CATRIN

Czech Advanced Technology and Research Institute

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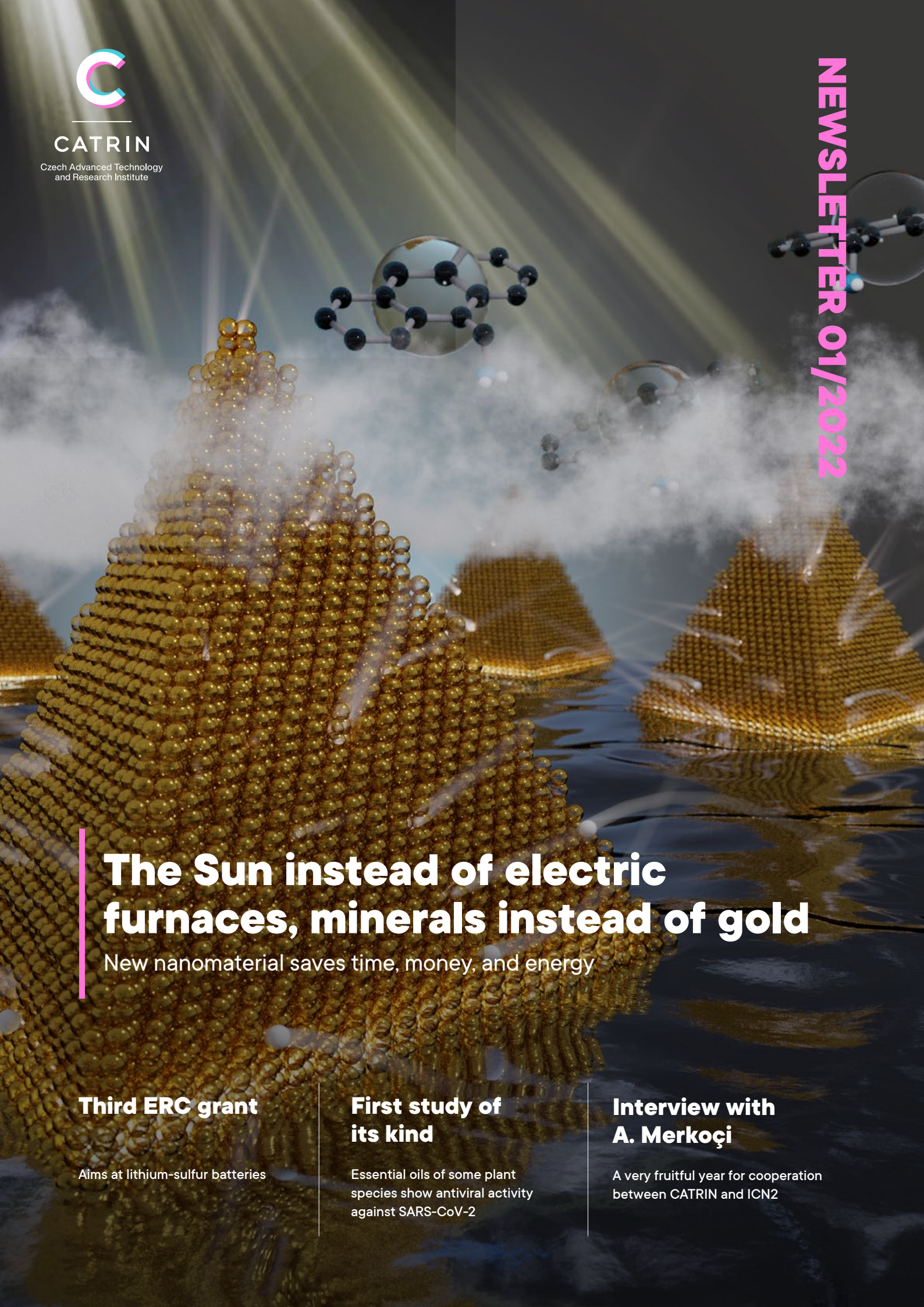


