BNN

03/2022

QUARTERLY

Digital Magazine for Developments in Sustainable Technology

FOCUS TOPIC:

Nanomedicine

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Editorial

CONTEMPORARY ISSUES FROM THE NETWORK

If the last few years have taught us anything, it is that investment in biomedical research is paramount to healthy and functional societies. We have seen great success in nano-enabled application of research to diagnostics and treatments for cancer and several other diseases. There-fore, we are dedicating this BNN QUARTERLY to the topic of nanomedicine, which has been a key aspect in our work since the very beginning. Identification of nanomaterials for medical applications, the assessment of those, and the further design to gain safety and sustainability with these technologies are just some of the aspects that are assets of the BioNanoNet community. Besides science, research and development, and projects (e.g., PHOENIX), the interaction with stakeholders has also become an integral part of BNN's and its communities' activities, and that's why we're promoting it in this BNN QUARTERLY.

Over the last few months at BNN we have been grateful to be able to meet our partners in person again where possible, as we find personal connection to be a cornerstone of collaboration. However, the pandemic has left us with important learnings in the field of digitization. BNN has broadened its activities towards making networking more accessible and sustainable, with reduced travelling and easier connection with others.

Here is a sampling of what we will continue to offer you in the virtual world:

- ✔ Digital magazine BNN QUARTERLY
- ✔ BNN INFORMS (members-only digital news update)
- ✔ Webinars
- ✔ Bi- and multilateral web-meetings
- ✔ BNN YouTube Channel
- ✔ Social media coverage on Twitter and LinkedIn

Looking at our list of members, it's clear that BioNanoNet is already an international community: member organisations from 15 countries are involved in our network, and online connectivity with our members shall ensure that we are able to offer "support without borders".

Andreas & the BNN Team

BNN News

NEW BIONANONET MEMBERS

We are happy to welcome our new BioNanoNet members:

Silver Member

ILF Consulting Engineers Austria GmbH (Austria)

The ILF Group is an international engineering and consulting firm that helps its clients successfully execute technically demanding industrial and infrastructure projects. See website!

Extraordinary Members

APPLIED NANOPARTICLES SL (Spain)

Applied Nanoparticles S.L (AppNPs) is a nanotech engineering company focused on empowering researchers by designing and supplying high-quality nanoparticles colloids at unmatched high concentrations, smartly aliquoted at affordable prices while providing expert advice on its use. See website!

Dynamic & Security Computations (ANALISIS–DSC) (Spain)

ANALISIS-DSC is a mechanical engineering service and consultancy company, specialized in fluid, structural and thermal solutions. See website!

GreenTech Cluster Styria GmbH (Austria)

The Green Tech Valley is located in the south of Austria and is internationally regarded as the hotspot for innovative energy and environmental technology. See website!

Microfluidics Innovation Hub (MIH) (Austria)

The Microfluidics Innovation Hub (MIH) offers its customers a single entry point to a wide range of existing cutting-edge microfluidic technologies from Europe's top research centers and companies, covering the entire value chain to accelerate the demonstration of exciting new scientific breakthroughs towards a working prototype, and beyond into mass manufacturing. See website!

Technical Office for Chemistry – Dr. Karl Dobianer (Austria)

Dr. Karl Dobianer's Technical Officer for Chemistry offers consulting, R&D, training and QA for toxicology, chemistry, polymers and EDV. See website!

TEMAS Solutions GmbH (Switzerland)

From innovation to safe and sustainable products. TEMAS Solutions GmbH helps companies of all sizes respond to industry transitions in order to stay competitive. TEMAS Solutions staff has been trained on the main topics required by the Chemicals Strategy for Sustainability and currently assists companies to achieve this transition which moves Europe towards the Green Deal. See website!

University of Torino (Italy)

The research fields of the Structural and Functional Biochemistry group are in the area of protein and metabolic engineering, structural and functional proteomics. See website!

Visit our website to get to know all our BioNanoNet members.

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3RD BIONANONET MEMBER WELCOME WEBINAR

On 7 July 2022 we had the pleasure to host our third BioNanoNet Member Welcome Webinar. Three organizations that recently joined the BioNanoNet Association presented their organizations and expertise.

- IVL Swedish Environmental Research Institute presented by John MUNTHE
- TEMAS Solutions GmbH presented by Blanca SUAREZ-MERINO
- University of Torino presented by Sheila SADEGHI

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.

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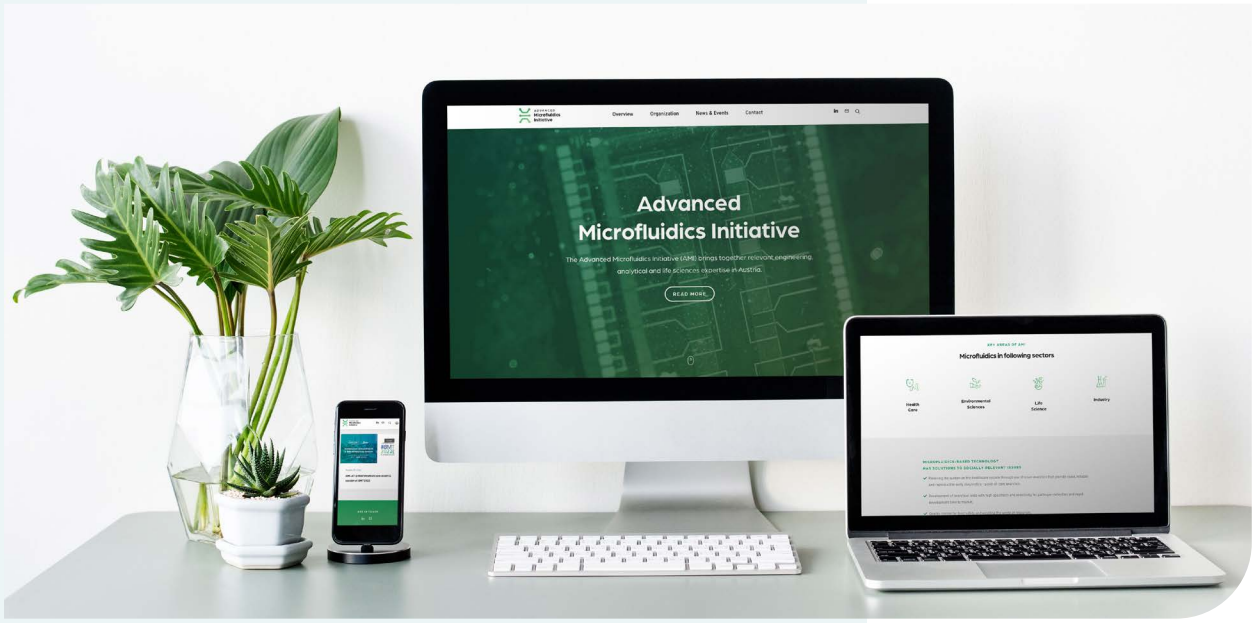
ADVANCED MICROFLUIDICS INITIATIVE (AMI) LAUNCHES BRAND-NEW WEBSITE



We are happy to announce the launch of the Advanced Microfluidics Initiative (AMI) website! Find out more about our strategic objectives and how we intend to reach them by connecting the microfluidics community. Visit the website and get in touch with us on LinkedIn to find out more.

Contact

BioNanoNet Forschungsgesellschaft mbH
Clemens WOLF & Melanie MAYR
office@microfluidics-austria.at
www.microfluidics-initiative.com

WEBINAR "PROMOTING YOUR RESEARCH ON SOCIAL MEDIA" BROUGHT TOGETHER BROAD AUDIENCE EAGER FOR DISCUSSION

On 7 September 2022 BNN hosted the webinar "Promoting your Research on Social Media". We invited BioNanoNet members, project partners and their colleagues to this webinar on how to effectively use social media to promote their research. Forty-six participants attended to learn some Do's and Don'ts for setting up their Twitter and LinkedIn accounts and sharing their research. We received many questions and had a lot of discussion in the chat!

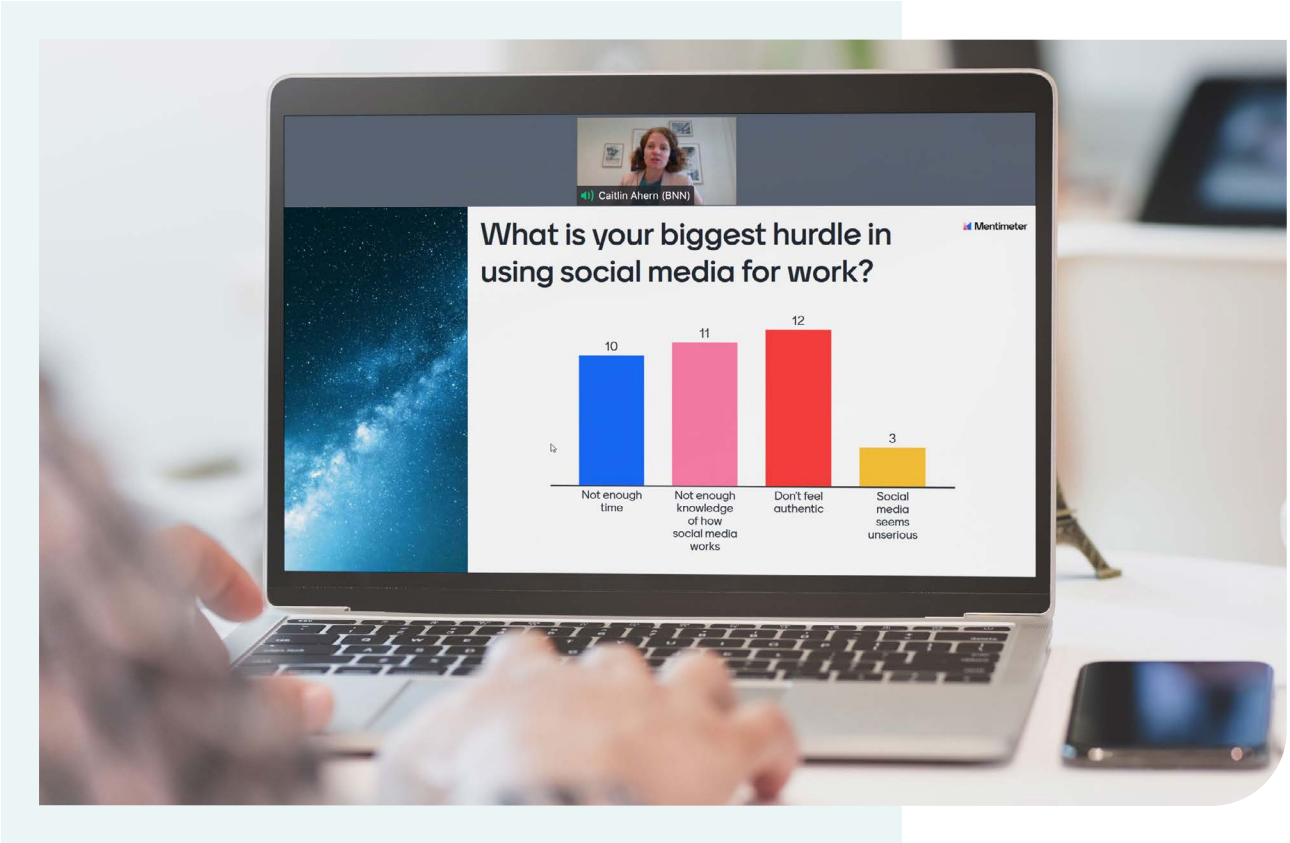
Here are three takeaways from the webinar:

1. **Start with the most important info!** Many people will see your post as a notification on their phone with just the first several words visible – or in the case of LinkedIn as just the first 3 lines. Make sure these first words say something meaningful!
2. **Video > Image > Text only.** Post an image to accompany your text wherever possible. (Have you noticed that people tend to post selfies or photos of flowers on their desk when making announcements? They know that posts with images will be seen much more than those without!) Even better are videos, so even a couple seconds' clip of you walking through a poster session can earn a lot of impressions and visibility for your project!
3. **Celebrate others.** If you feel uncomfortable promoting your own work, start by giving shout-outs to your colleagues. Congratu-

late others on their work and promote the activities of those in your department – it will help them get their research seen by a wider audience.

And of course, continue to engage with the BNN community on Twitter and LinkedIn.

Let's keep these conversations going!



Screenshot from the live survey on the hurdles of social media use

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BIOCERAMICS32

Stakeholder Workshop on "Safe–and–Sustainable–by–Design (SSbD) Paradigms Applied to (Nano)materials"

bio cera mics 32

Symposium and Annual Meeting of the International Society for Ceramics in Medicine

SEPTEMBER 20-23, 2022
VENICE *MESTRE*, ITALY
CONFERENCE CENTRE NH LAGUNA PALACE

The International Society for Ceramics in Medicine (ISCM) organised the Bioceramics 32, the 32nd Symposium and Annual Meeting of ISCM, on 20-23 September 2022 in Mestre (Venice, Italy). The conference, hosting material scientists, industrial and clinicians from all over the world, offered a unique opportunity to participate in a highly trans-disciplinary event covering the development and application of ceramic-based systems.

Within the framework of this conference, the NMBP-15 EU project ASINA organised its 1st Stakeholder Workshop focused on "Safe-and-Sustainable-by-Design (SSbD) paradigms applied to (nano)materials". The workshop aimed to provide an overview on the different S(S)bD tools currently developed in several EU projects, as well as identifying their specific key features and applicabilities. It was chaired by the ASINA coordinator, Anna Costa (CNR-ISTEC) and included the participation of Europe's top nanosafety and Safe-by-Design (SbD) experts, representing different ongoing European projects.

