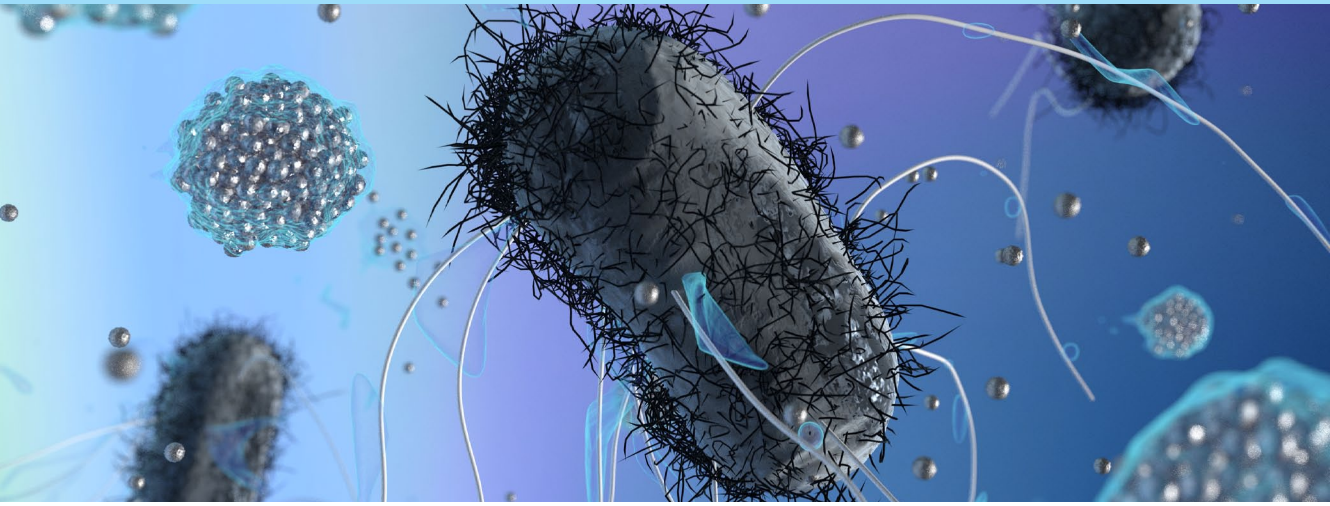
RCPTM NEWSLETTER
2/2018

REGIONAL CENTRE OF ADVANCED TECHNOLOGIES AND MATERIALS
Regionální centrum pokročilých technologií a materiálů

Palacký University Olomouc



Bacterial resistance to silver nanoparticles can be overcome

A mechanism that allows bacteria to resist the antibacterial effects of silver nanoparticles was discovered by scientists from the Regional Centre of Advanced Technologies and Materials (RCPTM) together with colleagues from the Faculty of Medicine and Dentistry of Palacký University and the Centre of the Region Haná. The scientists also developed a way to overcome this resistance mechanism. This remarkable achievement, which could play a significant role in resolving the global antibiotics resistance crisis, made the front page of *Nature Nanotechnology* in January 2018. This was the first time a team consisting solely of Czech scientists had published its results in this journal, which is arguably the most prestigious international journal of nanotechnology.

Scientists from Olomouc have been studying the biological effects of noble metal nanoparticles for twenty years. Details of their effects on diverse bacteria, including highly resistant phyla, were reported in 2006 (Panáček A. et al. *J. Phys. Chem. B* 110, 16248–16253, 2006), sparking intense academic and commercial interest in the applications of nanosilver. The increasing use of silver nanoparticles in commercial products prompted the team at Olomouc to consider the possible emergence of bacterial resistance induced by repeated exposure to nanosilver, which could weaken or eliminate its antibacterial activity. Bacteria have already developed resistance to several antibiotics, reducing their medical usefulness. After five years of study, the team discovered that bacteria can indeed develop resistance to nanosilver, but it can be easily overcome.

'It is already well-known that silver nanoparticles lose their antimicrobial effect if they form larger particles called aggregates. We found that flagellated bacteria can attack this weak point of silver nanoparticles. Repeated exposure to nanosilver causes some bacteria to secrete a protein called flagellin, which is a component of the flagella. This protein weakens the repulsive forces between the silver particles and acts as a glue, making them cluster into aggregates and thus lose their antibacterial properties,' said Aleš Panáček, lead author of the study.