The Sun instead of electric furnaces, minerals instead of gold

New nanomaterial saves time, money, and energy

Third ERC grant

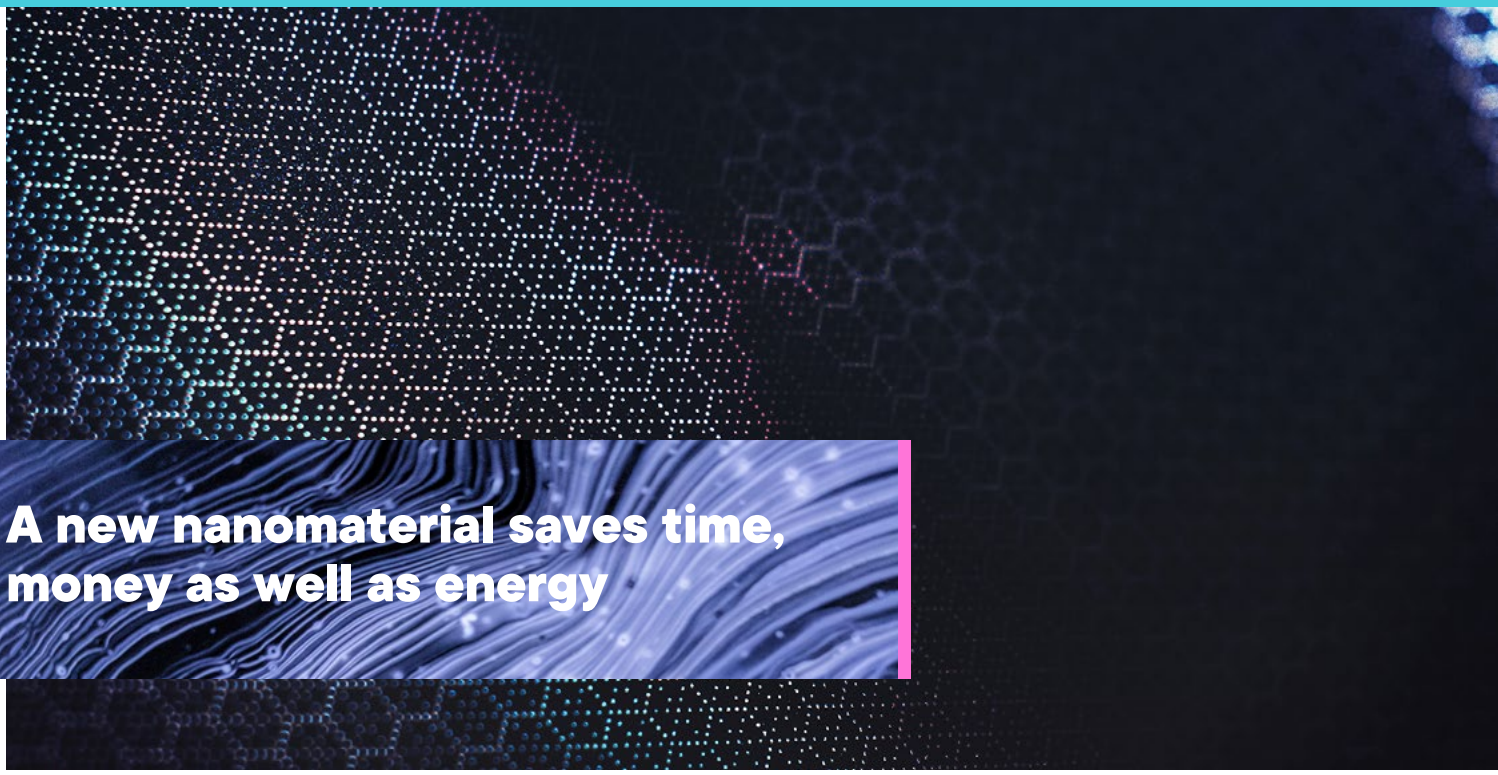
Aims at lithium-sulfur batteries

First study of its kind

Essential oils of some plant species show antiviral activity against SARS-CoV-2

Interview with A. Merkoçi

A very fruitful year for cooperation between CATRIN and ICN2



A new nanomaterial saves time, money as well as energy

The production of various pharmaceuticals, agrochemicals, plastics or dyes can be accelerated and made cheaper using a nanomaterial developed by scientists from the CATRIN of Palacký University

The nanomaterial's composition resembles that of common naturally occurring minerals, but it can replace currently used noble metals, needing only solar radiation as an energy source. This discovery was recently published in the journal Nature Nanotechnology and foreign investors have already shown interest in the material.

"In the current geopolitical situation and the related energy crisis, the European Union has no choice but seek ways to reduce the costs of industrial production and make maximum use of new green technologies so we can end our dependence on energy and raw material resources from Russia," said Radek Zbořil, Scientific Director of CATRIN-RCPTM and Head of the Materials-Envi Lab at CEET.

A team of Czech researchers alongside colleagues from the FORTH scientific institute in Heraklion (Greece) and the Leibniz Institute for Catalysis in Rostock (Germany) studied the industrial chemical synthesis of aniline compounds, which are widely used in the production of pharmaceuticals, plastics, dyes, and agrochemicals. Current industrial procedures for the synthesis of these compounds are very costly, energetically and financially, because they require high temperatures and pressures as well as the acceleration of the chemical reaction using catalysts made of noble metals such as gold, palladium, or platinum.

"The new technology is based on nanoparticles of chalcopyrite, a common iron-, copper-, and sulfur-based mineral found not only in the Czech Republic but also in many other locations in Europe, America, and Africa. This nanomaterial is cheap, can be easily produced on an industrial scale, and accelerates chemical reactions more efficiently than the mentioned noble metals, using only solar radiation," said Zbořil, describing the advantages of the new technology.

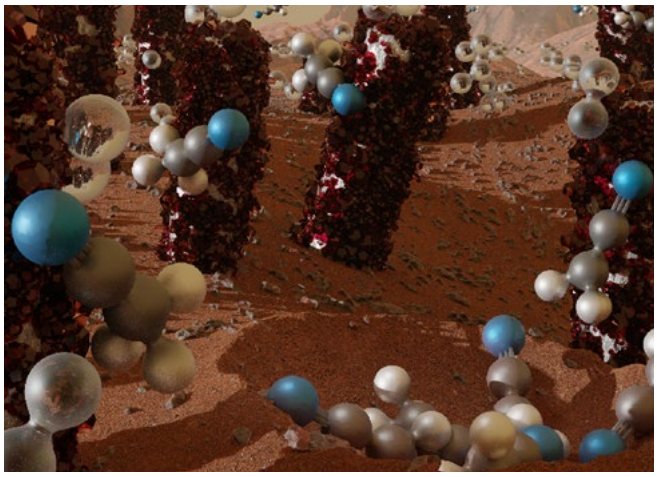
> The nanomaterial is cheap, can be easily produced on an industrial scale, and accelerates chemical reactions better than currently used noble metals, using only solar radiation.
>
> **Radek Zbořil**

Outstanding results were obtained when the new system's efficiency was compared to that achievable with dozens of commercial materials and recently reported catalysts. "The production rate relative to the price of the material is an order of magnitude higher than that of the best competing technologies. Experimentally and theoretically, we have demonstrated that this high efficiency is due to, among other things, the electronic structure of the nanomaterial, which harmonically matches that of the reaction's other components," added Bakandritsos.

Professor Zbořil's team has capitalized on the recent discovery of a catalyst based on iron nanoparticles (Nat. Catal. 5, 20-29, 2022). "Both materials show high efficacy in related pharmaceutical and chemical production processes. However, the new plasmonic material operates on a different principle and has, in our opinion, greater commercial potential, including a dramatic reduction in energy costs, unprecedented efficiency, easy and cheap production, and an elegant technological solution. Therefore, before publishing our findings, we decided to protect the technology with an international patent application. This was the right step, and we are already negotiating industrial applications of the technology with potential investors, especially in Germany," concluded Zbořil.

Poulose A. Ch., Zoppellaro G., Konidakis I., Serpetzoglou E., Stratakis E., Tomanec O., Beller M., Bakandritsos A., Zbořil R.: Fast and selective reduction of nitroarenes under visible light with an earth-abundant plasmonic photocatalyst, Nature Nanotechnology 2022, 17, 485–492.
IF = 41.813

A cheap and non-toxic catalyst resembles the surface of Mars



An effective, cheap, and eco-friendly nanomaterial that can accelerate and reduce the cost of industrial production of many important pharmaceuticals and chemicals has been prepared by scientists from CATRIN, VSB-TUO, and the Leibniz Institute for Catalysis in Rostock, Germany. The new hydrogen catalyst relies on iron and silica—widely available, non-toxic, and cheap materials. The discovery was reported in the journal Nature Catalysis.