The EC funded NMBP-15 and -16 projects are expected to deliver integrated approaches for the implementation of Safe-and-Sustai-

© ASINA project

From the left: Thomas Chamberlain (SABYDOMA), Wouter Fransman (HARMLESS), Susanne Resch (DIAGONAL)

nable-by-Design nanotechnologies, through relevant case studies, by developing e-infrastructures that support and facilitate decision making when having to weigh different criteria: technological and regulatory requirements, health and environmental impacts, as well as economic analysis, along the life-cycle of a nanomaterial, in its complex form and once integrated in nano-enabled products. In this workshop, all NMBP-15 and -16 projects presented their S(S)bD approach, their tools under development as well as their specific industrial case studies. Next to that, latest developments on sustainable nano-fabrication and planned activities to set-up an international SSbD infrastructure were presented. The regulatory perspective was covered by a talk from JRC and OECD, highlighting among others a newly developed early warning system for advanced materials. The workshop was a great opportunity to discuss latest developments in S(S)bD among experts and identify next steps and activities to maximise synergies between the projects. A roundtable discussion allowed participants to exchange different views around life cycle dimensions and data management strategies. As an outcome of this workshop, an overview table with all NMBP-15 and -16 S(S)bD tools was created, emphasising their "by design" component, assessment part, main inputs and outputs of the tools, as well as their key strengths. This table will be refined in the upcoming months by the EU NanoSafety Cluster WG E on "Innovation and Safe(r)-by-Design".

Click here for the whole program of the BioCeramics32 and the book of abstracts here.

These projects have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement n° 953152 (DIAGONAL), n° 953183 (HARMLESS), n° 886171 (NanoFabNet), n° 862296 (SABYDOMA) and n° 862195 (SbD4Nano). In addition, one project receives funding from the European Union's HORIZON EUROPE research and innovation programme under grant agreement n° 101058245 (IRISS).

BIONANONET ANNUAL FORUM & BNN NETWORKING EVENT

Mission Cancer, Horizon Europe and Technology Platforms

From the left: Thomas Mohr (Science Consult), Susanne Resch (BNN), Andreas Falk (BNN), Alexandre Pazos (ILF), Bettina Mihalyi-Schneider (TU Wien), Peter Ertl (TU Wien), Torsten Mayr (TUG), Clemens Wolf (BNN) and Günter Lepperdinger (PLUS) - ©BNN

In the middle of autumnal Tyrol, the BioNano-Net Annual Forum & BNN Networking Event took place September 27 at UMIT in Hall-in-Tirol. This year, three technology platforms coordinated by BNN were presented, and participants could join a B2B call matchmaking session, jointly organized and hosted by EEN, UMIT & BNN. Dr. Ines Haberl from the Austrian Research Promotion Agency (FFG) National Contact Point Health gave an interesting keynote, introducing the past and also upcoming calls in the field of the EU Mission on Cancer and presenting the goal of Mission on Cancer, namely, "By 2030, more than 3 million more lives saved, living longer and better."

Following the keynote, the respective general coordinators of our three technology platforms, Susanne Resch (NanoMedicine-Austria - NM-AT), Clemens Wolf (Advanced Microfluidics Initiative - AMI) and Andreas Falk (Sustainable Chemistry-Austria, SusChem-AT), provided insight into the core of the technology platforms.

The technology platform NM-AT was presented in a thematically fitting way for the BMT2022 starting the next day, and Susanne Resch, General Coordinator, announced its updated strategy including relaunch with website and social media presence, as well as a strong line-up of chairs.

The platform was founded (along with the other two platforms) in 2016; after some personnel changes NM-AT now has a full Board.

In his keynote for NM-AT, Thomas Mohr, one of the chairs, took all participants into the world of digitalization and presented the connecting points of bioinformatics with nanomedicine and highlighted "Applications and Challenges" therein.

The second platform presentation dealt with our Advanced Microfluidics Initiative, which was fully represented with all three chairs. Clemens Wolf, General Coordinator of AMI, gave insights on the topic "Achievements and Outlook to socially relevant issues" and presented the further planned activities. This platform also has a new look with a website and LinkedIn channel.

With the question "Quo vadis microfluidics?" Peter Ertl, one of the chairs of AMI, introduced his lecture and led from the development and necessity of research work on the topic of microfluidics in Austria to an overview of activities in the community and also in the start-up scene. The AMI community had gathered for a social dinner the night before, and it was a great pleasure to welcome some of our new members.

Last but not least, the developments and outlooks of SusChem-AT were given by the General Coordinator Andreas Falk. The platform was introduced alongside its strategy paper, which was adopted in the summer of this year, outlining the relationship and cooperation with the European technology platform.

The closing keynote of the Annual Forum was held by Alexandre Pazos. He gave exciting insights into the sustainable development of projects in recent years and also showed that an engineer can quickly and easily become an "ethical engineer". Mr. Pazos gave numerous tips on how this can be achieved.

Following the BioNanoNet Annual Forum, the BNN networking session kicked off. Here people participated in the Horizon-Europe-Matchmaking event, which was jointly organized by BNN with EEN, Standortagentur Tirol & UMIT and successfully continued the next day at BMT2022 in two further sessions.

On 28 September within BMT2022, many of our members followed our BNN focus session titled "Nanotechnologies for Safe & Sustainable Biomedical Applications" and stopped by for intensive exchange with us at our BNN booth at Congress Messe Innsbruck.

Thank you to all who made the trip to Innsbruck for such a rewarding week!

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

This project has received funding by the BMK project NanoSyn³.

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BNN HOSTS FOCUS SESSION ON SAFETY AND SUSTAINABILITY AT BMT2022 CONFERENCE

George Tsekenis (Biomedical Research Foundation of the Academy of Athens), Chiara Turrina (Technical University of Munich), Bettina Faustini (Paracelsus Medical University Salzburg), Taraneh Sadat Zavvar (Medical University Innsbruck), Martin Himly (Paris Lodron University Salzburg), Andreas Falk (BNN)

In the frame of the Joint Annual Conference of the Austrian, German and Swiss Societies for Biomedical Engineering conference "BMT2022" in Innsbruck, BNN organized and chaired the September 28th session entitled "Nanotechnologies for Safe & Sustainable Biomedical Applications". Bio- and nanotechnologies, key technologies of the 21st century, are used in many areas. However, the use of nanotechnology in the biomedical technologies field is still in its early days. Completely new applications, by offering for example improved methods for imaging techniques and diagnostic tools, nanomedicine/-pharmaceutics and also microfluidics for biomedical applications, have the potential to improve current therapies and diagnostics.

The session was multifaceted, including the following presentations:

- ✔ Iron oxide nanoparticles with supramolecular ureidopyrimidinone coating, presented by Chiara Turrina.

- Nanoparticle-based delivery of cmRNA as a novel therapeutic for tendon regeneration, presented by Bettina Faustini.
- Design and characterization of a novel multi-storey DNA nano-structure as a doxorubicin delivery system, presented by Taraneh Sadat Zavvar.
- Transforming nanosafety to SSbD: adopting emerging concepts and integrating novel tools into established workflows, presented by Martin Himly.
- NextGenMicrofluidics: low-cost, high throughput manufacturing approaches for the development of microfluidics-based molecular diagnostics devices, presented by George Tsekenis.

Within thoughtful presentations, the audience got a glimpse of innovative nanoparticles for coatings, drug delivery systems for regenerative medicine application, as well as DNA-origami-based drug delivery systems. Furthermore, the speakers made clear that the transformation from research to the market needs to be enabled by the implementation of the SSbD (Safe-and-Sustainable-by-Design) concept, making this approach a highly relevant competence. Finally, diagnostic device development and manufacturing approaches, which have already undergone SSbD measures, were demonstrated in the microfluidics area.

The session was a great showcase with two important messages: first, the excellence and competence available in the field of nano-enabled biomedical applications, and second, that all this nanomedical expertise brings huge potential for innovative applications in the health sector. BNN coordinates the nanomedicine community in Austria through the national technology platform NanoMedicine-Austria and we are open for enthusiastic colleagues from science, research or companies, who are willing to collaborate to bring benefits from research to society.

These projects have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement n° 862092 (NextGenMicrofluidics), n° 964248 (DeDNAed), n° 953110 (PHOENIX) and by the BMK project NanoSyn³.

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BNN BRINGS NANOMATERIALS TO EUROPEAN RESEARCHERS' NIGHT 2022

Beatriz Alfaro Serrano (left) and Caitlin Ahern (right) from BNN at ERN 2022

"Nano" is a term that yields interest and scepticism in the general population, bringing to mind high-tech innovations and potentially invasive medical treatments. How can we educate non-scientists, from kids to adults, about what "nano" really means, and the impact that nanomaterials and nanotechnologies have on their lives? BNN attempted to bring the topic closer to the public at European Researchers' Night on September 30th!

The European Researchers' Night (ERN) is an event that takes place simultaneously once a year throughout Europe and invites the public to get a taste of the everyday life of research institutions.

This year, the Austrian Centre of Industrial Biotechnology (acib) and the University of Applied Sciences St. Pölten organized jointly a hands-on event for Austria under the motto "Life is Science – in a digital world," targeted to all ages, from school classes to families to students considering careers in science, focused on the topics of Health & Food, Climate & Environment, Digital Transformation and Culture & Community at the crossroads of cutting-edge research and everyday life.

BNN, represented by Beatriz Alfaro Serrano and Caitlin Ahern (Project Communications), had a booth in St. Pölten, roughly half an hour from Vienna, with the topic "Nanomaterials & Nanotechnology". We created a poster with an overview of nanomaterials in our everyday lives, and had an interactive matching game about nanomaterials, linking the general in-

formation tailored to a broad public to the developments in the 19 complex European projects we are currently involved in, including DIAGONAL, HARMLESS, Gov4Nano, and many others.

More than 50 people, ranging from children to students to adults, stopped to chat with us and play our games. We were impressed with the level of awareness the visitors had about everything "nano", and had many interesting conversations. We also enjoyed perusing the other EU projects stationed nearby.

In addition to the exhibition hall with the many interesting booths where people were able to perform experiments, visitors could attend live workshops, watch a science film and visit the keynote presentation by Niki Popper. All in all, an enriching evening!

These projects have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement n° 964430 (BreadCell), n° 964248 (DeDNAed), n° 953152 (DIAGONAL), n° 956544 (DIRNANO), n° 814401 (Gov4Nano), n° 953183 (HARMLESS), n° 953183 (Hi-Accuracy), n° 886171 (NanoFabNet), n° 731032 (NanoCommons), n° 862583 (NanoPAT), n° 862092 (NextGenMicrofluidics), n° 953110 (PHOENIX), n° 829010 (PRIME), n° 862296 (SABYDOMA), n° 862195 (SbD4Nano) and n° 883315 (SixthSense). In addition, two projects receive funding from the European Union's HORIZON EUROPE research and innovation programme under grant agreement n° 101058245 (IRISS) and 101057014 (PARC). The STARS project has received funding from the EU's Competitiveness of Small and Medium-Sized Enterprises (COSME) programme under the grant agreement n° 101037897.

Focus topic of this issue:

Nanomedicine

NANOMEDICINE-AUSTRIA

The National Technology Platform addresses scientific and technological challenges in the nanomedicine field

Nano Medicine AUSTRIA

Nanomedicine opens up fascinating new chances for medical applications by offering improved methods for drug delivery systems, imaging techniques and diagnostic tools. The national technology platform NanoMedicine-Austria brings together bio- and nanomedical experts to promote science and research in this field. Its mission is to build references on Austria's nanomedical research and innovation capability, and to achieve joint impact through community-driven activities. Embedded in the European nanomedicine ecosystem, the regional competences are connected internationally.

NanoMedicine-Austria's vision is to increase the visibility of nanomedicine as a benchmark for research and innovation at national and international levels, and to promote Austria's excellent basic and applied research to strengthen the transfer of nanomedical applications from lab to clinical practice.

Objectives of the platform:

- Tackle medical challenges to achieve a more efficient and affordable healthcare, as well as new solutions to improve medical treatments
- Contribute to a better understanding of biological processes in the human body at the molecular and nanometric levels
- Connect experts in the nanomedical field
- Create synergies through multidisciplinary cooperation

- Support the Austrian nanomedical community and link it to European and global initiatives
- Facilitate close collaboration with industry to allow large-scale manufacturing production of efficient and safe nanopharmaceuticals
- Provide support in nanosafety, quality and sustainability issues to meet regulatory requirements
- Enhance access to national and international research projects and funding

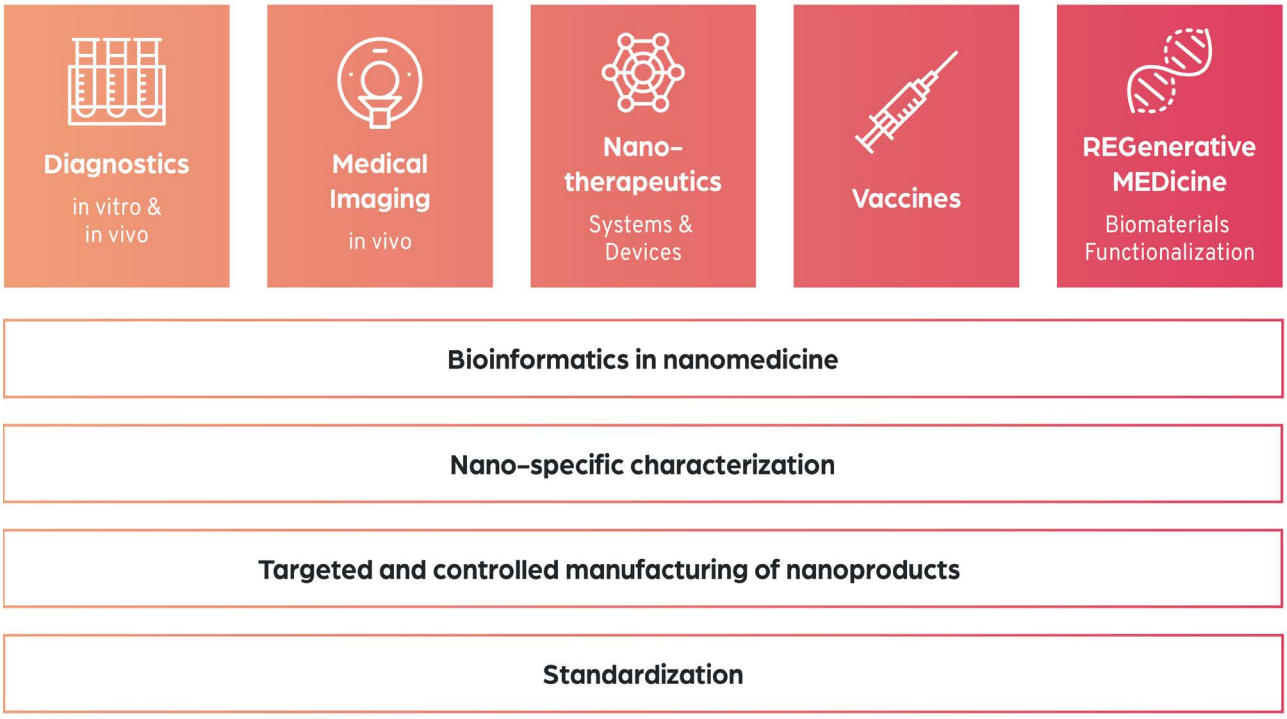
We warmly welcome our new platform chairs:

