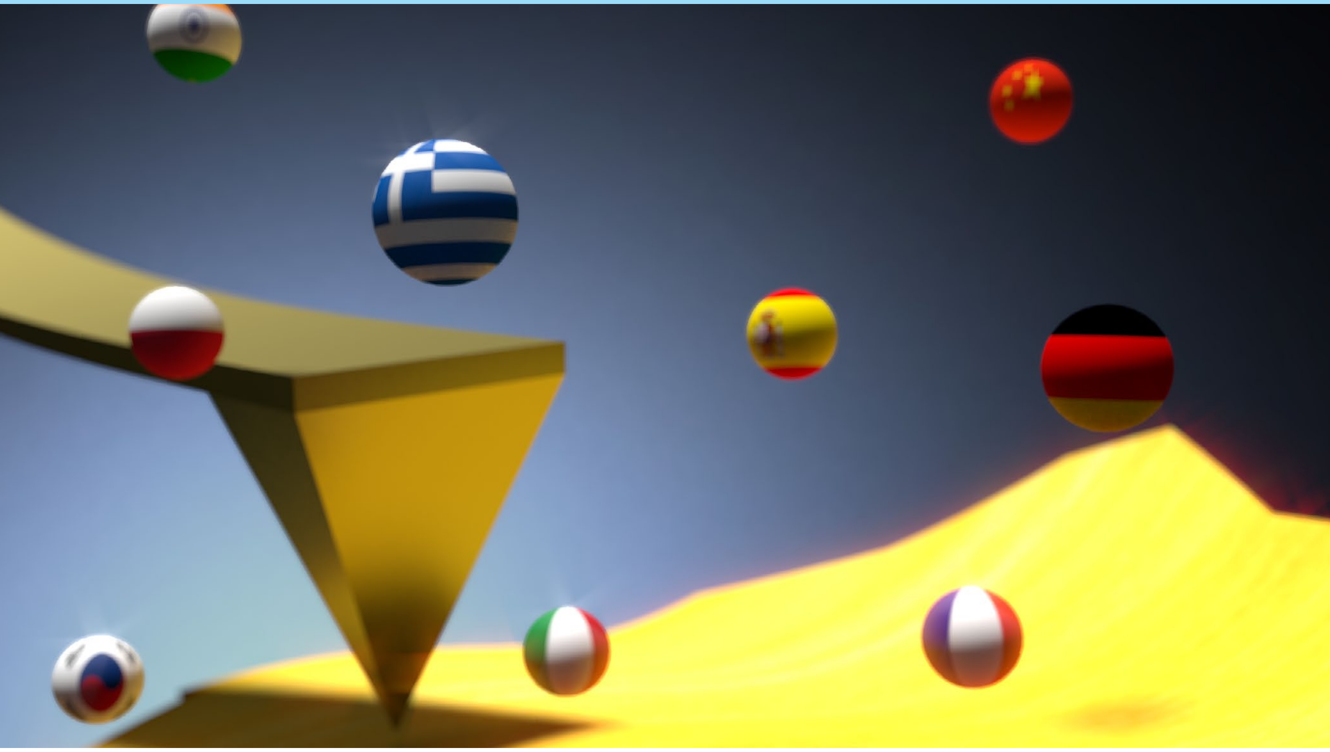
RCPTM NEWSLETTER

2/2017

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

Palacký University Olomouc



RCPTM welcomes a new wave of outstanding Czech and foreign scientists

It will be five years in October since the opening of the new RCPTM building. During that time, dozens of scientists from 20 countries around the world have worked here. RCPTM has launched another round of internationalization and staffing of individual working groups this year. In this issue of our quarterly newsletter, we introduce you to the scientific activities of the Centre's new employees through their publications under the aegis of RCPTM. You can read about the research into alternative sources of green energy mediated by 1D nanostructures, led by Patrik Schmuki from Germany (Kment S. et al. *Chem. Soc. Rev.* 46, 3716–3769, 2017) and possible applications of plasmonic materials being explored by Alberto Naldoni from Italy (Naldoni A. et al. *Science* 356, 908–909, 2017), who has energized the Photoelectrochemical group with fresh knowledge and skills. You can also learn about our cooperation with collaborators from the Technical University of Munich (Jayaramulu K. et al. *Adv. Funct. Mater.* In Press, 2017), from where Jaya Ramulu Kolleboyina is coming to RCPTM. He works on metal organic frameworks for advanced energy and environmental applications. The first joint work (Onoda J. et al. *Nat. Commun.* 8, 15155, 2017) between RCPTM and the Institute of Physics of the Czech Academy of Sciences is introduced by Pavel Jelínek, who was interviewed by Martina Šaradínová about the unique possibilities of looking into molecules' microcosms with scanning tunneling microscopy (STM) and new additions from abroad to the newly built microscopy laboratory in Olomouc. In this issue, we also present new members of the Learned Society of the Czech Republic (Michal Otyepka, a group leader of the Carbon nanostructures team) and Royal Society of Chemistry (Manoj B. Gawande, a leader of the Nanocatalysis group). Moreover, the next speaker in the Rudolf Zahradník Lecture Series, Paolo Fornasiero from the University of Trieste, an editor of the journal *ACS Catalysis*, is introduced. He is a leading scientist in the development of nanomaterials used in energetics and heterogeneous catalysis, and author of a number of publications in *Science* and the *Nature* family of journals. We are also