Bionanopolys

HIGHLIGHTS NO. 1

WELCOME

to the first 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 question or cooperation request.

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WHAT BIONANOPOLYS IS ABOUT

The Horizon 2020 project Bionanopolys unites 27 European partners to create an Open Innovation Test-Bed (OITB) for an improved performance for packaging, textile, agriculture, cosmetics, pharma or food.

In order to create a more sustainable future for all of us, the project team is eager to develop biomaterials with high quality and, therefore, to provide potential alternatives to fossil-based materials. These novel biomaterials must offer functional properties for high-volume applications and need to perform even better in order to drive their adoption by industry and end users. Besides, fossil-based materials are still cheaper – a barrier for a successful market entry of biomaterials.

Bionanopolys opens up a platform for driving "open innovation" in this field. In order to provide materials with the requested properties, the Bionanopolys community makes use of sustainably sourced renewable feedstocks in Europe for manufacturing innovative bionanocomposites and producing bio-based nano-products for different industry sectors. To speed up the introduction of bio-based nano-enabled materials into the market, a single entry point (SEP) for stakeholders, who are willing to contribute or to make use of the OITB services is a central objective of the project.

For the start, Bionanopolys created a network of 14 pilot plants and their complementary services: Five pilot plants will focus on the development of bionanomaterials from biomass, three pilot plants are dedicated to bionanocomposites and six pilot plants aim at manufacturing bio-based nanoproducts in order to reach a wide range of applications in different sectors. Pilot lines are going to be upgraded and fine-tuned across the entire Bionanopolys value chain.

BIONANOPOLYS FACTS

27 partners from 12 European countries
Project Coordinator: ITENE
Budget: 11.75 million Euro
Duration: 2021 – 2024

Therefore, Bionanopolys offers to create an integrated platform of technologies and scientific expertise as well as technicians devoted to the nanotechnology based on bio-based raw materials for the first time. A comprehensive portfolio of services for the development and integration of new bio-based nano-enabled products complements the outputs of the project. The services of the OITB comprise scientific consultancy for the production on the one hand, and complementary considerations in terms of ethics, security, life cycle assessment, economic analyses etc. on the other.

THE IDEA OF THE BIONANOPOLYS TEST BED & ITS BENEFITS

Written by Raquel Moreno (AXIA Innovations)

Bionanopolys Open Innovation Test Bed

An Open Innovation Test Bed (OITB) or Open Innovation Ecosystem is a set of entities, providing common access to physical facilities, capabilities and a wide range of services in a specific field of competence. The objective is to assist Small and medium-sized enterprises (SMEs), large enterprises and other stakeholders to bring new innovative materials, products, processes and services closer to the market, "TRL 7" (Technology Readiness Level), within the reach of companies and users.

"Bionanopolys OITB for developing safe nano-enabled bio-based materials and polymer bionanocomposites for multifunctional and new advanced applications", will strengthen the circularity of nano-enabled bio-based materials in the economy, by developing innovative bionanocomposites and bio-based nanoproducts from main feedstocks in Europe.

Bionanopolys OITB will improve technologies and processes, with the purpose to increase the acceptance of new technology by the market, ensure seasonal of feedstocks, offer price competition and market positioning, reduce regulatory constraints, and ease safety, economic and technical barriers.
The transformation of biobased materials to the nanoscale will offer new functional properties for high-volume applications such as packaging, cosmetic, medical, foam, nonwoven, coating, 3D printing, textiles and cellulose-paper.

Expected Benefits

The objective of the Bionanopolys Open Innovation Environment is to build a European reference ecosystem for the upscaling of nano-enabled bio-based materials and polymer bionanocomposites. The Ecosystem will offer a holistic solution, including their infrastructure, their capabilities and all associated services easy to find, accessible, transparent and interoperable, through a unique access contact point, called Single Entry Point (SEP), in a form of a "restaurant menu".

Through the SEP, Bionanopolys OITB will create an integrated open environment to offer end-users technical, legal, regulatory, safety, economic and financial support. Hence, reducing risks and barriers for commercial exploitation and accelerating market uptake and innovation process.

In addition, SME, industries and potential customers will benefit from Bionanopolys OITB at reasonable costs and conditions. Any customer of the OITB, European or global, will be able to access it through the SEP at any point of a specific development stage, trying to address their needs with BIONANOPOLYS' know-how.

