CATRIN
Czech Advanced Technology and Research Institute

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AMADEUS to accelerate drug discovery

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Research.com

CATRIN's researchers score high again

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I want to promote interdisciplinary interactions and search for new, unaddressed topics

AMADEUS to accelerate drug discovery

The renowned chemist Alexander Dömling at the Czech Advanced Technology and Research Institute CATRIN, Palacký University Olomouc is developing a breakthrough technological platform, known as AMADEUS, to make drug discovery more sustainable, cost effective and time efficient. Thanks to a prestigious project grant with a budget of €3.4 million funded by the European Research Council (ERC), the AMADEUS platform aims to revolutionize the process of drug discovery and optimization by enabling autonomous, AI-driven, highly miniaturized automation for compound identification.

The main goals of the five-year AMADEUS (Automated, MiniAturizeD, and acceleratEd drUg diScovery) project are to accelerate the development of new drugs, reduce the financial costs and environmental burden of the process and increase its safety. The use of miniaturization and automation is proving to be the right approach. Unlike current industry practices that rely on large-scale synthesis, the research will enable syntheses at a 100,000 times smaller scale.

"We will design and validate a comprehensive AMADEUS technology platform that will be capable of synthesizing thousands of small molecules per day in nano- or picolitre-scale volumes based on hundreds of chemical reactions that we can effectively investigate and improve their properties using artificial intelligence. Thanks to this reduction in scale, we will also significantly reduce the amount of toxic waste, increase the sustainability and speed up the whole drug discovery process. My ambition is to fundamentally change the early phase of drug discovery, which has been used in pharmaceutical companies around the world for more than half a century," said Dömling.

According to him, AMADEUS may facilitate applications not only in medical chemistry but also catalysis and the tuning of material or plant properties.

> **I believe AMADEUS represents a significant step towards achieving sustainability in research and development and will support innovation and progress in various scientific fields**
>
> Alexander Dömling

The benefits of miniaturisation and automation, which can enable sustainable chemistry and more efficient development of new pharmaceuticals, nanomaterials and bioactive compounds, such as plant protection substances, are also being explored by Professor Dömling at CATRIN within the European ERA Chair ACCELERATOR project. The main pillar of his research is multi-component organic reactions, which allow the preparation and testing of tens of thousands of chemicals in a highly economical and diverse fashion.

"The two projects are complementary and will enable me to accelerate my research. I believe AMADEUS represents a significant step towards achieving sustainability in research and development and will support innovation and progress in various scientific fields," added Dömling.

Professor Dömling is the first recipient of a prestigious ERC Advanced grant at Palacký University. These grants focus on supporting internationally recognized experts who have already established themselves in the field and have demonstrably influenced it. The physical chemist Michal Otyepka has also been successful in stiff ERC competitions in the past, winning four times (three of them in the Proof-of-Concept category, which supports successful ERC grant awardees in the earliest phase of commercialization of outputs from their research activities). Both scientists work at CATRIN.

Unique butterfly-shaped magnetic graphene nanoparticle combines two concepts of magnetism formation

An international team of scientists led by Czech physicists has successfully developed a unique magnetic nanographene for the first time. They combined two concepts of magnetism and were the first to detect their magnetic signal using advanced scanning electron microscopy and quantum mechanical calculations. Graphene nanoparticles have the potential to be used for information storage and processing in quantum computing.

The paper, published in Nature Chemistry, describes an innovative method to design, prepare and verify the magnetic properties of graphene in the shape of four rounded triangles resembling "butterfly wings". Each of these triangles contains an unpaired π electron responsible for the magnetic properties.

"Previous approaches were limited to a single magnetic origin, which limited the number of correlated spins or type of magnetic ordering in nanographenes. In this work, we were able to combine two approaches for the first time to create a unique magnetic nanographene with four unpaired electrons. Moreover, by combining experimental and theoretical calculations, we were able to provide irrefutable evidence for its magnetic character," said Adam Matěj from the Institute of Physics of the Czech Academy of Sciences and CATRIN.

The experimental and theoretical verification of the nanographene properties was conducted in collaboration with scientists from the National University of Singapore, Nanjing University in China, and two institutes of the Czech Academy of Sciences.

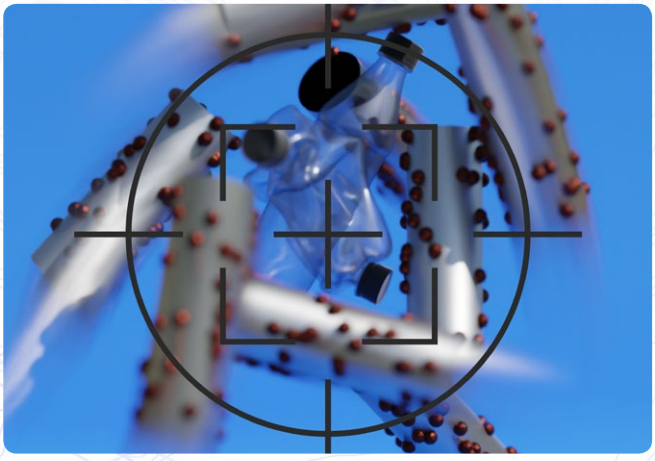
Song S., Pinar Solé A., Matěj A., Li G., Stetsovych O., Soler D., Yang H., Telychko M., Li J., Kumar M., Chen O., Edalatmanesh S., Brabec J., Veis L., Wu J., Jelinek P., Lu J.: Highly entangled polyradical nanographene with coexisting strong correlation and topological frustration. Nature Chemistry 2024. 16 (6), 938-944. IF = 19,2

Czech scientists develop nanorobots that can remove microplastics from water

Nanotubes of titanium dioxide powered by UV radiation and hydrogen peroxide as a fuel have been developed by scientists from CATRIN, the Center for Energy and Environmental Technologies (CEET) and the Faculty of Electrical Engineering and Computer Science of VSB-TUO in cooperation with colleagues from CEITEC-VUT in Brno. These so-called nanorobots were developed using defective and atomic engineering in order to capture microplastics in water. The work opens up new possibilities for the use of light-driven nanorobots in water purification technologies.

In a study published in the journal Advanced Functional Materials, scientists developed a nanorobot that can irreversibly capture microplastics in polluted water with high efficiency on a timescale of the order of tens of seconds. As model microplastics, they used spherical particles of about 5 μm in size.

