two panels with a gap

The spectrum of inquiries is very wide. Recent orders have dealt with indoor air emissions, medicine overdose, explosives, road surfaces, lead poisoning, biocides, FFP2 masks, bonding in automotive industry, flue emissions, food plastics and wood materials, among others. The connection to nanotechnology is mainly given in the fields of toxicology and material.

Numerous scientific publications and citations, leaderships in international research projects as well as national and international lectures and presentations complete the professional spectrum of the Technical Office for Chemistry - Dr. Karl Dobianer.



Approximate distribution of spherical particles in the respiration tract



Typical decline of emissions from a wood-based material

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Dermagnostix fills a major diagnostic gap with PsorX, the world's first test to distinguish psoriasis from eczema at the molecular level. The innovative products are expected to expand the toolkit of pathology laboratories and hospitals. Source: Dermagnostix GmbH

HAHN-SCHICKARD

European Innovation Council funds Dermagnostix with 2.5 Million Euros

Dermagnostix GmbH, a joint spin-off of Hahn-Schickard, Helmholtz Munich and Technical University of Munich, was one of 30 companies to qualify for a direct grant from the European Innovation Council (EIC) and will receive 2.5 million euros to bring its product portfolio to market under the new European In Vitro Diagnostic Regulation.

Read the whole article here.

GRAZ UNIVERSITY OF TECHNOLOGY

Growth of Nanoholes Visible for the First Time Thanks to Helium Scattering

Scientists at TU Graz in cooperation with the University of Surrey were able to observe and document the growth of hexagonal boron nitride for the first time. The material is mainly used in microelectronics and nanotechnology.

Read the whole article here.

GRAZ UNIVERSITY OF TECHNOLOGY

Enzyme Research between Cholera and Targeted Design

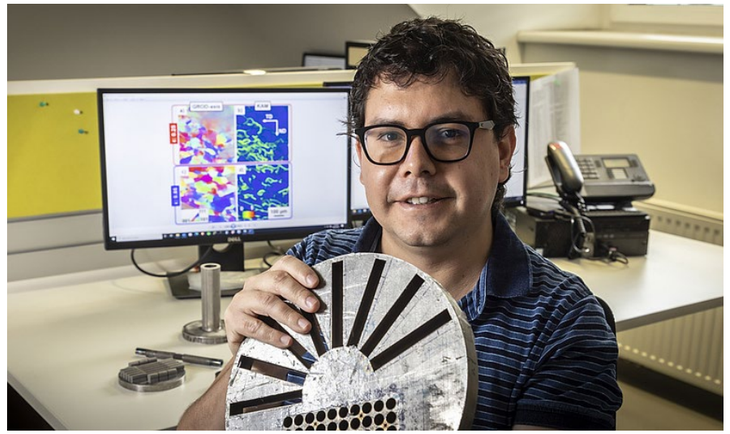
TU Graz biochemists Horst Lechner and Daniel Kracher have received BioTechMed-Graz Young Researchers Group funding. Both want to use it to conduct research on enzymes in different areas. Read the whole article here.

Horst Lechner and Daniel Kracher. Source: Lunghammer – TU Graz

GRAZ UNIVERSITY OF TECHNOLOGY

"I just Loved Knowing What Things are Made of"

This quote comes from TU Graz researcher Ricardo Buzolin. The 30-year-old is actually a mechanical engineer, but switched to materials science because "every machine is made of materials". Read the whole article here.



Ricardo Buzolin is working on the properties of metallic materials. Source: Lunghammer – TU Graz

At COREMED, Marlies Schellnegger deals intensively with the topic of healthy aging.
Picture: JOANNEUM RESEARCH/Schwarzl

JOANNEUM RESEARCH, COREMED

Physical Exercise as a Key to Eternal Youth

Regular physical exercise can positively influence aging processes and slow them down. This is proven by a collaborative study of COREMED and Medical University Graz.

A rolling stone gathers no moss. A recent study by COREMED, the cooperative Center for Regenerative Medicine, and Med Uni Graz proves the youth-preserving effect of physical exercise at the cellular level: regular exercise can positively influence and demonstrably slow down processes of aging.

