



# Bionanopolys

HIGHLIGHTS NO. 7



## WELCOME

Welcome to the seventh newsletter issue of the Bionanopolys Open Innovation Test Bed (OITB) project!

Every six months we would like to keep you posted about our project activities, about previous and upcoming events, where to meet our consortium members and we invite you to gain insights into specific aspects of Bionanopolys implementation.

Enjoy reading, feel free to share this issue with your colleagues and don't hesitate to drop us a line in case you have any questions of cooperation requests.

## CONTENT

- 2 -

Exploring New Horizons:  
Practical Applications of Bionanomaterials

- 4 -

Biotrend: Experts in Fermentation Process  
Development, Optimization and Scale-up

- 6 -

Ionic liquids as smart additives for  
bioactive nanoparticles

- 7 -

Highlights from the past 6 months

- 10 -

Upcoming Event

## EXPLORING NEW HORIZONS:

# PRACTICAL APPLICATIONS OF BIONANOMATERIALS

Written by Katharina Schwaiger, ACIB

In the quest for sustainability, the rise of bio-based materials marks a significant shift towards a circular economy. Derived from renewable sources such as agricultural by-products, plants, and microorganisms, these materials offer significant environmental benefits. With the bio-based materials market anticipated to grow exponentially<sup>1</sup>, projects like Bionanopolys are at the forefront of this green revolution. Bionanopolys is dedicated to introducing safe, nano-enabled bio-based materials and polymer bionanocomposites for advanced applications.

## UNDERSTANDING BIONANOMATERIALS: DEFINITIONS, SOURCES, AND TYPES

Bionanomaterials are derived from biological entities or inspired by biological systems, encompassing materials such as proteins, polysaccharides, and nucleic acids. These materials are produced through biological processes involving bacteria, fungi, algae, and plants. For example, Bionanopolys utilizes high lignocellulosic feedstocks to produce:

**Cellulose nanofibers:** These fibers are produced from plant cellulose and are known for their exceptional strength and lightweight properties. They are used in applications ranging from biomedical devices to sustainable packaging materials.<sup>2,3</sup>

**Cellulose nanocrystals:** Extracted from cellulose, these nanocrystals have high crystallinity and are used in reinforcing materials, enhancing the mechanical properties of composites.<sup>3</sup>

**Nanolignin:** Derived from lignin, a natural polymer found in the cell walls of plants, nanolignin is used in applications such as UV protection and as an antioxidant in polymers.<sup>4</sup>

**Metallic nanoparticles:** These nanoparticles have applications in medical imaging, drug delivery, and antimicro-

bial treatments. For a green synthesis approach of metallic nanoparticles<sup>5</sup> read into the potential of ionic liquids as smart additives for bioactive nanoparticles, as discussed in a recent review article published in Green Chemistry by Małgorzata Policht and Joanna Feder-Kubis.

[More on page 6.](#)

Additionally, the project employs high sugar content feedstocks to create essential building blocks, organic acids, polyhydroxyalkanoates (PHAs), and active compounds for nanocapsule production. This innovative approach ensures that the materials produced are both high-performing and sustainable<sup>6</sup>.

## INNOVATIVE APPLICATIONS OF BIONANOMATERIALS

There are several niche applications that showcase the versatility and potential of bionanomaterials:

**1. Advancing medical implants:** Bionanomaterials can significantly enhance the functionality and longevity of medical implants. For instance, cellulose nanofibers are used for targeted drug delivery and imaging, offering less toxicity and better performance compared to conventional materials.<sup>7</sup>

**2. Environmental remediation:** Bionanomaterials such as cellulose nanocrystals are being used to tackle environmental pollution. These nanoparticles can effectively degrade pollutants and remove heavy metals from water sources, making them valuable tools in cleaning up contaminated environments.<sup>8</sup>

**3. Innovative agricultural solutions:** Nanomaterials synthesized from agricultural waste are being explored for their antimicrobial properties and potential use in enhancing crop protection and soil health. This approach not only utilizes waste materials but also provides a sustainable method for improving agricultural productivity and re-

ducing reliance on chemical pesticides.<sup>9</sup>

**4. Biomedical sensors:** Advanced bionanomaterials are being utilized in the development of sensitive and selective biosensors for disease detection. For instance, polysaccharide-based nanoparticles are being used in biosensors to detect glucose levels in diabetes patients, offering a non-invasive and accurate method for monitoring health.<sup>10</sup>

