

NanoPAT Newsletter

May 2023

Online real-time characterisation solutions for
nanoparticle production processes

#06

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Welcome

Dear reader,

The NanoPAT project is glad to present our **sixth project newsletter** aiming to communicate our latest technical achievements, introduce our innovative partners and share inputs and curiosities related to nanotechnology and process monitoring.

In this sixth issue you will find an update of the project status. Furthermore, two of NanoPAT's project partners will be presented and our achievements of the last months will be highlighted!

In January 2023, Ioannis Kakogiannos left his role in NanoPAT as project coordinator. I, Poojan Timilsina, have the honour to be his successor. As new coordinator, I am joining at the right moment where technologies developed over the previous period need to be validated in the field over the next months. I believe my background and experience in industrial automation and process monitoring technologies will help us to move towards the right direction. Research and Technology Organisations (RTOs) and partners from the industry are already guaranteeing professionalism on the approach of each case study.

At this point, I would like to thank our ex-coordinator, Ioannis Kakogiannos, for his dedication to the project and wish him the best of luck for the future. He is leaving behind a healthy project and big expectations for us to fulfil.

If you are interested in the evolution of NanoPAT activities, coming from an academic, industry, or other perspective, and would like to closely follow the progress of the project and its outcomes, do not hesitate to contact us on nanopat_coordination@iris-eng.com and to [subscribe to our newsletter](#) to receive further information and explore possible collaborations.

Best regards and enjoy the read,



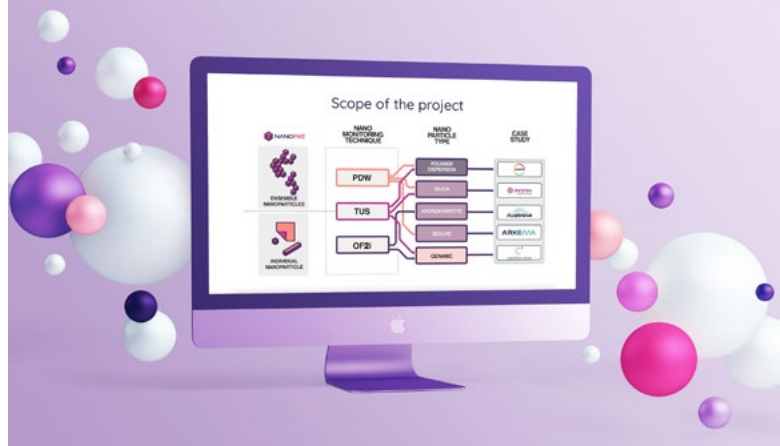
Poojan Timilsina,
Coordinator of NanoPAT



Project status

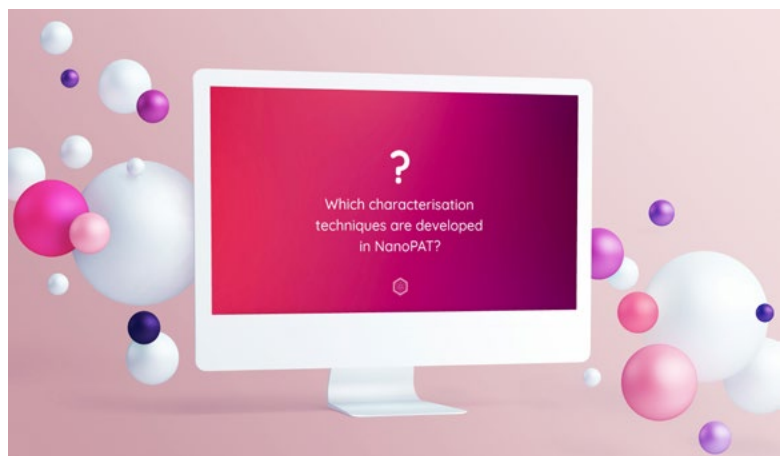
Since our last newsletter (issue #5 - Nov 2022), and thanks to a hardworking team, there have been plenty of activities within the NanoPAT project within the last 6 months.