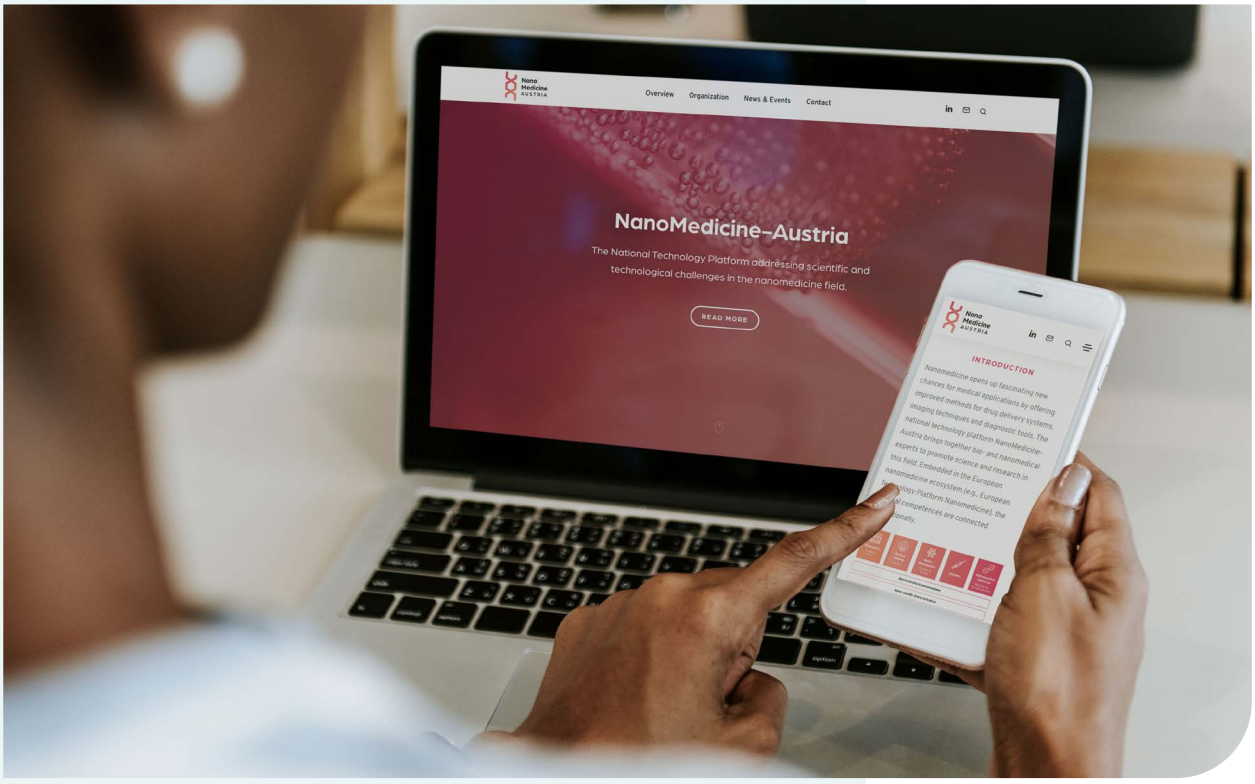
Daniel Baumgarten
UMIT Tirol GmbH

Ramona Jeitler
University of Graz

Thomas Mohr
ScienceConsult

Sebastian Schwaminger
Medical University Graz





NanoMedicine-Austria is an open platform to which any interested organization or expert can potentially contribute and participate at any time, as long as the necessary expertise and interest in the nanomedical field is provided. Get in touch if you want to join the platform!

Recently, we launched the new NanoMedicine-Austria website and LinkedIn channel.

Visit our website to learn more about this platform and connect with us on LinkedIn. We will update you with interesting news and events about nanomedicine!

Contact

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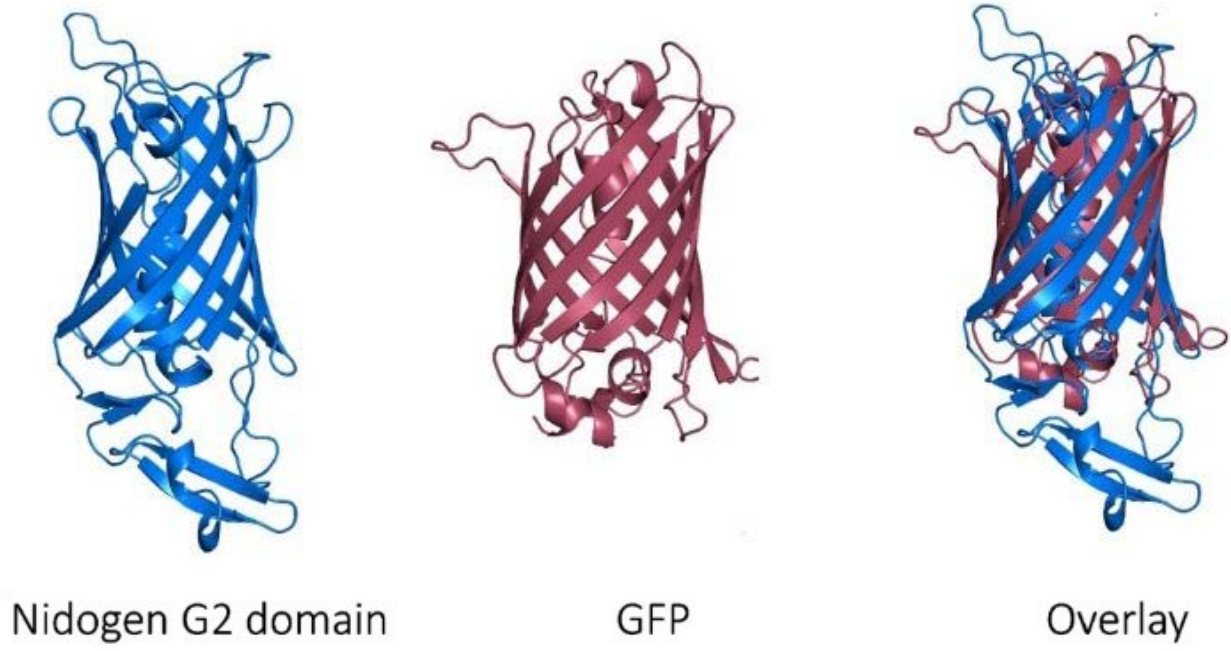
CONTRIBUTION FROM CIBER-BBN

How Engineered Protein Helps Nanomedicine Fight Cancer



The use of protein nanoparticles as biomaterials has been rising in recent years due to their characteristics: high biocompatibility, structural versatility, biodegradability and plasticity of design. We can later incorporate peptide ligands for specific targeting as fusion proteins and use these nanoparticles for targeted nanomedicine.

However, not all proteins can be used as scaffolds for targeted drug delivery, as they need to meet certain criteria. First, it is crucial that the proteins used as a scaffold allow site-specific drug conjugation. The stability and proteolysis resistance of these proteins is also important to remain assembled during the bloodstream circulation.

In addition, the scaffolds must be biologically neutral, meaning that they should not interact with other human proteins that interfere with their capacity to reach and specifically deliver their cargo. The lack of immunogenicity of these proteins is also desired to avoid immune system recognition. And, ideally, the proteins used as a scaffold should not have post-translational modifications to ensure that they fold equally in both prokaryotic and eukaryotic cell factories for production. The scaffolds that have all these properties have a better chance to both achieve a proper biodistribution and to successfully deliver their cargo molecules into the target cells.

The Green Fluorescent Protein (GFP) satisfies most of the desired characteristics for a scaffold. Moreover, its intrinsic fluorescence allows the tracking of the protein distribution and intracellular localization both in vitro and in vivo. The use of GFP as a protein scaffold for targeted drug delivery has been extensively studied by the Protein Production Platform (PPP) of NANBIOSIS/CIBER-BBN. The PPP team has been able to deliver cytotoxic drugs through their patented platform for targeted delivery. This platform consists of a cationic peptide ligand (T22) and a hexa-histidine peptide that act as self-assembling tags. T22 is a CXCR4 ligand that enables a targeted delivery to CXCR4+ cells, a receptor that is overexpressed in metastatic cancer cells. They have demonstrated previously in an in vivo model that more than the 85% of the administered product was accumulated in the tumor and that they could efficiently conjugate Floxuridine (a genotoxic antimetabolite) to our T22-GFP-H6 nanoparticles, resulting in a strong anti-metastatic activity.

Despite these very promising results, GFP is an exogenous protein from Aequorea victoria and, consequently, triggers an immune response, which limits its clinical use. Thus, we needed to find a human protein that matches the exceptional properties of GFP as a protein scaffold.

Fortunately, a non-fluorescent GFP-like protein has been described in humans and it corresponds to one of the three globular domains of Nidogen, a structural protein that binds to collagen IV, laminin and perlecan with high affinity. The globular domain G2 has a beta-barrel structure with a central alpha-helix that folds very similarly to the GFP, despite that these proteins share very low sequence identity.

Notably, this domain does not have post-translational modifications that could interfere with its production and folding in prokaryotic cells. However, perlecan and collagen IV binding sites have been reported within this G2 domain. Therefore, we needed to selectively mutate these binding sites in order to assure the biological neutrality of the nanoparticles.

After a thorough structural analysis, the PPP team incorporated four different mutations to engineer a biologically neutral product that was named HSNBT. There were no differences detected between the wild-type G2 domain and the engineered HSNBT protein regarding the predicted structural epitopes, which suggested that the introduced mutations would not generate immunogenicity. In order to validate the new scaffold, they used the above-mentioned patented platform with T22 and the hexa-histidine tag, replacing GFP for the new HSNBT scaffold.

First, they characterized the resulting nanoparticles and they determined, both by Dynamic Light Scattering (DLS) and Scanning Electron Microscopy (SEM), that they had a size of around 10 nanometers. Next, they observed that the T22-HSNBT-H6 nanoparticles were internalized effectively by CXCR4+ cells. This specificity was corroborated when they used a CXCR4 antagonist (AMD) and saw a notable decrease of their internalization.

Then, they successfully conjugated floxuridine to the nanoparticles (T22-HSNBT-H6-FdU) through the free lysine-amino groups of the

protein and they demonstrated that the nanoconjugates had a potent cytotoxic effect in CXCR4+ cells. Once they had validated these nanoconjugates in vitro, they tested them in a colorectal cancer mouse model.

Notably, they saw an important tumor growth inhibition after several doses of these nanoconjugates. The inhibitory effect was slightly higher when using the new scaffold than with GFP. They also saw a significant increase in cell death bodies and caspase-3 activation in the tumor after the treatment with the nanoconjugates. Again, the effect was more potent with HSNBT as a scaffold than with GFP. Remarkably, the treatment did not result in any histological toxicity and there were no differences between the weight of the treated mice when compared to the untreated mice.

This technology is protected by 3 patents: The ligand to enter CXCR4+ cells (WO2012/095527), the nanoconjugates (EP17382461.6) and the human scaffold protein HSNBT (EP19383201), all three licensed to Nanoligent SL.

Contact

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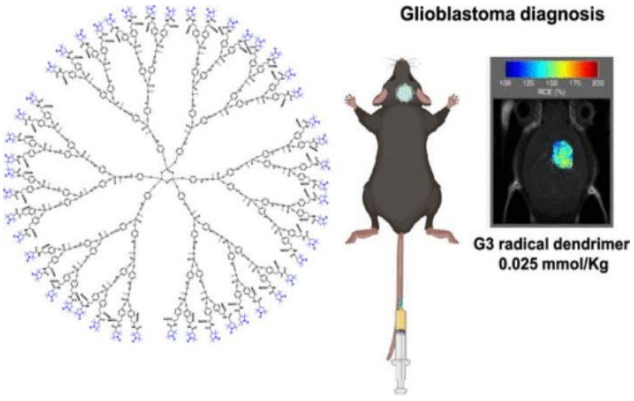
CONTRIBUTION FROM CIBER-BBN

Metal–Free Contrast Agents: Novel Approaches

The joint expertise of CIBER-BBN Nanomol Group – NANBIOSIS Biomaterial Processing and Nanostructuring Unit at ICMAB-CSIC (José Vidal and Vega Lloveras) and the NANBIOSIS Unit of NMR Biomedical Applications I at UAB (Ana Paula Candiota), led to a recently published article in the journal *Biomacromolecules*.