This resistance could be overcome by adding substances that inhibit the production and release of flagellin. Such substances can be found in pomegranate extracts. 'If a pomegranate extract is applied along with silver nanoparticles, the bacteria will fail to produce flagellin, destroying their resistance to the silver nanoparticles,' said Libor Kvítek, a pioneer of nanosilver research at Olomouc.

Olomouc scientists have also developed a technology (which has been patented in Europe and the USA) that circumvents this resistance mechanism by forming strong chemical bonds between nanoparticles and various materials including plastics, metals, and fabrics. Immobilizing the nanoparticles like this prevents their aggregation, disabling the flagellin-based resistance mechanism and preventing the formation of bacterial films on the treated material. A couple of businesses in Europe have already expressed interest in this technology. 'This is the right course of action because robust nanosilver binding will prevent nanoparticle aggregation and eliminate bacterial resistance based on flagellin. At the same time, the nanoparticles will be not released into the environment and non-bacterial organisms will not be exposed to them,' explained Radek Zbořil, RCPTM Director.

The scientists from Olomouc have already published several studies in which they explored the high activity of silver nanoparticles against yeasts and the possibility of restoring the activity of antibiotics against multidrug-resistant bacteria by applying them in conjunction with nanosilver at very low concentrations that are non-toxic to mammalian cells.

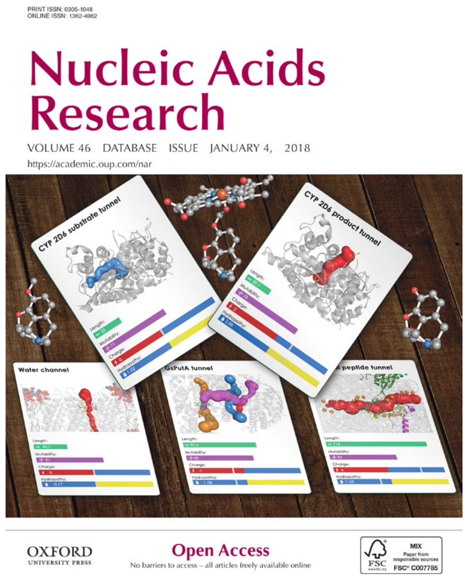
Panáček A., Kvítek L., Smékalová M., Večeřová R., Kolář M., Röderová M., Dyčka F., Šebela M., Prucek R., Tomanec O., Zbořil R.: Bacterial resistance to silver nanoparticles and how to overcome it, *Nature Nanotechnology* 2018, 13 (1), 65–71. IF = 38.986

Scientific Results

New database of biomacromolecular channels

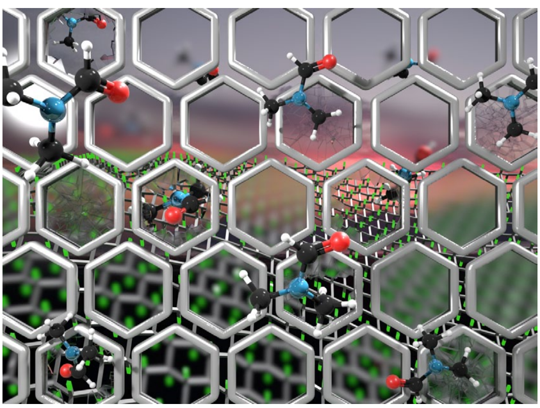
The structures of proteins and other macromolecular systems often contain channels or tunnels that can allow access to the active site or create selective transmembrane pores. Researchers from RCPTM have been studying these biomacromolecular channels for over ten years. Their efforts are important because understanding the function of these tunnels helps to explain the substrate specificity of key enzymes such as cytochromes P450. By collaborating with their colleagues at CEITEC Brno, the RCPTM researchers created a database of all known biomacromolecular channels — ChannelsDB. When establishing this database, they drew heavily on their experience in developing a toolkit called MOLE, which can be used to locate and characterize channels in biomolecular structures. The ChannelsDB database gathers information on individual macromolecular channels that have been explored previously and presents their geometrical and physical-chemical properties using a convenient interactive browser. These qualities make the database a sophisticated tool for analysing the functions of individual channels. This database and its supporting innovations made the front page of the prestigious biomedical journal *Nucleic Acids Research*.