## FUTURE TRENDS IN BIONANOMATERIALS

The future of bionanomaterials is set to revolutionize various industries. Digital integration will enhance the precision of bionanomaterials, leading to smart materials with real-time monitoring capabilities. This advancement will benefit energy storage, offering sustainable solutions for batteries and supercapacitors.<sup>11</sup> In electronics, bionanomaterials will make flexible and wearable devices more efficient and sustainable.<sup>12</sup>

Nanomaterials will drive innovations in solar energy and

hydrogen fuel cells, enhancing renewable energy adoption.<sup>3</sup> In agriculture, precision farming techniques and advanced agrochemicals will improve crop yields and reduce environmental impact.<sup>14</sup> Food safety and quality will benefit from better packaging materials and contaminant-detecting sensors.<sup>15</sup>

In healthcare, nanomedicine will revolutionize diagnostics and treatment, with nanorobots and nanosensors enabling precise medical procedures and real-time health monitoring.<sup>16</sup>

Overall, the future of bionanomaterials is bright. The continuous improvement in the synthesis and functionalization of bionanomaterials will likely lead to broader adoption across industries, driving market growth. For example, Bionanopolys partners like Biotrend are advancing the production and optimization of biopolyesters from renewable raw materials, ensuring the produced biopolymers meet various application needs, from automotive components to mulch films for agriculture – read more on the next page.

<sup>1</sup> <https://www.zionmarketresearch.com/report/bio-based-materials-market>

<sup>2</sup> <https://doi.org/10.1016/j.jobab.220.10.001>.

<sup>3</sup> <https://doi.org/10.1016/j.jcomc.2021.100164>

<sup>4</sup> <https://doi.org/10.1016/j.scitotenv.2023.163316>

<sup>5</sup> <https://doi.org/10.1007%2Fs12011-023-03645-9>

<sup>6</sup> <https://www.bionanopolys.eu/shaping-the-future-the-bionanopolys-projects-influence-on-the-bio-based-material-market/>

<sup>7</sup> <https://doi.org/10.3390/ma16124447>

<sup>8</sup> <https://doi.org/10.3390%2Fnano11113008>

<sup>9</sup> <https://doi.org/10.3389/fnano.2024.1346069>

<sup>10</sup> <https://doi.org/10.3390%2Fbios13010040>

<sup>11</sup> [https://doi.org/10.1007/978-981-99-9931-6\\_3](https://doi.org/10.1007/978-981-99-9931-6_3)