Brain tumors such as glioblastomas are a challenge in the clinics, and proper diagnosis and follow-up are crucial for patient outcome. Contrast agents are usually administered to patients for assessing blood-brain barrier integrity, and quantitation of enhancing areas are part of the clinical criteria for estimating response/relapse. However, most contrast agents currently used in clinics are based on metal elements such as Gadolinium and are not free of risk. In addition, due to the renal excretion route, administering such agents to some patients is contraindicated. Our work explored the potential of organic radicals anchored to dendrimers to act as contrast agents for glioblastoma studies, proposing a metal-free alternative for contrast-enhanced glioblastoma studies. The article describes details of synthesis and characterization of these agents, as well as in vivo, ex vivo and in vivo magnetic resonance studies. The orthotopic immunocompetent GL261 glioblastoma murine model was used for in vivo and ex vivo studies. The novel contrast agent proved to be non-harmful for wild type mice and produced sustained and long-lasting contrast in tumor-bearing mice, even in much lower doses in comparison with gadolinium administration.



The diagnosis and follow-up of high-grade brain tumors such as glioblastomas relies mostly on MRI. The researchers' approach explores organic radicals anchored to dendrimers as a metal-free alternative to produce contrast enhancement in MRI, safer than Gadolinium-based compounds, and with translational potential.

Article of reference:

Zhang S, Lloveras V, Lope-Piedrafita S, Calero-Pérez P, Wu S, Candiota AP, Vidal-Gancedo J. Metal-Free Radical Dendrimers as MRI Contrast Agents for Glioblastoma Diagnosis: Ex Vivo and In Vivo Approaches. Biomacromolecules. 2022 Jun 24. doi: 10.1021/acs.biomac.2c00088.

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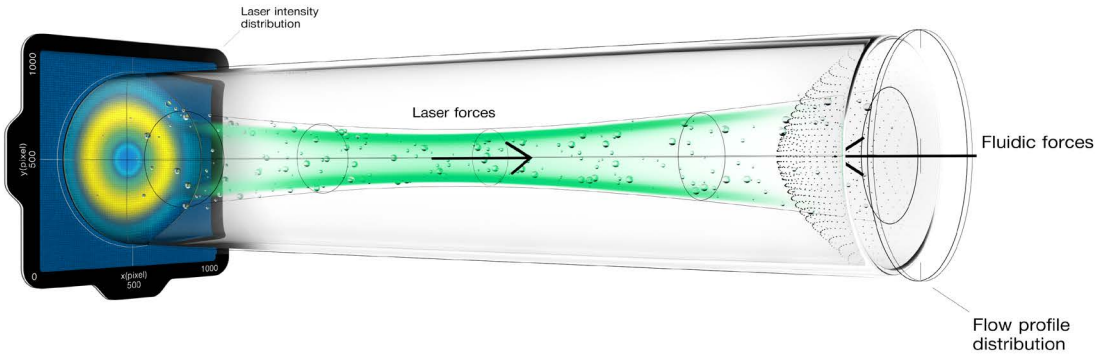
CONTRIBUTION FROM MEDICAL UNIVERSITY OF GRAZ

Graz Researchers Count Nanoparticles in Real Time: Patented Technology Finds its Way into Industry



Optofluidic force induction scheme (OF2i®) © BRAVE Analytics

Nanoparticles are taking on an important role in many modern industries. Medicine, biotechnology, cosmetics and many other industries are embracing these tiny particles to achieve special properties. Med Uni Graz spin-off and deep tech company BRAVE Analytics has celebrated breakthroughs in this area in cooperation with the University of Graz thanks to its innovative devices.

Research on the smallest scale

In a paper that has just appeared in Physical Review Applied, scientists from Med Uni Graz and Uni Graz recommend a measurement method that allows rapid, reliable and robust determination of these critical particle sizes. "In this method, the nanoparticles under investigation are pumped through a channel while a weakly focused laser beam moves in the direction of the flow and performs two tasks. First, the nanoparticles can be observed through the scattered light, and second, the light exerts forces on the nanoparticles," explains Ulrich Hohenester from the University of Graz.

Floating particles

In the current research, the nanoparticles are trapped by optically induced forces from the light field when they "float" through the measuring cell while being accelerated in the direction of the flow. Measurement and analysis of the acceleration of individual nanoparticles yields detailed information about the size distribution, geometry and concentration of the nanoparticles. The idea for this method comes

Process unit B1 © A.Leljak / BRAVE Analytics

from Christian Hill of Med Uni Graz, who is currently developing a commercially available measuring instrument based on this method with his company BRAVE Analytics. Marko Šimić and Ulrich Hohenester of the Institute of Physics at the University of Graz were responsible for the theoretical description and evaluation of the experiments. "This interdisciplinary collaboration between medical research, theoretical and technological development along with medical and biomedical application also fits in well with the goals of BioTechMed-Graz," says researcher and entrepreneur Christian Hill.

New projects

With this innovative technology in tow, a project funded by the FFG (Austrian Research Promotion Agency GmbH) has started that explores sample preparation of nanotechnology/pharmaceutical fluids and particles for bone formation, emulsions, vaccines or similar products. The project began on 1 April 2022 and is scheduled to run through 20 June 2023. This research has been promoted and supported by the European Commission through the project NanoPAT (grant agreement number 862583), in which Med Uni Graz is also involved. This project explores the linkage of patented OF2i® technology in industrial processing plants in order to improve automated quality control and to reduce and eliminate bottlenecks. The project currently focuses on pharmaceuticals, biotechnology and materials science.

Market launch early next year

A highlight for the spin-off will be the official market launch of the B2 device series for lab applications at the beginning of next year. The series provides the described OF2i® measu-

ring method as a compact lab device and can be used to measure time-resolved particle formation processes or detect very low concentrations "...as they play an important role in areas such as analysis of the water chemistry of plastic nanoparticles," explains Christian Hill.

The road to industry

The preliminary presentation and product demo at Analytica 2022, the world's largest trade fair for laboratory technology, have already generated great interest, and close cooperation is also underway with various institutes at the Medical University of Graz, the University of Leoben and other interested parties. "The manufacturing, assembly and final inspection of high-tech devices are carried out completely in the heart of Graz," says co-founder and CFO/COO Gerhard Prossliner. "Currently we are producing a good number of devices." Advance orders are possible and handled on a first come, first served basis.

Read the publication here

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

Get connected with NanoPAT on:

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B2 device © A.Leljak / BRAVE Analytics

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CONTRIBUTION FROM DEDNAED PROJECT

Cluster Decorated Functional DNA Origami–Based Biosensor: Towards a Next Generation of Innovations in Nanodiagnostics

Biosensors are small but smart devices responding to external stimuli, widely used in many fields including clinical diagnostics, healthcare, environmental monitoring, and more. Now it is more important than ever to fabricate sensitive, stable, reliable sensors. Nanodiagnostics, defined as the use of nanotechnology for diagnostic purposes, is a specific scientific topic focused on meeting the demand towards increasing the levels of sensitivity and earlier detection capacity of the biosensors[1].

The next generation of nano-innovations in diagnostics are based on the use of cutting-edge technologies within the nanodiagnostics field, including the use of nanoparticles, DNA nanotechnology, nanostructured surfaces, microfluidics, and Lab- or Organ-on-a-chip systems, in which the sample is completely unknown. The programmability of the DNA molecules with accurate design and freely defined constitutions has led to the rapid progress in DNA nanotechnology, designing multitudinous DNA nanomaterials with different shape and size based on the classic Watson-Crick base-pairing for molecular self-assembly[2].

Among the various dimensional architectures, DNA origami structures provide a versatile platform with which one can engineer nanoscale structures and devices that are able to sense, compute, and actuate[3,4]. The DNA origami technology is able not only to construct arbitrary shapes in two and even in three dimensions but also to precisely control the arrangement of molecules with different functionalities.

Surface–enhanced Raman Spectroscopy (SERS) is a surface-specific spectroscopic technique that employs metal surfaces to enhance Raman signal from molecules. Next to rugged metal surfaces, metal nanoparticles are routinely used in a SERS application enhancing the low-concentration single-molecule Raman signal by several orders of magnitude. Because of the huge signal enhancement provided by plasmonic hot spots, SERS can become a highly sensitive spectroscopic method and provide the means for single-molecule studies. Furthermore, precise, and reliable fabrication of versatile hot-spot-based SERS sensors by accurate arrangement of plasmonic nanoparticles using DNA origami structures[5-8]- is crucial. After all, the plasmonic nanoparticle arrangement enables measurement of single molecules indicating future applications of DNA origami-based nano-antennas in biosensing.

The DeDNAed project

The DeDNAed project intends to develop a cutting-edge bioanalytical biosensor platform with advanced sensitivity and versatility by using Surface Enhanced Raman Spectroscopy (SERS) as an ultrafast optical analysis method. The bioanalytical biosensor platform will be based on the assembly and integration of sensing elements (transducer and biorecep-

tor) by DNA origami. The DNA origami will serve as a “nano-breadboard” in order to precisely control the position of the biorecognition elements (bioRE) with respect to the plasmonic hotspots of NPs, which are positioned on the DNA origami in a similar fashion. In this way, highly sensitive SERS measurements are enabled. To combine DNA origami structures and nanoparticles while guaranteeing high arrangement precision, short oligonucleotide sequences are used, being active elements to DNA origami. Additionally, the concept includes the integration of metallic atomic cluster (AC) within the bioRE, providing enhanced properties compared to other NP-based systems while their synthesis is based on novel etching methods that avoid the denaturation of the bioRE[9-11].

Finally, the DeDNAed biosensor platform uses an immobilization system to selectively deposit DNA origami hybrids in an aligned manner on both solid and flexible substrate for efficient assay development, resulting in signal optimization. The sensor is designed to achieve the best signal-to-noise ratio in order to generate the highest possible sensitivity of the used SERS measurement. To ensure a good alignment of the individual bioRE, nanostructured surfaces through lithographic technologies and compatible immobilization procedures are of special interest. Potential applications of the DeDNAed-SERS biosensor include e.g., the detection of human biomarkers such as interleukin-6 to counteract side effects in cancer therapy at an early stage, or in food safety and agriculture to rule out contamination with mould toxins such as aflatoxin.

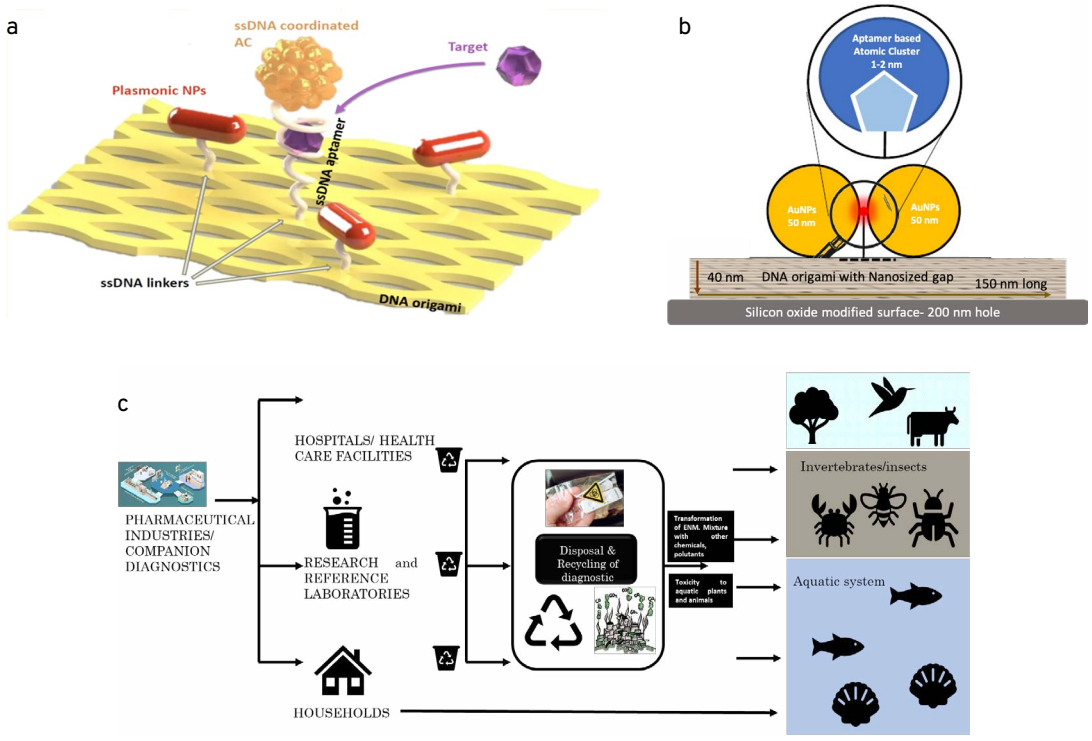

Figure 1. DeDNAed project: a) Cluster decorated DNA origami-based biosensor, b) Integration of nanoscale components in DeDNAed biosensor and c) nanoIVD devices life-cycle.

Roadmap for developing safe and sustainable diagnostic devices

As part of the development and innovation process, clarity about the safety of new technologies is one of the most important prerequisites for technology acceptance. Eliminating hazards at the design or planning stage is often easier and cheaper than making changes later on, when the hazards become real risks. Integration of nanoscale dimension materials in the biosensor composition such as gold nanoparticles, atomic cluster based bioRe, DNA origami structures and nanostructured surfaces will deal with chemicals, materials and processes that should be assessed.

Additionally, the increased availability of diagnostic tests for medical practice and public health has led to a 10% increase of the annual growth rate market projections for global point-of-care tests market (from $43.3 billion in 2022 to $72 billion in 2027)[12].

The production and disposal of single-use devices poses significant challenges for the environment and human health. This need to be addressed in the following decade[13] not only because most of the devices are commonly manufactured from unsustainable polymeric materials[14] but also because many devices contain toxic chemicals and/or materials that can harm the environment and be dangerous for human health[15,16] if not disposed of safely.