starting a section called Our Graduates, where Kateřina Holá, who recently completed her doctoral studies, discusses the joys and sorrows of a scientific profession. She has coauthored works in various journals, for instance, *Nano Today* (2014), *Chemical Reviews* (2016), *Advanced Materials* (2015), and *Nature Communications* (2016, 2017). In this issue, the Our Grants section focuses on the applied results and publications of the Nanobiowat Competence Centre of the Technology Agency of the Czech Republic, and collaboration with Czech and foreign partners in water and soil treatment by nanotechnologies.

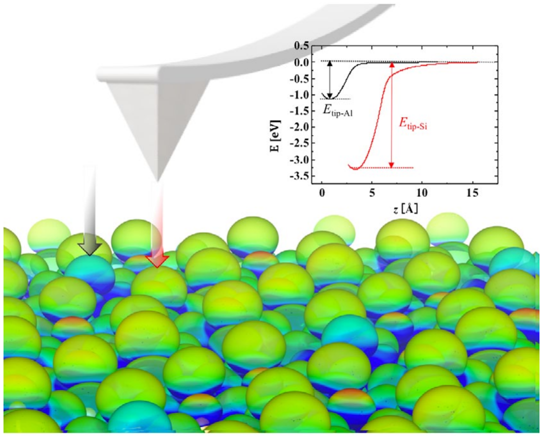
I wish you pleasant reading and an enjoyable summer

Radek Zbořil
General Director

Scientific Results

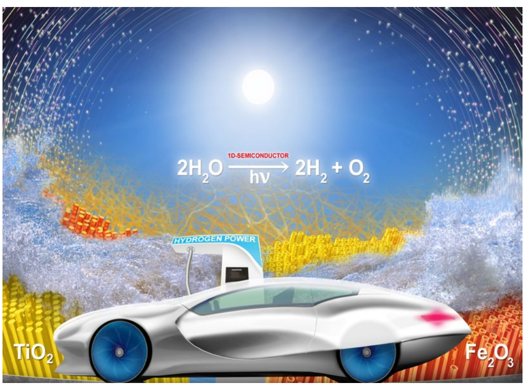
A new method changes views of elements' chemical properties

The electronegativity of elements, which determines (among other things) the ability of a given atom to react with its surroundings and create chemical bonds, could only be determined until recently by techniques involving large atom complexes. However, pioneering research by Pavel Jelínek and his colleagues from the Institute of Physics of the Czech Academy of Sciences and University of Tokyo has provided new options. Thanks to their new method, atomic force microscopy provides means not only to determine the electronegativity of an atom on the surface of a solid but also its dependence on the chemical surroundings. Following up their earlier work (Sugimoto Y. et al. *Nature* 446, 64–67, 2007), the teams' new method overcomes limitations of the original process of chemical identification of atoms and provides a way to identify chemical elements with different electronegativities. The researchers have shown that previously obtained data on elements' electronegativity only applies to the isolated atoms. The possibility to determine changes in an atom's electronegativity linked to changes in its chemical environment brings new views not only of this property but also of the related nature of bonds in chemical compounds and chemical reactivity. The researchers have empirically proved the characteristic linear dependence between the binding energies of surface atoms in different chemical milieu. Thus, they have experimentally verified the validity of the Nobel Prize-winning chemist Linus Pauling's equation describing the polarity of covalent bonds.