Differences in biological age between people who exercise and people who don't can be more than 10 years. No miracle cure for eternal youth has yet been found, but the solution here may be more obvious than one might think: studies give us hope that regular exercise helps to protect and preserve our cells, making us not only healthier but also helping us age more slowly.

Read the whole article here.

PAYER GROUP

PAYER is Procter & Gamble "Partner of the Year" 2022

The global corporation Procter & Gamble (P&G) honors PAYER with the "PARTNER OF THE YEAR" Award 2022 in the GROOMING category. On the evening of 10 November 2022, the Procter & Gamble "Partner of the Year" award ceremony took place in Cincinnati, USA. On behalf of PAYER, Mr. Michael Viet, CEO of PAYER Group, and Mr. Shing Leong Hui, Owner & Chairman of the Board of PAYER Group, attended the ceremony and were able to accept this coveted award. Eleven P&G partners, who are an integral part of the global market leader's ecosystem, were honored in various categories and business areas.

Read the whole article here.

KOMPETENZZENTRUM HOLZ GMBH

Technology for Processing Biomass Waste from Forestry for Advanced Polymer Composites – TECHBIKOM INTERREG V–A, 2014–2020 ATCZ287

In January 2022, a new project TECHBIKOM "Technology for processing biomass waste from forestry for advanced polymer composites" started as a part of Interreg 2014-2020 funding, coordinated by the Brno University of Technology and Wood K plus as a project partner.

Read the whole article here.

KOMPETENZZENTRUM HOLZ GMBH

Area Wood Chemistry and Biotechnology of Wood K Plus at the Eurobiotech Congress 2022 in Prague

The Wood Chemistry and Biotechnology Area was happy to accept the invitation to give a keynote on “New results in the development of bio-based products and biorefineries” and moderate a session by the organizing committee of the Eurobiotech 2022 Congress. The congress took place from 6-8 October in Prague, Czech Republic.

Read the whole article here.

BDI–BIOENERGY INTERNATIONAL GMBH

Strategic Reframing and New Managerial Duo at the Styrian World Market Leader BDI–BioEnergy International GmbH

For 25 years, BDI-BioEnergy International GmbH has been market and technology leader in the planning and construction of tailor-made biodiesel plants and has established itself as a globally acting company for solutions in the field of chemical recycling.

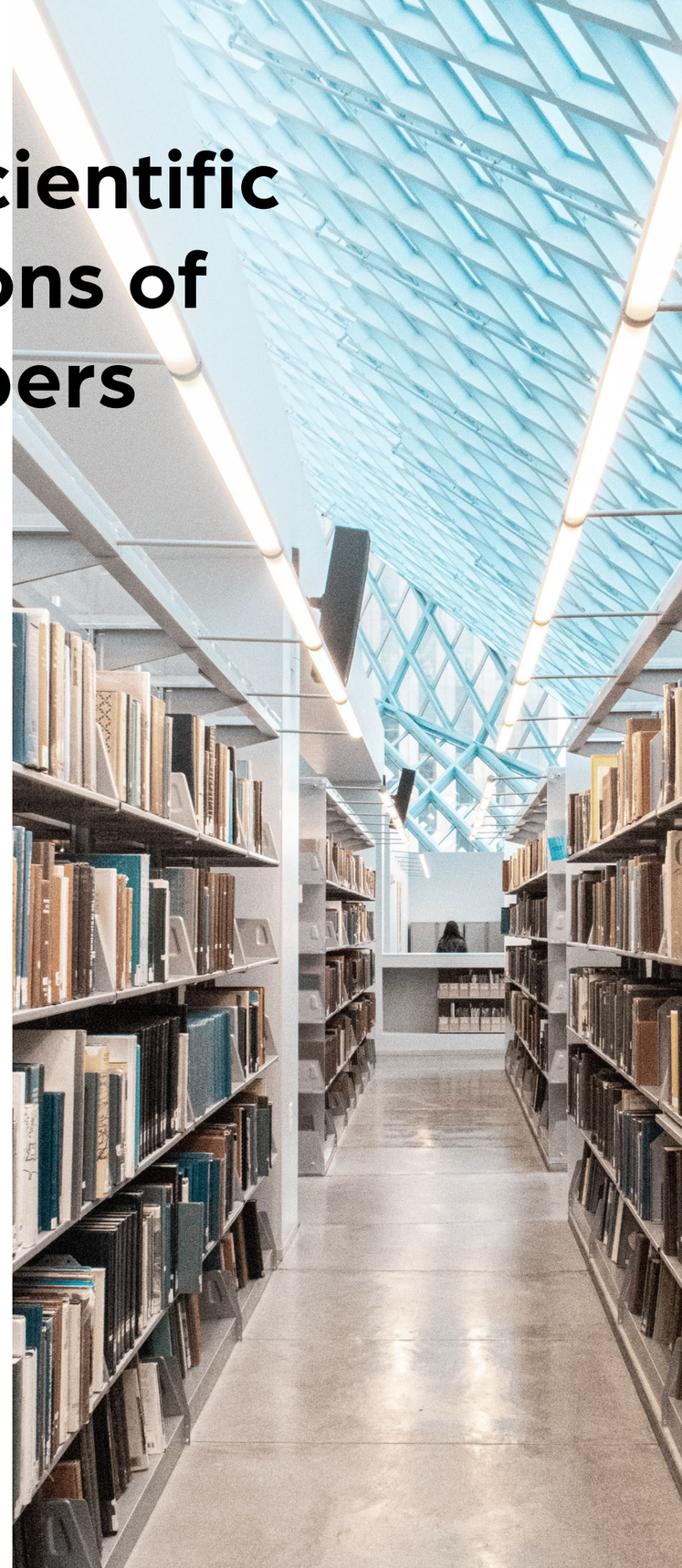
Read more about the strategic reframing and new managerial duo at the Styrian world market leader BDI-BioEnergy International GmbH here.