In January 2023, all project partners met in San Sebastian (Spain) for our **General Assembly** (M32). It was a great get-together with lots of very fruitful discussions and getting up-to-date with the developments and achievements during the last months, which set the basis for the last months.

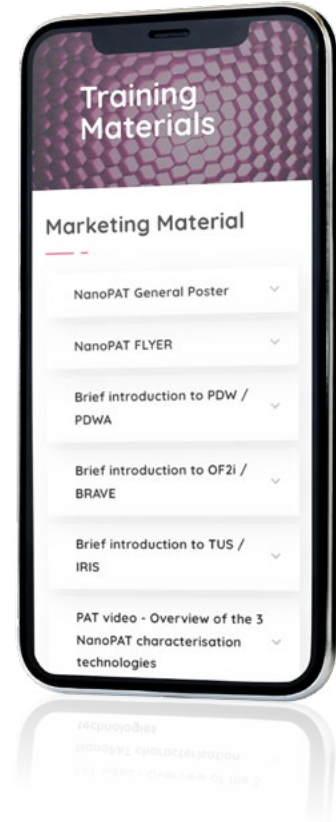


We have also launched a **general project video** which provides an overview about the NanoPAT project. It explains why the characterisation of nanoparticles is crucial for manufacturing processes, which are the main features of conventional characterisation technologies and which novel technologies are being developed in NanoPAT to overcome the shortcomings of the traditional ones. Furthermore, the scope of the project, the 3 real-time in situ particle size characterisation technologies (Photon Density Wave Spectroscopy (PDW), OptoFluidic Force Induction (OF2i), Turbidity Spectrometry (TUS)), as well as the 5 case studies where the technologies will be validated are presented. You can watch the whole video [here](#).

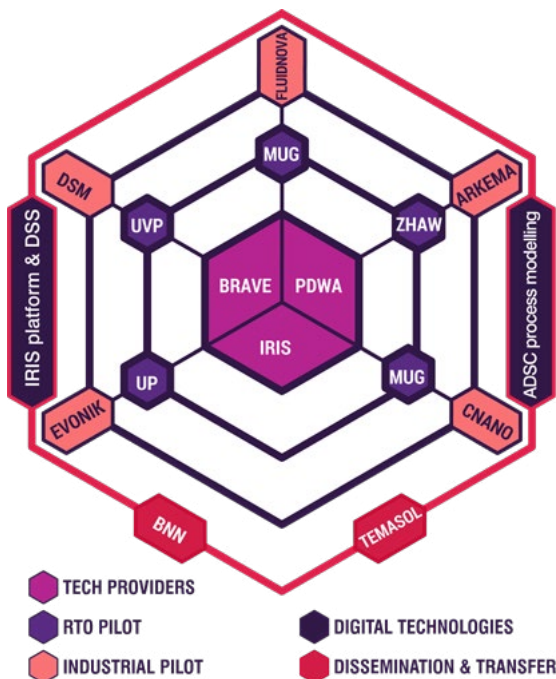
Additionally, we have also created a **video on NanoPAT's Process Analytical Technologies (PAT)**, which gives a brief overview of the three novel complementary real-time in situ particle size characterisation technologies (PAT) that are being developed in the project: – Photon Density Wave Spectroscopy (PDW) – OptoFluidic Force Induction (OF2i) – TURbidity Spectrometry (TUS). You can watch the whole video [here](#).



Furthermore, we have launched a new section on our project webpage, which contains all training materials the project has produced until now. They are divided into different categories so that you can find them more easily: marketing material (flyers, brochures, videos, general presentations, information sheets, etc.), reports (public deliverables), conference materials (posters, presentations, recordings), standardisation materials, publications, newsletters, user manuals.



