NanoPAT Newsletter

December 2022

Online real-time characterisation solutions for nanoparticle production processes

#05

Content

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Welcome

Dear reader,

The NanoPAT project is glad to present our fifth 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 fifth 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!

NanoPAT is currently running its third year and so far we are very satisfied with the progress all the partners have made. In a technical aspect, all the three technologies have been successfully validated in the laboratory by our research organisations. Now we are moving towards the pilot scale validation incorporating the PAT systems into the lines of the five demonstrators participating in the project. On the other hand, our monitoring system is in its last phase of development and soon will be ready to communicate with all the PAT systems and other devices in the industrial field. As a last step, a further processing of data will take place using data fusion AI algorithms.

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,

Ioannis Kakogiannos,
Coordinator of NanoPAT

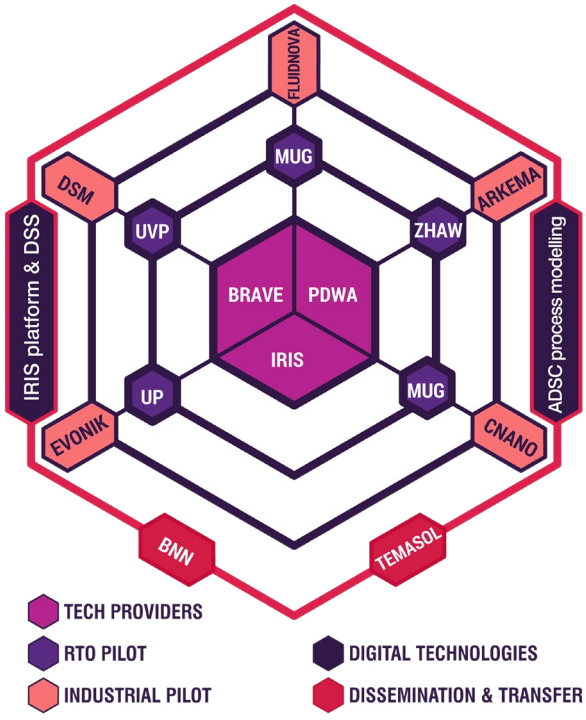
Project status

Since our last newsletter (issue #4 - May 2022), and thanks to a hardworking team, there have been plenty of activities within the NanoPAT project within the last 6 months.

The lab-scale validation 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. 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.

Within the last months the lab-scale validation (at the RTOs) was carried out. The end users are already preparing their pilot lines for hosting the prototypes, therefore, the technology providers (BRAVE, PDWA, IRIS) have been visiting the end users and RTOs for preparing the installation of the sensors. The upcoming step, within the next months, will be to proceed with the installation of the sensors at the end users facilities, i.e., the industrial pilot plant demonstration of the technologies. For this, the industrial pilot plants are currently being adapted to provide the needed technical prerequisites for the different monitoring devices (i.e., the corresponding PAT technology for each case study).

The PAT-Box software will be a platform integrating the three process monitoring technologies, deployed for both onsite and cloud infrastructures. Its latest developments in data hosting and visualisation are performing well.