The concept of Safe-and-Sustainable-by-Design (SSbD) offers some solutions to incorporate considerations at an early stage of development while reducing environmental impacts in research and product development while ideally improving product performance, reliability, and controlled manufacturing processes; this also serves the economic sustainability of advanced materials.

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Role of BNN in DeDNAed project: Communication & Dissemination, Graphic Design, Safety-by-Design, Project Management

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CONTRIBUTION FROM PHOENIX–OITB PROJECT

PHOENIX–OITB Open Call: Join Forces to Overcome Common Barriers in Nanopharmaceutical Development

Ever wonder how to overcome the "innovation valley of death"? Have you ever needed to advance your research data to the next level but didn't have the resources? The PHOENIX project is here to help!

PHOENIX-OITB is a unified body and operational structure aiming at merging all services necessary to develop nanopharmaceutical solutions and products for end-users from the world of nanopharmaceuticals and diagnostics. PHOENIX-OITB's mission is to offer a single-entry-point for a consolidated network of facilities, technologies, services and expertise for all technology transfer aspects from characterization, testing, verification up to scale-up, GMP compliant manufacturing and regulatory guidance in the field of nanopharmaceuticals.

What does this mean for active players in the field? PHOENIX-OITB will provide services and expertise to end-users including production and characterization from R&D till under GMP conditions, safety evaluation, regulatory compliance and commercialization boost. The PHOENIX-OITB portfolio comprises diversified services under five major categories (Fig. 1), covering, all together, the prerequisite topics needed for bringing nanopharmaceuticals from early stage to entry into clinical trials.

PHOENIX-OITB will offer the possibility for its end-users to avail of its services pro bono during the project run time with the aim of validating and verifying the consolidated services. The pro bono demo-cases will be chosen in the frame of a competitive Open Call (follow PHOENIX website for application guideline and deadline). By means of pro bono demo-cases, PHOENIX-OITB will generate a track record of GMP manufacturing capability of nanopharmaceuticals with advanced quality, safety and efficacy data. The establishment of cGMP in nanopharmaceutical production at large scale is the key step to successfully transfer nanopharmaceuticals from bench to bedside and to overcome the so-called "innovation valley of death" for the nanopharmaceuticals translational process.

An Evaluation Committee, composed of experts from the PHOENIX project, will be responsible for the selection and recommendation of the appropriate candidate(s) among the received applications based on the criteria specified in the Open Call Guidelines. Once the pro bono demo-cases have been selected, the services offered by PHOENIX partners will be brought together to achieve the applicant's objective. Each selected demo-case will be handled according to the best practice in project management and confidentiality.

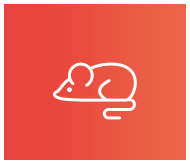
Excited for this opportunity? Are you a potential end-user interested in PHOENIX-OITB services? Apply to the Open Call and join us in the journey to enable timely and smooth transfer of nanopharmaceuticals from bench to bed-side. Stay tuned when we launch the call via the PHOENIX website!

Physico–Chemical Characterisation

Services to perform an accurate physicochemical characterization, including techniques to characterize not only nanoparticles but also small and large molecules (syntetic or biological ones) as well as the characterization of the conjugated.

***In vitro* Characterisation**

Services that permit an extensive *in vitro* characterisation of the nanomedicine under development, allowing specific and critical questions to be answered related to its toxicity, like cytotoxicity, cell viability, sensitization & irritation, etc.



***In vivo* Characterisation**

Services that allow to cover part of the pre-clinical in vivo characterisation of the nanomedicine under study. Most of the assays available follow OECD/ICH test guidelines.

Manufacturing

Services needed for the scale-up until the GMP manufacturing of a nanopharmaceutical.

Innovation

Services that help the customer reach its goals. Transversal and complementary services to the ones in the other categories, equally necessary when developing novel nanopharmaceuticals.

Figure 1: Services offered by the PHOENIX-OITB. For more information, refer to the PHOENIX-OITB Service Portfolio available online.

Role of BNN

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.

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

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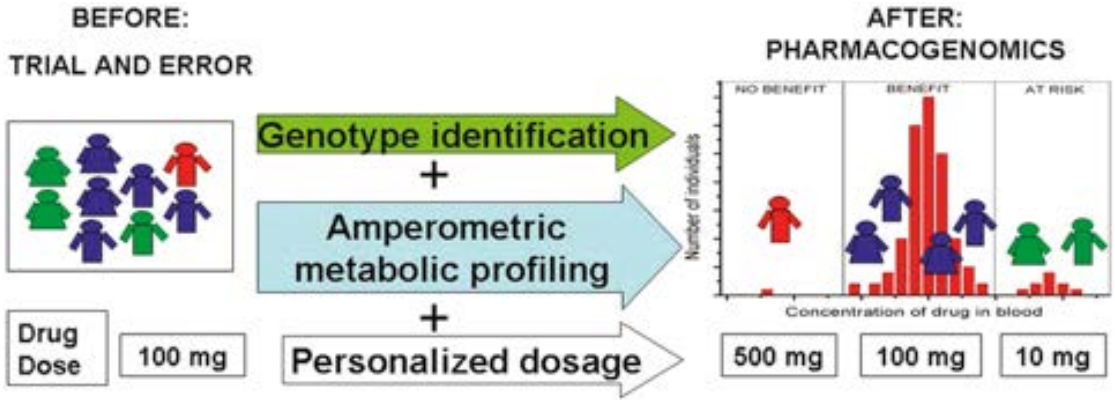
CONTRIBUTION FROM STRUCTURAL AND FUNCTIONAL BIOCHEMISTRY GROUP, UNIVERSITY OF TORINO

UNIVERSITÀ DI TORINO

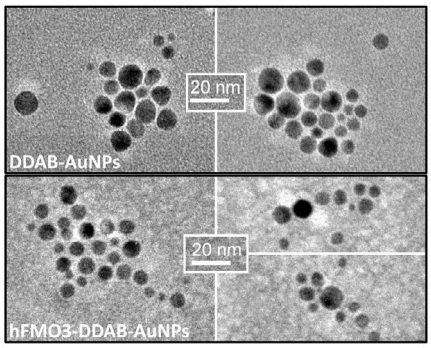
Human Drug Metabolizing Enzymes and their Relevance to Personalized Medicine

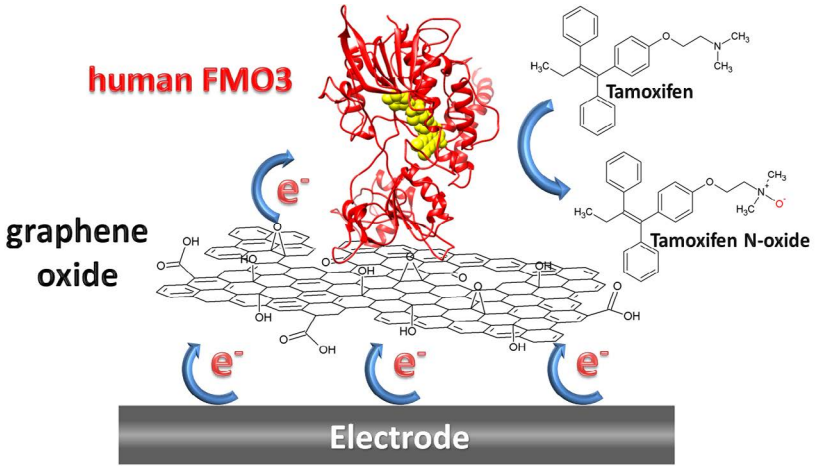


It is known that patients administered a particular drug can exhibit significant inter-individual variability in their response to treatment. Unfortunately, some patients will totally fail to respond to the therapy, while others will suffer dose-related adverse reactions, resulting in significant costs and in some instances even fatalities.

Two hepatic enzyme families are mainly responsible for this effect, namely cytochrome P450s (CYP) and flavin-containing monooxygenases (FMO). They are the most important Phase I drug metabolizing enzymes and together are responsible for the metabolism and clearance of more than 85% of all drugs and xenobiotics taken by humans. Moreover, some CYPs and FMOs are highly polymorphic with many of their single nucleotide polymorphisms present at reasonably high frequency within the population (in some cases as high as 25%). These polymorphic variants can have a profound impact on the metabolism of drugs, leading to a diminished or enhanced drug efficacy; this is the reason behind the observed inter-individual differences in drug response observed in the population.

Currently within the different stages of the drug development process, there is very little consideration for the genetic variability (polymorphism) in drug response within the population (one size does not necessarily fit all). Progress in the human genome analysis has made it possible to identify a patient's enzyme make up (genomics). However, genotyping needs a parallel enzyme-based platform (proteomics) capable of rapidly measuring a drug's pharmacokinetics and clearance (metabolomics). To date such a platform is unavailable. Ongoing work in our laboratory at the University of Torino addresses this gap by developing bioelectrodes based on CYPs and FMOs and their polymorphic variants.





Production of human enzymes

In order to construct the bioelectrodes, our research group has cloned and successfully expressed and purified many of these hepatic drug metabolizing enzymes together with their polymorphic variants. Having access to the pure enzymes has aided not only the in vitro characterization of their pharmacokinetic behavior towards the clearance of diverse drugs, but also the differences between wild-type and polymorphic variant enzymes in their activity towards the same drugs.

Data on common polymorphic variants have demonstrated that although in a majority of cases compared to the wild-type, a decrease in the activity of the variant enzyme is observed, in specific cases a reversal of this trend is observed. Ultimately in a not too distant future, by deciphering the enzymatic activity of the many polymorphic variants, a dose adjustment of different prescribed drugs based on the genetic makeup of each patient can be envisaged i.e. personalized medicine. This will aid in increasing the rate of success of drug-based treatments within the society by reducing adverse drug reactions and removing the unnecessary fatalities associated with it.

Wiring CYPs and FMOs to electrode surfaces in presence of AuNps and graphene

Different methodologies have been pursued in order to effectively “wire” the purified CYPs and FMOs to carbon and gold electrodes. Both families are redox enzymes with haem and FAD as their active site cofactors and therefore amenable to electrochemical techniques. Being membrane-bound human enzymes has entailed many years of research to stabilize their 3D fold and hence their activity once wired to electrode surfaces. In order to enhance the signal of these enzymes, the addition of gold nanoparticles (AuNps) as well as inclusion of graphene oxide has been successfully demonstrated by our research group. The future application concerning the human drug metabolizing enzymes is the creation of an electrochemical microfluidic cell where arrays of different enzymes will be immobilized to generate a matrix that mimics the human liver and its complex response to drug metabolism. Here enzymes can be exposed to vari-

ous drugs, as their substrates or inhibitors, in tandem or in parallel, where the effect of the metabolite produced by one enzyme can be studied on a second different enzyme including the polymorphic variants.

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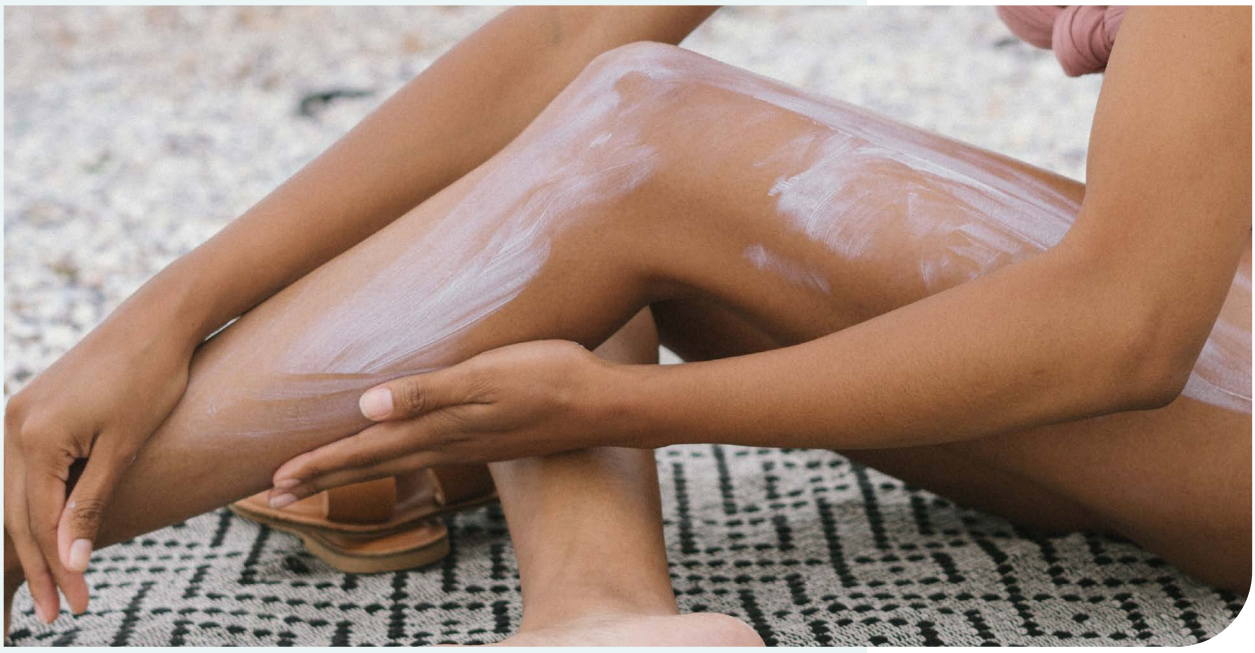
CONTRIBUTION FROM JOANNEUM RESEARCH

Nanoparticles in Sunscreen Should not "Get Under Your Skin"!



It is well known that sunscreens offer many advantages: they protect against harmful UV radiation and subsequently against skin aging and skin cancer. Many people wonder whether sunscreens have harmful side effects for the human organism in addition to their protective effects. In case of so-called mineral sunscreens, inorganic minerals such as titanium dioxide or zinc oxide reflect UV rays away from the skin. These sunscreens usually leave behind a white layer on the skin. No wonder, because zinc oxide or titan oxide are also used as pigments in painter's colors or food coloring. To avoid the white layer and be invisibly protected, these micro-sized minerals have been modified to nanoparticles that vary in size from one to 100 nanometers.