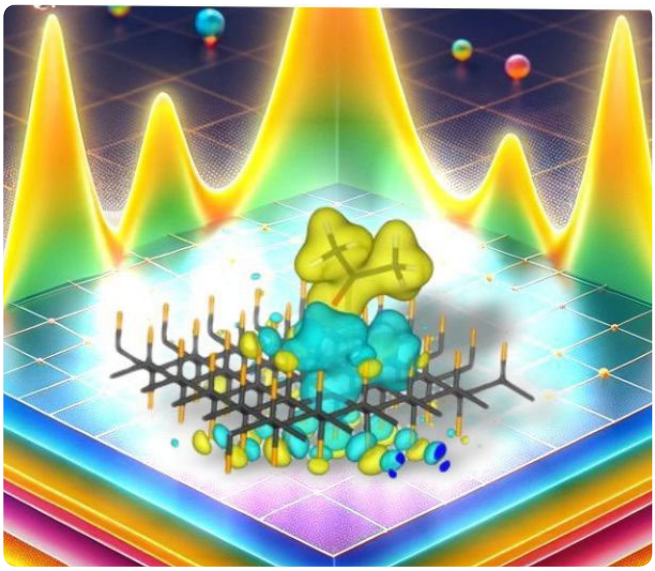
Using defective and atomic engineering, the scientists were able to control the direction and speed of movement of the nanorobots in water. Titanium dioxide nanotubes, with a diameter of about 250 nm and length of several microns, were prepared by electrochemical anodization. Oxygen defects in the titanium dioxide structure were created by ignition in a hydrogen atmosphere. Platinum atoms were added into the defective structure using deposition techniques.



The scientists showed that by creating defects in the structure of titanium dioxide, nanorobots move at a higher speed in the x-y plane. Moreover, the incorporation of platinum led to the phenomenon of negative photogravitaxis, enabling platinum-enriched nanorobots to move against gravity in the z-axis direction. Such control over the speed and direction of motion of nanorobots offers potential in a range of environmental, chemical or biomedical applications.

Jančík-Procházková A., Kmentová H., Ju X., Kment Š., Zbořil R., Pumera M.: Precision Engineering of Nanorobots: Toward Single Atom Decoration and Defect Control for Enhanced Microplastic Capture. Advanced Functional Materials 2024, in press. IF = 18,5

Scientists find a new way to influence fluorographene properties using UV light



The prestigious Journal of the American Chemical Society recently published the discovery of a fascinating phenomenon by which special particles known as polarons can be created in a two-dimensional material, fluorographene. The research by scientists from Palacký University's CATRIN and VSB-TUO has opened new avenues in the development of nanotechnologies and demonstrates how technological improvements can be achieved by a simple change of environment. The importance of the discovery was recognised by its selection for the front cover of JACS.

Polarons are special electrically charged particles that can affect the properties of materials, including their conductivity and magnetic capabilities. They can be used in various advanced applications, ranging from solar panels to optoelectronic devices, molecular sensors and magneto-optical devices.

"The published research shows that polarons can be generated in fluorographene by using UV light, with the type of solvent in which fluorographene is dispersed playing a key role. During experiments, we found that fluorographene in acetone under UV light produces a strong signal of polarons, indicating the formation of active spin states. In benzene, on the other hand, this phenomenon is less pronounced and almost non-existent in cyclohexane. The observed phenomenon is essential for understanding how the surrounding environment affects the formation of polarons," explained one of the authors, Michal Otyepka.
The experiments were supported by theoretical calculations, which showed that polarons are formed near the radical sites of fluorographene, which interact strongly with acetone molecules. After UV irradiation of acetone, the charge from the solvent is transferred to the radical centres in fluorographene, resulting in transient magnetic states of a polaronic nature.

The research demonstrated the importance of the environment in which materials are used. By exploiting the interaction of materials with different solvents, new ways may developed for designing and producing materials with precisely defined properties for specific applications.

Zoppellaro G., Medveď M., Hrubý V., Zbořil R., Otyepka M., Lazar P.: Solvent Controlled Generation of Spin Active Polarons in Two-Dimensional Material under UV Light Irradiation. Journal of the American Chemical Society 2024. 146 (22), 15010–15018. IF = 14,4

New analytical tool facilitates monitoring of metabolites in plants

A new analytical method for the simultaneous analysis of amino acids, biogenic amines and their acetylated and methylated derivatives in plants has been proposed by researchers from CATRIN. The method may provide plant sciences with a powerful analytical tool for investigating the functions of these important nitrogen metabolites in plants, whose biological significance has not yet been fully clarified.

"This method involves the simple extraction of two to five milligrams of lyophilized plant material, followed by fractionation. The analytical endpoint is then hydrophilic interaction liquid chromatography or reversed-phase liquid chromatography with mass spectrometric detection. This approach allows high sample throughput, which significantly reduces the time required for analysis and lowers its cost," said the corresponding author of the paper, Petr Tarkowski. In cooperation with the Isotope laboratory at the Institute of Experimental Botany the researchers also presented a new synthetic route for deuterated polyamines.

The study has been published in the Journal of Experimental Botany. According to the authors, the new method offers high extraction efficiencies and good chromatographic resolution, as well as good sensitivity and selectivity. Thus, it has the potential to accelerate research on these rare metabolites, as well as improve our understanding of their biological significance in different plant species.

Ćavar Zeljković S., De Diego N., Drašar L., Nisler J., Havlíček L., Spíchal L., Tarkowski P.: Comprehensive LC-MS/MS analysis of nitrogen-related plant metabolites. Journal of Experimental Botany 2024, in press. IF = 5,6

CATRIN scientists are the first to use a graphene ink for cheap and affordable sensor printing

CATRIN scientists have become the first in the world to print a universal electrode for a variety of electrochemical sensors using a standard inkjet printer with handmade graphene ink. Compared to commercially used products, the electrode exhibited the same performance and sensitivity, but it was significantly cheaper to produce. The success was presented in the journal Biosensors and Bioelectronics.

The new approach is significantly more cost-effective than current procedures and requires a very small amount of material thanks to the inkjet printing. "Milligrams of material are needed in commercial methods, and the electrodes cost tens of Czech korunas. In contrast, our method needs a thousand times lower amount of material, i.e., micrograms and we calculated the cost of the material for one electrode at about two Czech korunas. The performance is comparable to commercially used sensors prepared by other methods, but the production is very accurate and easy. Moreover, as we care about the environment, we have chosen to use water as the solvent for the ink," explained one of the authors, David Panáček, from CATRIN.