Furthermore, Bionanopolys Open Innovation Test Bed will build up the network between technology providers, service providers and the industry by driving collaborative open innovation.

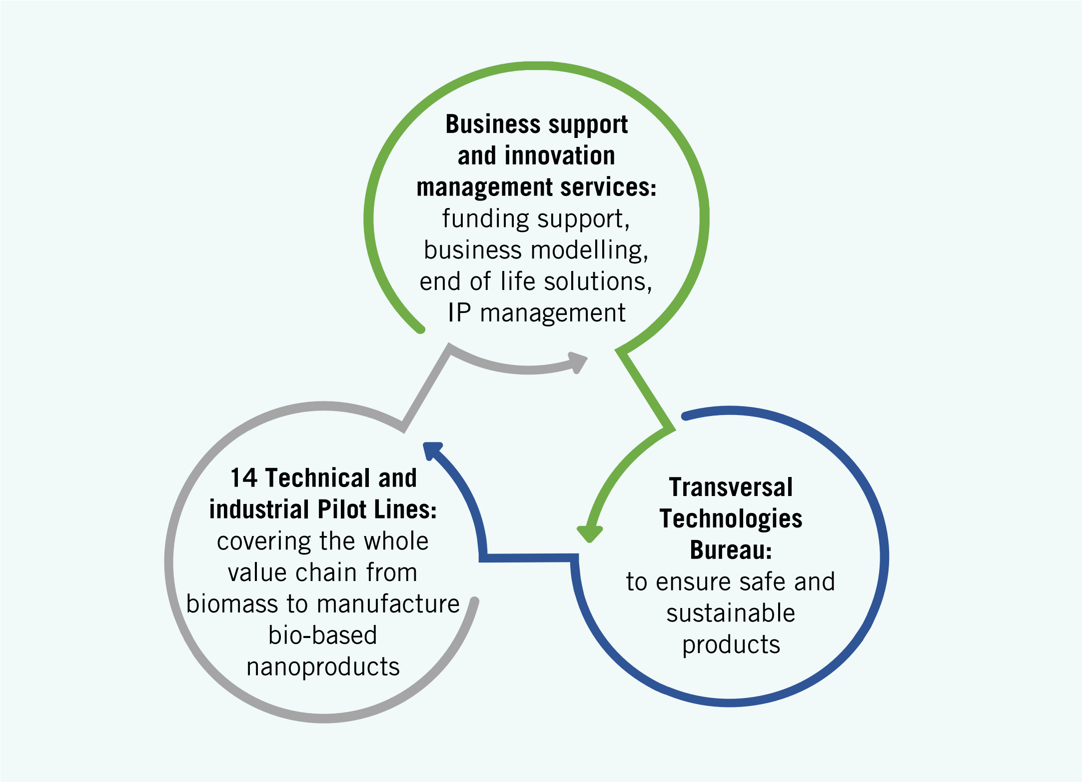


Figure 1: Bionanopolys Test Bed Services

Figure 2: Bionanopolys Service Menu

LET'S SHED A LIGHT ON BIONANOPOLYS' PILOT PLANTS!

BIOMASS

Extraction of raw materials, solvents, monomers and oligomers from biomass

Written by Bruno Ferreira, Biotrend (Pilot Plant 1 Leader)

Pilot Plant 1 of the BioNanopolys project is focused on the extraction of raw materials, solvents, monomers and oligomers from biomass, from TRL4 to TRL7.
A cooking and bleaching pilot plant will be upgraded for the extraction of cellulose from annual plants, enabling the process optimization.

Figure 3: Pilot plant 1

The hence extracted cellulose polymers will be hydrolysed to produce solutions of fermentable sugars. For the purpose, enzymatic treatments will be carried out in high solid load (20-25 %) in order to produce a solution with high sugar content, necessary for the implementation of highly productive fermentation processes. A multipurpose bioprocessing pilot plant with stainless steel, steam-sterilizable fermenters of 10L, 50L and 200L working volume and diverse pilot scale DSP equipment will be upgraded with advanced process monitoring capabilities (fermentation and DSP) and integrated control software to support the optimisation and scale-up of different fermentation processes. The cellulosic hydrolysates produced in the project will be used as raw materials to produce lactic acid and succinic acid, used as solvents of building blocks of biopolymers and also for the production of polyhydroxyalkanoates, biopolyesters produced directly in microbial biomass.