As part of the large, 4-year Horizon 2020 European project "Biorima" researchers at HEALTH - the Institute for Biomedical Research and Health Sciences at JOANNEUM RESEARCH - have investigated whether these nanoparticles can penetrate the skin and how the skin reacts.

The research team, led by Thomas Birngruber, used their open microperfusion technology (OFM) to investigate if and how many nanoparticles penetrate the skin. Sunscreen formulations containing nanoparticles were applied to

the skin and a minimally invasive OFM probe was inserted into the skin. A carrier liquid was pumped through the OFM probe into the skin and used to collect samples of any ingredient that had been absorbed from the sunscreen into the skin. These samples were analyzed regarding nanoparticles and any biomarker that would indicate a skin reaction.

Results showed that no nanoparticles were able to penetrate the top layer of the skin. Thomas Birngruber summarized the results: "Our results indicate that titanium dioxide nanoparticles in the tested sunscreens do not penetrate the protective barrier of healthy skin and thus do not harm the organism."

So keep on applying that sunscreen!

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This project has received funding from the European Union's HORIZON 2020 research and innovation programme under grant agreement n° 760928.

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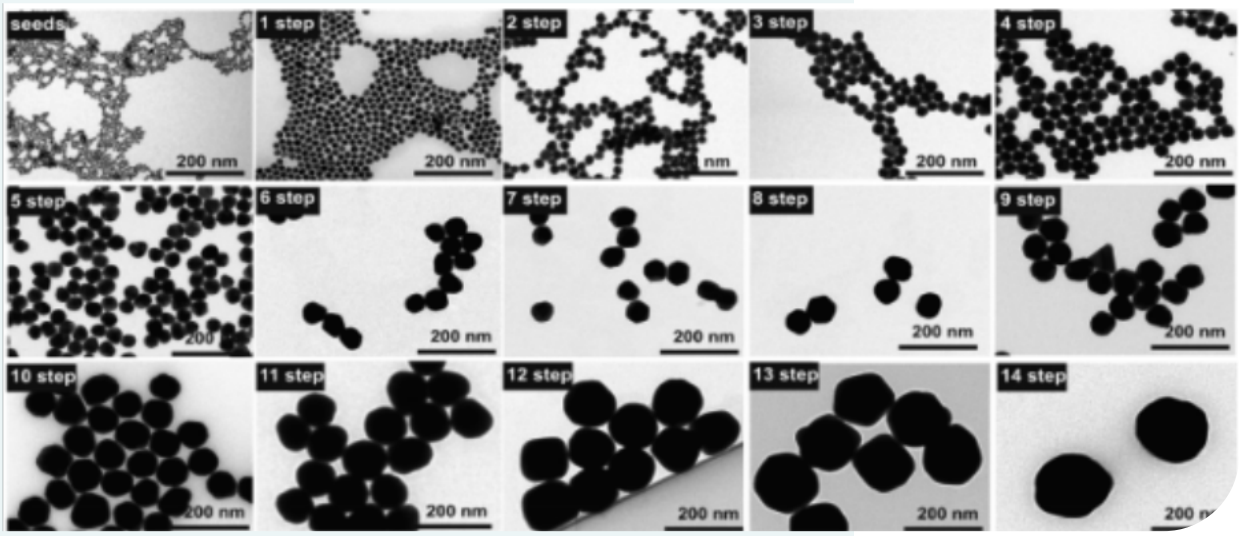
BioNanoNet Member Updates

MEMBER PRESENTATION OF APPLIED NANOPARTICLES SL



AuNPs of growing size following a seeded-growth strategy. Langmuir 2011 27 (17), 11098-11105

Applied Nanoparticles SL (AppNPs) is a nanotech engineering spin-off company derived from the Universitat Autònoma de Barcelona (UAB), the Institut Català de Recerca i Estudis Avançats (ICREA), and the Catalan Institute of Nanoscience and Nanotechnology (ICN2). AppNPs is based in Barcelona and its core business is the design and production of highly monodisperse inorganic nanoparticles colloids at unmatched high concentrations at affordable prices while providing expert advice on their use. Our mission is to empower researchers and developers both in academia and in industry by providing high-quality nanoparticles colloids, enabling the next generation of nanotechnology while promoting Responsible Research and Innovation for the rapid uptake of nanotechnology by society in a responsible manner, to help solve pressing Grand Societal Challenges.

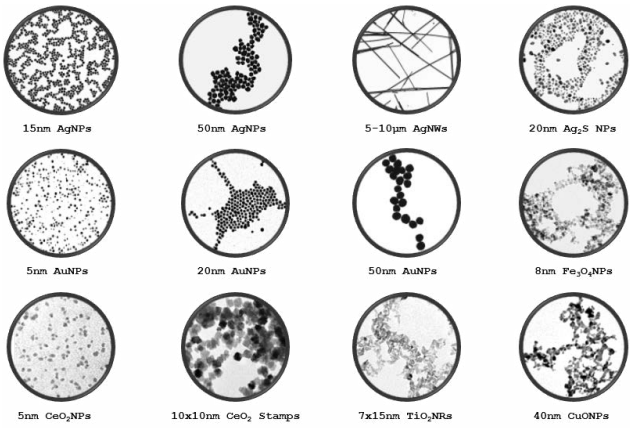
Products and services

Our team, led by Prof. Víctor Puntes as Scientific Director, has a strong academic background in synthesis, characterization and functionalization of nanoparticles, nanotoxicity and Safety-by-Design but also on industrialization of synthetic procedures, nanotechnology regulatory framework and marketing. This multidisciplinary approach allows us to

provide an array of innovation products and services including design, production and advanced characterization of nanoparticles, consultancy activities, product development as well as training and education in nanoscience and nanotechnology.

Design and production of high–quality inorganic Nanoparticles Colloids

We supply highly monodisperse inorganic NPs colloids both for industrial (e.g. biosensing and diagnosis, conductive inks for printed electronics, catalysis, etc.) and academic purposes. Within the latter, we have been involved in several research projects at the EU (FP7 and H2020 Programmes) and national levels (e.g. Norwegian Research Council) as partners responsible for the provision of both model NPs from our Catalogue and ad hoc designed NPs to fulfil the Project Consortium's requirements.



Our NPs catalogue covers more common metal (Au, Ag, Pt, etc.) and metal oxides NPs (TiO_2, Fe_3O_4NPs, CuO, etc.) of different sizes and morphology, to Quantum Dots, to more exotic multicomponent core-shells, heterodimers with high monodispersity and remarkably colloidally stable at high concentrations, such as our recently developed Au-labelled polystyrene NPs as a traceable model to study biodistribution and bioaccumulation of microplastics. At AppNPs we champion and encourage the use of highly concentrated NPs colloids over the use of nanopowders, both for quality and safety reasons. Concentration and aliquoting is tailored case-by-case to match the requirements of our client and partner use cases.

Scale up and product development

Complexity and novelty of nanotechnology makes it difficult to successfully advance up the TRL ladder. We can help to understand the potential uses of nanotechnology, propose a solution to fulfil needs, and ultimately guide you through the technical and legal requirements to achieve industrial-scale production and commercialization.

As examples, we have successfully designed and scaled up production of small Fe_3O_4 NPs as a ready-to-use additive to boost biogas production during the anaerobic digestion of organic waste, or AuNP conjugated to aptamers that detect coronavirus spike protein for the rapid detection of SARS-CoV-2 in saliva in disposable tests.

Training and Education

AppNPs devotes significant effort to education, public debate and public awareness of nanotechnology, organizing nanotechnology workshops for different ages and levels of expertise, but also by providing training on both nanoparticles synthesis and manipulation and on Responsible Research and Innovation. AppNPs also provides hands-on training courses to PhD students within EU ITN Programmes, Summer Schools and other tailored courses. All of them focused on the responsible, safe and sustainable design, synthesis, characterization and handling of nanoparticles, based on the paradigm of Safer-by-Design. AppNPs' aim is that every researcher working with nanoparticles, regardless of their field of expertise, becomes a Nanoparticles and Nanosafety Expert (following "patient expert" concepts).

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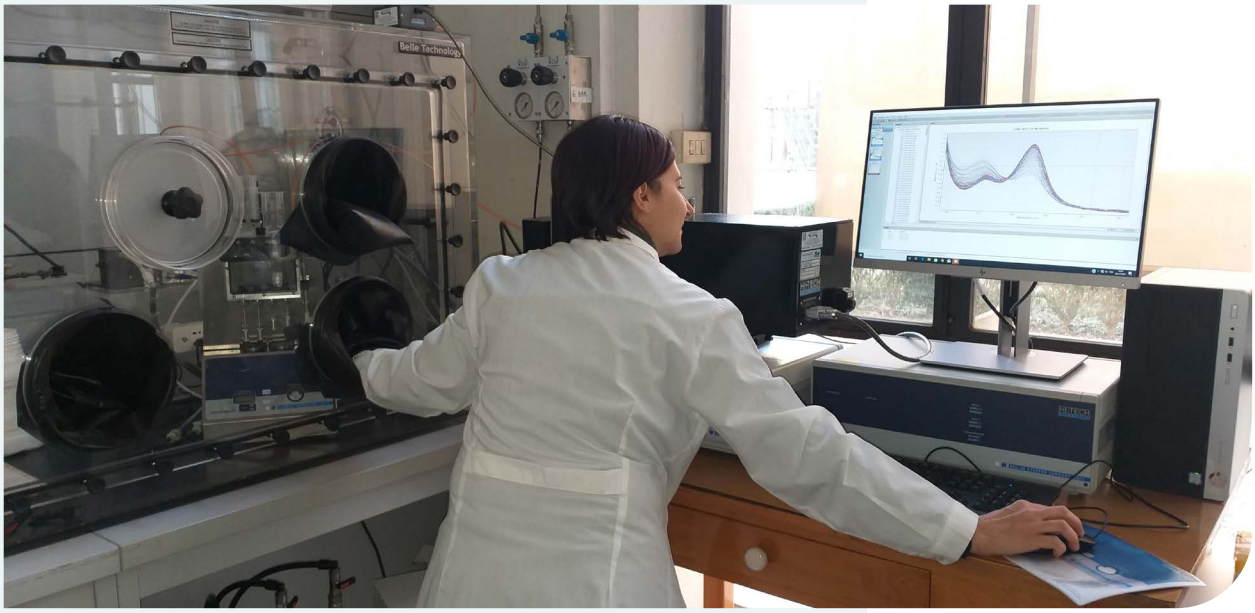
MEMBER PRESENTATION OF UNIVERSITY OF TORINO, DEPARTMENT OF LIFE SCIENCES & SYSTEMS BIOLOGY

UNIVERSITÀ DI TORINO

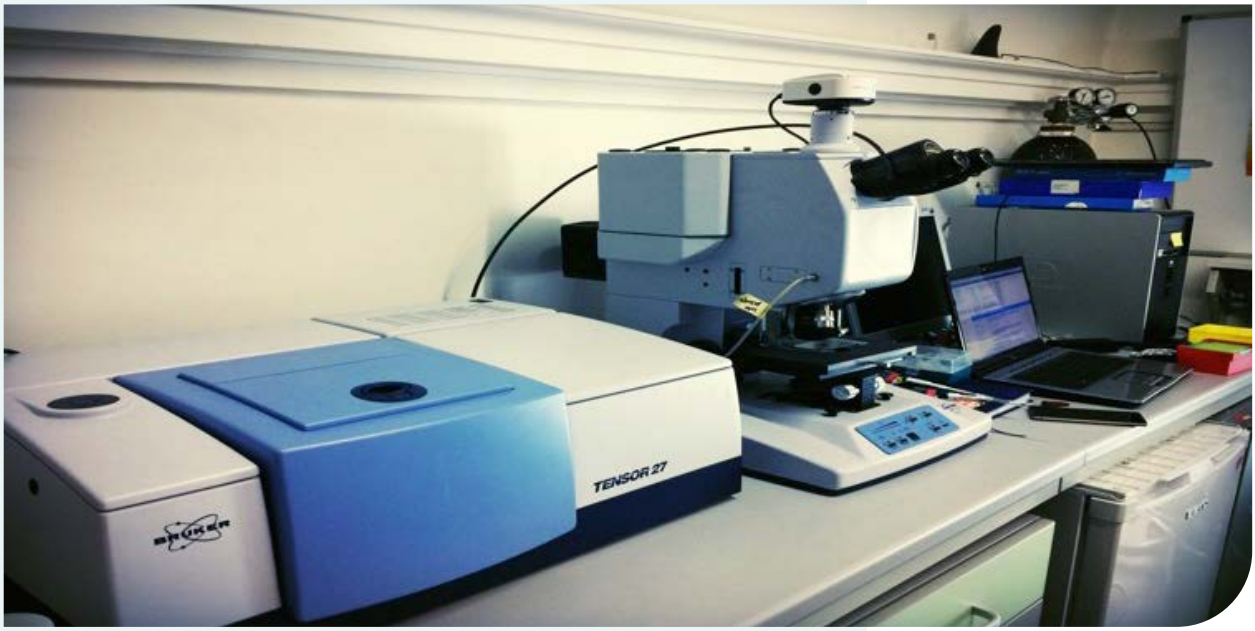


© University of Torino – Stopped-flow spectrophotometry is a powerful tool for the measurement of fast reaction kinetics. Through the study of reaction kinetics the reaction rate and the underlying molecular mechanisms of the activity of an enzyme can be determined. In some instances, these measurements need to be carried out in the absence of oxygen (within a glove box under nitrogen pressure).

The University of Torino is a public research university in the city of Torino, in the Piedmont region of Italy. Founded in 1404, it is one of the oldest universities in Europe and continues to play an important role in research and training.