The researchers want to go further. The goal is to prepare different types of inks for specific applications by functionalizing graphene, e.g., by attaching a specific molecule that will "catch" the substances of concern. The potential applications are very diverse, including the detection of microbes, antibiotics, pesticides, markers of disease or pollutants in the environment.

The development of a process for the production of graphene ink for printing stable, sensitive and selective electrodes for application in biosensors and verification of them under laboratory conditions are the main aims of a prestigious grant awarded to Michal Otyepka last year by the European Research Council (ERC) in the Proof-of-Concept category.

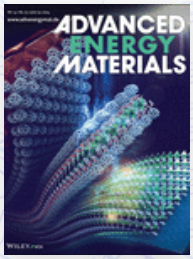
Nalepa M. A., Panáček D., Dědek I., Jakubec P., Kupka V., Hrubý V., Petr M., Otyepka M.: Graphene derivative-based ink advances inkjet printing technology for fabrication of electrochemical sensors and biosensors. Biosensors and Bioelectronic 2024, 256, 116277. IF = 10,7

Our latest reviews

A. Sharma, S. B. Eadi, H. Noothalapati, M. Otyepka, H. Lee And K. Jayaramulu

"Porous materials as effective chemiresistive gas sensors"

Chemical Society Reviews 2024, 53 (5), 2530-2577. IF = 46,2



P. Dubey, V. Shrivastav, T. Boruah, G. Zoppellaro, R. Zbořil, A. Bakandritsos And S. Sundriyal

"Unveiling the Potential of Covalent Organic Frameworks for Energy Storage: Developments, Challenges, and Future Prospects"

Advanced Energy Materials, in press, 2024. IF = 27,8

I want to promote interdisciplinary interactions and search for new, unaddressed topics

Lukáš Spíchal, an expert in the chemical biology of plant hormones, has been the head of CATRIN-CRH, one of CATRIN's three divisions, since May this year. He succeeded Ivo Frébort, who no longer sought the position.

Until now, you have led one of CATRIN's research groups. Why did you decide to apply for the position of head of CATRIN-CRH?

As the head of the Phenotyping research group, which is interdisciplinary in its focus and staffing, I perceived a great perspective and potential for collaboration between groups at CATRIN-CRH, but also between groups across CATRIN divisions. I have tried to exploit this potential, and the successful building of these interactions is already translating into publication and project successes, which I am sincerely pleased about. My motivation for applying for the position of Division Head was therefore, among other things, to capitalise on this experience and from a leading position foster these links and stimulate the creation of new ones. I would like to see the CATRIN-CRH research groups thematically linked as much as possible in pursuit of a common research goal of responding to the challenges of food security, sustainable agriculture and climate change with innovative solutions.

Is the recent restructuring of the research groups one way towards this goal?

Yes, I felt that too much atomisation into smaller groups creates mental barriers and encourages a tendency to compete internally. This is not to the benefit of the whole. It is the removal of these barriers that can foster an awareness of mutual benefit. I merged groups where thematic or project connections already existed. In addition, I wanted to bring some groups together to form more comprehensive teams of complementary staff and become more balanced in terms of their potential towards basic and applied research.

What other tasks have you set for yourself?

I would like to further increase the grant success rate, create strategic partnerships with research institutions in the Czech Republic and abroad as well as in the commercial sphere. I would like to support the growth of young, promising scientists as much as possible. CATRIN-CRH is already a place where many students and researchers from abroad come for short or longer research stays. I will do my best to ensure that our division, as a proud part of CATRIN, helps to promote the reputation of Palacký University in the world.

You mentioned that building interactions is already translating into publishing and project successes. Can you be more specific?

A good example is the HE PATAFEST project, in which two CATRIN-CRH groups are involved. The discussions that members from quite different thematic areas were forced to have with each other during the preparation of the project, but also now during its implementation, have led to a greater mutual understanding and finding points of contact. They have generated new ideas for further joint projects, which have been submitted together, and hopefully some of them will receive financial support. In the area of publications, the link between the Phenotyping and Phytochemistry groups is certainly a good example, which has resulted in the formal merging into one research group of Plant-Environment Interactions.

The transfer of knowledge into practice is also important for CATRIN. Do you have any plans in this area as well?

Yes, the successful valorisation of new in-house knowledge is one of the key areas I want to pursue. Due to my years of experience with various forms of know-how valorisation, through applied research projects with industrial partners, licensing know-how, and setting up and running a spin-off company, I am well aware of all aspects of this process, i.e. not only that a result with commercial potential can be produced, but also what all this entails externally, as well as within the group. In this respect, I can rely on the excellent team in CATRIN's Technology Transfer Office, with whom we are already mapping the potential of each group and working together to develop a strategy for CATRIN-CRH.

What has surprised you during your first weeks in the role and what are you most excited about?

As I have been with CATRIN-CRH since the beginning and already knew its operations from my position as leader of the research group, there were not many surprises. I am certainly happy about the positive acceptance of my vision at the level of CATRIN management and the other divisions, including their research groups, and the immediate support of the group leaders to link our topics. The first great achievement could be the establishment of a joint facility extending the biosensing research that is well underway in CATRIN-RCPTM to the crop production and food security topics addressed in CATRIN-CRH.

How do you see CATRIN-CRH now and where would you like to see it at the end of your term?

CATRIN-CRH is now in a period of necessary stabilization and adaptation to the conditions in which it was established as part of the UP and with which it has to contend. Due to our strongly project-oriented funding method, we have already demonstrated that we can obtain sufficient funding from European and national competitions. I would like to see CATRIN-CRH operate as one team, which, thanks to its multidisciplinarity, will be able to find new topics, not yet addressed at UP, that are attractive to students and young scientists from abroad. I would also like to see CATRIN-CRH remain a sought-after and successful partner for international consortia, as well as industrial partners.

Mgr. Lukáš Spíchal, Ph.D. (*1978)

Lukáš Spíchal, a biology-chemistry graduate, has been working as a junior researcher at the Haná Regional Centre for Biotechnological and Agricultural Research since 2010, and after the establishment of CATRIN, he led the Phenotyping research group. Since April this year, he has been leading one of CATRIN's divisions. In 2012, he won the award "The best R&D team competition" at the international Bioforum in Brno.

His research focus includes the chemical biology of plant hormones, development of agrochemicals and technologies for plant growth regulation, high-throughput bioassays and automated plant phenotyping. According to Web of Science, he has authored more than 110 publications that have received over 3500 citations and his h-index is 34. He also has over 30 granted patents to his credit, three of which are licensed to commercial entities, including multinational companies.