The lab-scale validation of the three PATs of the project (PDWA, OF2i, TUS) has been successfully executed for the different case studies and user manuals as well as 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. With that, the project has entered the stage of industrially implementing the three technologies, i.e. the demonstration of the NanoPAT technologies in an industrial environment.



Overview of roles of the partners in NanoPAT

Our industrial partners, the end users, are currently adapting their facilities to provide the needed technical prerequisites for each PAT. The technology providers (BRAVE, PDWA, IRIS) have been visiting the end users to prepare the installation of the sensors and some first measurement campaigns have already been performed. The next step will be to proceed with the installation and trials of the sensors at the end users facilities, i.e., the industrial pilot plant demonstration of the technologies.

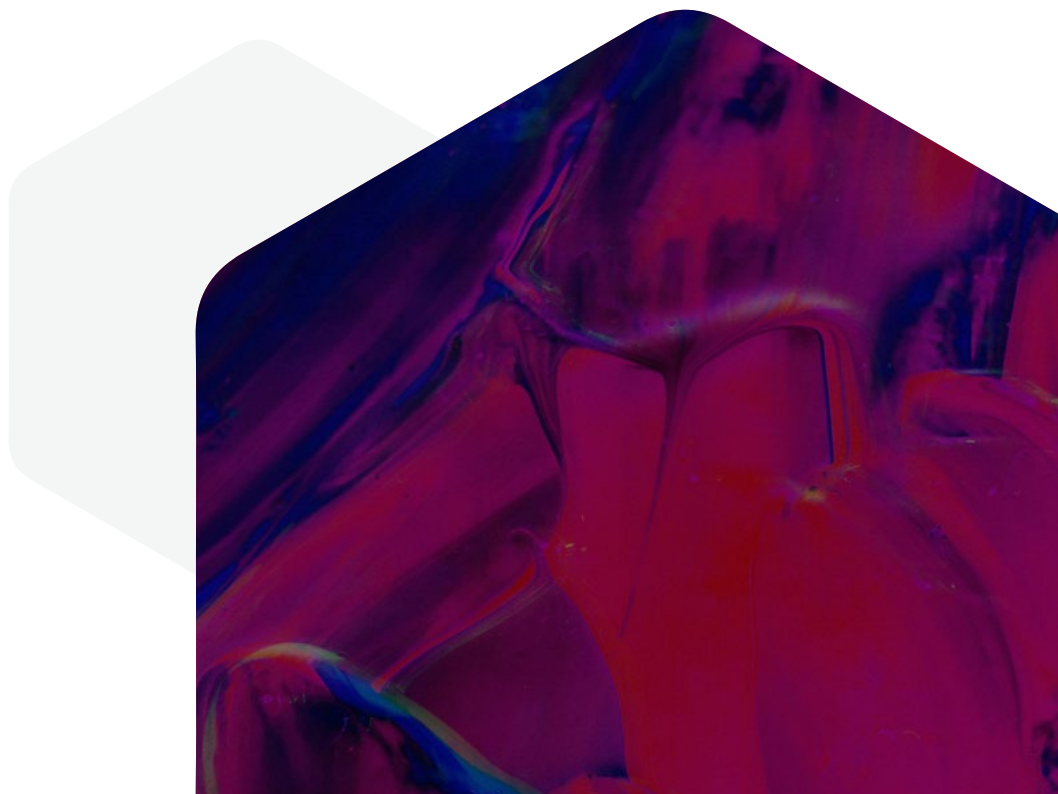
The Computational Fluid Dynamics (CFD) analysis of the Case Studies is running as planned to correctly place the PATs in the respective case studies and help understand the phenomenology of the different nanomaterials creation in the respective case studies.

The **PATBox platform** that will store, manage and share the data produced by the PATs is under development. The first integration tests at UPV have been performed with one of the technologies (TUS). Further tests will follow in the upcoming months.