Pravda L., Sehnal D., Svobodová Vařeková R., Navrátilová V., Toušek D., Berka K., Otyepka M., Koča J.: ChannelsDB: database of biomacromolecular tunnels and pores, *Nucleic Acids Research* 2018, 46 (D1), D399–D405. IF = 10.162



Fluorographene's radical centres are its Achilles heel

Developing methods for the controlled functionalization of graphene is a key goal in the chemistry of 2D materials because it opens up opportunities to prepare novel 2D materials with tailored electrical, magnetic, and optical properties. Because pristine graphene is rather unreactive, its direct functionalization requires quite harsh conditions that yield products with unstable compositions and irregular structures. Back in 2010, researchers at RCPTM showed (Zbořil R. et al. *Small* 6, 2885–2891, 2010) that fluorographene is a reactive material that is amenable to both substitution and reductive elimination under appropriate conditions, making it a versatile



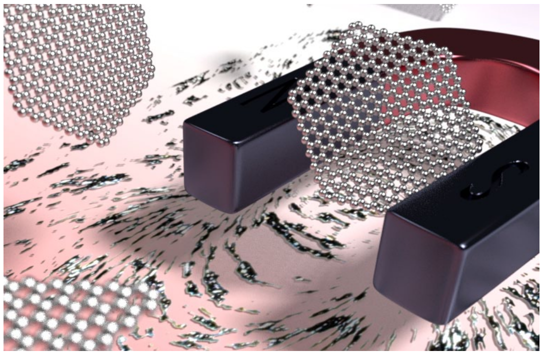
precursor for the controlled preparation of chemically modified graphene derivatives. Several reports have shown that it is possible to tune the chemical composition of fluorographene-derived materials by adjusting the reaction conditions (Bakandritsos A. et al. *ACS Nano* 11, 2982–2991, 2017; Chronopoulos D. D. et al. *Chem. Mater.* 29, 926–930, 2017), but it is clear that a deep understanding of the relevant reaction mechanisms at the molecular level will be needed to truly control the process. The reactivity of fluorographene is particularly interesting: because it is a 2D analogue of Teflon with very strong C-C and C-F bonds, it was expected to be chemically inert (Nair R. R. et al. *Small* 6, 2877–2884, 2010). Subsequent publications identified the antibonding σ^* orbital of the C-F bond as a potential weak point that might explain this material's surprising reactivity. However, when the RCPTM team stepped in to test this hypothesis, it was found to only be relevant in reactions involving very strong reducing agents. To explain the reactivity of fluorographene in a satisfactory way, we needed to consider the role of radical defects in the structure. A joint effort by theoretical and experimental groups at RCPTM led to the discovery that these radical centres have a significant electrophilic character and, depending on their environment, can trigger either reduction or nucleophilic substitution. We can therefore see these radical centres as the Achilles heel of fluorographene.

Medveď M., Zoppellaro G., Ugolotti J., Matochová D., Lazar P., Pospíšil T., Bakandritsos A., Tuček J., Zbořil R., Otyepka M.: Reactivity of fluorographene is triggered by point defects: beyond the perfect 2D world, *Nanoscale* 2018, 10 (10), 4696–4707. IF = 7.367

Manipulating graphene's morphology as a strategy for tuning its magnetic features

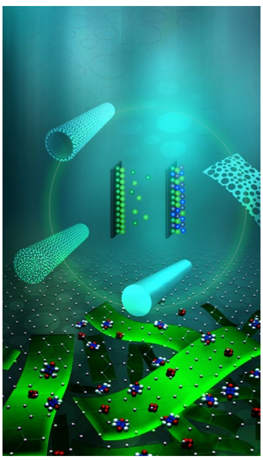
Graphene is a material with unique optical, electrical, mechanical, and transport properties. One of its few drawbacks is the absence of the magnetic ordering. Therefore, since its discovery, many research groups around the world have searched for ways of instilling sustainable magnetism into graphene. RCPTM researchers have previously described a way of triggering strong magnetism in graphene by sulfur and nitrogen doping (Tuček J. et al. *Adv. Mater.* 28, 5045–5053, 2016 and Błoński P. et al. *JACS* 139, 3171–3180, 2017), showing the crucial role of the dopant's concentration and its structural configuration in the 2D architecture of graphene. Last year, the same group proposed a completely new way of creating the first non-metallic magnets based on an *sp*^{3}-functionalized graphene derivative known as hydroxofluorographene. The antiferromagnetic arrangement of this material is sustained even at room temperature (Tuček J. et al. *Nat. Commun.* 8, 14525, 2017).