Research.com pronounces UP a domestic leader in materials science thanks to CATRIN scientists

CATRIN of Palacký University (UP) scored high in this year's edition of Research.com's international ranking. In materials science, the physical chemist Radek Zbořil was ranked as the second-best domestic scientist with an excellent 434th position worldwide. Michal Otyepka was ranked fifth in the Czech Republic (2106th in the world). Thanks to them, UP is the leader in material sciences among all institutions in the Czech Republic. Both scientists also ranked high in chemistry and helped UP to reach second place in the Czech Republic in this scientific discipline.

"I am very proud of the results of our scientists, and I congratulate them from the bottom of my heart. I have always stressed that the foundation of a university and its success lies in the people, their talent, enthusiasm and, above all, hard work. I am glad that the most successful ones come from CATRIN or intensively cooperate with CATRIN," commented CATRIN Director Pavel Banáš on the success.

In the field of Materials Science, the assessment included 27,059 scientists. The position in the ranking was based on the H-index, which includes only publications and citations in the relevant field. The bibliometric data was collected in November 2023. The domestic ranking was led by Martin Pumera (H-index 112) from Brno University of Technology, who works closely with CATRIN, including as a member of the research team conducting the OP JAK TECHSCALE project. However, at CATRIN, Radek Zbořil (H-index 110) was right behind him and Michal Otyepka (H-index 76) was fifth. Both UP scientists also achieved outstanding success in Chemistry. Although Pavel Hobza from the Institute of Chemistry of the Academy of Sciences reigned supreme in the domestic ranking in Chemistry (247th in the world), Radek Zbořil was only three places behind his scientific mentor, meaning that in the world comparison, he was again listed in the top 500 scientists. Michal Otyepka was ranked tenth in the Czech Republic and 2323rd in the world in Chemistry. More than 72302 scientists were assessed in the field of Chemistry.

Young scientist gains a prestigious position at the University of Oxford

In June, Benjamin Mallada Faes joined the University of Oxford to take up a post-doc position. He worked at the Regional Centre of Advanced Technologies and Materials during his master's and doctoral studies, and subsequently at CATRIN, and was involved in many scientific breakthroughs. At the prestigious university in the UK, he will be a Postdoctoral Research Associate in Biochemistry and Biophysics.

Benjamin Mallada Faes has already achieved great success in measuring the charge distribution of single atoms and molecules with subatomic and submolecular resolution, culminating in publications in prestigious journals such as Science and Nature Communications. He and his colleagues experimentally confirmed the existence of an uneven distribution of electron charge around a halogen atom, a so-called sigma hole. Among other accolades, this led to them being awarded the Werner von Siemens Award for 2021. They also advanced the possibilities of imaging techniques to confirm the existence of π-holes.

At CATRIN, this is seen as another example of the success of young scientists who have gained their scientific spurs in Olomouc continuing their development at top foreign universities. Previously, newly completed doctoral candidates have been offered positions at the University of Cambridge and the Karolinska Institute.na Univerzitu v Cambridge nebo na Institut Karolinska.

Radek Zbořil Wins Prestigious Team Award for Scientific Contribution in Water Research

A prestigious international prize, the Prince Sultan Bin Abdulaziz International Prize for Water (PSIPW), awarded for outstanding scientific and technological contributions in water-related research, is coming to the Czech Republic for the first time. In the Alternative Water Resources category, the prize was awarded to a team that includes Radek Zbořil. The PSIPW aims to promote sustainable technologies related to water treatment and water resources management and has been awarded to several Nobel Prize winners in the past.

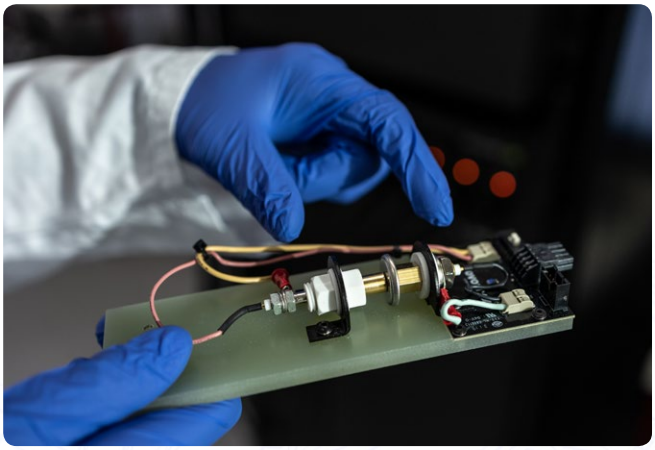
Prince Sultan Bin Abdulaziz International Prize for Water

The leader of the award-winning team of four is Virender K. Sharma from Texas A&M University, with whom the physical chemist Radek Zbořil has long collaborated. Together, they have published over 50 papers, garnering more than 6,000 citations. The scientists received the award for their groundbreaking technologies using iron compounds in high oxidation states in advanced water purification processes, particularly for the effective removal of antibiotics and pharmaceuticals from wastewater.

"The award is very much appreciated. As always, the competition was tremendous, and I am honoured to work alongside great scientists from universities in Texas, Berkeley, and Milan. Securing drinking water is one of the global challenges, and each and every step, however small, that brings us closer to this goal is very meaningful," said Zbořil.

The PSIPW Prize was established in 2002 to support scientific research and innovation aimed at addressing global water challenges, including water scarcity, water pollution, and effective water management. This year's awardees include Paolo D'Odorico from the University of California, Berkeley, who is renowned for his groundbreaking papers published in journals such as Nature Water, Nature Sustainability, and Nature Climate Change.

CATRIN joins a European project to develop new generation batteries



Since March, an international team has been working on the development of new generation batteries for the storage of green energy as part of LESIA (Laser Engineered Surfaces/Interfaces for Advanced Batteries). LESIA is a four-year project funded by the Marie Skłodowska-Curie Actions (MSCA) programme. Under the leadership of Aarhus University, it will involve European partners from Denmark, Germany, Spain, Italy and the United Kingdom, but also colleagues from Hong Kong and China as associate partners.

The project investigator for Palacký University is Radek Zbořil from CATRIN.