Additionally, several activities have been pushed and carried out by BNN and TEMASOL towards collaboration with other EU funded projects with similar or supplementary focus. Moreover, the project partners have been very active with the organisation and/or participation in conferences and other events to promote their research as well as external and internal knowledge transfer activities for exchanging ideas with professionals of the industry.

Finally, the project has released its second publication on the Theoretical Description of Optofluidic Force Induction (OF2i), as an optical nanoparticle characterization scheme which achieves real-time optical counting with single-particle sensitivity and high throughput.

You can find more details about all these activities in the upcoming sections.



Partner presentations

In this issue, we will present the project partners Covestro and Fluidinova.



About Covestro

Covestro is one of the world's leading manufacturers of high-quality polymer materials and their components. With its innovative products, processes and methods, the company helps enhance sustainability and the quality of life in many areas. Covestro supplies customers around the world in key industries such as mobility, building and living, as well as the electrical and electronics sector. In addition, polymers from Covestro are also used in sectors such as sports and leisure, cosmetics and health, as well as in the chemical industry itself.

The company is committed to becoming fully circular and is striving to become climate neutral by 2035 (scope 1 and 2). Covestro generated sales of EUR 18 billion in fiscal 2022. At the end of 2022, the company had 50 production sites worldwide and employed approximately 18,000 people (calculated as full-time equivalents).

The R&D center for waterborne dispersions located in Waalwijk, The Netherlands, will take part in the NanoPAT project. The team consists of experienced polymer and analysis chemists and is able to provide a well-equipped R&D

lab and pilot plant for processes from several liters up to 1000 liters scale. To optimise the waterborne processing, particle size is one of the parameters which is monitored off-line. The technologies being developed in the NanoPAT project should allow a reliable in-line particle size measurement. Such in-line control would give opportunities to drive the process more effectively and would open new insights in particle formation. A reliable online particle size measurement would bear big potential for production and development.

Contact:

www.covestro.com



Ron Peters

Lead scientist characterization



Ronald Tennebroek

Lead scientist materials

About FLUIDINOVA (FLU)

FLUIDINOVA is a specialised manufacturer of synthetic nano-hydroxyapatite and tricalcium phosphate materials, which are commercialised worldwide for several applications (e.g., oral care, biomaterials, 3D printing, food supplements, biotech, etc) under the brand name nanoXIM®. Innovation is a keyword in the company, starting with its patented reactor NETmix® that allows the production of calcium phosphates with unique features and quality. FLUIDINOVA is able to supply a great variety of products in paste and powder forms, available in different concentrations and particle sizes, respectively.

The company has a strong R&D background since its foundation in 2005, being engaged in several National and European projects over the years. Particularly within the NanoPAT project, FLUIDINOVA is strongly involved in the Case Study 3 for the characterization of nano-hydro-

xyapatite particles using the OF2i technology. Together with the partners MUG and BRAVE Analytics, FLUIDINOVA will implement the OF2i sensor at its industrial line in Oporto to enable the online monitoring of the particle suspension during the production process. For FLUIDINOVA, this is the most relevant task in the project since it will not only validate the OF2i technology in this industrial environment, but also bring new input that can improve the nano-hydroxyapatite production process.

Contact:

www.covestro.com



Catarina Coelho

Highlights

As a result of the hard work of our project partners **BRAVE Analytics** and **Medical University Graz** in the past months, a peer-reviewed **scientific publication** on the journal *Physical Review Applied* was released in March 2023.