<sup>12</sup> <https://doi.org/10.1002/advs.202200560>

<sup>13</sup> <http://dx.doi.org/10.51594/estj.v5i5.1137>

<sup>14</sup> <https://doi.org/10.3390/agrochemicals2020016>

<sup>15</sup> <https://doi.org/10.1007%2Fs10068-023-01486-9>

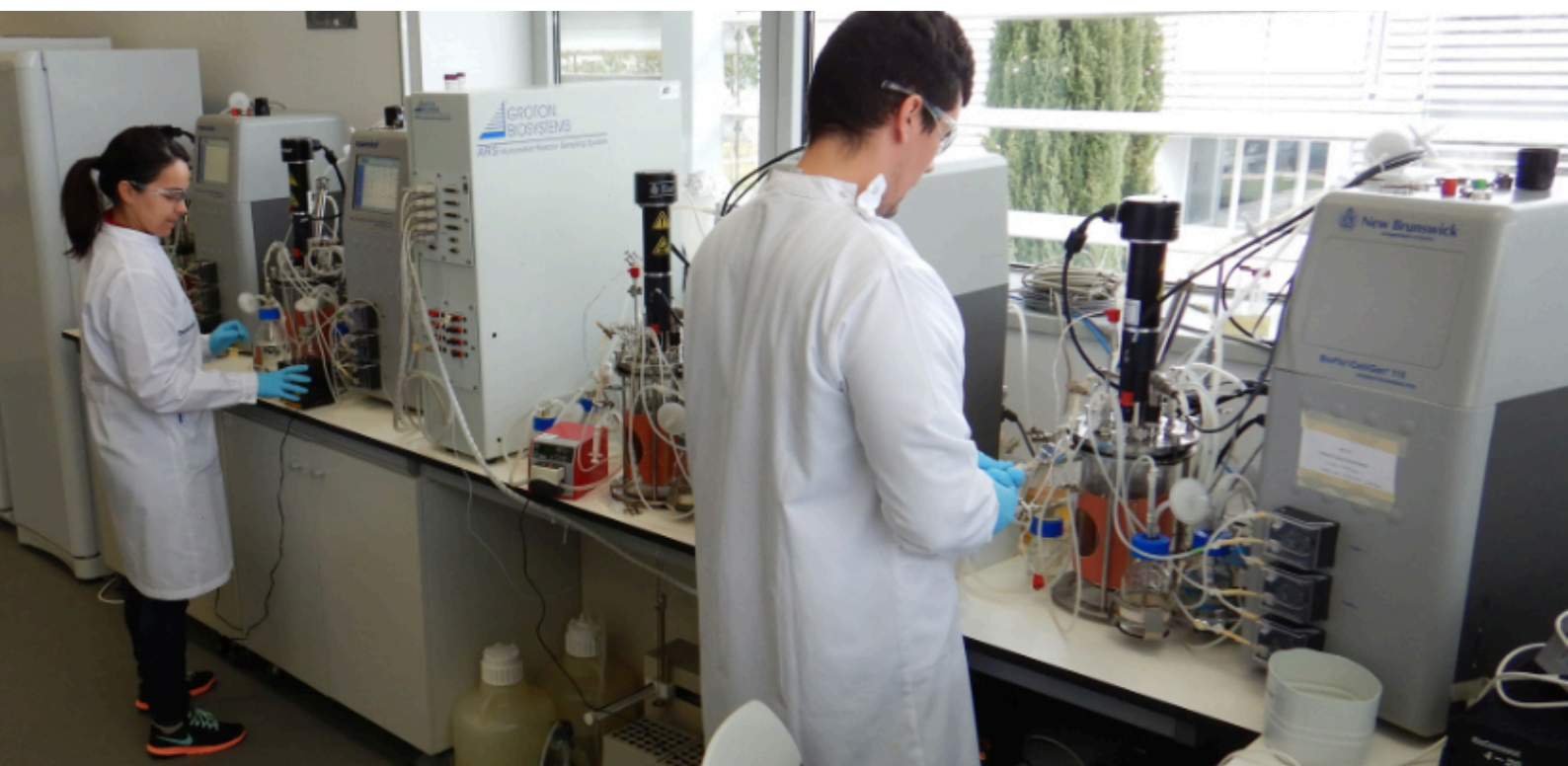
<sup>16</sup> <https://doi.org/10.3390%2Fmolecules28186624>



## BIOTREND:

# EXPERTS IN FERMENTATION PROCESS DEVELOPMENT, OPTIMIZATION & SCALE-UP

Written by Bruno Sommer Ferreira, Biotrend



## ABOUT BIOTREND

Biotrend is a research-based company offering advanced services in the area of industrial and marine biotechnology, specialised in the development, optimisation and scale-up. Process optimization and scale-up

When proof of concept of a new process is obtained at lab scale and low TRL (technical readiness level), the next step is the process optimization in order to improve the productivity. This means, increasing the amount of product obtained per unit of equipment capacity and unit of time. Maximised productivity results in lower CapEx (capital expenditures) and OpEx (operating expenses) and hence contributes to the economic feasibility of the processes. Further, a process needs to be validated across successively higher scales, derisking it and making sure that it is robust enough to yield product with the required

specifications without deviations from batch to batch at commercial scale. Biotrend's capabilities have allowed deploying processes, based on renewable resources, to produce microbial biomass and extracts, industrial enzymes, biopesticides, biomaterials, chemicals and nutraceuticals, just to name a few.

## EXPERTISE IN PRODUCTION OF BIOPOLYESTERS

Biotrend has more than a decade experience in the research on the production of biopolyesters from renewable raw materials, namely on the production of polyhydroxyalkanoates (PHAs) by naturally producing bacteria, using diverse raw materials. Priority has been given to the conversion of renewable raw materials that do not compete with the food and feed supply chain, focusing on industri-



al side-streams such as sugars obtained from lignocellulosic hydrolysates from pulp and paper and agro-industrial side-streams, glycerol from the biodiesel industry, and volatile fatty acids from the processing of the organic fraction of municipal solid waste and from anaerobic digestion leachates. For example, within the Bionanopolys project, sugar-rich hydrolysates produced from wood pulp were used by Biotrend as raw materials to produce polyhydroxyalkanoates, that were extracted and purified to be used in formulations to produce films of biodegradable plastic materials.