Existing battery systems still suffer from low stored energy capacity, low recyclability rates and safety problems. The use of new electrode materials is therefore considered to be a necessary step for the development of a new generation of batteries. LESIA aims to employ an innovative approach to battery development by laser and chemical treatment of electrode surfaces. On one hand, CATRIN's researchers have years of experience in this area, whereas on the other, the materials may exhibit various limitations in practical applications.

"Our task will be to test various graphene derivatives for possible electrode modification. In the past, we have demonstrated the high efficiency of chemically modified graphene in many energy storage systems, including supercapacitors and lithium batteries, but also modern Li-S batteries. In cooperation with foreign partners, we want to combine new chemical and physical approaches to improve the properties of battery systems. With the help of a number of unique instrumental techniques available in various workplaces, we will study the phenomena on the phase interface between the electrode and electrolyte, an understanding of which is crucial for the development of new generation batteries," said the CATRIN-RCPTM Scientific Director, Radek Zbořil.

Dominik Kusý wins the CATRIN award for outstanding scientific performance

Dominik Kusý from the Biodiversity and Molecular Evolution research group received the Award for Outstanding Scientific Achievement at this year's CATRIN annual conference. The Lifetime Achievement Award went to the former head of CATRIN - CRH, Ivo Frébort, who decided not to run for the leading position anymore.

According to CATRIN Director Pavel Banáš, Dominik Kusý received the award not only for his outstanding scientific results but also his undying enthusiasm for scientific work. "Although he is still a Ph.D. student, he has already become an invaluable scientific support in his research group at CATRIN. His publication record of around 30 publications in prestigious journals, approximately 300 to 400 citations and a H-index of 11, is something many of his habilitated colleagues would be proud of. It is all the more extraordinary that Dominik was able to achieve these results at the very beginning of his scientific career," said Banáš. The award made the young scientist very happy. "I see it as an award for our entire research group. Thanks to our collaboration, we have been able to publish some very interesting results in prestigious journals," Kusý said.

CATRIN contributes to the AFO

CATRIN supported the international festival of popular-educational films "Academia film Olomouc" again this year as one of its partners. Renowned researchers Alexander Dömling and Radek Zbořil joined the programme of the festival. At the closing ceremony, Director Pavel Banáš presented one of the awards to the filmmakers.

"Scientific and technological progress is an essential part and driving force of our society. However, research and development of new technologies alone is not enough—the knowledge, beauty but also the risks of modern science need to be clearly presented to the general public. And this is exactly what the AFO science-popularization festival does, and therefore it has CATRIN's support," said the CATRIN Director Pavel Banáš, explaining the reasons for the partnership.

Workshop attracts world's leading nanomaterials scientists

The world's top nanomaterials scientists were brought together by the NanoLumCat Ostrava 2024 workshop to share knowledge in the field of carbon dots and single-atom catalysis for renewable energy sources. Participants learned about the latest scientific advances and discussed the possibilities of new technologies in the field of nanomaterials for sustainable development. It was one of the largest meetings dedicated to this topic in the world.

The workshop was held in May at the IT4Innovations supercomputer centre with the participation of 39 experts from Italy, Germany, Spain, Poland, Slovakia, China, the Czech Republic and other countries. It was attended by, among others, Dirk M. Guldi, who is currently a professor at the University of Erlangen–Nuremberg, Germany, Andrey Rogach from the City University of Hong Kong and Paolo Fornasiero from the University of Trieste. VSB-TUO and Palacký University's CATRIN joined forces to organize the workshop. The event was held under the auspices of the Global Experts programme and the SAN4Fuel project.

ERA Chair Accelerator project invites entrepreneurs to a roundtable

Participants of the ERA Chair ACCELERATOR project's roundtable, led by the renowned chemist and principal investigator Alexander Dömling from CATRIN, spoke about the possibilities of cooperation, current challenges in synthetic chemistry and knowledge sharing. The meeting took place at the Rector's Office of Palacký University with the participation of researchers and representatives of the CATRIN Technology Transfer Office, as well as industrial partners from the Czech Republic and abroad.

"Professor Dömling's group focuses on research that extends from basic research to industrial applications. However, the so-called "valley of death" needs to be bridged during the technology transfer process. The aim of the meeting was to contribute to balancing the needs and expectations from both academics and industry," explained the CATRIN Director Pavel Banáš.

Foreign diplomats are introduced to CATRIN's research

The leadership of the Ministry of Foreign Affairs presented scientific diplomacy to foreign diplomats as one of its priorities. Michal Otyepka presented the research activities and accomplishments of CATRIN, Palacký University Olomouc, to almost 100 ambassadors and representatives of diplomatic missions on Wednesday, February 28, at the Czernin Palace.

"I am glad that I was able to talk about our research in front of diplomats and demonstrate that international cooperation is one of the pillars of CATRIN. Of course, I expressed my interest in further development in this area as well. I commend the Ministry of Foreign Affairs for the development of scientific diplomacy. As the meeting disclosed, the modernization of the country cannot be done without quality cooperation in the field of innovation and science," said Michal Otyepka, Head of CATRIN-RCPTM.

Paolo Fornasiero becomes chairman of the ISAB of TECHSCALE

At its first meeting in February, the International Scientific Advisory Board (ISAB) of the OP JAK TECHSCALE project — Technology Beyond the Nanoscale — elected as its chairman a renowned expert in the field of electrocatalysis and author of several groundbreaking papers in the journal Science, Paolo Fornasiero from the University of Trieste.

The ISAB is an independent advisory body of the project's expert team helping with the strategy and evaluation. In addition to Paolo Fornasiero, its members include Srinivasan Madhavi, the Executive Director at the Energy Research Institute of Nanyang Technology University in Singapore; Svetlana Mintova, the Research Director of the CLEAN Centre at Normandy University in France; Subodh Mhaisalkar, the Executive Director of the National Research Foundation in Singapore; Mathias Beller, Professor at the Leibniz Institute for Catalysis; and Roberto Millini from the Italian company Eni S.p.A., who represents the industry.

CATRIN meets with potential investors at the Nuremberg trade fair

A promising material for use in electrical energy storage devices, i.e., supercapacitors, was presented by CATRIN representatives Jiří Navrátil and Tomáš Zedníček at the PCIM trade fair in Nuremberg with the aim of moving it closer to commercial use. This trade fair is an important meeting place for experts from industry, science and research, where they can get familiar with the latest technologies, products and innovations in the field of power electronics.