This publication is on the theoretical description of the Optofluidic Force Induction (OF2i) technique, as an optical nanoparticle characteriza-

tion scheme which achieves real-time optical counting with single-particle sensitivity and high throughput. In this paper a detailed account of the model ingredients, including the full working equations, is given. Furthermore, additional justification for the assumptions underlying OF2i is provided, and directions for further developments and future research are discussed. [Theoretical Description of Optofluidic

dic Force Induction. Marko Šimić, Christian Hill, and Ulrich Hohenester, Phys. Rev. Applied 19, 034041 (March 2023) - DOI: [10.1103/PhysRevApplied.19.034041](https://doi.org/10.1103/PhysRevApplied.19.034041)]

We proudly congratulate our partner FLUIDINOVA, as their [nanoXIM•CarePaste](#), which is a **nano-hydroxyapatite (nHAp)** product, has been **approved as safe for use in oral care cosmetics by the European Scientific Committee on Consumer Safety (SCCS)**. The SCCS adopted and published on 23rd March 2023 a [Final Opinion SCCS/1648/22](#) on hydroxyapatite (nano) safety regarding its use in oral care products. This approval was based on data provided by FLUIDINOVA over the past decade, and it states that hydroxyapatite (nano) is safe to use in toothpaste at concentrations of up to 10% and up to 0.465% in mouthwash.

The safety evaluation applies only to nanoXIM•CarePaste, which is composed of rod-shaped particles with specific characteristics and is not coated or surface modified. This evaluation is not applicable to hydroxyapatite (nano) composed of needle-shaped particles. The limits of 10% nHAp for toothpaste and 0.465% nHAp for mouthwash correspond to 64.5% and 3% nanoXIM•CarePaste, respectively.

This SCCS Final Opinion applies only to the nanoXIM•CarePaste product manufactured by FLUIDINOVA and referred to in the studies.

The Final Opinion on Hydroxyapatite (nano) can be downloaded from the SCCS website, [here](#).



NanoPAT News

Several **visits between NanoPAT partners** were performed during the last six months, with the main objective of networking and **internal knowledge transfer activities** to ease the developments within the projects in the upcoming months:

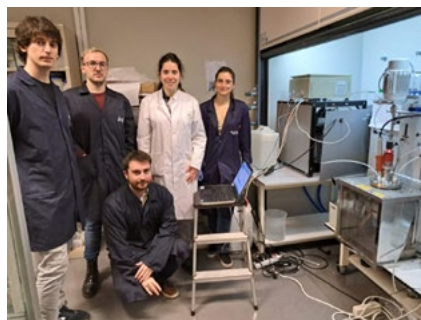
- ➔ In November 2022, the **IRIS** team visited **BRAVE's** facilities in Graz (Austria) to perform experiments with IRIS' TUS sensor in Cnano's nanoparticle suspensions, to measure the turbidity and obtain the particle size of the different particle suspensions. Read more about it [here](#).
- ➔ Some colleagues from the **IRIS** team travelled in February 2023 to the labs of **UPV/POLYMAT** in San Sebastian (Spain) to conduct measurements of the dilution system for the TUS sensor and perform off-line tests to configure the dilution parameters before proceeding with the on-line measurements. Read more about it [here](#).

- End of February 2023, colleagues from **UP**, **PDWA** and **UPV/POLYMAT** performed a PDW measuring campaign at the laboratories of our industrial partner **Covestro**, in The Netherlands, to test PDW spectroscopy at Covestro's R&D Lab for various syntheses that are significant to their production portfolio. Read more about it [here](#).
- In March 2023, **IRIS** team visited **UP** labs to conduct TUS measurements in silica syntheses on a 6 L scale. Read more about it [here](#).
- In the end of April 2023, **IRIS** team visited **Cnano** premises to perform experiments with the TUS detector for the online monitoring of nanoparticles in Cnano's plating baths. Read more about it [here](#).
- Mid May 2023, some colleagues of **BRAVE** visited **Cnano** facilities to test BRAVE's OF2i sensor prototype for the online monitoring of SiC nanoparticles in Cnano's electroplating baths for the production of nickel nanocomposite coatings. Read more about it [here](#).