Obtaining cellulose nanofibers and nanocrystals, nanolignins

Written by Mohammed Krouit, CTP (Pilot Plant 2 Leader)

Thanks to their unique properties, nanoparticles are of interest in many sectors: composites, building, transport, packaging etc. In addition to their outstanding properties, they are also expected to contribute to a more sustainable future. And cherry on the cake, they can also be obtained from biomass. The objective of Pilot plant 2 is to be able to extract from wood & annual plant biomasses the following biosourced nanoparticles: cellulose nanofibres (CNF), cellulose nanocrystals (CNC) and nanolignin.
The bottom down route is applied. CNC are obtained thanks to chemical hydrolysis of the cellulosic fibres. CNF are produced by combining enzymatic and mechanical treatments of the biomass on grinding stones and twin screw extruder equipments at ITENE and CTP respectively. These two pilots are based on intensive mechanical fibrillation of process to generate highly fibrillated nanofibers with high specific surface area.

Characteristics of the twin screw extruder

- Evolum™ 32 bivis extruder (Clextral)
- Flow: 5 to 20 kg/h in equivalent dry matter content
- Screw elements diameter: 32 mm
- Total length of the barrel: 1280 mm
- Motor power; 50 kW
- Rotation speed: 300-1200 rpm
- Temperature regulation of the barrel: 30 to 300°C

The main objectives are to:

- move from batch to continuous production processes, produce NFC at high consistency (20-30%),
- Increase production capacities up to several kg/days,
- Ensure that quality of cellulose-based nanoparticles meets the requiments.

These cellulose-based nanoparticles will be used in the project to manufacture bionanomposites, bionanomaterials and finally bionanoproducts.

Figure 4: Pilot plant 2

BIONANOCOMPOSITES

Modification and functionalization of nanomaterials in liquid and gaseous medium

Written by Natalia Ortuño, ITENE (Pilot Plant 6 Leader)

Modification and functionalization of nanomaterials is a common way to reduce the strong attraction between them, enhance the chemical compatibility with polymer matrices and improve the properties of certain substrates based on nano-cellulosic materials. For this objective three approaches have been considered within BIONANOPOLYS project carried out in the Pilot Plant 6: liquid-solid and gas-solid reactions as well as grafting by chromatogeny technology.

Liquid-solid reactions normally are carried out in vessels equipped with mechanical stirring systems, and sometimes followed by ultrasonication for de-agglomerating and dispersing nanomaterials in a liquid medium. However, the high amount of reagents, time of reaction and energy consumption involved in the modification process as well as in the post-treatment process to obtain the additive in powder form, are the main causes involved in the final price of this kind of nanomaterial. To solve this, the implementation of different dispersing systems to break particle agglomerates, increasing the specific surface area of the nanomaterials, will allow to increase of the reaction yield, a reduction of reagents, time and energy consumed, with the consequent saving in raw materials, energy and production of chemical residues.

By other side, to also apply the concept of "green chemistry" in modification processes of nanomaterials to achieve more cost efficient and environmentally friendly nanomaterials, gas-solid reactions will be carried out in BIONANOPOLYS project. In this kind of reactions, the use of solvents and the post-treatment processes are unnecessary in comparison with liquid-solid reactions. In BIONANOPOLYS, this technology will be used to modify nanomaterials in a more sustainable way.

Other modification technology consists of the chromatogeny technique which create a water repellent surface while keeping recyclability and biodegradability, being therefore highly interesting for the cellulosic materials. Until now this process, based on a roll-to-roll solvent-free surface treatment, has been optimized to treat cellulosic materials and in the BIONANOPOLYS project will be focused on the upgrade of this technology to be applied on different nano-cellulosic materials to improve mainly their sensitivity to water.

Figure 5: Pilot plant 6

BIONANOPRODUCTS

Textiles and non-woven fabrics

Written by Romy Naumann & Anna Grosse, STFI (Pilot Plant 11 Leader)

Basis for STFIs research activities in the field of nonwovens is the multifunctional nonwoven machinery available at STFIs technical labs. The combination of know-how and technical equipment at the institute as well as the complex cooperation with companies from the nonwoven industry, led in the year 2000 to the establishment of the Competence Center of Excellence in Nonwovens and in the year 2005 to the inauguration of the new Technical Center for Spunbond Nonwovens.