Michael Schrems, Kurt Ternegg, Markus Dielacher | Photographer: Thomas Kubin

Recent Scientific Publications of our 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.

If you want to view all members’ publications sent to us from 2018 up to November 2022 you can download the document BioNanoNet member publications.



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Project Presentations & Updates

HARMLESS / OECD SG AdMa Workshop

On 15 November 2022, the H2020 project HARMLESS, together with the OECD Working Party on Manufactured Nanomaterials Steering Group on Advanced Materials (OECD WPMN SG AdMa), organised a virtual workshop on Advanced Materials (AdMa) with the main aim of testing current foresight schemes to anticipate their safety and sustainability issues. The workshop was not public but intended for the members of the OECD Working Party on Manufactured Nanomaterials (WPMN) only, although experts from the NMBP-16 sister projects (DIAGONAL and SUNSHINE) were also invited, as we are closely collaborating with them.

During the workshop, more than 50 participants from all over the world and from different stakeholder groups (scientific community, SMEs, large industry, policy makers, regulators, NGOs), had the opportunity to get more information about a few current foresight schemes to anticipate safety and sustainability issues regarding AdMa and to test them in terms of the selected HARMLESS case study on Aerogels, as façade insulation material (as one of many layers of the façade of a building).

After a short presentation of the HARMLESS project by HARMLESS coordinator Otmar Schmid (HMGU), Otmar introduced the workshop to the audience. Subsequently, Lars Montelius, from Lund University (Sweden) gave a talk on the Materials 2030 Roadmap, informing about the Advanced Materials 2030 initiative and sharing his thoughts related to advanced materials. The next session was led by Wendel Wohlleben (from BASF) in his role as Case Study leader in the HARMLESS project, who briefly introduced the Aerogel case study (Fibre-aerogel-mats for façade insulation). After that, participants were divided into two break-out rooms to assess and discuss the different schemes in more detail. The break-out room on **"InnoMat.Life and Early4AdMa"** was moderated by Blanca Suarez (TEMASOL) and the schemes were presented by Wendel Wohlleben (BASF) and Agnes Oomen (OCD WPMN SG AdMa). The second break-out was on **"Early4AdMa & Arvidsson"** and was moderated by Susan Dekkers (TNO) and the schemes were presented by Andrea Haase (BfR) and Anders Baun (DTU). In both break-out sessions, after a short introduction to the different schemes (aim, developed by, application), vivid discussions took place as the participants gave feedback to the schemes to further improve them in the future. The workshop finished with a plenary session moderated by Blanca Suarez, summarizing the suggestions and thoughts raised in both break-out rooms, and a discussion with the participants on strengths and opportunities for integrating the presented approaches into the real-life processes which will help fine-tune them.