The Department of Life Sciences and Systems Biology within the University of Torino is the point of reference for topics that bring together biology, environment and biotechnology, and present multidisciplinary aspects. Our department carries out teaching and research in biology, environmental sciences, biotechnology and health.

The research group of STRUCTURAL and FUNCTIONAL BIOCHEMISTRY within the department is headed by Prof. Gianfranco Gilardi. The areas of research include proteins involved in drug metabolism, bioremediation, bioenergetics, biocatalysis, food biochemistry, protein-based biosensors, enzymology, microbial metabolism, protein structure-function, protein rational design and directed evolution for bioconversions.



© University of Torino – FTIR is a useful tool for determining the secondary structure of proteins. In our laboratory a gold-PET flat surface is used as the protein support and experiments are performed using the single reflection grazing angle attenuated total reflectance (GATR) tool. These measurements are valuable in determining whether the 3D structure and hence activity of the enzymes are altered upon immobilization on electrode surfaces for biosensing.

University of Torino joined BioNanoNet Association as an Extraordinary Member in 2022.

Contact

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KOMPETENZZENTRUM HOLZ GMBH

Wood K plus celebrates successful COMET evaluation and 22 years of existence

22 years of curiosity, creativity and passion for new things, process-oriented thinking and independent action have always led the Kompetenzzentrum Holz GmbH - Wood K plus to innovative solutions in the fields of wood chemistry, composites, solid wood and surfaces. The successful COMET evaluation for a K1 centre with a research budget of € 22.7 million and the 22-year anniversary were celebrated on 22 September 2022 at its site in Tulln (Austria).

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.

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

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Project presentations & updates

MAJOR EU INITIATIVE LAUNCHED TO ACCELERATE THE TRANSITION TO SAFE AND SUSTAINABLE MATERIALS, PRODUCTS AND PROCESSES

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. Thus, the EC has launched a major initiative, IRISS, which will accelerate the transition to safe and sustainably designed materials, products and processes. The consortium, led by IVL, will create a global network of experts and stakeholders. Six value chains represented in the project will provide a clear picture of the industry's ongoing and future transformation.

"The chemical industry and all value chains that manufacture materials and products are facing major transformations to create safe, circular flows. To achieve this, optimised processes and products based on sustainable raw materials that are safe for humans and the environment are needed," says Emma Strömberg, researcher and project coordinator at IVL Swedish Environmental Research Institute.

The EU is investing more than €3.5 million in the IRISS project, which will build a network of stakeholders, including companies, researchers, authorities, and other societal actors, to support this transition. Fundamental to the whole effort is the concept of Safe-and-Sustainable-by-Design, SSbD, which includes focusing early in the supply chain on providing products that are part of circular models while avoiding properties that may be harmful to human health or the environment. It integrates circularity, climate neutrality, functionality and safety of materials, products and processes throughout the life cycle.

"These are four important building blocks that must all be included when designing new materials and products. By taking action and making improvements already at the design stage, we can reduce resource consumption and climate emissions and at the same time design products and materials that can be more easily circulated and recycled. This is a prerequisite for us to achieve the goals that have been set in the EU Chemicals Strategy for Sustainability and the UN's Sustainable Development Goals," says Emma Strömberg.

IRISS, which stands for The International ecosystem for accelerating the transition to Safe-and-Sustainable-by-design materials, products and processes, will support companies, both with knowledge and through the implementation of research, and contribute to guiding principles for the development of life cycle thinking in material and product design. In collaboration with industry, a number of roadmaps will be developed to implement research and innovation, but also to demonstrate needs that exist in the policy area. Six value

chains are in the focus of the work: textiles, construction, electronics, energy, automotive and packaging.

"The implementation of the SSbD concept is an important area where we will support the industry to meet the challenges that exist and achieve set goals," says John Munthe, Director of Research at IVL. "In addition to the fact that the EU Chemicals Strategy for Sustainability includes the implementation of SSbD, there is pressure on the development of future materials and products that will meet the goals of EU Green Deal for the transition to climate neutrality and sustainability. We hope that IRISS will contribute with an important piece of the puzzle."

Facts

IRISS, The international ecosystem for accelerating the transition to Safe-and-Sustainable-by-design materials, products and processes, is a three-year project, start date 1st of June 2022, funded by the EU's framework programme for research and innovation, Horizon Europe. It has a budget of €4.3 million, of which approximately €3.5 million come from the EU, as well as additional funding through the University of Birmingham and Swiss Federal Laboratories for Materials Science and Technology.

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 the project, BNN is in charge of leading the work package designed for Communication, Dissemination and Consultation support of IRISS.

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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.

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NANOWEEK 2022 AND NANOCOMMONS FINAL EVENT

Projects participating in NanoWeek2022

On the occasion of the NanoCommons Final Conference, the European nanosafety community came together for NanoWeek 2022, which took place in Limassol, Cyprus from 20-24 June 2022. Led by the NanoCommons project, 18 other currently running nanosafety projects joined forces and supported organizing the event.

The conference theme was “Evolution of nanosafety and materials sustainability as we transition into Horizon Europe”, and included the following topics:

1. Safe-and-Sustainable-by-Design of (nano-enabled) products & processes
2. New modeling methodologies and nanoinformatics approaches
3. Data Management – Databases – FAIR data
5. Emerging “hot” topics in nanosafety

The Scientific Committee responsible for setting the program and reviewing the abstracts comprised a group of experts from the H2020 projects that constitute the EU NanoSafety Cluster and was led by the NanoCommons Coordinator, Professor Iseult Lynch.

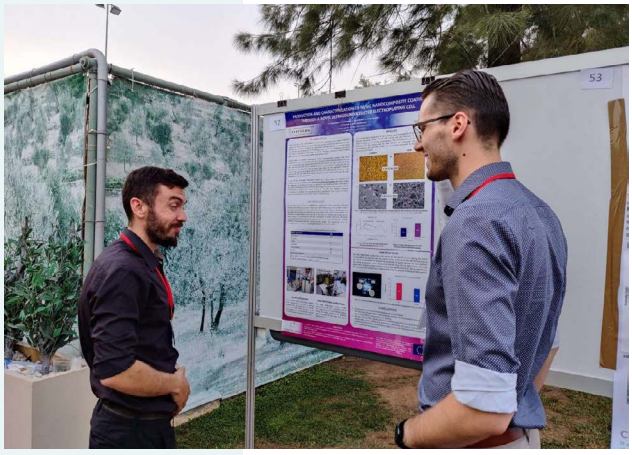
The hybrid event was very well visited with 250 attendees from the international nanosafety community interested in the breadth of activities compiled by the conference – from the Young Nanosafety Scientists speed dating (which was a massive highlight for all partici-

Half of the BNN team at NanoWeek 2022

pants), to the technical sessions, panel discussion and poster session, to the training events, the EU-US CoRs meeting, the NInChi meeting and a joint EU NanoSafety Cluster meeting. Next to that, many projects held their consortium meetings on the final day. One of the highlights of the NanoWeek2022 was the outdoor poster session with food and drinks in the amazing conference location, next to the beach.

After such a long time in online meetings, it was fantastic to meet so many from the community in person again and have some offline discussions. All-in-all, the conference was wonderful and we made great memories including some midnight-swimming in the sea.

Some highlights of the conference:



The conference program can be viewed here and the book of abstracts is available here.

For more information about the conference, visit the NanoCommons page.

Several projects in which BNN participates were actively involved in the conference. You can read more about their contributions here: SABYDOMA, HARMLESS, NanoPAT, DIAGONAL and NextGenMicrofluidics.

Role of BNN

Community building, Business plan development, Sustainability aspects, Exploitation

This project has received funding from the European Union's Horizon 2020 programme under grant agreement n° 731032.

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NANOCOMMONS' FINAL SHOW

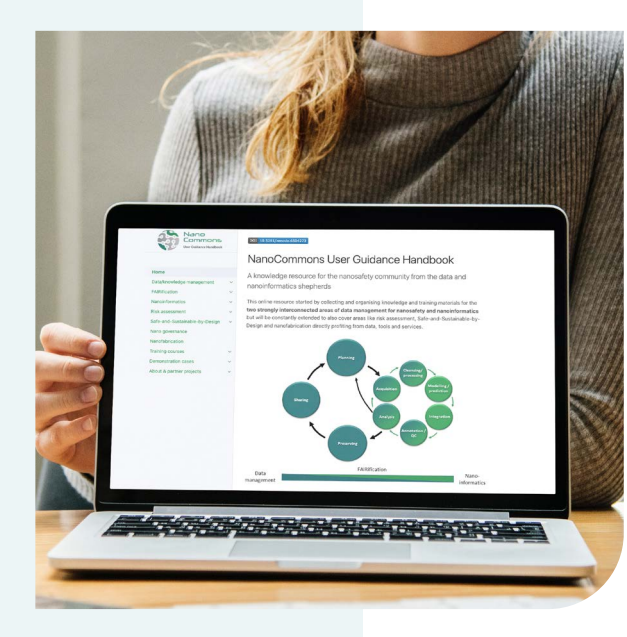
4.5 Years Guiding the Nanosafety Community in Data and Nanoinformatics Challenges

NanoCommons, the H2020 infrastructure project under the official name "The European Nanotechnology Community Informatics Platform: Bridging data and disciplinary gaps for industry and regulators", has come to an end after an amazing 4.5 years full of activities, workshops, hackathons, and more.

NanoCommons was funded as an infrastructure project for an emerging community, to build the concepts and foundation on which the community can continue to build solutions and services to address their data and nanoinformatics needs. It fostered implementation and adoption of harmonization, FAIR policies and openness needed in targeted and centralised efforts provided by a central infrastructure.

NanoCommons did not start from scratch and benefitted from a general appreciation of the value of data reuse and computational predictions in the (nano)safety community. This was further enforced by the public, regulatory and funding agencies and demand by industry was accelerated by the ban on animal testing in the cosmetics industry and the European Green Deal.

But this journey is not over and continuous support will be needed to achieve sufficient levels of digitalization, global adoption of reporting standards both in scientific and regulatory setting, machine-readability, all leading to better quality and reproducible research and more trust in the data and understanding of its applicability for reuse. This starts with sustaining what NanoCommons has created in the last 4.5 years: the NanoCommons Knowledge Infrastructure, the NanoCommons User Guidance Handbook, the implemented services from NanoCommons, as well as other associated partners and projects, the collaboration with other projects established beyond the borders of nanosafety research, and the generated training materials. This is now handed over to the community transferring NanoCommons from an infrastructure project to a community-driven infrastructure.



NanoCommons User Guidance Handbook

As the final conference of the project, NanoCommons organised NanoWeek 2022, where the European nanosafety community joined together in Limassol (Cyprus) and hybrid on 20-24 June 2022. Read more about the event above in this newsletter.

Role of BNN

Community building, Business plan development, Sustainability aspects, Exploitation

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This project has received funding from the European Union's Horizon 2020 programme under grant agreement n° 731032.

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Personal note

NanoCommons was my first European project. I would like to personally thank the whole consortium and especially Iseult Lynch and Thomas Exner (project coordinator and co-coordinator), Cristiana George (project manager) and some great project partners (Martin Himly, Dieter Mayer, Lee Walker, Philip Doganis, and many more...) who helped me grow as a professional and made me really enjoy the experience! Of course, thanks to my colleagues Andreas Falk, Susanne Resch, Johanna Scheper and Clemens Wolf for your support and guidance in some critical moments of the project.

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THE NANOFABNET HUB HAS LAUNCHED!

Left: Steffi Friedrichs introduces the new NanoFabNet digital platform. Right: Faith Blakemore and Clarissa Marquardt present the various services and benefits of the new Hub

It is always a satisfying feeling to see hard work and effort come to fruition, and this was exactly the experience of the NanoFabNet project partners upon launching the NanoFabNet Hub at the beginning of July. After two and a half years of researching, discussing, forming, planning, and building, the culmination of the NanoFabNet project has become a reality, centralised around the new digital platform www.nanofabnet.net, which was introduced to a community of stakeholders online and in-person during the Joint Networking Conference of NanoFabNet and sister project, SUSNANOFAB.

The launch event was hosted at the International Iberian Nanotechnology Laboratories in Braga, Portugal, an international centre for nanotechnology research and development, and therefore a fitting venue for such an occasion. This wider conference brought together global stakeholders to exchange about the current status and future developments of sustainability within the nano- and microtechnology sector, with speakers including NanoFabNet partner-representatives Steffi Friedrichs (AcumenIST), who introduced us to the NanoFabNet goals and aims, Georges Favre (LNE), presenting aspects of metrology and standardisation to support sustainable nanofabrication, and Clarissa Marquardt (KIT IAI), who discussed science communication and research infrastructures in nanotechnology. Other formative sessions were also delivered by Jürgen Tiedje (DG RTD, European Commission), Karin Wiench (BASF), Fernando De La Vega (PV NanoCell) and Michel de Labachelerie (EuroNanoLab), to name but a few!

Each session brought us closer to the understanding of the meaning and requirements for sustainability within this quickly evolving sector, as well as the importance of collaborative working to support ongoing developments. Safety, sustainability, digitalisation, and regulation, whilst each requiring development within their individual fields, also calls for joint communication and community building to enhance their progression. It is with this ethos in mind, that the NanoFabNet Hub has been created.

It was therefore timely and necessary to launch the NanoFabNet Hub during this event, highlighting the features and benefits that the Hub offers, based firmly in its main strength, which is the capacity to bring together the global community as a central point for the exchange of information, knowledge, skills, and services. As a 'one-stop-shop' solution, the Hub, which supports international accessibility through the digitalisation of the Hub actions, enables all member organisations to access peer, partner and support organisation information, reports, research outcomes and business support services, which will help bolster business development, co-collaboration, and communication for actors.