For BIONANOPOLYS, STFI is the leader of two project-related nonwoven pilot plants – a melt-blown plant and a fibre nonwoven line. Nonwovens for different applications can be produced at a semi-industrial scale. The plants are also available for customer trials and practically very well tested. Both will be part of the Open Innovation Test Bed (OITB) of the BIONANOPOLYS project.
The meltblown plant from company Reifenhäuser Reicofil GmbH & Co. KG is an extrusion nonwoven line with a working width of 60 cm. Currently, it is equipped with a single row nozzle unit having a throughput of 10 kg polymer granulate per hour depending on the processed polymer material. The plant is used for the production of nonwovens made of very fine up to ultra-fine filaments for filtration or medical applications. To achieve even finer filament diameters and a higher efficiency (material throughput), the installation of a new multirow nozzle unit is planned for summer 2021. A second improvement is dedicated to the electro-charging unit used for online surface modification of the filaments during the meltblown process. Current challenge is to prepare a retrofit conception for this.

The fibre nonwoven line from company DILO Systems GmbH with a working width up to 240 cm has a working speed of max. 10 m/min. It can process natural and synthetic fibres in a range of 1 to 28 dtex fibre fineness. The produced webs have a mass per unit area reaching from 50 to 1500 g/m2 and subsequent web bonding can be done by needling, stitch-bonding or spunlacing. Main application fields for the fibre nonwovens are the automotive or building sectors. The upgrading aims at the improvement of quality parameters, such as homogeneity, tolerances in grammage and thickness of nonwovens. Therefore, control units and digital interfaces are implemented to enhance the scalability and reproducibility of the produced fibre nonwovens. Furthermore, a monitoring unit to continuously control mass per unit area and/or the thickness of the fibre nonwovens and to detect material variations is planned in cooperation with project partners IRIS and CEA.