More recently, the RCPTM team worked together with the group of Prof. Pumera in Singapore to prepare ultra-small graphite sheets with various morphologies. A detailed experimental and theoretical study revealed that the morphology of the sheets has a surprisingly strong influence on the sustainability of the magnetic ordering due to the synergistic effects of size, morphology, edge architecture, and the angles between adjacent edges. Triangular motifs were identified as particularly promising magnetic materials, retaining ferromagnetic ordering at up to 100 K. These morphologies thus have considerably more practical potential than the much more widely studied graphene nanoribbons. By combining morphology-based strategies with methods such as chemical doping and functionalization, it may be possible to prepare materials with important applications in magnetic transport or spintronics.



Tuček J., Błoński P., Malina O., Pumera M., Chua C.K., Otyepka M., Zbořil R.: Morphology-Dependent Magnetism in Nanographene: Beyond Nanoribbons, *Advanced Functional Materials* 2018, in press, DOI: 10.1002/adfm.201800592. IF = 12.124

New ways to store energy employing porous carbon nanostructures



The development of new high-efficiency supercapacitors with high energy storage capacities is linked to the use of advanced nanomaterials. A paper recently published in *Advanced Materials* describes how the RCPTM team worked together with colleagues from Germany to develop a new class of two-dimensional nanoporous carbon structures that display extraordinary efficiencies when used as electrode materials for supercapacitors. Carbon nanosheets prepared by the decomposition of metal organic frameworks (MOFs) exhibit hierarchical porous structures with large surface areas that facilitate ion transport. Using potassium iodide as the redox-active component and sulfuric acid as a supporting electrolyte, a record energy density of 90W/kg was achieved, which is higher than that for commercial rechargeable batteries. This new synthetic strategy thus enables the development of multifunctional systems combining the properties of the most powerful existing batteries and capacitors.

The research builds on the long-standing collaboration between RCPTM scientists and the group of Prof. Fischer at TUM in Munich (e.g. Dubal D.P. et al. *J. Mater. Chem. A* 6, 6096–6106, 2018; Jayaramulu K. et al. *Adv. Mater.* 29, 1605307, 2017; Jayaramulu K. et al. *Angew. Chem., Int. Ed.* 55, 1178–1182, 2016).

Jayaramulu K., Dubal D.P., Nagar B., Ranc V., Tomanec O., Petr M., Datta K.K.R., Zboril R., Gómez-Romero P., Fischer R.A.: Ultrathin Hierarchical Porous Carbon Nanosheets for High-Performance Supercapacitors and Redox Electrolyte Energy Storage, *Advanced Materials* 2018, 30 (15), 1705789. IF = 19.791

Other publications from RCPTM

Šponer J., Bussi G., Krepl M., Banáš P., Bottaro S., Cunha R.A., Gil-Ley A., Pinamonti G., Poblete S., Jurečka P., Walter N.G., Otyepka M.: RNA Structural Dynamics As Captured by Molecular Simulations: A Comprehensive Overview, *Chemical Reviews* 2018, in press, DOI: 10.1021/acs.chemrev.7b00427. IF = 47.928

Halder A., Kilianová M., Yang B., Tyo E.C., Seifert S., Prucek R., Panáček A., Suchomel P., Tomanec O., Gosztola D.J., Milde D., Wang H.-H., Kvítek L., Zbořil R., Vajda S.: Highly efficient Cu-decorated iron oxide nanocatalyst for low pressure CO_2 conversion, *Applied Catalysis B: Environmental* 2018, 225, 128–138. IF = 9.446

Dubal D.P., Jayaramulu K., Zboril R., Fischer R.A., Gomez-Romero P.: Unveiling $BiVO_4$ nanorods as a novel anode material for high performance lithium ion capacitors: beyond intercalation strategies, *Journal of Materials Chemistry A* 2018, 6 (14), 6096–6106. IF = 8.867