Using different carbon sources and tuning the fermentation strategy implemented, it is possible to tailor the polymer properties from rigid to highly flexible and transparent materials. Different monomeric compositions and polymer molecular weight will determine different mechanical properties of the polymer. Additionally, Biotrend has developed intellectual property in the field of the extraction and purification of PHAs using an aqueous process, hence contributing to the increased sustainability of PHA production processes. The hence produced PHAs, with their wide range of properties, can be used in different applications, including, for example, composite materials for the automotive industry, components of multilayer food-packaging materials and mulch films for agriculture.



### WE THRIVE ON OUR CUSTOMER'S CHALLENGES

Biotrend is a partner of the Bionanopolys Open Innovation Test Bed (OITB) through which its expertise is put into use. Currently, Biotrend is helping the OITB client Algaesys in the scope of the open call test case "PHAs extraction from microalgae" with the aim to characterise PHA-containing biomass, obtained through the treatment of brewery effluents, and extract PHA from the client biomass using a proprietary aqueous PHA extraction method

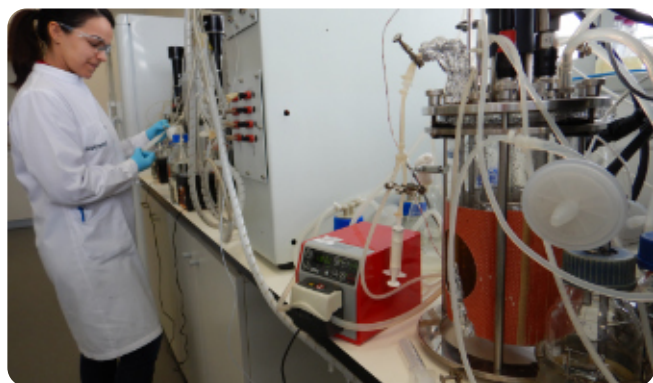
previously developed, optimised and patented by Biotrend.

Through its expertise, Biotrend serves the motivation of customers to contribute to the circular economy and reduce production costs by redirecting a carbon-rich secondary stream of their process to the production of biodegradable biopolyesters or to incorporate a bio-based and biodegradable biopolymer in their products, a far more environmentally friendly alternative than the fossil fuel-derived plastics.

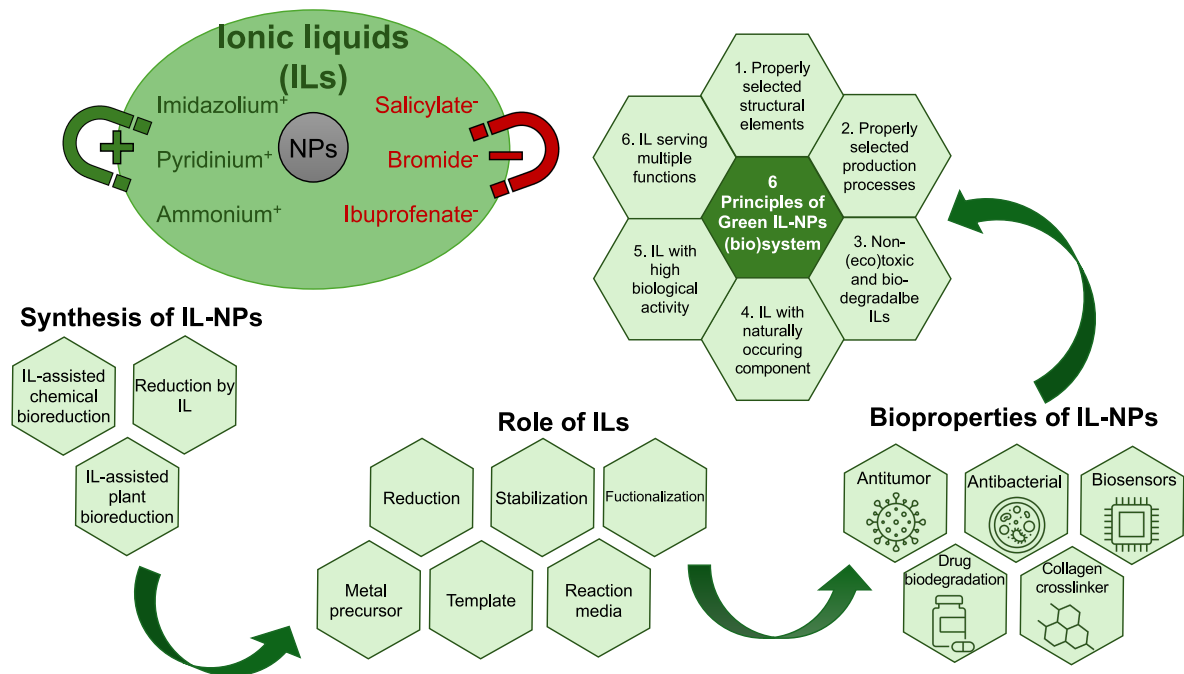
le-up of bioprocesses, often based on non-conventional microorganisms and industry-relevant renewable raw-materials.



