PRESS RELEASE

01.02.2021, Thessaloniki

Biobased Nanomaterials and Polymer Nanocomposites for the European Circular Bioeconomy

A research and industrial community serving the uptake of a revolutionary technology.

One of the keys for a successful implementation of the European Circular Economy is the increasing reliance on bio-based products derived from biomass. A wider adoption of such products can solve several problems linked to solid waste disposal, as they could be further re-used at the end of their life cycle, ensuring full circularity. Nano structured bio-based materials (NBM) are the answer to many challenges faced by our society, embracing several applications in the fields of packaging, automotive, printed electronics, agriculture, and construction.

But what exactly are nanomaterials? They are materials made by very small particles, ranging from 1 to 100 nanometres. For instance, the influenza (flu) virus is roughly 100 nanometres in diameter. Due to their small size, nanomaterials have peculiar physical, mechanical, chemical, and electrical properties which could expand the range of revolutionary applications.

NBMs are made up by bio-based polymers, which are polymers derived from biomass, or synthesized from biomass-originated monomers. They have recently gained increasing interest as an alternative to fossil-based polymers. Their annual production growth is estimated by around 18-20% using renewable sources, thus reducing CO_2 emissions by 60-80% and the needs for Non-renewable energy use at about 70%. However, many technical, economical, and regulatory barriers still hinder the full deployment of bio-based polymers and nanomaterials on the market and limit the implementation of solutions based on such materials. The new Horizon2020 project BIOMAC aims at reducing these barriers and fostering the European Bioeconomy. It is one of the biggest EC-funded projects with 33 partners (academia, institutions, and companies) from 12 European countries. BIOMAC establishes a self-sustainable Open Innovation Test Bed (OITB) capable of upscaling the market-readiness and production of NBMs. SMEs will be granted access

to the services and facilities of the BIOMAC ecosystem after an initial validation phase, where practical applications of NBM will be demonstrated.

How the Ecosystem works

The BIOMAC ecosystem will function as a cluster of parallel activities taking the form of 17 Pilot lines (PLs) covering the whole value chain, from biomass fractionation and intermediate chemicals to final-enabled biopolymers. The PLs are grouped in 3 clusters and their activities will enable the realization of 5 concrete outputs (Test Cases), demonstrating the validity of BIOMAC's approach and the high value of NBM applications. Here is the list of the Test Cases (TeCs):

- ### TeC1: Automotive

Bio-based resins reinforced with NBMs will be used in the fabrication of interior car parts and components for the automotive industry. These will be succinate-based polyesters and isocyanate-free polyurethane resins with exceptional physical properties including toughness, flexibility, and resistance to abrasion and temperature.

- ### TeC2: Agricultural applications

The use of different biomaterials and NBMs will be validated in agricultural applications. Succinic and lactic acid will be derived from biomass and will be used as monomers in the development of completely biodegradable succinate and PLA biopolymers. Both biopolymers will be nano-reinforced with nano lignin, nano biochar, nanocellulose, etc., to create materials with enhanced mechanical properties and decreased water vapor transmission rates, as well as with antioxidant/optical properties and UV/thermal resistance appropriate for mulch films, injection-molded clips, thermoformed/injection molded pots, seeds coating, coating for controlled-release fertilization etc., to be used in agriculture. Biopolymers and nano additives will contribute to soil amendment and remediation after biodegradation of bioplastics in soil, to improve technical performances while increasing soil health and quality.

- ### TeC3: Food packaging

Vacuum thermoforming will be post-utilized to produce bio compostable and biodegradable food containers, using bio-based PLA foils. These will be reinforced with BNC and NL to enhance the mechanical and antibacterial properties of flexible packaging materials. Two additional techniques will be applied on PLA film i.e., coating with NBMs to improve its permeability to gaseous compounds (water and oxygen), and specific micro/nano textured geometries will be designed, fabricated and replicated using nanoimprint lithography. This will further enhance the antimicrobial and antifungal properties of the film's surface, leading to improved food maintenance/conservation and safety.

- ### TeC4: Construction

Bio nanocomposites will be tested in the construction industry. A footbridge module (2m x 0.45m x 0.65m) made from isocyanate free TPU biopolymers reinforced with nanolignin, biochar and NFC will be constructed with 3D printing technology. Fused filament fabrication

(FFF) filaments prepared by melt extrusion will be used, and simple printing tests of the bio-filament will be performed using conventional fused deposition modelling equipment. The final product is expected to have high UV and fire resistance >80°C, anti-fouling & easy-cleaning capability.

- TeC5: Printed Electronics

The main objective will be to develop stretchable conductive layers embedded into textiles (sock with integrated conductors) using a bio-based stretchable substrate, an ink and adhesives with printed electronic processes. Bio-based inks will be reinforced with bio-resins. TPU produced by REX and biobased succinate polyesters will be used as flexible substrates, and nano-copper for stretchable electrical prints will be integrated directly into textiles as stretchable circuitry between sensors and electronics. To achieve this, nano biochar will be modified by nano-copper and silver to enhance their electrical conductivity.

The open call and after-life sustainability

After the successful demonstration of the five TeCs, BIOMAC will launch an Open Call aiming to select 5 new TeCs by companies and research bodies interested to access the ecosystem services. The BIOMAC ecosystem will offer them services for upscaling biomaterial concepts through the Pilot Lines and cover the assessment of regulation, safety, sustainability, circularity, and market potential. It will provide open services and solutions, accessible to SMEs or other Industries from a single-entry point. Through the Pilot lines, technologies that have been developed up to TRL 4-5 will be upscaled and validated up to TRL 7. This same procedure will be extended after the project's official duration, granting innovators and researchers access to the ecosystem's services at fair conditions and cost beyond 2024.

BIOMAC - European Sustainable BIObased nanoMAterials Community

BIOMAC is an Innovation Action (IA) started in January 2021 that will run until December 2024.

The project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No. 952941. EU's contribution is € 14 807 314,50 on a total budget of € 16 596 702,50.

Partners: AUTH, EUBIA, BEECO, LTU, BBEU, LIST, RISE, ATB, UEDIN, AIMPLAS, FH-WKI, CNANO, ITENE, AIMEN, POLIMI, DTI, NNT, IDE, AXIA, UBU, ABIS, EXELISIS, EUBP, UNIPD, IRIS, RDC, DIAD, OHM, EVERSIA, ACC, NOVAMONT, ISQ, STAM.

Contacts

Professor Dimitrios Bikiaris (Project Coordinator AUTH): dbic@chem.auth.gr

Dr. Giulio Poggiaroni (Dissemination & Communication Manager, EUBIA): giulio.poggiaroni@eubia.org

Coordination team of Aristotle University of Thessaloniki (AUTH): biomac@chem.auth.gr

Website: www.biomac.oitb.eu