The assessment concepts that were discussed in the workshop were:

- Advanced Materials 2030 Initiative: Materials 2030 Roadmap
- Early4AdMa (RIVM, BfR, UBA, BAuA 2022). DOI: 10.21945/brochure-advanced-materials
- AdMGRID AdMa categorisation (Kennedy et al. 2019). DOI: 10.1111/risa.13304

- InnoMat.Life AdMa categorisation (2022). It will be refined and published in 2023.
- Nano-enabled AdMa screening (Arvidsson et al. 2022) - Arvidsson, R., Peters, G., Hansen, S.F., Baun, A. (2022). Prospective environmental risk screening of seven advanced materials based on production volumes and aquatic ecotoxicity, NanoImpact, 25, 100393, https://doi.org/10.1016/j.impact.2022.100393

Read more about this workshop on the project website.

Role of BNN:

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

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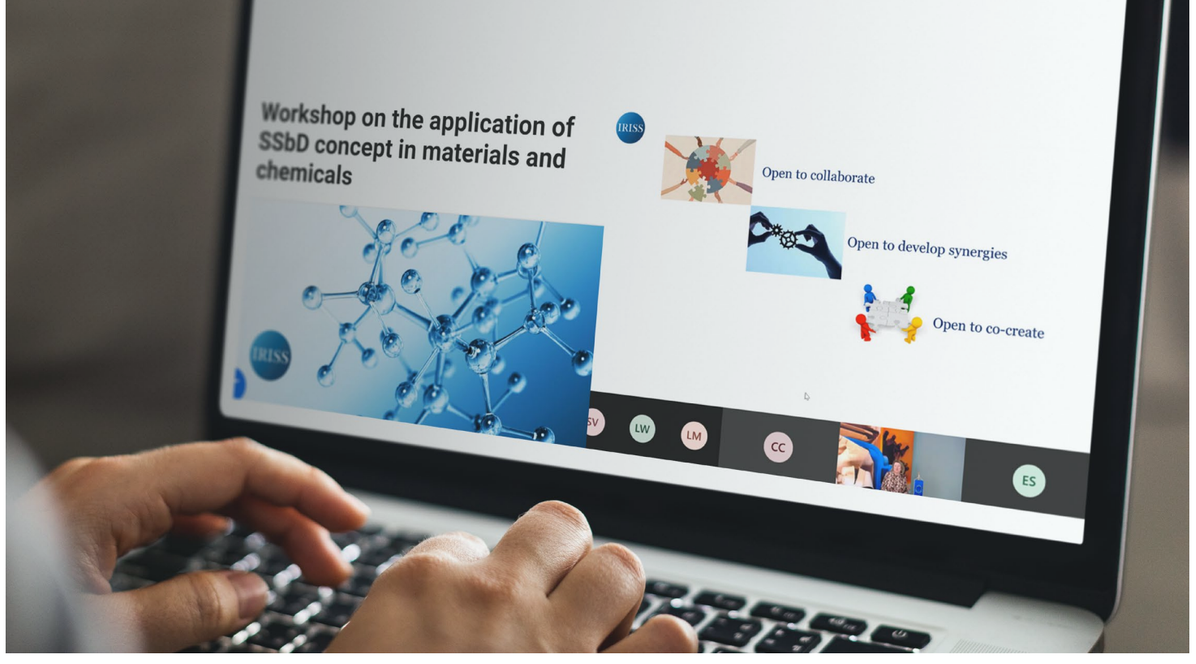
HARMLESS

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

Connect with HARMLESS:

SEE WEBSITE



Workshop on the application of SSbD concept in materials and chemicals

To ensure that materials are sustainable for humans and the environment, to increase recycling and use resources in a more efficient way, efforts are required from an early stage of design and manufacturing.

The major EU initiative IRISS was launched in June 2022, aiming to connect, synergize and transform the Safe-and-Sustainable-by-Design (SSbD) community in Europe and globally towards a lifecycle approach, with a holistic integration of safety, climate neutrality, circularity and functionality.