A nitrogen-doped graphene material has been developed by scientists in Olomouc. This material is now being tested and prototypes of capacitors are being prepared as part of the prestigious Trans2DChem project of the European Innovation Council. Experts have already confirmed its unique properties and introduced them to manufacturers of supercapacitors at the fair.

CATRIN scientists are working on the project with colleagues from Bar-Ilan University in Israel and the Italian company ITELCOND. The aim is to develop a supercapacitor that is safer, more environmentally friendly, cheaper and, above all, has a high capacity and long life.

PCIM Europe (Power Conversion and Intelligent Motion) is an international trade fair and conference focusing on power electronics, intelligent motor drives, renewable energies and energy management. It was held in Nuremberg, Germany, from 11 to 13 June.

NANO4TARMED holds a final conference to review results

The approaching conclusion of the NANO4TARMED project (Advanced hybrid theranostic nanoplatforms for an active drug delivery in the cancer treatment) from the Twinning call of Horizon2020 provided the opportunity for an event to showcase the results of this 3.5-year international scientific collaboration. Therefore, CATRIN, as coordinator, invited partners from the Consiglio Nazionale Delle Ricerche and National University of Ireland Maynooth to a final conference, which took place in early June in Prague.

Participating institutions were united in their efforts to advance research on the treatment of osteosarcoma, the second most common bone cancer that most affects adolescent children. "Scientifically, NANO4TARMED has delivered significant results. For example, through a wide range of educational activities and internships in partner institutions, significant progress has been made in developing the professional skills of early-stage researchers. An important task was to build a research cluster, a kind of collaborative platform, and to increase the chances of obtaining large European grants. According to the project's coordinator, this was done to perfection. The project, with a total budget of 744,898.75 euros, was CATRIN's first (formerly RCPTM) consortium project.

Tibor Béres
Helping people with his research

Tibor Béres spent quite a long time looking for "his topic" in research but finally found it in research on medical cannabis. Originally a biologist, he has gradually switched to phytochemistry since about 2015. He considers that this area offers many opportunities for applied research, which he prefers. He would like to take at least some of his results forward toward practical use, for example in the form of a medical product.

"We produce cannabis extracts and, in cooperation with partners, we test their biological activity. From a phytochemical point of view, there is a great chance of success. Cannabis contains different substances, and many of them may be biologically active, and therefore potentially useful for medicinal purposes," said the researcher.

Although cannabis has been considered for medicinal purposes for many years, many aspects of its use are still unexplored. For example, current legislation allows for the indication of medicinal cannabis in surface treatments in dermatology. However, in practice, this application is hampered by the lack of a standardised procedure for the preparation of dermal dosage forms in pharmacies. This is precisely what scientists at CATRIN decided to change by developing a potentially feasible procedure and publishing it in a peer-reviewed journal. "Although there are other options, I hope that the procedure I was involved in developing will start to be used in practice. I consider this my greatest scientific achievement so far," added Béres, who moved to Olomouc after completing his master's degree in Košice and stayed. His route to CATRIN took him through the Growth Regulator Laboratory and CRH. He has been on internships abroad in Austria and Sweden.

In addition to research, he is also involved in popularising science to raise awareness of cannabis and its potential uses and contribute toward destigmatising this medicinal plant.

Martin-Alex Nalepa
A childhood dream realized

A future profession is sometimes determined by sheer coincidence. Martin-Alex Nalepa, a nanomaterials chemist, knew from an early age that he wanted to be a scientist, but his interest in a specific field was sparked by a TV show. Watching "Hyde Park Civilization," where the host Daniel Stach interviewed the physical chemist Radek Zbořil about nanotechnology, inspired the then high school student. He later connected with scientists from what is now CATRIN and continued to collaborate with them throughout his university studies. Today, he is living his dream of being a scientist.

"When I heard Professor Zbořil talk on TV about nanotechnology and the research in Olomouc, I was instantly captivated. His enthusiasm made it clear to me that this field had a promising future. If I had chosen to watch a different programme that night, my path might have taken a different direction," smiles Martin, a recent graduate from UP's Master's programme in Nanomaterials Chemistry. When applying to university, Martin focused solely on nanomaterials chemistry, inspired by his involvement in the SOČ (Středoškolská odborná činnost), which introduced him to the RCPTM, now part of CATRIN.

At the beginning of his bachelor's studies, Martin asked for a chance to be involved in research at RCPTM, and he got it. During his master's studies, he joined Michal Otyepka's ERC PoC project, which aims to develop a process for producing graphene ink for printing electrodes. These electrodes can be used to design affordable, sensitive and selective biosensors. The initial groundbreaking results were recently published in Biosensors and Bioelectronics, with Martin listed as the first author of the article! He plans to pursue this area as part of his doctoral studies, aligning perfectly with his goal to participate in research that reaches people and makes a difference to their lives.

