



Press release

EU project "NanoHybrids" concluded

**Presentation of project results at PARTEC and POWTECH in Nuremberg on
9-11 April 2019**

In cooperation with well-known industrial partners, the European research project NanoHybrids has successfully developed production systems for organic aerogel particles and manufactured larger quantities of these novel materials for the first time. This represents an important step towards industrial mass production and application of particulate aerogels by the industrial and research consortium. Results and products will be presented to a specialist audience at PARTEC and POWTECH on 9-11 April 2019.

The success is the culmination of three and a half years of intensive work on particulate aerogels, their manufacturing processes and prototypes for industrial application coordinated by Professor Irina Smirnova of Hamburg University of Technology (TUHH) with BASF as industrial lead. It is not just the project partners who are delighted by the results; the review by European Commission technical experts was also very positive.

The material and the research goal

Up till now it was only possible to manufacture aerogel particles based on natural raw materials such as alginate, chitosan, cellulose or synthetic polymers as well as hybrid materials in small quantities in the laboratory. To upscale these materials from research to industrial applications, manufacturing processes have to be developed further to make industrially relevant quantities and prototypes possible. Back in June 2018, the first production system for aerogels in particle form was set up on the pilot scale of 50 l per



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batch in TUHH's technology centre. Following a positive optimisation phase it was then possible to manufacture alginate-based aerogel particles in larger quantities at BASF.

Aerogels exhibit a porous structure in the nanometre range and yet are not classified as nanomaterials under EU regulations. In line with its Safe by Design philosophy, however, industry partner BASF brought its nanotoxicology expertise to bear and ran orienting toxicological investigations on 22 of the project consortium's aerogel variants. The results suggest that the aerogels investigated are harmless.

The drying of the gel precursors, where the porous structure is first formed using a cross-linking reaction in a solution, to produce the desired aerogels represents a decisive process step. Special drying conditions are needed to carefully extract the solution from the gel precursors with supercritical carbon dioxide, so-called supercritical drying. Thanks to this drying phase, the aerogels retain their light, stable, three-dimensional network plus a large inner surface area and thus have wide application potential. Their low thermal conductivity means they are ideal for high-performance thermal insulation, for example, while their capacity to take up other substances predestines them for use as adsorption materials.

Supercritical drying of gel particles opens up a new field of aerogel research. At the beginning of the NanoHybrids project there was, for instance, no suitable mathematical model to describe the drying stage. The team from Koç University, MUCTR and TUHH have now closed this gap. In a combination of experiments and mathematical modelling, a model was developed that now predicts the drying time for given process conditions and gel properties. Describing heat and mass transport for porous aerogels represents a further challenge for manufacturing process development and optimisation on an industrial scale. Comprehensive multi-scale modelling for supercritical drying was thus developed as part of the project.



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The overall outcome is that it is now possible to predict and optimise the conditions for all production steps of the production of organic aerogel particles for upscaling to the industrial scale. The models were confirmed experimentally and not least by the successful pilot production runs at BASF. The next steps can now be planned more efficiently and with a higher chance of success.

Following project completion the first pilot-scale production system is ready for the development of the next generation of nanoporous organic and hybrid aerogels. The many conceivable applications for these ultra-light, porous solids, e.g. for the adsorption of gases and moisture, as food additives or in cosmetics, can now be tested industrially on a larger scale.

The research project

In the past 42 months 12 European partners from universities, research institutes and industry have been working together on the project.

In addition to TUHH as coordinator, the NanoHybrids research partners are the German Aerospace Centre (DLR Cologne), Koç University in Turkey, ARMINES in France, the National and Kapodistrian University of Athens and MUCTR in the Russian Federation. Industrial partners, between them representing the complete value chain, are BASF Polyurethanes GmbH, BASF SE, Dräger Safety AG & Co. KGaA, Arçelik A.Ş., Nestlé and RISE Bioeconomy.

The project is funded under Horizon 2020, the biggest European research and innovation programme. Horizon 2020 is the EU Framework Programme for Research and Innovation. The goal of the funding programme is to build a science and innovation-based society and a competitive economy throughout the EU while contributing to sustainable development.