On 25 November 2022 IRISS organised its first digital workshop focusing on the application of the SSbD concept in materials and chemicals. It was held back-to-back with IRISS' 1st General Assembly in Stockholm (Sweden).

Invited speakers included representatives from different EU-funded projects developing Safe-by-Design (SbD) tools and methods, as well as from DG-RTD, the JRC and the PARC initiative. In addition, IRISS partners presented activities and outcomes of the project.

The workshop focused on the following:

i) getting an overview of the mapping on SbD in chemicals and materials,

ii) getting information on whether SbD tools can be used to define SSbD,

iii) learning more about how sustainability can be evaluated at the design phase of products and process development, and

iv) learning more about the value chain perspective on implementation of SSbD.

Main objectives were to support the State-of-the-Art mapping activities of SSbD, obtain first insights on how to translate the framework for SSbD criteria to practical methodologies and tools for SSbD, and to identify the applicability of the framework, alongside challenges and barriers from a value chain perspective of SSbD.

To achieve the goals, the workshop opened with the EU Commission vision and recommendations presented by Javier Sanfelix (DG-RTD) followed by a presentation of the framework for SSbD criteria and case studies by Carla Caldeira (JRC). The workshop continued with the presentations of two interesting overviews about i) an SSbD mapping performed by TEKNIKER during the first six months of the project, presented by Amaya Igartua, and ii) the ongoing work on and related to SSbD toolboxes within the PARC initiative, presented by Tomas Rydberg.

After a short break the SbD tools and methodologies developed within the on-going NMBP-15 and NMBP-16 EU-funded projects were presented. Socorro Vazquez (LEITAT) showed an overview about the 4 NMBP-15 EU-funded projects (i.e. ASINA, SbD4Nano, SABYDOMA and SAbyNA), then Cris Rocca (UoB) and Lya Soeteman-Hernandez (RIVM) presented the tools and methodologies developed within the 3 NMBP-16 EU-funded projects (i.e. DIAGONAL, HARMLESS and SUNSHINE).

After this interesting overview about what is under development in the different EU-funded projects, the workshop followed with a session dedicated to an introduction about tribology and life-cycle-assessment (LCA) tools and their importance and impact at the design phase of products and processes, as well as some related case studies, presented by Amaya Igartua (TEKNIKER).

The last block of the workshop focused on providing insights about the perspectives of the different value chains (i.e., packaging, textiles, construction chemicals, automotive, energy and electronics). The different speakers, all of them partners of the IRISS project, provided the participants with an overview about the main SSbD challenges and specific issues to be considered in the different value chains, as well as first recommendations on how to implement the SSbD concept in each of them. The slot was moderated by Anne-Chloe Devic and the different value chain perspectives were presented by: i) Maudez LeDantec from the Institut Plastiques et Composites (IPC) for the packaging value chain, ii) Luz Walter from the European Textile Technology Platform (ETP) for the textiles value chain, iii) Johan Breukelaar for the European Federation for Construction Chemicals (EFCC) for the construction value chain, iv) Beatriz Ildefonso from the European Association of Automotive Suppliers (CLEPA) for the automotive value chain, v) Philippe Jacques from the Energy Materials Industrial Research Initiative (EMIRI) for the energy value chain, and vi) Dmitri Petrovykh from the International Iberian Nanotechnology Laboratory (INL) for the electronics value chain.

The workshop concluded with a wrap-up of the main messages, outputs as well as an outlook on the IRISS activities that will take place during the following months to provide its stakeholders with updated information.

The IRISS – International SSbD Network invites you to stay updated on news and forthcoming workshops by becoming a member of the network. To do so, visit the IRISS website – and click on the “Join the Network” button! We will be delighted to welcome you as a member of IRISS!

This workshop was organised in the frame of the IRISS EU-funded project and with the collaboration of all NMBP-15 and NMBP-16 EU-funded projects, the EC and the JRC. The NMBP-15/-16 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° 953152 (DIAGONAL), n° 953183 (HARMLESS), n° 862296 (SABYDOMA,), n° 862419 (SAbyNA), n° 862195 (SbD4Nano).

