NanoPAT Newsletter

June 2021

Online real-time characterisation solutions for nanoparticle production processes

#02

Content

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Welcome

Dear reader,

NanoPAT project is glad to present our second project newsletter with the main aim of sharing with you our latest technical achievements, introducing our innovative partners and sharing with the community inputs and curiosities related to nanotechnology and process monitoring.

In April 2021, Simona Neri left her role in NanoPAT as project coordinator. I have the honour to be her 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 wish 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 professionality on the approach of each case study.

At that point I would like to thank our ex-coordinator, Dr. Simona Neri, for her dedication to the project and wish her the best of luck for the future. She is leaving behind a healthy project and big expectations for us to fulfill.

In this second issue you will find an update of the project status. Furthermore, two of NanoPAT's project partners will be presenting themselves. Additionally, some aspects of the last months will be highlighted!

On behalf of the NanoPAT project I would like to thank you all for being interested in innovation and technology asking you to stay tuned during the next 3.5 years!

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.cat** and 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

The project is reaching its first year of life next month (June 2021). The previous year was a key period for the success of the project with a lot of activity and significant results in PDW, TUS and OF2i nano monitoring techniques. Technology providers, research technology organizations and demonstrators have worked together in order to prepare the transition from laboratory level to the industrial field for the validation of those techniques. At the same time, partners in the communication field are leading the way of dissemination of our activity in order for the work done to find its position in the industry.

For each of the three PDW cases (silica particles @ UP, zeolites @ ZHAW, polymers @ UPV), at least one industrial process has been successfully replicated in lab-scale at the corresponding RTO. UP and ZHAW have monitored the production processes with first online PDW spectroscopy measurements and are currently optimising the measurement parameters. The third PDW spectrometer for UPV is about to be completed and delivered to the POLYMAT team. Meanwhile, a PhD student from POLYMAT will visit UP over the month of June for training and networking purposes. ZHAW is currently looking to organise a similar exchange of one of their students at the UP.

Within the last months, BRAVE and MUG teams worked together with Cnano and FLUIDINOVA on downscaling their production to lab conditions. They succeeded to fully simulate the processes and offline characterization measurements, together with reference methods, were performed. Current online measurements are in progress. Furthermore, BRAVE's team optimized and adapted the OF2i hardware, software and underlying physical models to reach the next steps of full PAT simulation at TRL5 level.

IRIS in collaboration with UPV tested the laboratory level TUS setup with polymeric nanoparticles and proved that the system is capable of detecting their sizes. At the same time, IRIS is building and testing the RTO level TUS setup that will be sent to UPV at the end of May for extensive calibration. Additionally, IRIS is developing a dilution system that will allow the nanoparticle measurements even in the case of high solid content solutions.

Partner presentations

In this issue, we will begin presenting two of the academic partners, UP and BRAVE.

About Universität Potsdam (UP)

Founded in 1991, the University of Potsdam (UP) has developed from a small institution of higher education into one of the leading middle-sized universities in Germany. UP is now among the World's 250 Best Universities in the International THE Ranking. More than 21,000 young people (2019) study here at the largest university in the Federal State Brandenburg. UP has a total of around 2.800 employees, among them there are 317 professors. The University benefits from a close cooperation with the whole range of renowned non-university research institutes in the region. By combining its own research capacities with them, promoting international research cooperation as well as technology transfer and supporting promising young researchers, the UP permanently raises its national and international visibility. Among the seven UP faculties, the Faculty of Science, located in Potsdam-Golm, is the largest. The laboratories and research groups at the Institute of Chemistry cover all aspects of the chemical sciences. Research fields range from inorganic & organic to physical & theoretical, and polymer & colloid chemistry. Research within the physical chemistry (PC) section (Bald, Kumke, Löhmannsröben, Müller-Werkmeister) focuses – both on fundamental and practical levels – on photophysics & photochemistry, plasmonics, ultrafast molecular dynamics, optical & laser spectroscopy and process analysis. The groups play a leading role in, e. g., light scattering & photon density wave spectroscopy (PDWS), synthesis & characterization of hybrid nanostructures, multidimensional spectroscopy & imaging as well as optical process analytical technology.