The team's research focused on the production of various chemicals used in the pharmaceutical, agricultural, petrochemical, or food industry by so-called hydrogenation, i.e., reactions with molecular hydrogen. A catalyst is needed to accelerate these reactions and obtain high yields. Current industrial processes rely heavily on noble metal catalysts, which are costly, or nickel catalysts, which are toxic. The goal was therefore to develop a material that would make the conversion of organic compounds cheaper and more efficient.

One of the corresponding authors, Professor Radek Zbořil, described the material by saying that "Thanks to its chemical composition and topography, the material we developed can be likened to the surface of Mars, but on a much smaller scale. Rod-like iron nanoparticles are grown from a quartz mass, forming crater-like structures on the catalyst surface. These iron nanoparticles are coated in a multi-nanometre shell of iron oxide, which seems to be crucial for obtaining a high amine yield. Equally important is the presence of small amounts of aluminium."

"It's an almost magical nanomaterial in which all components have a defined role. I believe that this joint work could have a major impact on the global effort to find an industrially usable low-cost catalyst that can replace widely used noble metals and will also work in other important reactions involving molecular hydrogen," concluded Matthias Beller, who is the German Team Leader and Director of the Leibniz Institute for Catalysis in Rostock. The material can be reused and is extremely effective in the synthesis of diverse amines.

Chandrashekhar V. G., Senthamarai T., Kadam R. G., Malina O., Kašlík J., Zbořil R., Gawande M. B, Jagadeesh R. V., Beller M.: Silica-supported Fe/Fe–O nanoparticles for the catalytic hydrogenation of nitriles to amines in the presence of aluminium additives. Nature Catalysis 2022, 5, 20-29. IF = 41,813

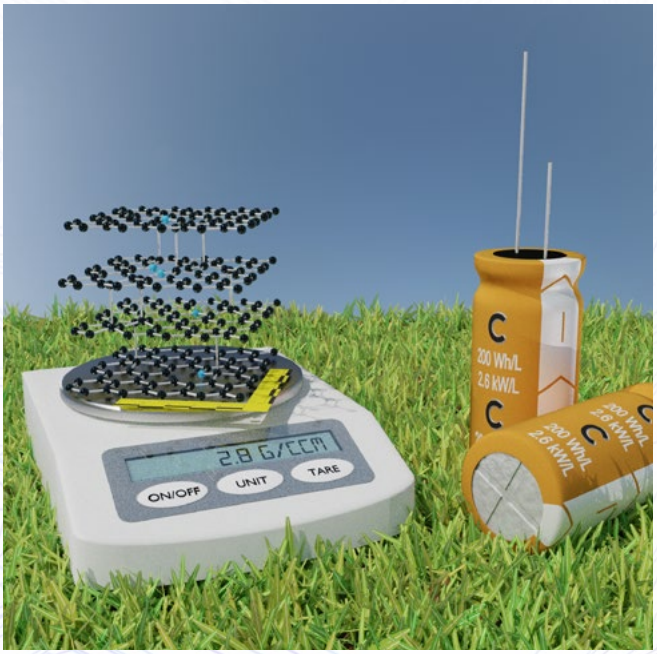
Nitrogen-doped graphene suitable for use in supercapacitors

Nitrogen-enriched graphene developed by CATRIN scientists is proving to be a very promising electrode material for supercapacitors. Its benefits were reported in the journal Energy & Environmental Science.

Researchers prepared nitrogen-doped graphene for supercapacitors using fluorographene chemistry. "The material has high density, which, combined with its ability to adsorb ions from the electrolyte, leads to a volumetric energy density significantly greater than that achievable with any previously described carbon- or graphene-based supercapacitor material," said Michal Otyepka, the Principal Investigator of three European Research Council (ERC) grants focusing on the development and potential application of new 2D materials.

"The new material can be prepared from graphite fluoride, an industrial lubricant available on tonne-scales, which increases its potential commercial availability. At the same time, we took great care to make the resulting components as environmentally friendly as possible, which we achieved by choosing the electrolyte in the supercapacitor," added the main author Veronika Šedajová, who is also a co-author of a recently granted European patent protecting the material. The next step in the development will be to build prototypes of the supercapacitors in cooperation with international partners.

The research result is another response to the global demand for electrochemical energy storage facilities with better performance, higher safety, lower costs, and reduced environmental impacts. Carbon-based supercapacitors offer long life, ultra-fast charging and discharging, and high safety.



Šedajová V., Bakandritsos A., Błoński P., Medveď M., Langer R., Zaoralová D., Uggoloti J., Dzíbelová J., Jakubec P., Kupka V., Otyepka M.: Nitrogen doped graphene with diamond-like bonds achieves unprecedented energy density at high power in a symmetric sustainable supercapacitor. Energy & Environmental Science 2022, 15, 740-748. IF = 38.532

Analyses of insect DNA change perceptions of biodiversity

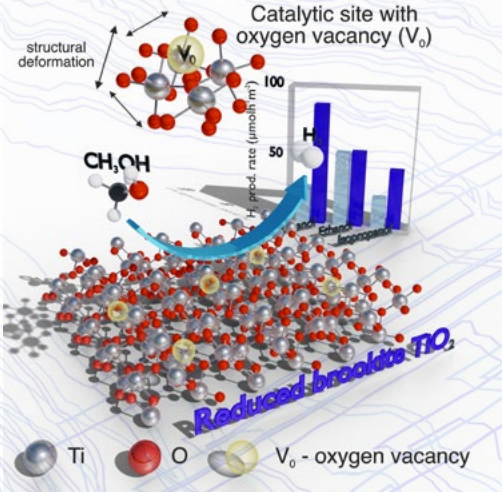
A new perspective on species diversity and endemism in the tropics has been provided by a method based on large-scale genetic analyses of insects. CATRIN zoologists used this new method to examine samples from over 800 sites in Asia, Africa and Australia and found around 2,000 species in a single group of beetles, half of them previously unknown. Their method, which is based on validated data, makes it possible to obtain information needed for conservation more quickly and at lower cost than conventional methods. Their findings were published in the British journal eLife.