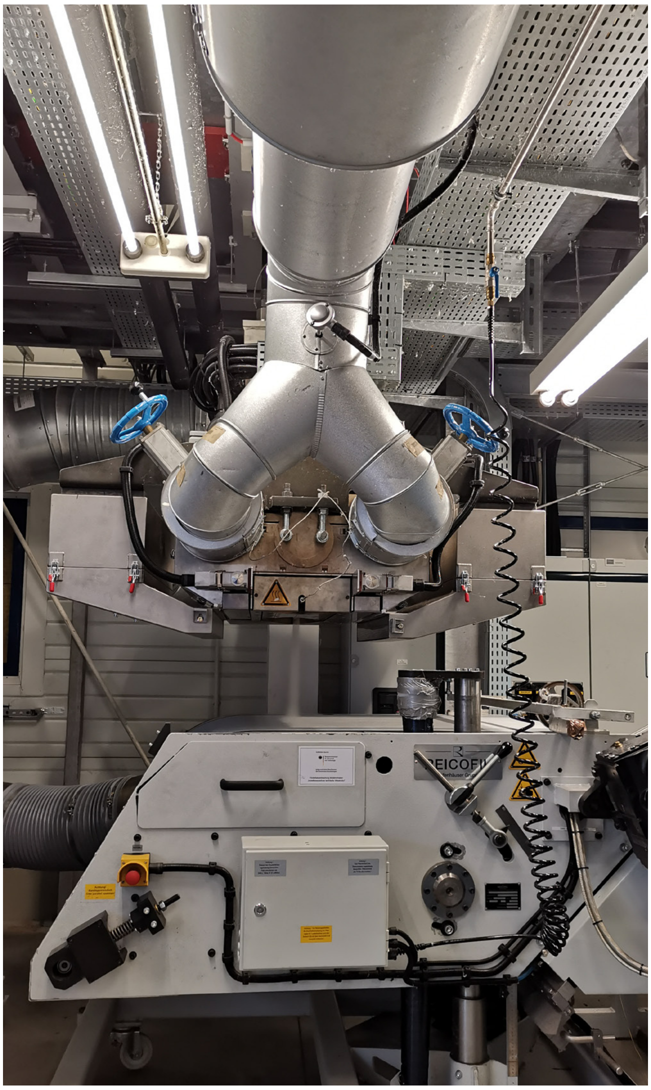


Figure 6: Pilot plant 11

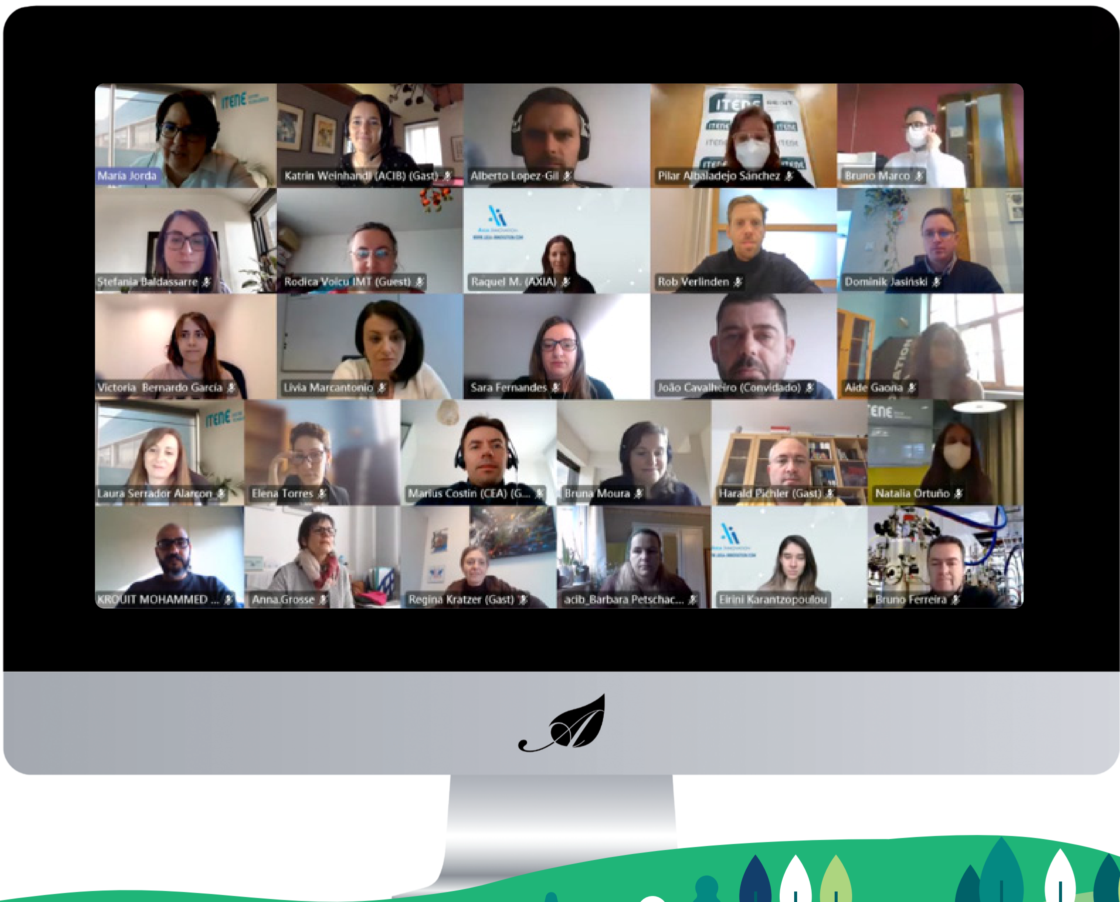
HIGHLIGHTS FROM THE FIRST 6 MONTHS

Bionanopolys kicked off in January 2021 and was forced to hold a virtual meeting due to the COVID-19 situation. Nevertheless, the team of 27 partners is highly motivated and keeps the mood on a high level!

In March 2021, Bionanopolys project went online! The website was created and is ready for continuous updates now. Stay tuned and visit us on www.bionanopolys.eu

A delegation from ITENE, AXIA and ACIB participated in the virtual **OITB workshop at the Euronanoforum on 4th May,** organized by the H2020 project FlexFunction2Sustain and gained some important information about running an OITB successfully.

The first Executive Board Meeting was held on 2nd June and a lot of progress has been seen already at this early stage



UPCOMING EVENTS

Bionanopolys General Assembly Meeting,

July/August 2021

www.bionanopolys.eu

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