Conference and trade fair



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On 11 April 2019 the EU project NanoHybrids will be presenting its results on the international stage at the PARTEC scientific congress, split into eight presentations during one session. Specialist visitors from industry and science can examine the aerogels produced at the parallel trade fair POWTECH and explore the potential for their application with the consortium partners. The NanoHybrids stand is in Hall 3, stand 408.

The theme of PARTEC 2019, the international congress on particle technology, is "Particles for a better life". It will be chaired by Professor Stefan Heinrich of TUHH.

Professors Heinrich and Smirnova cooperate closely at TUHH on developing particles for industrial applications, especially in the food industry. While Professor Heinrich specialises in solids process engineering and particle technology, Professor Smirnova and her team are experts in the supercritical drying of aerogels.



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Further information and pictures:

<https://tutech.de/oc/index.php/s/jegXastBYHZP68w>

<http://www.nanohybrids.eu/>

<https://www.tuhh.de/v8/home.html>

www.corpus-magazine.com

<http://www.pu.basf.de/>

<https://www.partec.info/>

<https://www.powtech.de/>

<http://ec.europa.eu/programmes/horizon2020/>

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ATTACHMENTS

Background information:

Aerogels - highly porous materials: Aerogels are a fascinating class of nanoporous materials that exhibit a wide array of extreme and unique materials properties. Aerogels have traditionally been obtained through a combination of sol-gel technology and supercritical drying. However, in recent years numerous new compositions and processes have made possible a wide range of amazing new materials and applications. As a result the importance of aerogels has increased significantly worldwide. Their many uses include insulation for buildings and oil pipelines, lightweight structural materials, aerospace, adsorbents and catalysts, capacitors and batteries.

The Institute of Thermal Separation Processes is part of the "Process and Chemical Engineering" school of study at Hamburg University of Technology. The institute's research includes experimental and theoretical work on the following topics:

- High-pressure engineering
- Supercritical fluids
- Thermodynamics of biologically relevant systems
- Downstream processes

Professor Smirnova has been head of the institute since 2008. In the course of her scientific career she has worked at the University of St Petersburg, TU Berlin, University of Erlangen-Nuremberg and Sogang University in South Korea.

The goal of the EU project "NanoHybrids - New generation of nanoporous organic and hybrid aerogels for industrial applications: from the lab to pilot scale production" is to develop a pilot-scale production system for novel aerogels and test potential industrial applications. It is funded under Horizon 2020, the biggest EU research and innovation



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programme, as one of a series of projects charged with bridging the gap between nanotechnology research, pilot-scale production and markets. The Institute of Thermal Separation Processes led by Professor Smirnova coordinates the project with the support of Tutech Innovation GmbH, a TUHH subsidiary.

In addition to TUHH (Institute of Thermal Separation Processes), the project involves well-known industry partners and research institutes, in particular BASF Polyurethanes GmbH, BASF SE, Dräger Safety AG & Co. KGaA, Nestlé and the German Aerospace Center (DLR Cologne). The project brings together a total of 12 international partners.

Horizon 2020 is the EU Framework Programme for Research and Innovation. The goal of the funding programme is to build a science and innovation-based society and a competitive economy throughout the EU while contributing to sustainable development.

About BASF's Performance Materials division

The Performance Materials division brings together BASF's entire materials know-how regarding innovative, customised plastics under one roof. Active in four major industry sectors - transportation, construction, industrial applications and consumer goods - the division has a strong portfolio of products and services combined with a deep understanding of application-oriented system solutions. Chief profitability and growth drivers are our close cooperation with clients and our clear focus on solutions. Strong R&D skills are the basis for developing innovative products and applications. In 2017 Performance Materials division's global sales were €7.7 billion.



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About BASF

BASF creates chemistry – for a sustainable future. We bring together commercial success, care for the environment and social responsibility. More than 115,000 staff in the BASF Group are working to contribute to the success of our clients from nearly every sector and almost every country worldwide. Our portfolio is structured in six segments: Chemicals, Materials, Industrial Solutions, Surface Technologies, Nutrition & Care und Agricultural Solutions. In 2017 BASF generated global sales of over €60 billion. BASF is listed on the Frankfurt (BAS), London (BFA) and Zurich (BAS) stock exchanges. Further information: www.basf.com.



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