Biotrend operates a state-of-the-art development lab and a bioprocessing pilot plant and performs the transition of processes to industrially relevant scales through access to facilities within its network of partners. Our advanced bioprocessing know-how has been serving clients from small biotech startups to global corporations from all across the world.



**biotrend**  
experts in bioprocessing



# IONIC LIQUIDS AS SMART ADDITIVES FOR BIOACTIVE NANOPARTICLES

Written by Małgorzata Policht, Joanna Feder-Kubis, WUST, Poland

As many conventional routes for the synthesis of metallic nanoparticles (NPs) are not entirely safe and environmentally friendly, there is a need to seek greener approaches. One such approach is the use of ionic liquids (ILs) to create a hybrid system of ILs and bioactive NPs. The use of ILs in the synthesis of NPs provides efficient, environmentally friendly methods with precise control over properties such as surface shape, functionality and size, in line with green chemistry principles for various biological and biomedical applications.

**Key Achievements:** In a recent review article published in *Green Chemistry*, we have established the **6 principles of green IL-NPs (bio)system**, as practical guidelines to follow when using ionic liquids (ILs) in the synthesis and biological and biomedical applications of NPs. It is a major step forward in eco-friendly nanotechnology.

1. Use targeted IL with properly selected structural elements to design safe salts that possess desired physicochemical properties
2. Use targeted IL with properly selected production processes to replace those with high environmental risk
3. Choose non-(eco)toxic and biodegradable IL
4. Choose an IL that possesses naturally occurring components
5. Choose an IL with a confirmed high biological activity
6. Use an IL that serves multiple functions

**Applications:** The applications of greener IL-NPs are vast and promising, especially in the fields of biotechnology and bio-

medicine. They can potentially revolutionise drug delivery systems, improve diagnostic techniques, combat resistant pathogens and enhance the functionality of biosensors. The controlled synthesis enabled by ILs could lead to more effective and targeted therapeutic interventions, offering significant benefits in medical treatments.

**Future Directions:** Despite these promising developments, there are still several areas that require further investigation. Future studies are needed to optimise the IL-NPs systems to ensure that they can be effectively scaled up for industrial use, while maintaining the desired properties and low environmental impact. Researchers are also called upon to investigate the long-term stability and biocompatibility of these NPs in various applications. Overcoming these challenges will be crucial to real sustainable nanotechnology.