Han H., Kment S., Karlicky F., Wang L., Naldoni A., Schmuki P., Zboril R.: Sb-Doped SnO_2 Nanorods Underlayer Effect to the α-Fe_2O_3 Nanorods Sheathed with TiO_2 for Enhanced Photoelectrochemical Water Splitting, *Small* 2018, in press, DOI: 10.1002/smll.201703860. IF = 8.643

Li D., Jing P., Sun L., An Y., Shan X., Lu X., Zhou D., Han D., Shen D., Zhai Y., Qu S., Zbořil R., Rogach A.L.: Near-Infrared Excitation/Emission and Multiphoton-Induced Fluorescence of Carbon Dots, *Advanced Materials* 2018, 30 (13), 1705913. IF = 19.791

Interview

"The positive atmosphere at RCPTM is contagious"

Martin Pumera, one of the world's most esteemed chemists, has spent most of his professional life abroad. He is currently a lead foreign researcher at the University of Chemistry and Technology Prague (VŠCHT), where he is assembling a new research group to work on the development of nanorobots. He has also been collaborating with RCPTM for around five years, and his ideas instantly struck a chord with the team.

During your time working abroad, you maintained a close collaboration with RCPTM. When did it start?

I began working abroad in 2001 and have been cooperating with RCPTM since 2013. Back then, I was in Singapore, and Professor Otyepka invited me to come to Olomouc. I was very busy at the time, but I gladly accepted his invitation because it was clear that RCPTM has a very professional approach and is conducting world-class research. The centre works on materials similar to those that my team studies, but primarily focuses on different applications. This creates opportunities for extremely fruitful cooperation. The scientists in the RCPTM team are very determined and results-oriented, which really appeals to me. Our first meeting produced broad visions of several different projects, many of which we managed to realize within two years.

Which areas does the collaboration involve? How do you benefit from it?

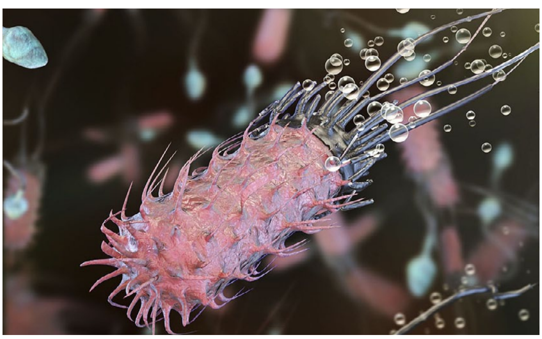
We have focused on developing 2D materials for catalysis, electrochemistry, and biosensing. Our teams have different synthetic skills and are interested in different applications, allowing us to look at problems from several angles. Our results, published and unpublished, therefore have high added value, and our cooperation with other groups at RCPTM allows us to gain important insights that would otherwise be inaccessible.

Which of your accomplishments in cooperation with RCPTM are most important to you? What other challenges would you like to address?

Everything we have achieved is important. Research means looking for answers about nature and how it works. We are currently working with the theoretical group at RCPTM to explore and explain electrocatalysis on 2D materials; our challenge is to determine the rules that govern these processes on 2D materials ranging from chalcogens of transition elements to the group VA elements.

You seem to have kept a close eye on the progress of Czech science during your years abroad. How did you view it? What about the performance of RCPTM?

When you become less involved in something, you can obviously see it from a different perspective; you can focus exclusively on what is really important. Generally speaking, Czech scientists have very good technical knowledge, but there may be room for improvement when it comes to applying that knowledge in highly competitive research. As I see it, some Czech universities lack long-term vision; they do not know what they want to be like in 10 to 20 years' time. International ratings are calculated in relative terms, which makes the Czech Republic seem like an uncompetitive environment. However, RCPTM stands out as a leading centre in materials science and the life sciences. Professor Zbořil and his team deserve huge credit for having built a highly recognized centre that has succeeded against stiff international competition. RCPTM is full of enthusiastic and creative scientists and its positive atmosphere is contagious. It is always joy to come here.



You are putting together a new excellent research team at VŠCHT to study and develop nanorobots. Can you tell us more?

Research on nanotechnologies and nanomaterials is moving on from simply creating new nanostructures to designing functional materials. One of the most important areas of nanotechnology is nanoarchitecture —designing multifunctional materials with well-defined structures. The vast majority of nanomaterials, including nanostructures with high levels of organization, are static structures. However, there has been a strong shift of focus towards dynamic nanostructures in recent years. The area of autonomously moving nanorobots has attracted particular attention because such nanorobots can detect chemical substances in their environment and respond to them in specific ways. The robots have an engine component, which constitutes the main body of the nanostructure and makes it moveable. The body is also functionalized with elements that allow detection, such as using bioelements (ssDNA, proteins), a suspended load, or something that responds to electromagnetic waves.