„Knowledge of biodiversity is needed to establish a baseline and set priorities for conservation. Estimates suggest that we have identified between a quarter and a tenth of all animals, with insects making up around two-thirds of the fauna. About 400,000 species of beetles have been described so far, but the actual number of species is estimated to be over one million. Insects are rarely examined in large-scale biodiversity studies; conservation management usually relies on the less diverse but more studied birds and mammals. It is therefore essential to use innovative methods to speed up the cataloguing of insects. DNA-based monitoring is an appropriate way forward," said Ladislav Bocák, Leader of CATRIN's Biodiversity and Molecular Evolution research group.

The Olomouc team combined data from next-generation sequencing and traditional mitochondrial DNA markers to rapidly monitor the biodiversity of one group of beetles. They collaborated with the Czech Academy of Sciences, which has a research base in New Guinea, and with colleagues from the Natural History Museum in London.

Motyka M., Kusý D., Boček M., Bílková R., Bocák L.: Phylogenomic and mitogenomic data can accelerate inventorying of tropical beetles during the current biodiversity crisis. eLife 2021, 10, 71895. IF = 8,14

New photocatalyst boosts green hydrogen production



A new photocatalyst based on a less-studied crystalline form of titanium dioxide could increase green hydrogen production via a photoreforming process involving the specific conversion of alcohols from biomass. Behind its development is an international team of scientists from CATRIN, the University of Trieste, the Elettra Sincrotrone Research Center, and the Istituto di Struttura della Materia-CNR (ISM-CNR). The project's results were published in the journal Chem Catalysis.

"Among the many hydrogen production technologies that compete with the prevailing technology based on thermal reforming of methane, the photoreforming of water and alcohols derived from biomass waste is of paramount importance. It could enable greater production of hydrogen than would be possible using traditional water splitting alone as well as allowing the conversion of waste chemical compounds into value-added

products," said one of the article's authors, Alberto Naldoni. In an article in Chem Catalysis, the authors showed how the accurate atomic engineering of defects in photocatalysts allows increased oxidation of alcohols from biomass while increasing the production of green hydrogen in the photoreforming process.

"The current war in the Ukraine and Europe's dependence on energy resources from Russia clearly shows that we urgently need new sources of sustainable fuels. Our results are clearly helpful in this respect. We have shown that catalytic processes driven by sunlight can efficiently produce hydrogen from sustainable and cheap resources that are already integrated into the industrial production cycle, such as chemicals made from biomass," explained another author, Michal Otyepka.

Hejazi Hossein S. M., Shahrezaei M., Błoński P., Allieta M., Sheverdyaeva P. M., Moras P., Baďura Z., Kalytchuk S., Mohammadi E., Zbořil R., Kment Š., Otyepka M., Naldoni A., Fornasiero P.: Defect engineering over anisotropic brookite toward substrate-specific photo-oxidation of alcohols. Chem Catalysis 2022, 2, 1177-1190.

A study proved the activity of certain plant essential oils against the novel coronavirus

A study recently published in Frontiers in Pharmacology by authors from CATRIN showed that essential oils of some plant species from the Lamiaceae family show notable antiviral activity against SARS-CoV-2. These findings could be used in the future to combat this type of coronavirus.

„Our study is the first reported in vitro analysis of the activity of 19 different essential oils and their monoterpene components from plant species of the Lamiaceae family against SARS-Cov-2. We showed that essential oils from different species of the genus Mentha and their monoterpene constituents carvone, carvacrol, pelugone, menthofuran, and 1,8 cineol exhibit notable antiviral activity against SARS-Cov-2," said the paper's first author Sanja Ćavar Zeljković from CATRIN-CRH, who also works at the Olomouc site of the Crop Research Institute.

The cooperation that produced this paper will continue beyond its publication; Zeljković said that "colleagues from CATRIN-IMTM also tested essential oils for their anti-cancer effects. In addition, we are planning to use different extracts from cannabis to investigate their different biological activities. We will also involve our students in this research".

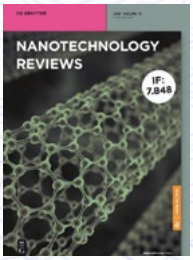
Ćavar Zeljković S., Schadich E., Džubák P., Hajdúch M., Tarkowski P.: Antiviral Activity of Selected Lamiaceae Essential Oils and Their Monoterpenes Against SARS-Cov-2. Frontiers of Pharmacology 2022, 13, 893634. IF = 5,810

Our Recent Reviews

A. Mičúchová, V. Piačková, I. Frébort, T. Korytář

„Molecular farming: Expanding the field of edible vaccines for sustainable fish aquaculture",

Reviews in Aquaculture 2022, 1-24. IF = 10.592



L. Giri, S. Rekha Rout, R. S. Varma, M. Otyepka, J. Kolleboyna, R. Dandela

„Recent advancements in metal–organic frameworks integrating quantum dots (QDs@MOF) and their potential applications",

Nanotechnology Reviews 2022, 11 (1), 1947–1976. IF = 7, 848

Arben Merkoçi from the Catalan Institute of Nanosciences and Nanotechnologies in Barcelona is one of the world's leading experts in sensor science. He started collaborating with CATRIN researchers several years ago and, as he says, this working relationship has evolved into friendship. Finding a common "scientific language" with Olomouc colleagues has proven very easy, as demonstrated by a number of joint publications and grants, among other things.

This year has been very successful for CATRIN and ICN2

Can you briefly introduce the research group you are leading in ICN2?

The research group I lead at ICN2 in Barcelona is working on the design and application of cutting-edge nanotechnology- and nanoscience-based cost-efficient biosensors. We focus on sustainable paper-/plastic-based nanobiosensors that integrate biological molecules (DNA, antibodies, cells, and enzymes) and other (bio)receptors with micro- and nanostructures/motors and their applications in diagnostics, environmental monitoring or safety, and security.

You have been collaborating with CATRIN, resp. RCPTM, for some time. How did this collaboration start?

My collaboration with CATRIN (resp. RCPTM) began long ago—it started when I met Michal Otyepka at a graphene conference in China, which led to a research visit by a postdoc from Olomouc, Petr Jakubec. I subsequently joined the international Scientific Board of RCPTM, now CATRIN, which has allowed me to get to know other great people including Radek Zbořil, the former RCPTM Director, and Pavel Banáš, the current CATRIN Director. Michal and Radek recently visited our centre and gave talks there; we were delighted to welcome them to Barcelona. Our collaboration and friendship is now anchored and I am very happy that we are going to foster it.