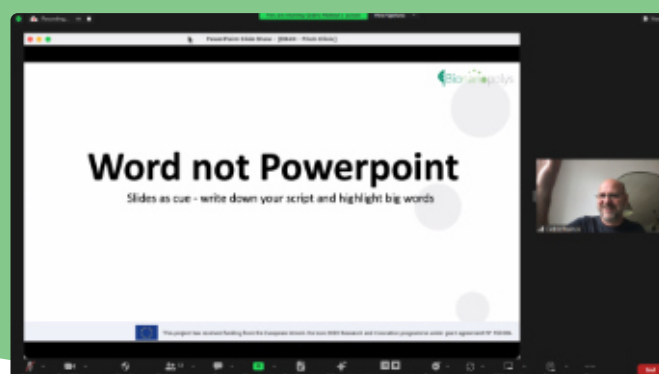
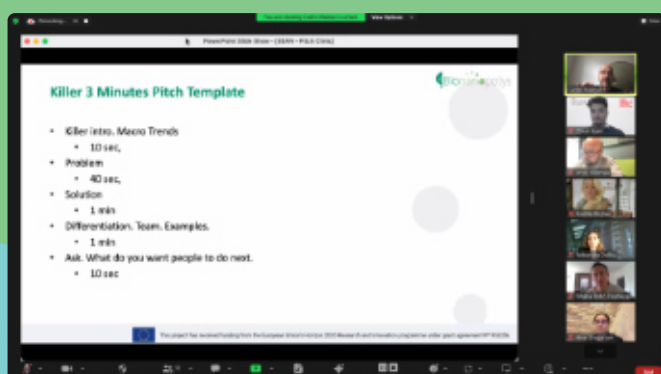
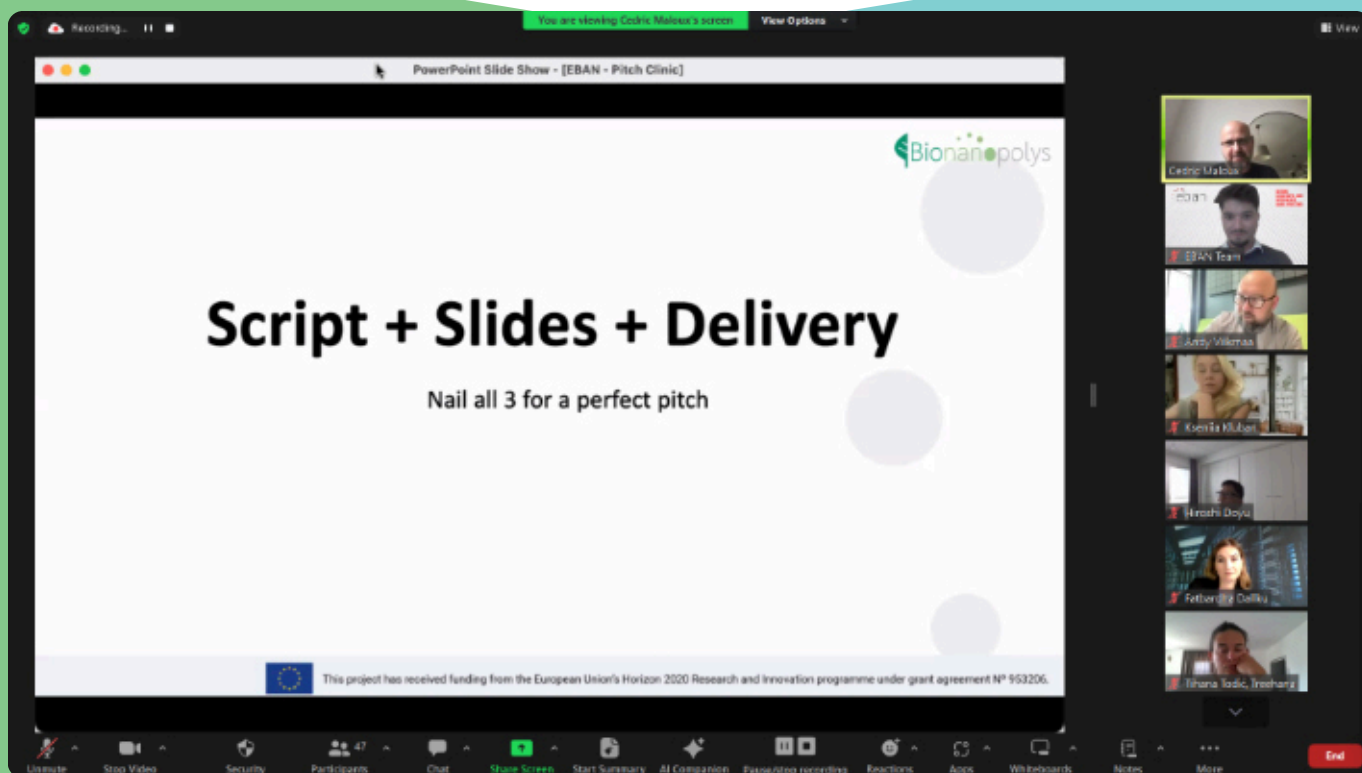
Full of valuable knowledge, practical insights, comments and recommendations, the review paves the way for more sustainable practices in NP synthesis, with far-reaching implications for science and industry. For details and future perspectives, see the full paper *Green Chem.*, 2024, 26, 3072;



**Go to Paper:**

<https://doi.org/10.1039/D3GC04387H>

# HIGHLIGHTS FROM THE PAST 6 MONTHS



## PITCHDECK CLINIC

The “Pitchdeck Clinic – Powered by Bionanopolys” workshop on May 7 was hosted by expert investor Cedric Maloux, CEO of Startup Yard in Prague, which is the oldest startup accelerator in Central Europe! He has invested in 94 companies and is also a highly experienced public speaker and mentor.