Onoda J., Ondráček M., Jelínek P., Sugimoto Y.: Electronegativity determination of individual surface atoms by atomic force microscopy, *Nature Communications* 2017, 8, 15155. IF = 12.124

1D nanostructures can speed the journey to green energy



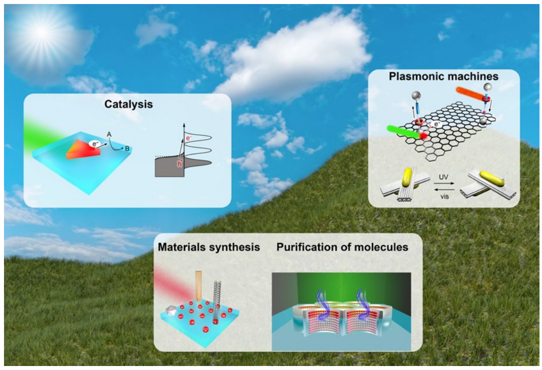
Kment S., Riboni F., Pausova S., Wang L., Wang L., Han H., Hubicka Z., Krysa J., Schmuki P., Zboril R.: Photoanodes based on TiO_2 and α-Fe_2O_3 for solar water splitting – superior role of 1D nanoarchitectures and of combined heterostructures, *Chemical Society Reviews* 2017, 46, 3716–3769. IF = 38.618

Production of energy from renewable sources, such as the sun and water, poses some of the greatest challenges of contemporary global science. Semiconductor materials like titanium dioxide (TiO_2) and iron oxide in the crystal form of hematite (α-Fe_2O_3) are considered the most promising materials for producing anodes that could be used to obtain hydrogen via photoelectrochemical water-splitting. Advantages of these materials include high stability, nontoxicity, ready availability, and low production costs. However, the problematic transfer of sun-generated charge carriers still considerably limits industrial application of this technology. In a review article, the RCPTM authors show that the key to overcome this drawback is to use TiO_2 and α-Fe_2O_3 anodes in the form of so-called one-dimensional (1D) nanostructures. These may be nanotubes, nanorods, or nanowires. Such 1D nanoarchitectures enable effective separation of photo-induced charged particles, which considerably reduces their repeated recombination.

The influence of 1D morphology substantially increases the specific surface of an anode, and thus the proportion of absorbed light and photoelectrochemical (PEC) transformation efficiency. In this publication, the scientists describe a number of synthetic methods leading to TiO_2- and Fe_2O_3-based 1D structures. They also mention other strategic modifications of 1D anodes, such as doping by various elements, co-catalyst use, and multicomponent nanoheterostructures, which can further increase PEC efficiency.

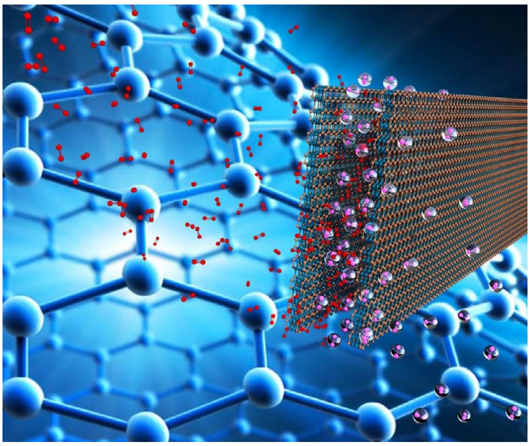
Applications of plasmonics for a sustainable future

Thanks to several key properties, plasmonic materials allow unprecedented use of incident light by clouds of electrons, called surface plasmons. An article including RCPTM staff member published in *Science* in the Perspectives section reviews the possible impact of plasmonics on future mechanisms of management, control, and optimization of chemical processes. Plasmonic materials allow, for instance, new chemistry of catalytic reactions, which are usually possible only under extreme conditions. The next potential use of surface plasmons in chemistry is intense local heating. This phenomenon can be used to increase the energetic efficiency of various chemical reactions, and has high-potential applications in the controlled growth of nanostructures, water treatment, and solar distillation. Another interesting opportunity is to create plasmonic machines capable of performing intelligent operations, such as molecular transport and information processing. Plasmonics can help to speed the transition to a clean and sustainable society by allowing, manipulating, and improving chemical processes with atomic-scale precision and control.