What have you succeeded in so far and in what areas is the collaboration most advanced?

My group has been collaborating with Michal's to integrate graphene materials into biosensing systems. Nanobiosensors have potentially important applications in healthcare, environmental management, food quality control, security, and other industries, and have therefore become quite a hot topic. However, they still need improvement in terms of their detection limits and selectivity, among other things. Expertise in preparing advanced graphene derivatives is therefore extremely valuable in the development of our technologies. My colleagues Ruslan Alvarez, who leads graphene activities in our group and with whom I co-coordinate two EU projects in collaboration with CATRIN, and Giulio Rosati, who leads our ink-jet printing projects, are already planning a very interesting cooperation with Michal's group, taking advantage of the recent visit of David Panáček, a PhD student from CATRIN.

Which common achievements do you value most?

Our cooperation has already produced very nice results. Thanks to the visit of David Panáček and his collaboration with Jose Flausino, a former group member and now postdoc at CATRIN, we created the first label-free and reagentless electrochemical genosensor based on graphene acid for detecting meat adulteration (published in Biosensors and Bioelectronics). Another two interesting results that we have achieved together relate to the detection and removal of heavy metals; these findings will be published soon.

You were one of the leading personalities who contributed to the signing of the Memorandum of Understanding between CATRIN and ICN2. What are your hopes for this partnership?

The MoU that the directors of both centres signed this month at the end of the workshop we held in Barcelona will open the door to many other collaborations between ICN2 and CATRIN. Colleagues from both institutions have identified new interesting areas for collaboration including energy-related devices, advanced graphene structures, and other nanomaterials that my colleagues at ICN2 are working with. These collaborations will be initiated in the near future.

This year alone, the collaboration between CATRIN and your research group has produced two large European projects and three mutual publications. It seems like you have a lot of work still ahead of you...

This year has actually been very successful for both of our centres. We have succeeded in obtaining two large joint European projects. The first one is GLEBioassay, a EuroNanoMed III project, in which we will collaborate with CATRIN as well as a hospital in Barcelona and a company in Turkey to develop a very interesting device for cancer diagnostics and therapy studies. The other is a Twinning project, SUSNANO, which we won together with the University of Tirana (UT, Prof. Majlinda Vasjari coordinator of SUSNANO) and a Belgian company. SUSNANO will strengthen the research and networking capacity of UT through a series of interesting activities in the coming three years. We will work together to develop sustainable biosensing platforms for detecting heavy metals, pesticides, and so on, and these devices will then be used by our colleagues in Albania to monitor contaminated waters.

Besides the aforementioned projects, do you have any further mutual plans?

Of course, we are also planning new collaborative projects in the framework of European programmes that will allow us to explore further synergies between our centres. Our work with CATRIN is a collaboration between great centres, great countries, and outstanding people, so I am certain that it will produce many more exciting results in the years ahead.

Prof. Arben Merkoçi

Professor Merkoçi obtained his doctorate at the University of Tirana (Albania) in the field of ion-selective electrodes and subsequently worked as a postdoc and senior scientist or visiting professor in the field of nanobiosensors and laboratory technologies in Italy, Spain and the USA. He has been at ICN2 (the Catalan Institute of Nanosciences and Nanotechnologies) since 2006 and currently serves as a professor at ICREA and Director of the Nanobioelectronics & Biosensors group at ICN2 in Barcelona, which is part of the Barcelona Institute of Science and Technology (BIST). He is also a member of the Albanian Academy of Sciences and Director and Coordinator of NANOALB (www.nanoalb.al), a regional network for nanosciences and nanotechnologies.

He has published around 310 peer-reviewed scientific articles (H-index: 74 WOS; 86 GS), supervised about 30 doctoral students and delivered around 200 invited lectures, including plenary and keynote talks, in various countries around the world.

Prof. Merkoçi is also a co-editor of Biosensors and Bioelectronics (Elsevier), a major international journal in his field, and co-founded the spin-off companies PaperDrop and GraphenicaLab.

Third ERC grant aims to develop lithium batteries with sulfur

The physical chemist Michal Otyepka has been awarded a third grant by the European Research Council (ERC). After obtaining Consolidator and Proof of Concept grants in 2016 and 2020, he won funding last year for another project aiming to support the translation of research results into practice. He and his colleagues will aim to prepare practically useful quantities of a nanomaterial based on fluorographene and, in cooperation with a commercial partner, verify its applicability in lithium-sulphur batteries.

The electrode material used in this project has been developed by exploiting the team's rich experience with so-called 2D chemistry, which has given them a deep understanding of the chemical rules of the two-dimensional world of ultra-thin carbon nanomaterials. In this project they developed a simple method that was used to prepare a new sulfur-modified graphene derivative on a laboratory scale. This material and its preparation are described in a patent application that has been submitted to the European Patent Office.

"This simple method could be very effective for the production of lithium-sulfur batteries with high performance and stability as well as long life. We have demonstrated these properties on a laboratory scale. I am very glad that the ERC Proof of Concept grant will allow us to improve the production process and verify the material's capabilities through industrial testing in commercial facilities. I also view the project as recognition of the results achieved by the CATRIN team in the field of graphene derivatives," said Otyepka. The one-year project won financial support of 150,000 euros.

A prestigious EIC grant to develop a supercapacitor

A prestigious European Innovation Council (EIC) Transition Challenges grant has been awarded to CATRIN researchers working with colleagues from Bar-Ilan University in Israel and the Italian company ITELCOND. This grant, which is the first of its kind to be awarded in the Czech Republic, will support the fabrication of a prototype high-capacity and nature-friendly supercapacitor for storing electrical energy. The scientists will use a graphene-derived material developed in Olomouc that is protected by a European patent.

"The nitrogen-doped graphene we have developed has great potential for use in supercapacitors. It is denser than graphite and has a very high capacity for adsorbing ions from the electrolyte, enabling the fabrication of supercapacitors with a much higher volumetric energy density than devices using other known carbon- or graphene-based supercapacitor materials. This has led to breakthrough advances in supercapacitor performance," said the team's leader, Michal Otyepka.