What is the main goal?

The primary goal is to design nanorobots capable of self-organization in big clusters. Such systems will be able to detect pollution, decontaminate the environment, transport biologically active substances (e.g. drugs) into cells, find and destroy cancer cells, perform micro-operations, or find natural resources in the ocean.

I suppose you use the contacts you have made across the world...

The centre for advanced functional nanorobots has currently 16 members, most of whom are from different parts of the world – we have members from Germany, England, Sweden, Iran, Spain, Portugal, Singapore, and Peru. In addition to doing research, we aim to be an institution that attracts the best scientists from around the world (we currently have 2 scientists here on Marie Curie fellowships) and students from VŠCHT.

Our Grants

Helping emerging biotechnologies and nanotechnologies go from the lab to the marketplace

Supporting research into pre-application stage nanotechnology and biotechnology – i.e. new technologies that are not yet ready for commercial use – is the main aim of a new joint project between the Regional Centre of Advanced Materials and Technologies (RCPTM) and the Centre of the Region Haná for Biotechnological and Agricultural Research (CRH). The centres have been granted 125,8 million Czech crowns from the Operational Programme Research, Development and Education—Pre-application research for ITI (Integrated Territorial Investment).

'This is another great achievement for RCPTM. Having succeeded in *Excellent Research* and *Excellent Research Teams* projects, we have now obtained funding for pre-application research. These successes are unmatched by any other institution in our country, said Radek Zbořil, RCPTM Director.

The scientists will develop new technologies with potential applications in agriculture, food processing, environmental remediation, and medicine. 'The project will connect the excellent research conducted at the two centres and support potential technology transfers. It will also explore commercial applications of the research results and secure legal protection for innovations that are made, allowing them to be licensed to commercial partners or used in other ways,' said Lucie Plíhalová, manager of the project.

Work done at Palacký University has made the Olomouc region consistently successful in transferring new technologies derived from fundamental research into industrial practice. However, there is still room for improvement. 'The uniqueness of the project lies in supporting applied research that is independent of any particular

commercial sector. The results will be finalized within the centres before being commercialized by a joint technology transfer effort involving both centres,' said Pavel Tuček, co-author of the project application from RCPTM.

The project will involve eight teams. The RCPTM team will work on nanotechnology for environmental applications such as waste processing that could be deployed in sustainable agricultural systems without adversely affecting farmland. The scientists will also explore the potential of magnetic nanoparticles as tools for identifying and separating biologically important molecules. These technologies may be useful in food processing, pharmacology, and biomedicine.

Importantly, the grant will enable the centres to buy essential new equipment to support their work during the pre-application stage. In addition, new vacancies will be established, providing opportunities for promising young scientists.

Work on the project will begin in June 2018 and continue until 2022. Its results will be made available to businesses in the Olomouc region.

Introducing a Scientific Infrastructure

X-ray photoelectron spectroscopy (XPS), also known as Electron spectroscopy for chemical analysis (ESCA), is one of the most effective characterization techniques used at RCPTM. XPS is an irreplaceable method for studying the chemical properties of material surfaces and thin layers. It allows materials to be analysed to a depth of up to 10 nm, providing detailed information on the chemical composition of surfaces and their bonding.

RCPTM possesses a unique instrument made by Physical Electronics (PHI VersaProbe II) that is equipped with a rotation Al anode and a monochromatic raster-scanned X-ray beam. This sophisticated XPS system enables the use of many different techniques including basic point spectroscopy, depth profiling using an argon sputter ion gun, chemical state imaging, angle-dependent XPS (with depth profiling using an automated sample manipulator), measurements of frozen samples, transportation of samples in sealed cells, and several other experimental techniques. The XPS system is directly connected to a high vacuum/high temperature reactor (permitting the use of pressures and temperatures of up to 20bar/650°C) and allows the use of several different reaction gases (N_2, CO, O_2, H_2, etc.). The direct connection allows samples

to be transferred between the analytical chamber and the reactor without leaving ultra-high vacuum. This outstandingly versatile XPS system enables sophisticated chemical analyses of surfaces and thin films.