The session covered: - How to structure your pitch - Key things investors want to see - Typical mistakes to avoid - Presentation skills and how to stand out - Graphics, charts and how best to use them. The session was designed to help prepare startups to pitch at the EBAN Congress.



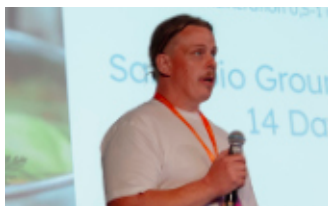


## EBAN CONGRESS 2024

On the 21st May the Bionanopolys project hosted a pitching session at the EBAN Congress 2024 with 8 exciting startups from across Europe! The EBAN Congress event, hosted in Tallinn, Estonia, brought together 600 of the top early stage investors in Europe and over 50 innovative startups looking to make connections, develop their skills and access new funding opportunities!

The Bionanopolys pitching session "Our Future: The Green, Clean and BioTech Showcase" was moderated by Alessandro Craglia from EBAN, and included pitches from two rising star companies supported by Bionanopolys, Ecorbio and Algaesys! These exciting startups were judged by an expert panel made up of experienced investors and founders, Andrey Kostyuk, Cyril Golub, Iro Tsagareishvili, and Ricardo Luz, who evaluated the pitches and selected the top startup of the session! A huge congratulations to runner up Lukas Jasiunas from Ecorbio, as well as all other companies pitching, and we are very proud to announce that Mahshid Sedghi from Algaesys was awarded as the top startup pitch of the session!

This great achievement gave her the opportunity to pitch again on the mainstage in front of over 500 investors, before receiving a trophy as one of the top 5 startups of the EBAN Congress!







## POLYMERS CONFERENCE 2024

The Bionanopolys project participated in Polymers 2024 - Polymers for a Safe and Sustainable Future, which was held from 28th to 31st May 2024 in Athens. Dr. Ioanna Deligkiozi and Dr. María C. Naranjo from AXIA Innovation GmbH attended the Conference physically and exhibited the Bionanopolys poster named Development of Safe Nano-Enabled Bio-Based materials and bionanocomposites for advanced applications – Open Innovation Test Bed (OITB). The poster offered an overview of Bionanopolys OITB, highlighting the technical services for nanoadditives and bio-based materials, bionanocomposites, and bionanoproducts, which are offered by the different pilot plants involved in the project.

This international event was an excellent opportunity to connect researchers from around the world who are involved in the development of new polymers produced by green and sustainable chemistry, which is essential for

the transition to climate neutrality and zero-pollution ambitions. Also, novel techniques for polymer recycling and reuse were discussed during the conference. Dr. Ioanna Deligkiozi, AXIA Innovation CEO, was one of the three conference chairs during the session Polymers for a Safe and Sustainable Future held on the first day of the conference.

Therefore, the Polymers Conference covered the latest progress in the field of polymers to produce new materials for a safe and sustainable world, with a special focus on the synthesis of safe polymers with unique properties for human health and environmental sustainability. This Polymers 2024 conference held in Athens followed the preceding events, which were Polymers 2018–Polymers: Design, Function and Application held in March 2018, Barcelona, Spain, and Polymers 2022: New Trends in Polymer Science: Health of the Planet, Health of the People held in May 2022 in Turin, Italy.

# UPCOMING EVENT



STAKEHOLDER  
WORKSHOP  
FOR THE BIOTECH  
COMMUNITY

GRAZ, AUSTRIA,  
12-14 NOVEMBER 2024

[www.esib.at](http://www.esib.at)

[www.bionanopolys.eu](http://www.bionanopolys.eu)



## EDITORIAL TEAM

**Coordinator:** Carmen Sanchez, ITENE • **Communication Manager:** Katrin Weinhandl, acib GmbH • **Newsletter Text:** Various  
**Layout:** Dietmar Cseh, acib GmbH • **Pictures:** Bionanopolys • **Contact:** [katrin.weinhandl@acib.at](mailto:katrin.weinhandl@acib.at)  
© by Bionanopolys 2024



Bionanopolys received funding in the frame from the European Union's Horizon 2020 Research and Innovation programme under grant agreement No. 953206