"The EIC Transition Challenges grants are highly prestigious, and to be awarded one at the first attempt is a significant accomplishment. Our satisfaction is enhanced by the fact that, like the ERC Proof of Concept grant previously won by Professor Michal Otyepka, this is the first grant of its kind to be awarded to a researcher working in the Czech Republic. Winning two ERC grants followed by an EIC project clearly shows that

Professor Otyepka is an outstanding scientist doing research of international excellence," added CATRIN Director Pavel Banáš. CATRIN will coordinate this project and is the only institution playing such a role in the Czech Republic and the so-called Widening countries (which include the EU member states that acceded after 2004). The grant provides almost 2.5 million euros of funding.

A new sensor for neuroblastoma immunotherapy

CATRIN researchers working with colleagues from Spain and Turkey are developing a device to monitor the effectiveness of treatments for the childhood cancer neuroblastoma, with support from a three-year European grant that was awarded in the Czech Republic under the EuroNanoMed 2021 call of the Technology Agency of the Czech Republic. The Olomouc scientists are drawing on their long-standing expertise in preparing graphene derivatives

Neuroblastoma is the most common cancer in children and can develop during the first year of life. Its survival rates are currently below 40 %. Immunotherapy-based treatments have recently made huge advances, but their effectiveness is hampered by the appearance of

so-called HAHA antibodies in the human body. While these antibodies can be detected using enzyme immunoassays (ELISA), this method is time-consuming and complex, requiring trained staff and expensive laboratory equipment. These disadvantages could be overcome using new graphene-based sensors based on the principle of paper electrophoresis. The Olomouc group was invited to join the multidisciplinary international project team by Arben Merkoçi of the Catalan Institute of Nanoscience and Nanotechnology in Barcelona, a world leader in the field of sensors and the project's coordinator.

"Our role in this project will be to develop new graphene derivatives. The choice of a suitable graphene derivative is essential for the sensor's design," said Michal Otyepka, the head of the Olomouc team. The research will be conducted in cooperation with the Turkish biotechnology firm Nehir Biyteknoloji Ltd. and the Spanish organization Fundació Sant Joan de Déu (FSJD), which provides neuroblastoma treatment.

A total of 43 Czech applicants engaged in 35 research projects submitted proposals to the international EuroNanoMed Call in 2021, which focused on research in the field of nanomedicine. The Technology Agency of the Czech Republic (TA CR) will support three successful Czech teams.

The first observation of a sigma hole scooped the Werner von Siemens Prize

The Werner von Siemens Award 2021 for 'the most important basic research result' was won by a young team of researchers at CATRIN of Palacký University Olomouc and the Czech Academy of Sciences led by Bruno De la Torre. These young researchers won the prize for their ground-breaking imaging method, which allowed them to make the world's first observation of the inhomogeneous distribution of electron charge around a halogen atom, the so-called sigma hole. As a result, they definitively confirmed the existence of sigma holes, which was theoretically predicted 30 years ago.

The award-winning team behind this extensive interdisciplinary collaboration includes Benjamin Mallada Faes, Aurelio Gallardo, and Maximilián Lamanec. The imaging technique used in the project, raster microscopy, was used a few years ago to image individual atoms. As a result of the team's efforts, the technique's resolution was greatly increased, making it possible to move from visualizing atoms to subatomic phenomena. As a result, they were able to make the first direct observations of the inhomogeneous distribution of electron charge around individual halogen atoms, which is known as the sigma hole. Accurate knowledge of the distribution of electron charge around atoms is vital for understanding the interactions between individual atoms and molecules, including chemical reactions.

"We are positive that our results will motivate other researchers to adopt our methodology in the near future. Our results provide new insights into halogen bonding, with potential applications in the development of new drugs or new macromolecular materials," said the team's members. The significance of the work is underpinned by the fact that it was published in the journal Science, where it received an incredible response.

Double success at "Vizionáři 2021"

The Regional Centre of Advanced Technologies and Materials (RCPTM), now part of CATRIN at Palacký University, won two awards at the Vizionáři 2021 contest. During the ceremony in Prague, the centre's representatives received an honorary mention for NANOBIOWAT, a system for groundwater treatment, and its contribution to protecting water resources and the environment. RCPTM, as a partner in Alterbio—another project funded by the Technology Agency of the Czech Republic (TA CR)—also contributed to the development of technologies using antimicrobial silver nanoparticles, for which the company Synpo, the principal investigator, was awarded.

NANOBIOWAT was an eight-year project funded by the Competence Centre of TA CR, which joined three academic partners (Palacký University Olomouc, Technical University of Liberec, and the Institute of Microbiology of the CAS) and major domestic remediation companies. Between 2012 and 2019, the project partners developed novel environmentally friendly nanotechnologies and biotechnologies that are capable of removing organic, inorganic, and microbial pollutants from contaminated waters and soils. This joint effort resulted in 4 patents, almost 30 proven technologies, and dozens of papers in world-renowned scientific journals. Another outcome worth highlighting is a book entitled Advanced Nano-Bio Technologies for Water and Soil Treatment, published by Springer.

"From my viewpoint, the NANOBIOWAT project was a great success. The cooperation of academic partners with remediation companies worked brilliantly and proved that cutting-edge research can be translated into industrial practice," added the Principal Investigator, Radek Zbořil.

RCPTM participated in another project supported by TA CR—Alterbio, for which Synpo was awarded. The Olomouc research group made key contributions to the design of a system for anchoring silver nanoparticles onto a polyurethane carrier that is now protected by a European patent.

Aristeidis Bakandritsos
With each new discovery comes joy and excitement

Six years ago, Aristeidis Bakandritsos decided to move with his entire family from Greece to Olomouc. Today, he is the head of a research group that forms part of CATRIN's scientific backbone and, together with colleagues, is developing new materials with properties tailored to specific applications.

"We focus primarily on the 2D chemistry of graphene and other low-dimensional materials that are used in areas such as energy storage and as catalysts in the production of chemicals," says the research chemist, who decided to pursue a career as a scientist during his doctoral studies at the National and Kapodistrian University of Athens and the 'Demokritos' National Centre for Scientific Research. "I still remember the excitement I felt when I first synthesized a material with better properties than its state-of-the-art counterparts and when I received a letter from the editor of a journal accepting my first scientific article for publication. That excitement motivated me to dedicate my career to materials research, which has turned out to be very rewarding because I experience the same excitement and joy with every new discovery," he explains.