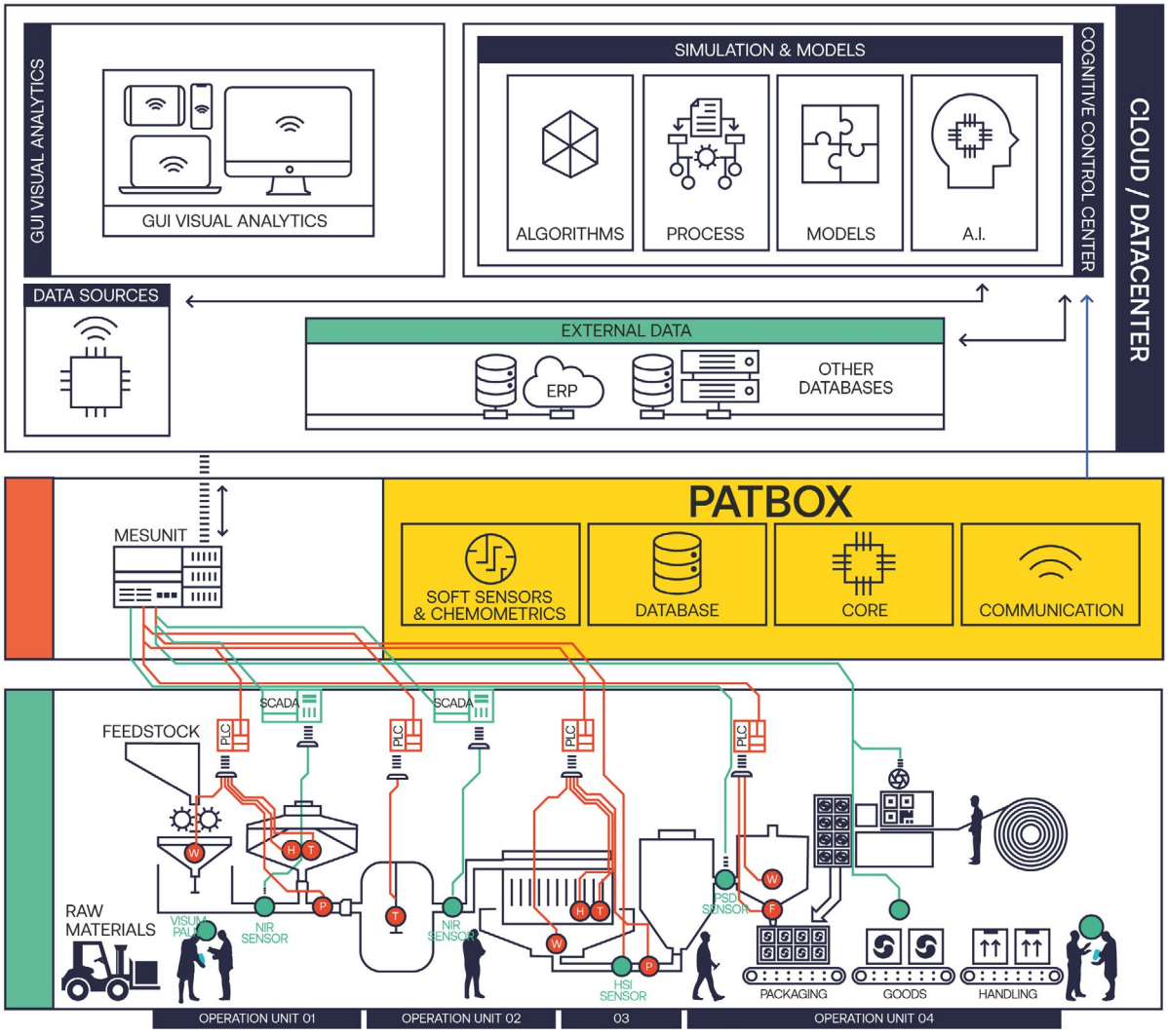


Overview of roles of the partners in NanoPAT

Additionally, a lot of activities have been carried out by BNN and TEMASOL towards collaboration with other EU funded projects with similar or supplementary focus (LightCOCE, HARMLESS). 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 first publication the Optofluidic Force Induction (OF2i) scheme for real-time determination of particle size distributions with high throughput.

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



Overview of the advanced monitoring system being developed within NanoPAT

Partner presentations

In this issue, we will present the project partners ANALISIS-DSC and Evonik.

About ANALISIS-DSC (ADSC)

ANALISIS-DSC is a Spanish SME engineering company, active in the areas of mechanics and industrial processes using advanced modelling tools. Since the foundation of the company in the year 2002, we have been working with over 160 customers for which we have developed over 240 engineering projects across almost all economic sectors. We have also been involved in R&D activities since the foundation of the company. We develop in-house R&D projects funded by our own resources. Additionally, we have been involved in European funded R&D programs since 2015. We have participated in 6 European H2020 and HE projects (IbD, DIY4U, ASTEP, NanoPAT, BioSPRINT, and DIVINE).

Specifically within the NanoPAT project, ANALISIS-DSC is the WP leader of the Modelling activities using CFD (Computational Fluid Dynamics) and Digital Platform Development to be designed and implemented by IRIS in collaboration with the technological measuring devices organisations (PDWA, IRIS, and Brave Technology) and the industrial partners (Fluidinova, Cnano, Arkema, Evonik, and DSM/Covestro).

Contact ADSC:

Juan Enriquez, Project manager for the ADSC participation in the project
www.analisis-dsc.com

About Evonik Industries AG (Evonik)

Evonik is one of the world leaders in specialty chemicals. The company is active in more than 100 countries around the world and generated sales of €15 billion and an operating profit (adjusted EBITDA) of €2.38 billion in 2021. Evonik goes far beyond chemistry to create innovative, profitable and sustainable solutions for customers. More than 33,000 employees work together for a common purpose: We want to improve life, today and tomorrow.