With the infrastructure and knowledge about process analytical technologies (PAT) and the experience in measurement campaigns in cooperation with industrial partners, UP downscales the silica process from EVONIK to a lab scale. All offline analysis can be directly done in the labs of UP to improve the authenticity of the synthesis development. With the experience with Photon density wave spectroscopy and other inline techniques UP will not only synthesize silica nanoparticles, but also develop the PAT used in this process in close cooperation with PDW-Analytics. To date it was possible to transfer the industrial process into the labs of UP and receive first inline, real time PDW measurement data. We are looking forward to receiving the newly developed TUS technology later this year to further improve our knowledge about the synthesis process.

About BRAVE ANALYTICS (BRAVE)

BRAVE ANALYTICS

BRAVE ambitions

Every ambition starts with an idea. Ours started with the Nobel Prize winning fact that matter can be controlled with laser light. This awareness, combined with the background expertise that BRAVE Analytics brings to the table, has been changing particle characterization one nanometre at a time – many times. Biophysics, technical physics, medical technology, product design and computer vision have been a fruitful background during eight years of (translational) research, powered by heaps of motivation: This is the basis of the 2020 founded spin-off BRAVE Analytics of the Medical University of Graz (Gottfried Schatz Research Center – Biophysics). Since then BRAVE Analytics has been continuously optimizing and translating the patented technology OptoFluidic Force Induction (OF2i®) into robust sensors designed for continuous detection and characterization of nanoparticles in industrial applications.

The BRAVE aim is to provide sensor platforms capable of automated on-line, real time, 24/7 continuous, statistically relevant, number-based nano particle characterization directly integrable into the manufacturing processes.

The revolutionary principle of the OF2i® technology is based on a targeted (de)acceleration of nano-particles in liquids with the aid of laser light forces: The particles set in motion this way are captured by a special camera system, tracked and evaluated by software algorithms and physical models. Based on their movement patterns, statistically relevant properties such as particle size, number-based size distribution and concentration can be calculated. Given the continuous and parallel high throughput abilities of OF2i®, it can be implemented directly into the manufacturing process as an on-line real time PAT solution. The benefits: OF2i® offers much deeper and representative live insights into the nano world compared to conventional reference measurement methods.

The impact of this innovation is huge: Being still a bottleneck in production processes, the measurement and characterization of nanoparticles drastically gains relevance. Pharmaceutical & medical products, cosmetics, paper, paints, surface coatings, lubricants and many more can radically be optimized by applying nano principles. As an example, the efficacy of pharmaceuticals is fundamentally improved through precisely tuned nanoparticles: reduce side effects, improve uptake and bioavailability, enable selective targeting etc. To achieve the desired performance, crucial parameters such as size, concentration and if possible, the shape of nanoparticles must be carefully designed and monitored.

BRAVE Analytics went far already to fill the gap: The prototype OF2i® sensor B1 was tested, optimized and verified in various Life Science applicational areas. Within the Horizon 2020 EU project NanoPAT, collaborations with the biotech companies FLUIDINOVA and Creative Nano have been launched. Together with FLUIDINOVA, the BRAVE Team works on process control for wet-chemical production of nanocrystals (nano-hydroxyapatite) designed for the remineralization of tooth enamel or the treatment of

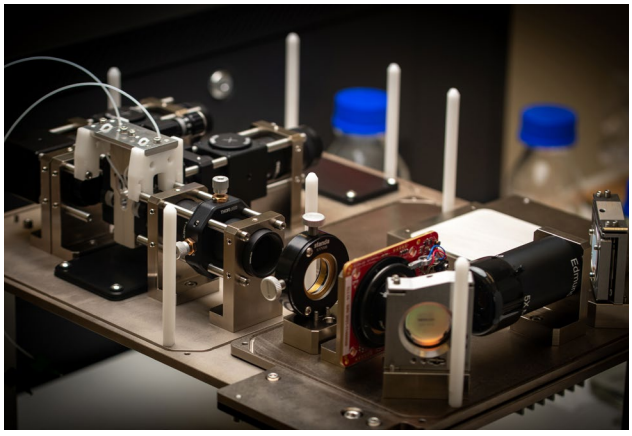
bone defects. Creative Nano is seeking solutions for reliable aggregation- and process control of nano-ceramic surface coating systems together with BRAVE Analytics, enabling low-friction, antibacterial, self-cleaning and chemically-inert surface properties of metals.