Naldoni A., Shalaev V.M., Brongersma M.L.: Applying plasmonics to a sustainable future, *Science* 2017, 356, 908–909. IF = 37.205

New 2D composites for efficient electrochemical water-splitting



In a joint publication, authors from RCPTM, the Technical University of Munich, and Ruhr-University Bochum have introduced a highly efficient composite electrocatalyst for a hydrogen evolution reaction (HER) and oxygen evolution reaction (OER), which are key parts of electrochemical water-splitting. The catalyst includes a unique combination of nitrogen-doped graphene oxide and nickel sulfide (Ni_7S_6) prepared by transformation of a nickel metal organic framework (MOF). It has exceptional electrocatalytic efficiency due to a large specific surface area, hierarchical structure of the 2D composite system with high pore volume, accessibility of the active metal centers, and doping of the graphene structure with nitrogen. Because of the high efficiency for HER and OER reactions and extraordinary stability, the composite material is a competitive alternative to the expensive commercial oxides based on precious metals (RuO_2 and IrO_2) that have been used so far.

Jayaramulu K., Masa J., Tomanec O., Peeters D., Ranc V., Schneemann A., Zbořil R., Schuhmann W., Fischer R.A.: Nanoporous Nitrogen-Doped Graphene Oxide/Nickel Sulfide Composite Sheets Derived from a Metal-Organic Framework as Efficient Electrocatalyst for Hydrogen and Oxygen Evolution, *Advanced Functional Materials*, Article in press, 2017. DOI: 10.1002/adfm.201700451. IF = 12.124

Other publications from RCPTM

Kou J., Lu C., Wang J., Chen Y., Xu Z., Varma R.S.: Selectivity Enhancement in Heterogeneous Photocatalytic Transformations, *Chemical Reviews* 2017, 117 (3), 1445–1514. IF = 47.928

Kalytchuk S., Adam M., Tomanec O., Zbořil R., Gaponik N., Rogach A.L.: Sodium Chloride Protected CdHgTe Quantum Dot Based Solid-State Near-Infrared Luminophore for Light-Emitting Devices and Luminescence Thermometry, *ACS Photonics* 2017, 4 (6), 1459–1465. IF = 6.756

Bartali R., Otyepka M., Pykal M., Lazar P., Micheli V., Gottardi G., Laidani N.: Interaction of the Helium, Hydrogen, Air, Argon, and Nitrogen Bubbles with Graphite Surface in Water, *ACS Applied Materials & Interfaces* 2017, 9 (20), 17517–17525. IF = 7.504

Fargašová A., Balzerová A., Prucek R., Htoutou Sedláková M., Bogdanová K., Gallo J., Kolář M., Ranc V., Zbořil R.: Detection of Prosthetic Joint Infection Based on Magnetically Assisted Surface Enhanced Raman Spectroscopy, *Analytical Chemistry* 2017, 89 (12), 6598–6607. IF = 6.320

Tuček J., Prucek R., Kolařík J., Zoppellaro G., Petr M., Filip J., Sharma V.K., Zbořil R.: Zero-Valent Iron Nanoparticles Reduce Arsenites and Arsenates to As(0) Firmly Embedded in Core–Shell Superstructure: Challenging Strategy of Arsenic Treatment under Anoxic Conditions, *ACS Sustainable Chemistry & Engineering* 2017, 5 (4), 3027–3038. IF = 5.951

Štarha P., Vančo J., Trávníček Z.: Platinum complexes containing adenine-based ligands: An overview of selected structural features, *Coordination Chemistry Reviews* 2017, 332, 1–29. IF = 13.324

Awards

Physical chemist Michal Otyepka receives membership of the Learned Society of the Czech Republic

RCPTM has strengthened its representation and standing in the Learned Society of the Czech Republic. Following Pavel Hobza and Radek Zbořil, Michal Otyepka (deputy director of RCPTM and ERC grant holder), has been awarded full membership, at the society's 23rd general assembly in May.

"It is really a great honor to join the company of leading Czech scientists. From my understanding, it is an appreciation of my work. I really value this and, of course, I cannot forget the support of my colleagues, without whom I would not have achieved such results," said Otyepka.