Evonik is a leading global manufacturer of silica. In addition to the fumed silica AEROSIL® and the precipitated silica ULTRASIL®, SIPERNAT®, ZEODENT® and SPHERILEX®, Evonik also produces silica based matting agents under the brand name ACEMATT® and other fumed metal oxides under the brand AEROXIDE®.

Overall, Evonik has a global production capacity for all silica-based products of about 1 million metric tons/year.

The important R&D centre for precipitated silica located in Wesseling, Germany, will take part in the NanoPAT project. The team consists of experienced chemists, process engineers and technicians and is able to provide a well-equipped lab and pilot plant for processes from several litres up to 1000 litres scale. The precipitation lays the groundwork for the properties of the end product, but until now we can determine them only offline. 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 be quicker and more effective and would open new insights in particle growth over the whole precipitation process. A reliable in-line particle size measurement would bear big potential for production and development.

Contact Evonik:

Thomas Pelster, Main contact
corporate.evonik.com

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 August 2022.

It demonstrates the **Optofluidic Force Induction (OF2i)** scheme for real-time determination of particle size distributions with high throughput. The setup is based on the principle of optical tweezers which was recently awarded the Nobel Prize in Physics (2018). In combination with a higher-order laser mode, this approach allows BRAVE and MUG to infer quantities such as particle size and concentration in a parallel manner by observing particle trajectories influenced by an excitation laser. [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]

In parallel with this paper, a **focus article** was published in the Physics magazine of APS physics in August 2022.

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:

- On 24th May 2022, the **UP team** visited the industrial plants of **COVESTRO**, where the PDW technology is to be implemented, in order to identify ways to set up the technology as well as potential technical / safety challenges. Read more about it **here**.
- Part of the team of **IRIS** visited **POLYMAT** in July 2022 to set up the dilution system sent from IRIS in order to on-line measure polymer particle sizes with the TUS sensor. Read more about it **here**.

Visit of UP at Covestro

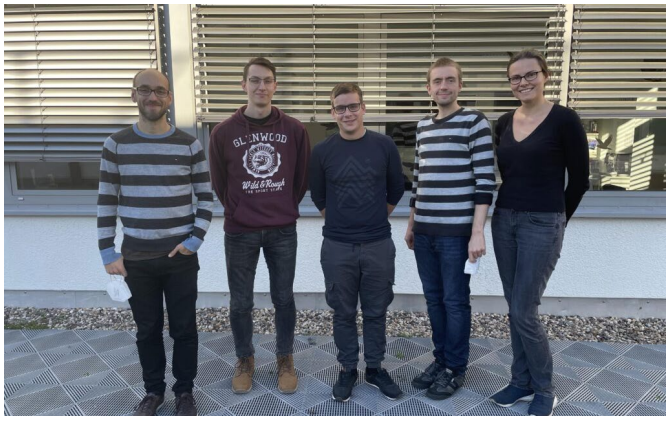
Visit of IRIS at POLYMAT

- In August 2022, the industrial partner **ARKEMA** visited the RTO pilot partner **ZHAW** to transfer their zeolite know-how to the Swiss team and to experience PDW spectroscopy in real life. Read more about it **here**.
- In September 2022, colleagues from the technology developer **BRAVE** visited the headquarters of the industrial partner **Cnano** in Athens to talk about the installation of BRAVE's technology (OF2i) at the industrial pilot plant aligned to the ceramics case study. Read more about it **here**.
- Some colleagues from **BRAVE** visited **Fluidinova's** facilities in Porto, in October 2022, to prepare the future installation of BRAVE's OF2i technology at the Fluidinova plant, which will be used for online quality control in the production of hydroxyapatite nanocrystals. Read more about it **here**.
- In October 2022, colleagues from **ZHAW** visited the facilities of **UP/innoFSPEC** for knowledge exchange, training and networking purposes, as well as to do some refractive index measurements related to the zeolites case study. Read more about it **here**.
- In November 2022, **IRIS** colleagues visited **UPV/POLYMAT** to continue working in the Dilution System for the Turbidity Spectrometry (TUS) sensor. Read more about it **here**.