And the next step is already in preparation; the technology will be thoroughly tested in the first pilot plants with selected partners: Collaborations with the pharmaceutical group Fresenius Kabi and the bio-based Nanolignin producer Lignovations (a spin-off project of the TU Wien) will lead to the integration of our B1 sensors into their industrial production lines for real time monitoring of critical quality attributes.

All this became reality with the financial support of the spin-off fellowship grant program of the FFG funded by the Federal Ministry of Education Science and Research (BMBWF), the support of the European Commission NanoPAT project and the participation at the aws Preseed Program funded by the Austrian Federal Ministry for Digital and Economic Affairs (BMDW). Thanks to the support of the Medical University of Graz, the Center for Knowledge and Technology Transfer in Medicine (ZWT), the human.technology.styria (HTS) Health Tech Cluster and the BioNanoNet Association (BNN) as well as Styrian Business Promotion Agency (SFG), the Gründungsgarage of the Center for Knowledge and Innovation Transfer (ZWI) and the high-tech start-up incubator Science Park Graz, BRAVE Analytics is getting closer to its BRAVE vision “sample in – data out” every day.

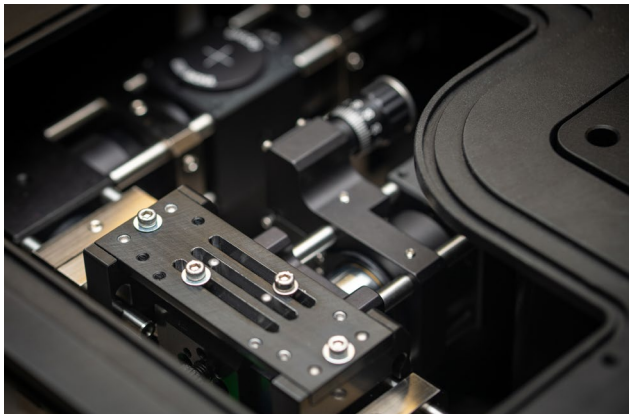
Highlights: OF2i industry proof prototype of BRAVE Analytics

Our new OF2i industry proof prototypes are getting built, tested and optimized for the different NanoPAT applicational areas in combination with our downscaled onsite reactors at the MUG facilities. Stability tests, offline validation and comparison to reference measurements together with improvements of our underlying physical modells are carried out. First fully automatized and remotely controlled PAT-measurements are on the way.



The vision of „sample in – data out“ on-line and in real time is already within reach.

For this, our Software H.A.N.S. 2.1 (High-throughput Analysis Nanocharacterisation Software) has been updated and reached prototype stage 2.1. It is currently being tested and evaluated. Lots of different sample analyzation features have been added experimentally, to explore and increase our OF2i applicational space. We are constantly adapting H.A.N.S. to reach our goal of stable real time online nano characterization process feedback. The platform provides an on-site data visualization suite, first remote access routines, basic data exchange and connectivity (OPC-UA, Modbus, MQTT, ethernet, USB, ...) interfaces.



NanoPAT News

During the coming months (June-August 2021) several consortium internal training activities will take place with the main aim of knowledge transfer and networking purposes within the context of the industrial case studies. For the PDW technology, a PhD student from POLYMAT will visit UP over the month of June and a similar exchange will be carried on by ZHAW with UP.

Assembly of BRAVE B1 prototype

Preparation of Cnano Samples by BRAVE

NanoPAT @ BNN Newsletter (March 2021)

Follow up – 1st Stakeholder Workshop on SSbD

Upcoming Events

EuroPACT 2021

NanoPAT will be on the EuroPACT 2021 - Do not miss the chance to meet us! More information coming soon, on our social media channels and on the project webpage!

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