Role of BNN

The consortium consists of European research institutes, trade associations, companies, authorities and universities, as well as National Technology Platforms within SusChem. Within IRISS, BNN is in charge of leading the work package designed for Communication, Dissemination and Consultation support.

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This project has received funding from the European Union’s HORIZON EUROPE research and innovation programme under grant agreement n° 101058245. UK participants in Project IRISS are supported by UKRI grant 10038816. Swiss participants have received funding from the Swiss State Secretariat for Education, Research and Innovation (SERI)

Connect with IRISS:

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NanoPAT Achieves lab-scale Validation of 3 PATs – Month 31 Status

NanoPAT is currently running its third year and, so far, we are very satisfied with the progress all the partners have made. In a technical aspect, all the three technologies have been successfully validated in the laboratory by our research organizations. Now we are moving towards the pilot scale validation incorporating the PAT systems into the lines of the five demonstrators participating in the project. On the other hand, our monitoring system is in its last phase of development and soon will be ready to communicate with all the PAT systems and other devices in the industrial field. As a last step, a further processing of data will take place using data fusion AI algorithms.

The lab-scale validation of the three PATs of the project has now been completed for the different case studies, and the checklists for Installation Qualification (IQ), Operation Qualification (OQ), and Performance Qualification (PQ) have been created; this will help future users with the general installation and operation of the instruments. With that, the project has entered the stage of industrially implementing the three technologies, i.e., the demonstration of the NanoPAT technologies in an industrial environment.

Within the last months the lab-scale validation was carried out at the RTOs. The end users are already preparing their pilot lines for hosting the prototypes; therefore, the technology providers (BRAVE, PDWA, IRIS) have been visiting the end users and RTOs for preparing the installation of the sensors. The upcoming step, within the next months, will be to proceed with the installation of the sensors at the end users' facilities, i.e., the industrial pilot plant demonstration of the technologies. For this, the industrial pilot plants are currently being adapted to provide the needed technical prerequisites for the different monitoring devices (i.e., the corresponding PAT technology for each case study).

The PAT-Box software will be a platform integrating the three process monitoring technologies, deployed for both onsite and cloud infrastructures. Its latest developments in data hosting and visualization are performing well.

Find out more in the latest 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.

Connect with NanoPAT:

SEE WEBSITE

The Microfluidics Innovation Hub @ COMPAMED 2022

Experiencing tomorrow's healthcare market LIVE!

In November 2022 the Microfluidics Innovation Hub (MIH) exhibited at COMPAMED 2022 in Düsseldorf for the first time. COMPAMED is the leading international marketplace for high-tech solutions in the medical technology sector.

We were thrilled to be there in a combined booth with some of our members from JOANNEUM RESEARCH, BiFlow, Genspeed, Inmold and Tecnalia. The fair was full of action and excitement, packed with networking opportunities with others in the industry and numerous occasions for connecting with potential customers. With our team of experts on-site, we were able to perform hands-on demos and showcase the latest technological advances and the whole bandwidth of MIH services.

Tecnalia featured their capabilities in assay development, surface functionalization and sensors development. The team presented the newest products and prototypes developed for the NextGenMicrofluidics project applications on Enzymatic Sensors for Bioreactor Control and Cell Culture Devices for Pharmaceutical Testing.

Biflow introduced the "30 minutes lab", a benchtop laboratory system capable of performing complex biochemical analyses at the point-of-need in less than one hour! Their new device consists of a portable instrument and self-contained cartridges, both of which can be adapted to different applications and businesses.

Genspeed gave live demonstrations of their universal CE-IVD certified Point-of-Care-Testing platform which enables fast, reliable and accurate test results.

JOANNEUM RESEARCH and Inmold presented multiple examples of customized microfluidic chip designs using their unique patented Roll-to-Roll (R2R) imprinting technology. R2R replication allows for a reduction of production time from weeks or even months to a couple of days. The team eagerly talked to visitors about the potential of this high-throughput manufacturing technology to revolutionize microfluidic device production.

And finally, the Microfluidics Innovation Hub had numerous discussions with companies interested not only in obtaining tailored solutions for their specific microfluidic needs but also keen on exploring funding and development support opportunities for their projects through our Open Call initiative. Exciting conversations were also had as visitors learned how they could establish close cooperation with the MIH or how they could become members of the MIH association.