Awards

Hanuš Memorial Medal awarded to Karel Lemr, a Czech analytical chemist at RCPTM

The Czech analytical chemist Karel Lemr has won the 2017 Hanuš Memorial Medal, the most prestigious award for scientific achievement in chemistry granted by the Czech Chemical Society (ČSCH). At RCPTM, Professor Lemr leads the Nanotechnology in Analytical Chemistry research group. He collected the prize during the opening ceremony of the international Advances in Chromatography and Electrophoresis & Chiranal conference in Olomouc, which was held at the end of January. Professor Lemr has helped organize this event for many years.

ČSCH awards prizes to successful domestic and international scientists every year; the Hanuš Memorial Medal is awarded to scientists who have made outstanding scientific and pedagogical contributions. 'Professor Lemr received the prize for his work on new methods for analysing biologically active substances using mass spectrometry together with high-performance separation methods. He has achieved great results that have attracted the interest of analytical chemists around the world,' said Vilím Šimánek, the head of the ČSCH subsidiary in Olomouc.

Professor Lemr considers the award a privilege because he sees ČSCH as a very valuable institution. 'It has a long and rich history, and its membership includes many eminent Czech chemists past and present, such as Otto Wichterle and Jaroslav Heyrovský. I am pleasantly surprised that the Society has chosen to recognize my work in this way, and of course very grateful – this award is both gratifying feedback on my achievements and outstanding motivation for further efforts,' said the honouree.

Prof. Lemr is the second member of the faculty at RCPTM to be honoured with the Hanuš Memorial Medal; in 2016, it was won by Prof. Pavel Hobza.

Congratulations!

We are delighted to extend our warmest congratulations to Prof. Pavel Hobza for a remarkable achievement: he is the first scientist in the Czech Republic whose Web of Science h-index has reached 100.

'Although I am the only one so far to hit this career milestone, there are several promising candidates at RCPTM who have the potential to achieve the same success in the future', said Prof. Hobza.

RCPTM student wins the Werner von Siemens Award for the best PhD thesis

Kateřina Holá and her PhD thesis supervisor Radek Zbořil, Director of RCPTM, have won the very prestigious Werner von Siemens Award for the best PhD thesis. Her work also won a special award for the best thesis written by a female scientist.

'Kateřina Holá is an outstanding scientific researcher who has been remarkably successful in an incredibly short period of time. She first demonstrated her potential and extensive knowledge during her master's studies, and has proven herself to be an outstanding scientist in the course of her doctoral work. She has also displayed excellent team spirit: as a doctoral student, she has published research results obtained in collaboration with internationally recognized scientists from the USA, Hong Kong, Greece, and Singapore. She has won the respect of everyone she has worked with,' said Zbořil.

Her doctoral thesis concerns the preparation and application of innovative nanostructures, particularly in biomedicine. By applying her knowledge of chemistry, physics, biology and medicine, Kateřina succeeded in envisioning and realizing the synthesis of carbon quantum dots. Carbon quantum dots can be used to create optical displays for medical diagnosis, to label cells, and in antitumor therapy. Their properties may also enable the development of new kinds of LED diodes and photocatalysts. Her work has contributed to the development of new graphene derivatives, and has been published in several prestigious journals including *Nature Communications*, *ACS Nano*, and *Advanced Materials*. She is currently a postdoctoral fellow at Uppsala University in Sweden.

Dr. Holá is the second Olomouc PhD student to win the Werner von Siemens Award; in 2012, it was awarded to Karel Lemr (now an assistant professor at the joint Laboratory of Optics at Olomouc) and his supervisor, Jan Soubusta.

Happened Recently…

The Course on Contemporary Chemistry aroused great interest

Jan Pirk, a heart surgeon at Prague IKEM; Karel Janeček, a mathematician, entrepreneur and anti-corruption campaigner; Jan Ryot, art historian and vice-rector at Charles University Prague; and Cyril Höschl, psychiatrist were all guest speakers in the 13th year of the Contemporary Chemistry lecture series, which is overseen by Pavel Hobza, *Česká hlava* honoree. The lectures covered a range of topics outside chemistry this time round, focusing on some serious social issues and attracting interest from both academics and the general public.