The members of the Learned Society honored his scientific work to date. His nomination states, "Professor Otyepka is a mature, successful, and internationally respected researcher, whose membership of the Learned Society is a great asset. He is one of the most successful research scientists in computational chemistry in the Czech Republic. He has achieved a number of extraordinary results in this field, including development of novel computational methods for analyzing biomolecular channels and studying their biological roles. He has also made significant contributions to nucleic acid simulations. His results in the field of so-called two-dimensional chemistry should be considered crucial."

The 42-year-old physical chemist was involved, among others, in the birth of fluorographene. He has shown that it can be used for preparing various graphene derivatives, some of which have unique properties. He also participated in discovery of the first nonmetallic magnet. Using the ERC Consolidator Grant he was awarded, he is pursuing development of new superfunctional materials with applications in medicine, environmental protection, electronics, electrotechnics, and highly efficient catalysts. In addition, he is a holder of a Neuron Impulse grant awarded by the Neuron Fund for Support of Science. So far, he has published over 160 papers in scientific journals with more than 6,000 citations.

The Learned Society, which was established on 10th May 1994, gathers prominent scientists working in the Czech Republic. It organizes regular lectures and comments on problems of the position of science in society.

Indian research scientist receives membership of the Royal Society of Chemistry

RCPTM group leader of the nanocatalysis team, Manoj B. Gawande, has been awarded Fellowship status by the Royal Society of Chemistry; the world's leading chemistry community, advancing excellence in the chemical sciences. Fellowship is a senior-category of membership, bestowed in recognition of excellent results in the field, which entitles holders to use the prestigious title FRSC.

"It is a great honor to be a member of the Royal Society of Chemistry in London. I believe that this recognition is a reflection of the excellent research facilities and funding available at RCPTM," said Gawande. In his research, he focuses on applications of advanced nanomaterials in nanocatalysis and sustainable chemistry. He has worked in RCPTM since 2013.

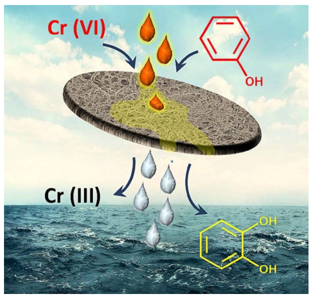
Another RCPTM representative also takes pride in a FRSC title, the physical chemist Pavel Hobza.

Our Grants

Nanotechnology - A prospective helper in water and soil treatment

The Nanobiowat Competence Centre of the Technology Agency of the Czech Republic led by Radek Zbořil, General Director of RCPTM, considerably contributes to the ambition of the Czech Republic to become a global leader in water and soil treatment. Partners from the three academic institutions, together with the largest Czech remediation companies, have been developing new environmentally friendly technologies within this framework since 2012. These can remove organic, inorganic, and microbial contamination not only from water but also soil.

Zbořil described the Centre's main principle of groundwater treatment as follows: "Our flagship is the technology based on iron nanoparticles, which can remove dozens of toxic substances by reduction and precipitation. Being a so-called *in situ* process is its great advantage. Polluted water does not have to be pumped to the surface, and it is not necessary to build expensive cleaning stations. Toxic substances are converted from very poisonous soluble phases to nontoxic or considerably less toxic forms directly underground. The products of iron nanoparticles' conversion are iron oxides that are common in nature." Zbořil is also a lead author of a European patent for technology that provides surface stabilization of iron nanoparticles (Zbořil et al., EU patent No. 2164656, 2014), which is necessary for their large-scale production. Thanks to this technology, the iron-based nanoparticles can be used in ton amounts for remediation of several areas in the Czech Republic. Pilot tests or remediation took place also, for example, in the Netherlands, Belgium, Germany, Spain, or the USA.



Researchers from RCPTM have been working for a long time on mechanisms underlying nanoparticles' behavior in aqueous environments (Filip J. et al. *J. Phys. Chem. C* 118, 13817–13825, 2014), and their interactions with key pollutants, such as heavy metals from uranium mining (Klimkova S. et al. *Chemosphere* 82, 1178–1184, 2011), chlorinated hydrocarbons (Soukupova J. et al. *Chem. Eng. J.* 262, 813–822, 2015), hexavalent chromium (Petala E. et al. *J. Hazard. Mat.* 261, 295–306, 2013)), and arsenic (Tuček J. et al. *ACS Sustain. Chem. Eng.* 5, 3027–3038, 2017). They are also striving to extend some nanotechnologies to surface water treatment, focusing on, for example, elimination of cyanobacteria (Marsalek B. et al. *Environ. Sci. Technol.* 46, 2316–2323, 2012).