Some impressions



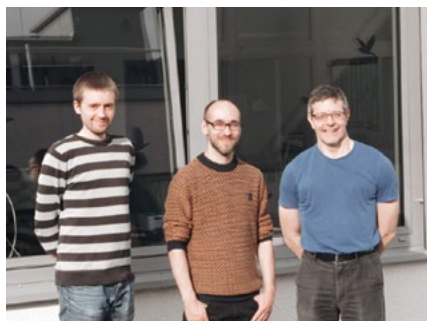
Visit of IRIS at BRAVE



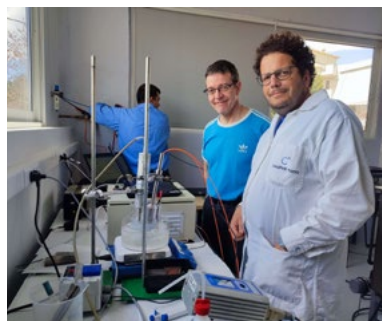
Visit of IRIS at UPV/POLYMAT



Visit of UP, PDWA, POLYMAT at Covestro



Visit of IRIS at UP



Visit of IRIS at Cnano



Visit of BRAVE at Cnano

Additionally, **External Trainings & Knowledge Transfer** as well as **Stakeholder Engagement activities** have been carried out to increase NanoPAT's visibility and raise awareness on the technologies we are developing:

- On 30th January 2023, the **Nanotechnology Industries Association (NIA)** organised a webinar giving an *Overview of the newest Characterisation Techniques available nowadays*. On behalf of NanoPAT, TEMASOL organised an opportunity to present NanoPAT technologies to the NIA members and public participants during this webinar. NanoPAT technologies were presented as part of the latest characterisation techniques available today to a very interested industrial audience. Special thanks to Dr. Anika Krause (PDW Analytics), who presented the Photon Density Wave Spectroscopy (PDW), Dr. James Bolton (IRIS Technologies), with the Turbidity Spectrometry (TUS), and Dr. Christian Hill (BRAVE Analytics) who presented the OptoFluidic Force Induction technology. Read more about it [here](#).



NanoPAT Retrospect

During the last six months, NanoPAT was very active participating in different **conferences and events**, sharing the developments of our project and our know-how:

- In December 2022, colleagues from UPV/POLYMAT and MUG attended the **11th edition of the Polymer Reaction Engineering Conference in Scottsdale** (Arizona, US). Jose Ramón Leiza (UPV/POLYMAT) co-chaired the session on “On-line tools – hardware and software – for the polymer industry”. Additionally, Usue Aspiazu (UPV/POLYMAT) gave a talk on the suitability of PDW spectroscopy to inline monitor the particle size of polyacrylate latexes during their synthesis. Moreover, Christian Hill (MUG), as invited speaker, gave an oral presentation on the possibilities of OF2i to online monitor the particle size and the particle size distribution of different kinds of nanomaterials and the benefits of using it in the manufacture of polymers. Read more about it [here](#).
- On 13th March 2023, BNN organised an interactive **Internal Stakeholder Workshop**, virtually, to further identify the relevant stakeholders for the project and define engagement activities with them. Read more about it [here](#).
- The Horizon Europe project IRISS organised, on 14th March 2023 an online informative session about **how the IRISS project applies the Safe-and-Sustainable-by-Design (SSbD) framework in value chains and SMEs**. NanoPAT partners (Laura Torres from Analisis-DSC and Blanca Sua-

rez from TEMASOL) participated in the event. NanoPAT sees a big potential in the IRISS project to see the different aspects that arise in the nanotechnology sector related to SSbD: about policies implemented, research taking place and recommendations on how to implement SSbD in industries, the challenges to be faced, etc. Case studies will be incorporated in the months of May and June 2023, at that moment they are opening the application period for those who want to get involved in the project. Read more about it [here](#).