The four days at COMPAMED 2022 seemed to have flown by. It was no doubt a successful event from our point of view, with a number of very impressive outcomes worth mentioning:

- ✔ We engaged with more than 150 relevant visitors in our booth
- ✔ We received 3 on-line applications for the Open Call within 14 days after the fair!
- ✔ We scheduled 20 high-quality follow-up calls to discuss specific customer challenges

These follow-up activities will keep us busy until Christmas. And because we achieved successful results this year, we are already looking forward to being part of COMPAMED 2023. We hope to see you there!

Visit our website a to learn more about the Open Call and how you too can apply for funded use of our services.

As part of the EU H2020 funded project NextGenMicrofluidics, the Microfluidics Innovation Hub offers its customers a single entry point to a wide range of existing cutting edge microfluidic technologies from Europe's top companies and research organizations.

Role of BNN

Safety-by-Design, Quality management, Project management, Graphic Design, Communication & Dissemination

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NextGen Microfluidics

Microfluidics InnovationHub

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement n°862092.

Connect with NextGenMicrofluidics:

SEE WEBSITE

Outlook

BNN EVENTS & EVENTS SUPPORTED BY BNN

Webinar "Sex and gender in biomedical research: concepts and examples"

7 February 2023 | 10:00 – 11:30 CET, online

In this exciting, timely workshop, Prof. Oertelt-Prigione will break down the many layers of sex and gender and their impact on biomedical research: from disaggregating drug trial results between men and women to the influence of researchers' sex/gender on experimental outcomes. She will guide researchers through the important questions to ask when setting up biomedical research: What do you have to consider, how to start, what should be measured during the experiments and what should be reported in the resulting publication? With several concrete examples from a variety of fields, this webinar should serve as an illuminating while practical source of information for all researchers working with humans and animals.

Sabine Oertelt-Prigione is a physician specialized in internal medicine, sex- and gender-sensitive medicine and public health with a professional focus on the development of user-centered innovative prevention methods for socially relevant issues (from gender inequality in health to refugee health to prevention of interpersonal violence and sexual harassment). She was a member of the European Commission Expert Group on "Gendered Innovations" and currently chairs the Expert Group on "Gender and COVID-19".

More information

NMBP–13 Future–proof Approaches for Risk Governance – Lessons Learned from Nanomaterials

26 January 2023 | online – More information

BioNanoNet Member Welcome Webinar

26 January 2023, 13:30 – 15:00 CET | online

Get to know our new members:

- Virtual Vehicle Research GmbH
- Green Tech Cluster Styria GmbH
- Microfluidics Innovation Hub (MIH)
- Applied Nanoparticles SL

More information

BioNanoNet General Assembly & BNN Networking Event

2 March 2023 |
Graz, Austria & virtually

More information

WORKSHOP International Nano–safety and Nanostandardization: Status, Gaps, Needs and the Role of INISS

16 February 2023 | online

This workshop is free of charge. We ask you for your registration.

More information

BioNanoMed 2023

12 – 14 April 2023 | Graz, Austria

We have the pleasure of inviting you to participate in the 11th International Congress – BioNanoMed 2023, the exclusive know-how-transfer meeting for researchers, engineers, students and practitioners from Natural Sciences, Medical Sciences and Engineering Subjects throughout the world. NanoMedicine-Austria is very pleased to sponsor the Best Talk Award 2023!

The best presentation will be selected by an international committee and the prize of € 500 will be awarded in the closing ceremony of BioNanoMed 2023.

More information

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 March 2023 and will focus on the topic **Materials Innovation Markets Driven by Science and Research** (see the AMI Materials 2030 Roadmap). BioNanoNet members are welcome to send their contributions regarding this focus topic as well as articles about their scientific research until 14 February 2023! Articles on other topics can be published anytime on the BNN website.

from left to right: Barbara, Angelika, Caitlin, Johanna, Christine, Andreas, Simone, Beatriz, Clemens, Susanne and Nerea

Contact
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Connect with us!

A sparkling new year awaits us, full of exciting projects and challenges that we will meet as a team – along with our many members and collaborators.

With our best wishes for 2023,

the BNN team

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