At present, the NanoFabNet Hub is gathering expressions of interest for joining the Hub as a member, which will open at the beginning of September. In the meantime, stakeholders can explore the new Hub and learn about the upcoming services available to paying members. To register your interest in joining the Hub, simply go to the Get Involved page of the Hub and add your email address. As soon as membership is opened, you will be informed and invited to set up an account. This account will provide members with full access to the knowledge and insights collated in the Hub, as well as preferential services. The vision for the Hub, is to bring together and support the integration of stakeholders into a global community, where continued engagement and collaboration will achieve increasing value and impact.

Services of the Hub include:

- ✔ Access to new partners and clients
- ✔ Funding and financing opportunities
- ✔ Career development and job openings
- ✔ Events and news from the global sector
- ✔ Research and reports
- ✔ Available infrastructures and laboratories
- ✔ Business support services and trainings
- ✔ Validation services

Role of BNN

Innovation management, Business planning, Network development

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement n° 886171.

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NANOPAT – ACHIEVEMENTS IN SUMMER 2022

The EU-H2020 project NanoPAT presents three novel real-time nano-characterisation Process Analytical Technologies (PAT) that help to overcome problems and limitations of conventional characterization technologies: the (1) Photon Density Wave spectroscopy (PDW), (2) OptoFluidic force induction (OF2i), and the (3) Turbidity spectrometry (TUS). These monitoring techniques provide real-time inline data which can be used for digital process monitoring and product quality control. They will be validated in 5 different industrial environments manufacturing and converting ceramic, polymer and mineral nanoparticles.

Thanks to a hardworking team, there have been plenty of activities going on during Summer 2022. Here is a summary of the project achievements from June-September 2022.

The development 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), Performance Qualification (PQ) have been created; this will help future users with the general installation and operation of the instruments/sensors. With that, the project has entered into a new stage with the industrial implementation of the three technologies. Additionally, the industrial pilot plants will be adapted to meet the needs of the different monitoring devices (i.e., the corresponding PAT technology for each case study).

As a result of the hard work of our project partners BRAVE Analytics and Medical University of Graz in the past months, a peer-reviewed scientific publication on Physical Review Applied was released in August 2022. It demonstrates the OF2i scheme for real-time determination of particle size distributions with high throughput. [*Real-Time Nanoparticle Characterization Through Optofluidic Force Induction, Marko Simic et al., Phys. Rev. Applied, 18, 024056 (August 2022) - DOI: 10.1103/PhysRevApplied.18.024056*]

Furthermore, as part of the on-site internal training and networking activities, the industrial partner ARKEMA visited the RTO pilot partner ZHAW in Wädenswil (Switzerland) in order to transfer their zeolite know-how to the Swiss team and to experience PDW (photon density wave) spectroscopy in real life. This was a great opportunity for exchanging information for the upcoming steps in the project.

Moreover, NanoPAT participated in several events during the last months. The most relevant were:

Athens Conference on Advances in Chemistry (ACAC2022) (26 June – 1 July 2022, Athens, Greece), where Cnano presented a poster showing their recent work addressing one of the main challenges of composite electroplating, the hydrodynamic conditions, explaining that a 3D printed Acrylonitrile butadiene styrene (ABS) based obstacle was introduced and the electroplating cell parameters were optimized. Read more about it here.

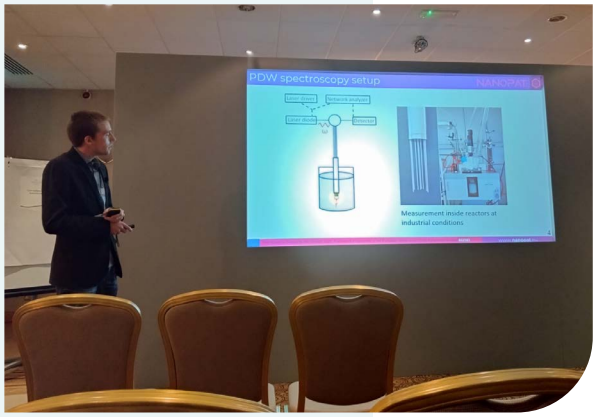
NanoWeek 2022 (20-24 June 2022, Limassol, Cyprus), where NanoPAT had a big role, not just being part of the Organisation and Scientific Committees but also with one poster presentation (Cnano with their novel electroplating technique) and two oral presentations (BRAVE presenting the Optofluidic Force Induction (OF2i) as a Process Analytical Technology, and TEMASOL showcasing the Transnational Access (TA) projects that NanoPAT is running with NanoCommons on data management solutions for inline/online processes). Read more about it here.

Left: NanoWeek 2022, Right: Analytica 2022

Analytica 2022 (21-24 June 2022, Munich, Germany), where the project presented the PAT Development of products developed within the NanoPAT project in an interesting booth and were able to make many interesting contacts. Read more about it here.

UPV organized a very successful meeting with industry producers of polymeric of the **Industrial Liaison Program** (7-8 Sept. 2022, San Sebastian, Spain), where UPV/POLYMAT presented their results on inline monitoring of emulsion polymerization processes by Photon Density Wave (PWD) spectroscopy. Read more about it here.

The **APACT 2022** (14-16 Sept. 2022) was a very relevant event where BRAVE and UP highlighted why modern nanoparticle research and production needs continuous, online and real-time characterization methods for waste reduction and performance control. Read more about it here.



NanoPAT partners couldn't miss the **17th PAT Colloquium** (19-21 Sept. 2022) on PAT technologies with a dedicated session on PATs, "PAT innovation: Novel real time PAT". In NanoPAT's presentations, BRAVE and UPV/POLYMAT showed the status of their developments in

OF2i and PWD spectroscopy. Read more about it here.

Our project coordinator, together with the other NMBP-08 projects, was invited to the **NanoInnovation 2022 – CHALLENGES Training School** (21-23 Sept. 2022) to present the status of the developments in the project and to jointly discuss in a round table about different topics. Read more about it here.

The BioNanoNet members BRAVE Analytics GmbH, Medical University of Graz, Zurich University of Applied Sciences, TEMAS Solutions GmbH, Analisis DSC as well as BNN itself are consortium partners in NanoPAT.

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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THE NGM & MIH EXPERIENCE AT THE OITB VILLAGE @INDTECH2022

From the left: Jan Hesse (JOANNEUM RESEARCH); Ronald Tingl (Microfluidics Innovation Hub), Anja Haase (JOANNEUM RESEARCH) and John Fahlteich (Fraunhofer)

Open Innovation Test Bed (OITB) projects are a relatively new initiative in the framework of the EU Horizon 2020 program. This year, an exhibition called the OITB Village ran alongside the IndTech2022 Conference in Grenoble. The exhibition was meant to serve as a platform to bring together all 25 currently existing OITBs and showcase their projects, exchange lessons learned and provide feedback to the European Commission (EC).

The 14 OITBs that were present were hosted in a dedicated tent where they were able to network with other EU project coordinators and representatives of Single-Entry Points (SEPs). During the first two days, this special exhibition area allowed participants to learn more about other OITB Villagers and served as a stage to host pitch sessions from OITB representatives and OITB end-users.

The OITB Village overlapping with IndTech2022 was meant to give conference delegates the opportunity to visit the exhibition area where OITBs were ready to showcase their work. This was unfortunately not fully realized as the expected number of target audience attendees consisting mainly of SMEs was not met. However, many representatives from the European Commission as well as policy makers from EU Member States were present and took part in in-depth discussions on

Ronald Tingl speaks during a lively Q&A session

various aspects of the programs including services, emerging results, and prototypes.

The third day of the OITB Village was specifically dedicated to a series of "Best Practices" Workshops focusing on key aspects of OITBs, namely Single-Entry Points (SEPs) and Open Calls. SEPs are legal entities that act as the sole interface between external customers and internal OITB members. Open Calls are funded OITB initiatives managed by the SEPs which awards funded services to external companies.

Presenters at the workshops elaborated on a variety of subjects such as legal and administrative challenges, setting up and running SEPs, as well as best practices for the Open Calls. A lively Q&A session complemented by feedback from representatives of the EC helped everyone gain new insights and learn from each other. It became clear that while the idea of establishing SEPs and running Open Calls present significant advantages to customers, specifically enabling SMEs to overcome hurdles moving their ideas forward, there remains much room for improvement in the design of the program. The conversation on the future sustainability of SEPs and OITBs and the need for more support and feedback to the EC continues after the event, and we as NGM and MIH are glad to be part of it.

Role of BNN

Safety-by-Design, Quality management, Project management, 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°862092.

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PHOENIX @ MTC MEDTECH CIRCLE EVENT

PHOENIX on the spot in the Upper–Austrian Med–Tech community

On 28 September 2022, Upper Austrian "MTC" – the Medical Technologies Cluster – celebrated its 20th birthday with a big event in Linz. 90 participants from companies (covering major med-tech enterprises and start-ups as well) and research gathered to exchange ideas for the future of medicine – and the medicine of the future.

The topics presented and discussed during the event ranged from simulation to certification of medical products and devices and also paid special attention to the challenges of "Health in an ageing society".

The presence of PHOENIX-OITB (represented by Austrian partner RECENDT) was a great vital sign and valuable milestone to make PHOENIX and its Service Portfolio known in the Upper Austrian community. Although the event's focus was not expressly on (nano-) pharmaceutics, the contact to the researchers and companies was extremely valuable – and positively, we got extremely good feedback regarding the basic idea and the services offered by PHOENIX-OITB.

Robert Holzer from RECENDT representing PHOENIX-OITB at the MTC MedTech.Circle event

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

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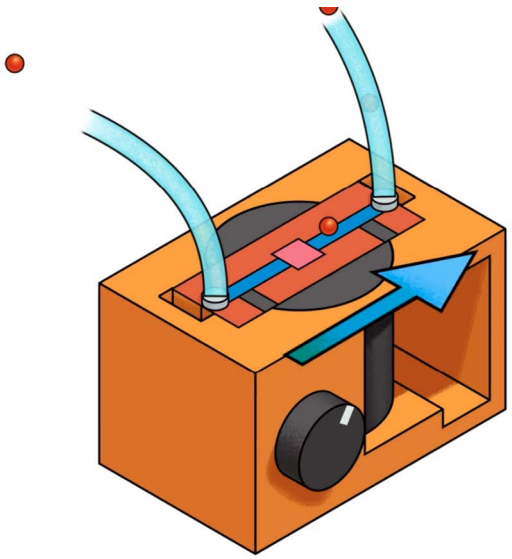
SABYDOMA'S DEVELOPMENTS IN VISUAL FORM

During the last months, SABYDOMA has prepared 2 videos showing the research of some of our project partners.



Screening platform for analysing effects of nanoparticles on humans

Within the SABYDOMA project, Fraunhofer IBMT develops a screening platform to analyse the effect of nanoparticles on human cells during the production process. This platform will be directly connected with the nanoparticle production lines from the project partners.

The video shows the general function of the screening platform with its two main subsystems, 1) the compact microscope and 2) the fluidic module comprising a microhole array chip. Cells are positioned on a membrane with microholes and then they are exposed to the nanoparticle material. The compact microscope allows the optical analysis of the cell behaviour during and after exposition of the cells to the nanoparticles. Additionally, electrical impedance spectroscopy is used to analyse the cells.

Together with the output of the other analysis tools developed within SABYDOMA, the results from this toxicity screening are used to adjust the parameters of the nanoparticle production line in order to increase the safety of the production process of nanomaterials.

Edward Yorke and Thorsten Knoll (Fraunhofer IBMT) created this video.

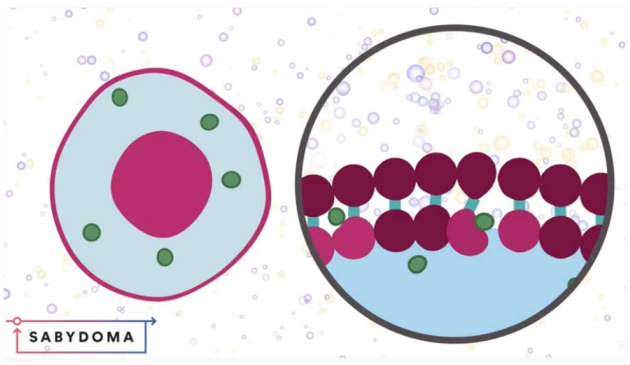
Watch it here.

Innovative method for testing the safety of nanomaterials on "a cell–membrane" system

Cells are the building blocks of life. But what happens when toxic material gets inside them?

Cutting edge studies at the University of Leeds have allowed researchers to create artificial cells. This may allow them to test hazardous materials without testing them on humans.

Our body is made of cells and each has a specific function. A key part of the cell is the membrane that wraps around the outside and holds



it together, like the shell around an egg. The membrane is made out of special molecules called “lipids”. Toxic material can attack the cell membrane, and if it finds itself on the inside it can also attack the machinery keeping the cell alive. Researchers of the University of Leeds have come up with an artificial way to form a celland to test if a material causes damage to it.

The UNIVLEEDS team is now investigating how this technique compares to real cells, hoping that one day we will no longer need to test stuff on “real” people.

William Stokes (UNIVLEEDS) created this video.

Watch it here.

Role of BNN

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

Contact

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Outlook

BNN EVENTS & EVENTS SUPPORTED BY BNN

NanoMedicine–Austria Webinar

When? 28 November 2022, 11:00 – 12:30 CET

Where? online

More information coming soon!

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

When? 7 February 2023, 10:00 – 11:30 CET

Where? 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

Click here to view all events on our website.

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 December 2022 and will focus on the topic **(Nano)materials Characterization: Novel techniques & tools and their contribution to standardization**. BioNanoNet members are welcome to send their contributions regarding this focus topic and also articles about their scientific research. Articles on other topics can be published any time on the BNN website.

Contact
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Connect with us!

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SUSTAINABILITY LEADS THE WAY.

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