'I told myself that the 13th year would be different, exceptional. I tried to meet the students' requirements and invite speakers who could help us to find answers to more complex questions. We were able to bring many leading researchers from a wide variety of disciplines to

Olomouc, allowing our students to explore the magic and beauty of science,' said Pavel Hobza, the coordinator of the lecture series.

Jan Pirk discussed the life of a heart surgeon. Two weeks later, Pavel Janeček introduced his vision of a novel election system called Democracy 21. Jan Ryot, a professor of art history specializing in the period between the early Christian and baroque eras, tackled the issue of God and his image across different religions over the course of history. Cyril Höschl concluded the series with a lecture on conscious and subconscious human behaviour.

'Professor Hobza's activity is tremendously valuable to all of us. The Course on Contemporary Chemistry enables our students to broaden their horizons greatly, and undoubtedly enhances the university's reputation,' said Michal Otyepka, Head of Department of Physical Chemistry, which organizes the event. Videos and further information are available on the *offical website of the department*.

First meeting of the new Scientific Board

The first meeting of the RCPTM Scientific Board was held on March 22 and introduced the Board to the centre's premises, activities, and results. The meeting was attended by seven of the board's eight members, and the centre's general director.

'The primary goal of this event was to introduce the activities of RCPTM to the members of the Scientific Board. We highlighted research done over the past three years in particular. All eight of the centre's research groups presented results from their fundamental and applied research programs and discussed their collaborations with commercial organizations,' said Ondřej Haderka, RCPTM's Scientific Director. The meeting also involved a tour of the centre and its laboratories. 'We introduced all the techniques we use here and the projects we are currently working on,' added Ondřej Haderka.

The Scientific Board, which has both Czech and foreign members, will meet once a year. Its members are Jiří Čejka (J. Heyrovský Institute of Physical Chemistry of the Academy of Science of the Czech Republic and Charles University Prague), Antonín Fejfar (J. Heyrovský Institute of Physical Chemistry of the Academy of Science of the Czech Republic), Roland A. Fischer (Technical University of Munich), Paolo Fornasiero (University of Trieste), Wolfgang Lindner (University of Vienna), Arben Merkoci (Catalan Institute of Nanoscience and Nanotechnology), Marián Valko (Slovak University of Technology in Bratislava), and Ladislav Kavan (J. Heyrovský Institute of Physical Chemistry of the Academy of Science of the Czech Republic). The Scientific Board monitors the centre's activities, suggests major areas of research, and highlights ways of translating the centre's scientific results into practical applications.

Niyazi Serdar Sariciftci delivered the latest talk in the Rudolf Zahradník lecture series

Physical and materials chemist Niyazi Serdar Sariciftci from Johannes Kepler University, Linz, spoke as part of the *Rudolf Zahradník Lecture Series*. He lectured on Organic and Bio-organic systems for Solar Energy Conversion and CO_2 Recycling on the 11th of April in the assembly room at the Faculty of Science of Palacký University in Olomouc.

Professor Sariciftci's research has resulted in several important discoveries in the fields of photo-induced charge transfer, optical behaviour, and magnetic resonance, as well as the description of many novel phenomena occurring in semiconductors and metal-containing polymers. He has invented solar cells that operate on the principle of conjugated heterotransitions between polymers and fullerenes. This work has triggered further investigations into new areas and devices such as polymer photodetectors and organic solar cells. His current work is focused on new topics including the electromagnetic reduction of carbon dioxide and bio-organic electronics.

'Our centre's research on solar cells and direct water splitting using solar energy has been driven by the application of novel nanotechnological approaches. Professor Sariciftci's research on organic systems for solar energy conversion and carbon dioxide recycling seems to complement our work very well, and could serve as the foundation for new joint research projects,' said Radek Zbořil, RCPTM Director.

Professor Sariciftci has published extensively in journals such as *Science*, *Nature Materials*, and *Nature Photonics*. He has authored over 600 papers and received over 45 thousand citations; his h-index is 91. Among other institutions, he worked at the Centre for Polymer and Organic Solids in California under the supervision of Alan J. Heeger, who won the Nobel Prize in Chemistry in 2000.

The Zahradník lecture series is named for Rudolf Zahradník, who was a pioneer of quantum chemistry. The lectures have been organized by RCPTM since 2013, and are intended to introduce the work of leading chemists and materials scientists to both academics and the general public.

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