In addition to reduction technologies, the Nanobiowat Competence Centre is also working on the development of environmentally friendly oxidation technologies involving use of iron compounds in high oxidation states, so-called alkali metal ferrates. They have proven efficiency (and active mechanisms) for treating diverse pollutants, including arsenites and arsenates (Prucek R. et al. *Environ. Sci. Technol.* 47, 3283–3292, 2013), heavy metals (Prucek R. et al. *Environ. Sci. Technol.* 49, 2319–2327, 2015), phosphorus (Kralchevska R.P. et al. *Water Res.* 103, 83–91, 2016), drugs, microorganisms and microbial toxins (Sharma V.K. et al. *ACS Sustain. Chem. Eng.* 4, 18–34, 2016; Sharma V.K. et al. *Acc. Chem. Res.* 48, 182–191, 2015). Last, but not least, RCPTM staff is developing new materials for advanced catalytic applications by "green chemistry" approaches, with the possibility to recycle and reuse them (Goswami A. et al. *ACS Appl. Mater. Inter.* 9, 2815–2824, 2017; Gawande M.B. et al. *Chem. Rev.* 116, 3722–3811, 2016; Rathi A.K. et al. *Green Chem.* 18, 2363–2373, 2016; Gawande M.B. et al. *Chem. Soc. Rev.* 44, 7540–7590, 2015).

Interview

"In RCPTM I appreciate the synergism between experiment and theory"

Atomic-resolution scanning microscopes offer scientists possibilities that were barely imaginable until very recently. One of the few experts who can exploit the breakthrough technology is physicist Pavel Jelínek. He has been a member of the RCPTM team since 2015.

You work at the Institute of Physics of the Czech Academy of Sciences and at RCPTM in the Carbon nanostructures and biomolecules group. How did this connection come about?

One of the main reasons is the current development of scanning microscopy, which enables unique resolution of molecules on surfaces of solids. With the help of new scanning microscopy techniques, we can see directly not only the chemical structure of molecules but also, for instance, charge distributions within a molecule. This opens up entirely new possibilities for studying chemical reactions of molecules on surfaces, transfer of charge in molecular systems, and intermolecular interactions. For these reasons, the Centre's managers decided to buy a low-temperature scanning microscope. However, operation of the microscope, particularly acquiring submolecular resolution, requires some experience. Currently, this resolution can only be achieved at 10 to 15 workplaces globally. I am glad RCPTM is one of them. Because we work with similar devices at the Institute of Physics and have extensive experience with the technique, we have been approached to cooperate. I think it is a good opportunity not only to increase the level of scanning microscopy, but also raise the overall level of Czech science. I think that if Czech science wants to be competitive worldwide, such collaboration between university workplaces and the Academy of Sciences is crucial.

What do you specifically work on with your colleagues at RCPTM?

One of the main directions is the study of organic molecules' interactions with functionalized graphene. We are currently investigating the interaction of organometallic molecules with graphene doped with nitrogen by carbon substitution. Graphene is known for its very low chemical reactivity. Nevertheless, our observations show that the presence of nitrogen defects has a significant impact not only on the arrangement of molecules on the surface but also on their electron structure. This is quite surprising, and opens up entirely new possibilities for influencing chemical properties of molecules by noncovalent interactions with graphene.

Furthermore, we pursue deeper understanding and further development of various imaging modes allowing submolecular resolution. Currently we are submitting an article that demonstrates the possibility to obtain submolecular images of molecules by simultaneous tunneling current, frequency shift, and nonelastic tunneling spectroscopy. Thus, we can get a relatively complex picture of the studied molecule, which could in future, for instance, enable us to identify the chemical milieu of atoms in a given molecule. Further, we would like to begin to examine light-controlled chemical reactions. That could allow the development of molecular structures on surfaces of insulators, where it is not possible to thermally induce chemical reactions.

During one of the lectures for students in Olomouc you said that nanotechnologies represented a new way of thinking. Can you clarify this?

I think that the answer to the question has several layers. The first is, of course, is that rapid development of nanotechnologies is significantly changing our society. For example, mobile technologies are to a

certain extent the product of nanotechnologies. The invention of scanning microscopes has also had fundamental importance for the emergence and development of nanotechnologies.