- BRAVE had a booth at the **Bio-Europe Spring 2023** exhibition in Basel (Switzerland) from 20th to 22nd March 2023. As the exhibition targeted biotech and biopharma companies wanting to set up collaborations with other biotech companies and pharmaceutical companies, and also meet potential investors and business developers, it was the perfect mix for BRAVE and NanoPAT to promote the project's technologies. Read more about it [here](#).
- BRAVE took part at the **BioNanoMed 2023 conference** at the University of Graz (Austria) from 12-14 April, 2023. BioNanoMed is a small and very specialised conference targeted at researchers in the field of nanotechnology in biology and medicine, becoming a great place to promote the NanoPAT technologies to this specialist group. Apart from their poster presentation on the Optofluidic Force Induction Scheme for the Characterization of Nanoparticle Ensembles, and their company presentation (Vitan Strasser), BRAVE's team enjoyed a number of fruitful discussions and came away with several interesting opportunities for further collaboration and or measuring campaigns with OF2i. Read more about it [here](#).
- The colleague from IRIS attended the **Advanced Factories** (18-20 April 2023) in Barcelona (Spain) to disseminate the project's developments to a wider community, possible end users and parties currently involved in sectors related to nanomaterials. Read more about it [here](#).
- NanoPAT couldn't miss the possibly most important European PAT conference, the **EuroPACT 2023**. The partners of BRAVE had a booth to promote their OF2i technology that is being developed within the NanoPAT project. Additionally, BRAVE gave an oral presentation on OF2i and UP had a poster presentation on the challenges of inline particle sizing during industrial silica precipitations and how photon density wave spectroscopy can contribute to the solution of the task. Read more about it [here](#).
- On 23 May 2023, BRAVE participated in the **Pint of Science** organised in **Graz** (Austria). Under the title „Invisible to the eye - New technologies under the magnifying glass“, Christian Hill (BRAVE) gave a very interesting talk on the principles of their OF2i technology. Read more about it [here](#).

Some impressions



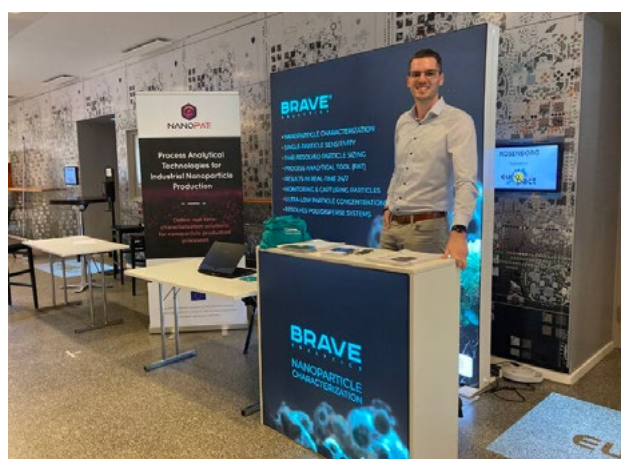
Bio-Europe Spring 2023



BioNanoMed 2023



Advanced Factories 2023



EuroPACT 2023



Pint of Science Festival

Upcoming Events

Before we head into the Summer break, some highlights of the events where NanoPAT will be present:

- [2nd World Conference on Materials Science and Nanotechnology](#), 26-28 May 2023, Brussels (Belgium)
- [EuroNanoForum 2023](#), 11-13 June 2023, Lund (Sweden)
- [International Polymer Colloids Conference \(IPCG2023\)](#), 18-23 June 2023, Ontario (Canada)
- [6th EU-Asia Dialogue on Nanosafety](#), 21 June 2023, Berlin (Germany)
- [14th International Workshop on Polymer Reaction Engineering \(PRE2023\)](#), 5-8 September 2023, Potsdam (Germany)
- [11th PhD student Workshop in PRE](#) (WPPRE 2023 - Working Party on Polymer Reaction Engineering), 8-10 September 2023, Potsdam (Germany)
- [ILMAC 2023](#), 26-28 September 2023, Basel (Switzerland)

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