Visit of ARKEMA at ZHAW

Visit of BRAVE at Cnano

Visit of BRAVE at Fluidinova



Visit of ZHAW at UP

Visit of IRIS at POLYMAT

Additionally, External Training & 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:

- Due to the increasing interest in real-time nanocharacterisation technologies, in October 2022, our technology developer BRAVE gave a talk on their OF2i technology to the **FELMI-ZFE** Institut für Elektronenmikroskopie und Nanoanalytik – Zentrum für Elektronenmikroskopie (Institute of Electron Microscopy and Nanoanalysis – Center for Electron Microscopy) at the Technical University of Graz. Read more about it **here**.
- In October 2022, the projects NanoPAT and the NMBP-01-2018 **LightCOCE** Open Innovation Test Bed met online to learn more from each other, exchange knowledge, and identify synergies and engagement points for joint collaborations. Read more about this **here**.
- In November 2022, BRAVE invited the partners of the EU funded project **HARMLESS** (NMBP-16) to their facilities in Graz to present them the NanoPAT project and the advantages of using their OF2i technology as online real-time characterisation solution for nanoparticle production processes. Read more about this **here**.

OF2i Seminar at FELMI-ZFI

Visit of HARMLESS at BRAVE

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:

- On 31st May 2022, BNN organised a webinar for the **BioNanoNet Gold Members**. The project partner MUG gave a presentation of the NanoPAT highlighting its own technology OF2i. Read more about it **here**.
- **13th Panhellenic Scientific Conference of Chemical Engineering (PESXM13)** (2-4 June 2022, Patras, Greece), where Cnano's team presented the project and highlighted their research on more sustainable electroplating methods. Read more about it **here**.
- **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 optimised. 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**.

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

- The project was presented in **Achema 2022** (22-26 Aug. 2022, Frankfurt, Germany) where BRAVE additionally talked about their OF2i technology.

- UPV organised 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**.

ACAC 2022

Industrial Liaison Program 2022

- 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**.

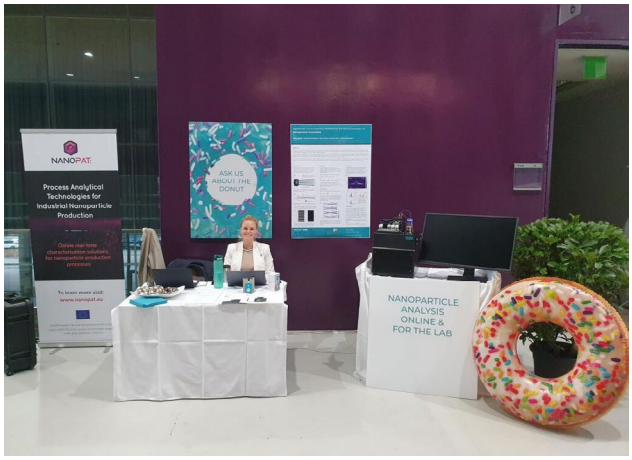
- NanoPAT partners couldn't miss the **17th PAT Colloquium** (19-21 Sept. 2022) on PAT technologies with a dedicated session on PATs, "PAT innovation: Novel real time PAT". In NanoPAT's presentations, BRAVE and UPV/POLYMAT showed the status of their developments in OF2i and PWD spectroscopy. Read more 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**.

- Cnano organised a **Citizen Engagement Event** (26 Sept. 2022) on plating technologies to promote the Safe-and-Sustainable-by-Design (SSbD) approach during the electroless and electroplating process implemented in NanoPAT. During the event, different types of coatings (Ni, Ni-P, Ni/SiC, Ni-P/SiC, precious metals) produced by Cnano were presented. Read more about it **here**.

- BNN had a very well visited booth at the **European Researcher's Night 2022** (30 Sept. 2022, St. Pölten, Austria) where the NanoPAT project was highlighted. Read more about it **here**.
- BRAVE had a very interesting booth at the **European Summit of Industrial Biotechnology 2022 (esib2022)** (14-16 Nov. 2022, Graz, Austria) where they presented the project, their OF2i technology, as well as their products, and where able to engage with potentially relevant stakeholders for industrial applications in biotechnology and pharma applications. Read more about it **here**.

European Researchers' Night 2022



esib2022

Upcoming Events

Have a look to the upcoming events where NanoPAT will be present:

- Polymer Reaction engineering Conference XI (ECI) (11-15 December 2022, Scottsdale, Arizona)
- EuroPACT 2023 (7-10 May 2023, Copenhagen, Denmark)
- nanoSAFE & NSC week 2023 (5-9 June 2023, Grenoble, France)
- International Polymer Colloids Conference 2023 (IPCG2023) (19-23 June 2023, Ontario, Canada)
- International Congress on Particle Technology 2023 (PARTEC2023) (26-28 Sept. 2023, Nuremberg, Germany)

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