He has had several remarkable successes, including articles published in globally renowned journals such as Nature Nanotechnology and a number of highly productive international projects. In future, he plans to translate his group's results into practical technologies. "We are developing advanced materials that will be crucial for ensuring our energy self-sufficiency. Efficient energy storage technologies will allow us to make better use of sustainable but intermittent resources such as the Sun and wind. Through catalysis, we will produce chemicals from waste, paving the way to a greener and safer future. I hope our materials and technologies will support the transition to a more sustainable civilisation," he said.

Véronique Bergougnoux-Fojtík
Roots are fascinating, studying them is a challenge

Véronique Bergougnoux-Fojtík, Head of the Plant Genetics and Engineering research group, could summarize her career to date as a journey from roses to cereal roots. Her mission is to help improve the characteristics of economically important crops to produce higher yields while protecting the environment. She believes this can be achieved without excessive use of chemicals or water.

She moved from her homeland 15 years ago on a date that is symbolic for the French—the 18th of June. "On this day in 1940, General de Gaulle called on the French to resist the enemy and fight for change. I took this day as a call for change in my life and scientific development," she said.

Whereas she had studied the effect of light on the development of roses in France, in Olomouc she switched first to studying tomatoes and later to cereals, especially barley and rice. "My team and I are trying to understand how plants tolerate drought stress, which is now probably the most important cause of yield decline worldwide. Our main focus is on understanding the development of roots, which not only anchor the plant in the soil but are responsible for water and nutrient uptake. If we understand their development and function, we can breed crops that use natural resources more efficiently and do not depend on irrigation or fertiliser for their development," she explained.

Studying roots in their natural environment is a big challenge, she said. This is also why she describes these underground plant parts as fascinating. "Once we understand how they work, we can use transgenesis and new genome editing methods to modify plants. We can also develop markers used in breeding programmes. An even bigger challenge will be to facilitate the domestication of some wild plants," added the scientist.

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Miloš Petřík
I like the connection between research and practice

Years ago, Miloš Petřík entered the Faculty of Pharmacy at Charles University in Hradec Králové in the belief that he would end up working in a pharmacy after school. However, during his studies he discovered an alternative path. His scientific career and research focus were decided by a doctoral internship at the Clinical Department of Nuclear Medicine in Innsbruck, where he later worked as a postdoc. Although his initial motivation for staying in Austria was his passion for skiing and hiking, he eventually became fascinated by research on radiolabelled substances. Since his return to Olomouc, he has been working in the Radioisotope Laboratory.

"Our primary research focus is on radiolabelled substances and potential radiopharmaceuticals, especially those for the diagnosis of cancer and infectious diseases. Our studies encompass everything from their synthesis and characterization to in vitro testing on cancer cell lines or microbial cells and testing on laboratory animals," said the pharmacist. He sees his greatest personal achievement in the fact that one of these compounds has reached patients and is currently being tested in a clinical trial in collaboration with Austrian colleagues.

The link between research and practice that he experienced in Innsbruck is very important to him. In Olomouc, he cooperates with the Nuclear Medicine Clinic of the University Hospital. "I am glad that the construction of a new building at the clinic has created opportunities for deeper cooperation. A laboratory for the production of radiopharmaceuticals planned in the new building should allow us to conduct clinical trials with the substances we are developing," he added.

His work would not be possible without cutting-edge imaging methods, such as PET/SPECT/CT, optical imaging, ultrasound, magnetic resonance imaging combined with positron emission tomography.

CATRIN and ICN2 lay the foundations for future scientific collaborations

A Memorandum of Understanding was signed on 10 May 2022 by the Directors of CATRIN and the Catalan Institute of Nanoscience and Nanotechnology (ICN2). The agreement establishes a scientific cooperation that will enable exchanges of ideas, knowledge, and researchers.

"The goal of this Memorandum is to foster collaboration and interchange of knowledge between CATRIN and ICN2. The two institutes will implement joint projects, identify suitable funding opportunities, and enhance the mobility of visiting scientists and students, in part by organizing scientific workshops and conferences," said Pavel Banáš, who signed the Memorandum alongside the Director of ICN2, Pablo Ordejón. The agreement will be valid for five years in the first instance, but the stakeholders hope that their cooperation will continue beyond this period.

This mutually beneficial cooperation has been encouraged by Michal Otyepka and Radek Zbořil from CATRIN and the Head of the ICN2 Nanobioelectronics and Biosensors Group, Arben Merkoçi, who has collaborated with colleagues from Olomouc for some time.

The G4G conference responds to global events and addresses an expanded range of topics

Renowned plant biotechnology experts Alan Schulman and Gary Vallad, who study pathogen biology, disease epidemiology and plant-pathogen interactions, will be the main guests at the international Green for Good VI conference. This conference, which bears the subtitle Global Challenges, is being organized by CATRIN and the European Federation of Biotechnology (EFB) and will be held in Olomouc between the 12th and 15th of September, marking the 200th anniversary of the birth of Gregor Johann Mendel, the founder of genetics.

Green for Good conferences traditionally bring together experts in plant biotechnology, genome editing of economically important crops, and so on. However, in accordance with this year's subtitle, the issues of bioeconomy and circular economy, energy harvesting and storage in biological systems, the Green Deal, the fight against climate change, and more will also be addressed.

"The programme will be divided into seven sessions. We are responding to current societal challenges and want to enable experts from diverse fields to inform each other about their latest results and perhaps jointly seek a path towards a more sustainable future. The programme will also include a panel discussion on sustainable agriculture and food production as well as a poster session," said Karolina Zavoralová from CATRIN on behalf of the organisers.

More detailed information is available at https://www.efbiotechnology.org/g4g, where it is still possible to register.

CATRIN and LIKAT's interest in cooperation resulted in a memorandum

Representatives of CATRIN of Palacký University and the Leibniz Institute for Catalysis the city of Rostock (LIKAT) have signed a Memorandum of Understanding (MoU) for research cooperation, implementation of joint research projects including doctoral theses, exchange of know-how or, for example, organization of joint conferences, workshops or seminars. Both institutions thus confirmed their interest in deepening their existing cooperation in the field of catalysis, nanotechnology, sustainable reactions, and new materials.