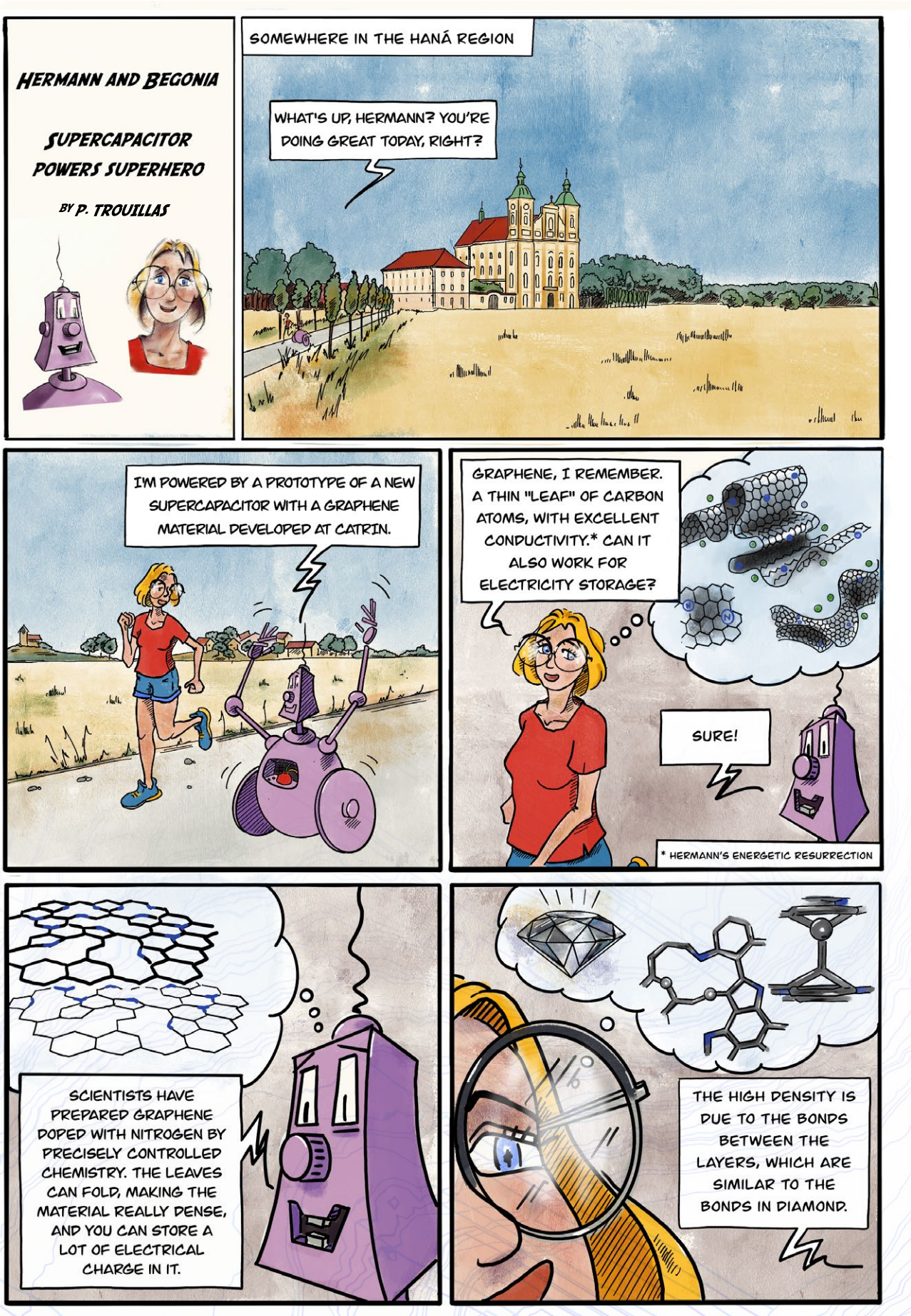
Soňa Gurská
The search for biologically active substances is toilsome

Finding a needle in a haystack—this is how Soňa Gurská compares high-capacity chemical screening as the first step in drug development. Using robotics and miniaturization, researchers look for biologically active substances that could be effective for a specific disease. For 11 years, the biochemist Soňa Gurská from CATRIN-IMTM has been working in this area of research, with a special focus on cancer treatment.

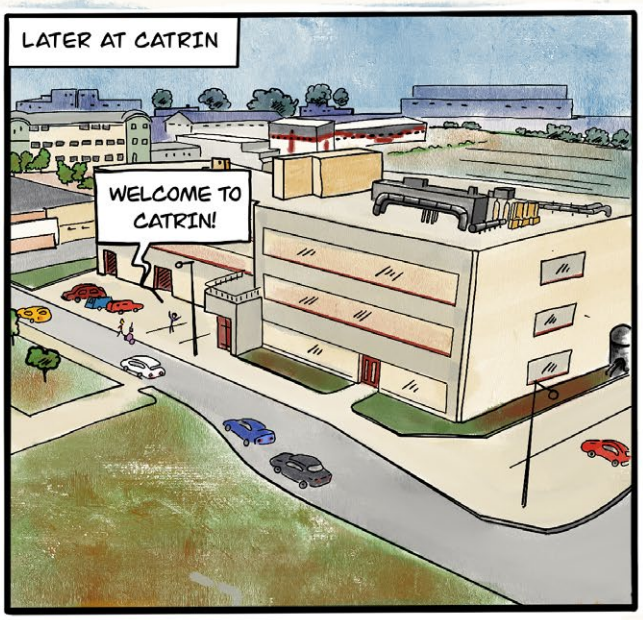
Soňa Gurská embarked on research immediately after studying biochemistry in Bratislava. She first worked at the Institute of Experimental Oncology of the Slovak Academy of Sciences, where she earned her doctorate. "I was driven to science by the need to learn new things, to gain profound knowledge and to self-develop. And, of course, there was also the dream of finding a cure for cancer. Now I know that one person cannot do it alone, and only multidisciplinary cooperation within a large team can achieve success," said Gurská.

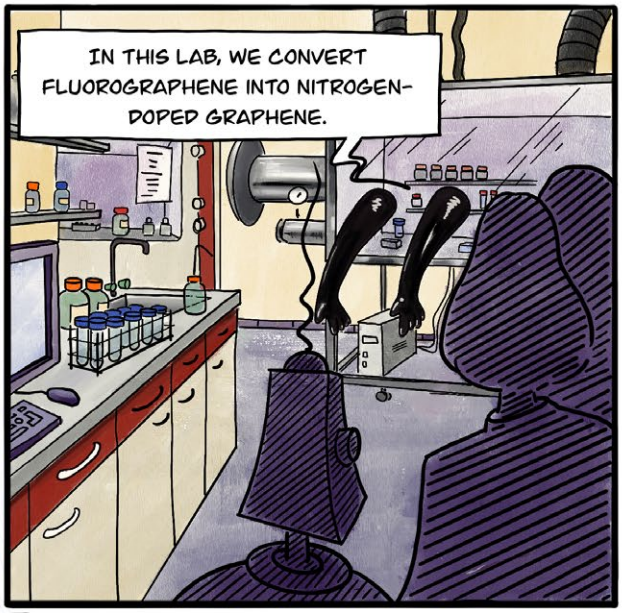
She came to Olomouc with her family at a time when a laboratory for high-capacity testing was being built at the IMTM. Since then, a huge number of substances have passed through her hands. "Our main task is to test chemical libraries against various biological targets and to find active candidates, so-called hits. Their identification and validation are a crucial first step in the early phase of drug development," she said, describing her work as a scientist.