"Entering into a key partnership with the Leibniz Institute for Catalysis is another important step for CATRIN in building an international network of strategic partnerships. With LIKAT, we have an intensive collaboration with the group of Professor Matthias Beller, who is a world-leading expert in the field of applied homogeneous and heterogeneous catalysis. Heterogeneous catalysis and single atom catalysis are important pillars of CATRIN's research focus, as evidenced, for example, by recent joint publications in Nature Catalysis and Nature Nanotechnology," said CATRIN Director Pavel Banáš.

According to the signatories, the purpose of the memorandum is to confirm the interest of both parties in research cooperation in the field and to create a platform for the preparation and implementation of joint projects. The memorandum is valid for five years.

For CATRIN, this memorandum is the second key partnership with a major foreign partner in a short period of time. In May, the Directors of CATRIN and the Catalan Institute for Nanoscience and Nanotechnology (ICN2) signed a Memorandum of Cooperation. CATRIN also has been in a similar agreement with the Bar-Ilan Institute of Nanotechnology & Advanced Materials (BINA) in Israel since last October.

CATRIN has followed the tradition of RCPTM and become a partner of the international festival Academia Film Olomouc

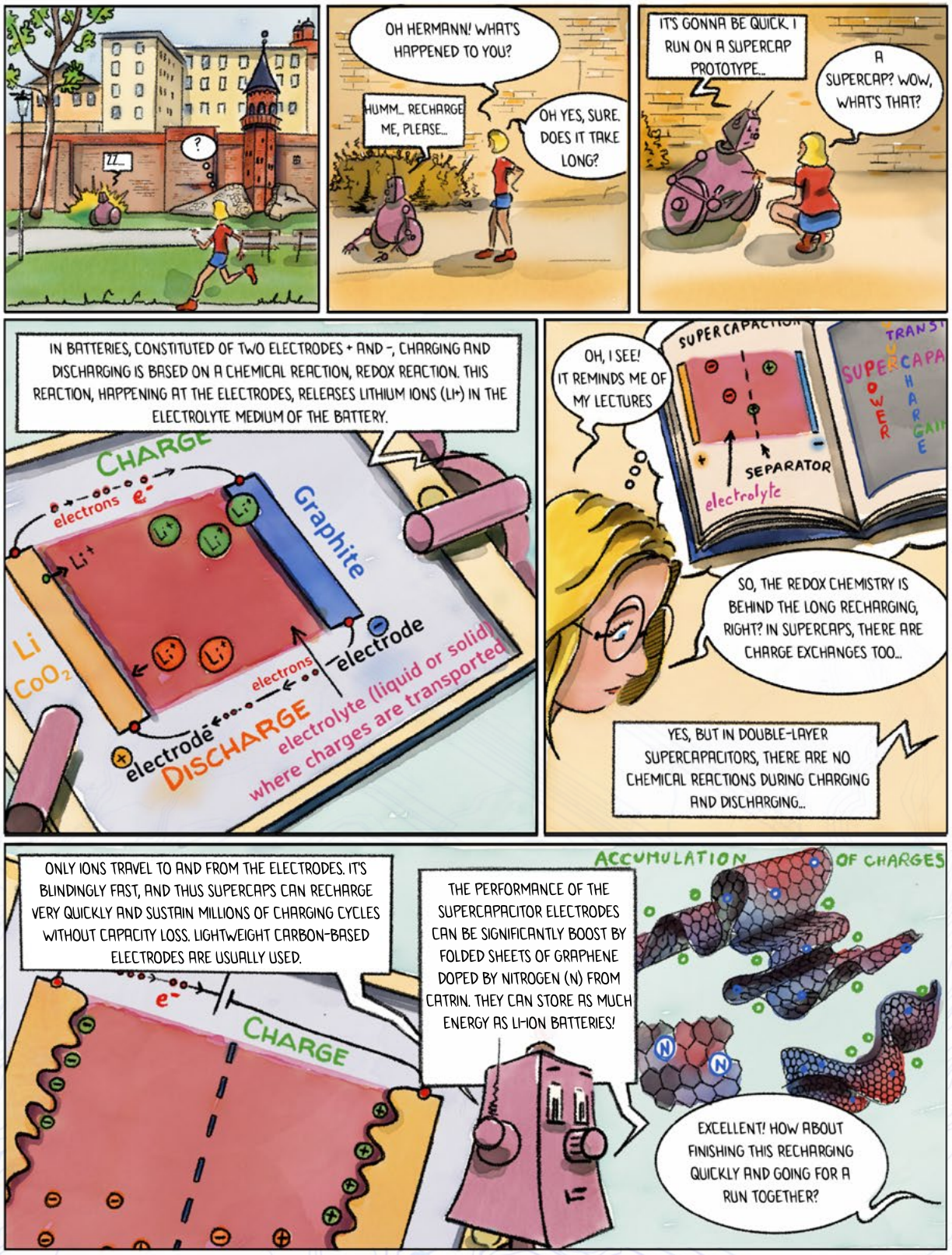
During the closing ceremony, CATRIN Director Pavel Banáš handed out an award in the short film category. "I salute all authors who are able to make science accessible to the general public. They're doing a great job, and it's totally necessary to continue," he said during the ceremony. In this international festival, as many as 30 different films from around the world competed to arouse the interest of the jury and viewers. The jury chose from 10 contributions in the Czech -Slovak competition and 17 in the short film competition.

• Presentations of research results and debates about possibilities of cooperation with academic and commercial partners were part of a "nano tour" in Benelux attended by representatives of CATRIN's management during the last week of March. In addition to meetings and seminars at embassies in Luxembourg, Brussels, and The Hague, they also visited the IMEC research institute in Leuven, which is active in the field of nanoelectronics and digital technologies. In May, CATRIN representatives also attended a similar event in Finland.

• A Czech-French project involving CATRIN and the Institut des Sciences de la Terre d'Orléans (ISTO) – Université D'Orléans was launched by a joint seminar at the end of April. This project will enable scientists at both institutions to obtain detailed information on the long-term stabilization of nanoparticles and to improve their efficiency in remediating organic water pollution while also establishing deeper contacts to enable further cooperation, for example within a large international project. CATRIN researchers have also conducted laboratory experiments with their French colleagues and have begun field experiments in wetlands using nanoparticles developed in Olomouc.

• CATRIN-RCPTM Head Michal Otyepka attended The Graphene Flagship Annual Meeting held in Dublin in April. The main topic was 2D chemistry.

HERMANN AND BEGONIA: HERMANN'S ENERGETIC RESURRECTION



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