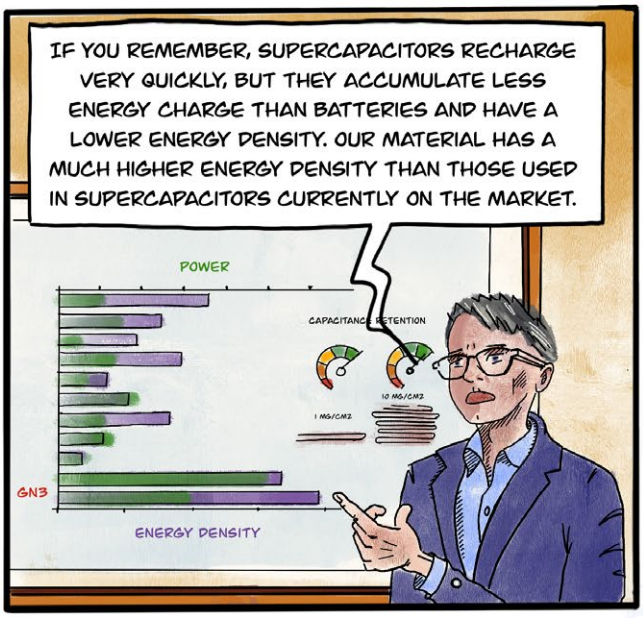
Hits are candidates that have the potential to become leading compounds in further drug development. They exhibit biological activity that is statistically significant and relevant to the pursued target. They then undergo further testing and optimization to develop effective and safe drugs.

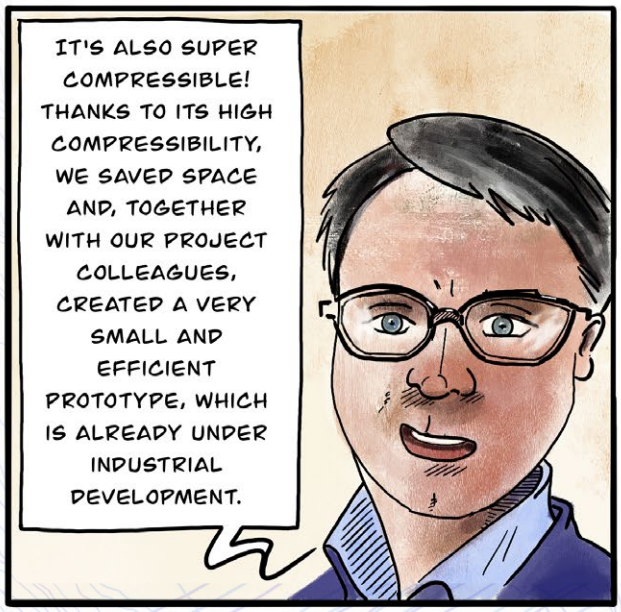

HERMANN AND BEGONIA
SUPERCAPACITOR POWERS SUPERHERO
BY P. TROUILLAS
SOMEWHERE IN THE HANÁ REGION
WHAT'S UP, HERMANN? YOU'RE DOING GREAT TODAY, RIGHT?
I'M POWERED BY A PROTOTYPE OF A NEW SUPERCAPACITOR WITH A GRAPHENE MATERIAL DEVELOPED AT CATRIN.
GRAPHENE, I REMEMBER. A THIN "LEAF" OF CARBON ATOMS, WITH EXCELLENT CONDUCTIVITY.* CAN IT ALSO WORK FOR ELECTRICITY STORAGE?
SURE!
* HERMANN'S ENERGETIC RESURRECTION
SCIENTISTS HAVE PREPARED GRAPHENE DOPED WITH NITROGEN BY PRECISELY CONTROLLED CHEMISTRY. THE LEAVES CAN FOLD, MAKING THE MATERIAL REALLY DENSE, AND YOU CAN STORE A LOT OF ELECTRICAL CHARGE IN IT.
THE HIGH DENSITY IS DUE TO THE BONDS BETWEEN THE LAYERS, WHICH ARE SIMILAR TO THE BONDS IN DIAMOND.

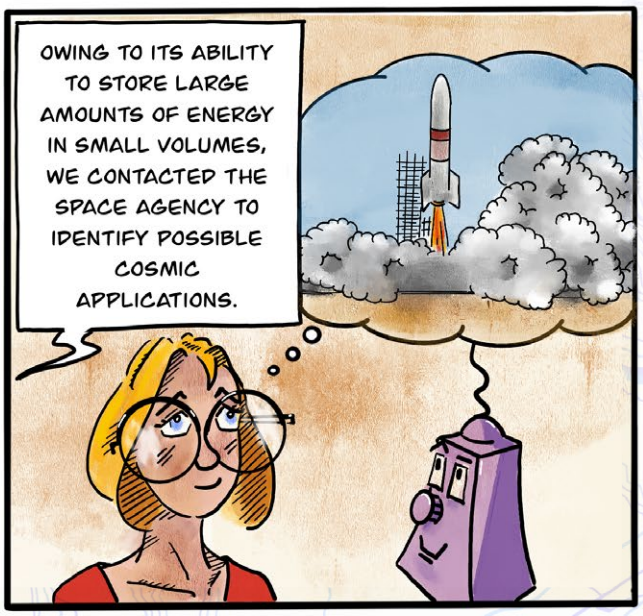

LET'S GO TO CATRIN, WHICH IS INVOLVED IN THE TRANSZDCHEM EUROPEAN PROJECT. THEY CAN TELL US MORE ABOUT THIS SUPER MATERIAL ON THE BORDER OF GRAPHENE AND DIAMOND.
LET'S GO!


LATER AT CATRIN
WELCOME TO CATRIN!


IN THIS LAB, WE CONVERT FLUOROGRAPHENE INTO NITROGEN-DOPED GRAPHENE.


IF YOU REMEMBER, SUPERCAPACITORS RECHARGE VERY QUICKLY, BUT THEY ACCUMULATE LESS ENERGY CHARGE THAN BATTERIES AND HAVE A LOWER ENERGY DENSITY. OUR MATERIAL HAS A MUCH HIGHER ENERGY DENSITY THAN THOSE USED IN SUPERCAPACITORS CURRENTLY ON THE MARKET.
POWER
CAPACITANCE RETENTION
10 MG/CM2
1 MG/CM2
GN3
ENERGY DENSITY


IT'S ALSO SUPER COMPRESSIBLE! THANKS TO ITS HIGH COMPRESSIBILITY, WE SAVED SPACE AND, TOGETHER WITH OUR PROJECT COLLEAGUES, CREATED A VERY SMALL AND EFFICIENT PROTOTYPE, WHICH IS ALREADY UNDER INDUSTRIAL DEVELOPMENT.


OWING TO ITS ABILITY TO STORE LARGE AMOUNTS OF ENERGY IN SMALL VOLUMES, WE CONTACTED THE SPACE AGENCY TO IDENTIFY POSSIBLE COSMIC APPLICATIONS.

Univerzita Palackého
v Olomouci

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