The second layer is the general perception of our world. If someone 50 years ago said they wanted to see individual atoms, most people would have laughed at him/her. In the Middle Ages, one would perhaps be even burned to death. Scanning microscopes have significantly contributed to the fact that we no longer regard atoms as abstract objects but as generally accepted realities. We can also physically move individual atoms or molecules, bring them purposely to excited states, or cause chemical reactions between them. Without realizing it, this changes our perception of the world.

Which goals have you already achieved in looking into the nanoworld and what challenges are waiting for you?

I think that we have already managed a few things that have been fairly well acclaimed in the scanning microscopy community. For example, chemical identification of atoms on the surface of solids by atomic force microscopy, theoretical description of the mechanism of submolecular resolution, development of high-resolution techniques, which enable not only the imaging of chemical structure of molecules but also charge distributions inside molecules. Further, we have managed to demonstrate the piezoelectric effect on the molecular level or the control of single-electron states within molecules.

A list of all the challenges would be quite long, and I am sure others are waiting for us around the corner. For instance, in the future we would like to study molecules in excited states, especially through imaging charge distribution. Another challenge for us is to reach spin-level resolution of individual molecules. In addition, we would like to try to demonstrate the concept of molecular quantum cellular automata using single-electron charge states in ferrocene-based molecules. Measuring transport through individual molecules is also challenging, mainly because we require deeper understanding of the relationship between the currents and forces they induce that may act on a molecule.

Which instruments are your most frequent assistants at RCPTM? How do you rate the Centre's infrastructure, for example, compared to facilities abroad?

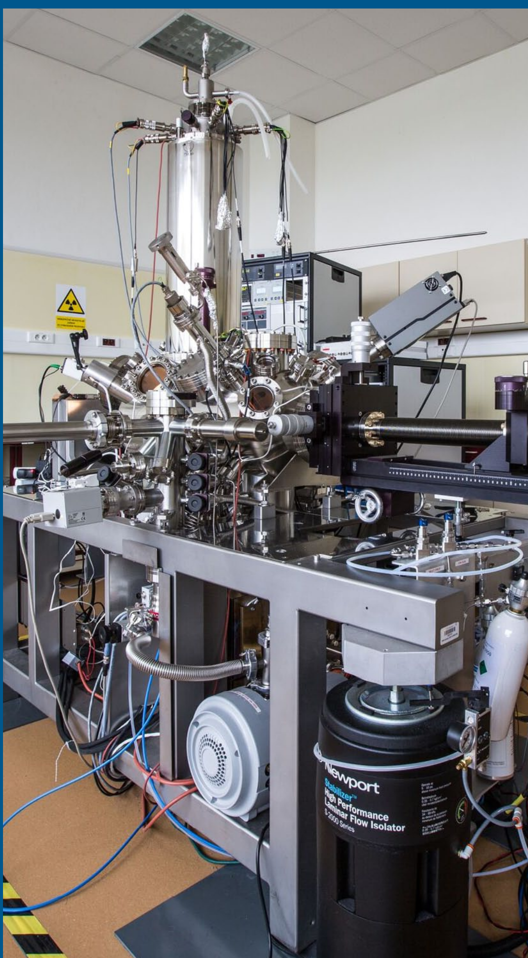
The main tool for our research is a low-temperature scanning microscope, which operates in ultrahigh vacuum. It is a commercial instrument from the company Createc, which is currently, in my opinion, one of the best microscopes on the market.

I believe that RCPTM has high-level facilities and can be compared with top sites of similar size worldwide. Nevertheless, I would like to mention that the facilities themselves do not guarantee top results. Sometimes I hear opinions that make me feel that every expensive instrument contains a printer for high-profile publications. Unfortunately, or thankfully, it is not so. A combination of an original idea, instrument, and a capable scientific team is essential. We are currently building an international laboratory in Olomouc, which will be led by our Spanish colleague Bruno de la Torre. He has great experience of working on graphene surfaces. What I most appreciate about RCPTM is that the members not only generate lots of ideas but also have a strong theoretical background, which enables precise interpretation of experimental results. Without this synergism between experiment and theory, it is practically impossible to succeed at the top level nowadays.

This year you and your Czech and Japanese colleagues have published a new method in *Nature Communications*. Thanks to this method you can determine the electronegativity of an atom on the surface of a solid and even its dependence on the chemical environment of the measured atom. Can you tell us more?

This method is suitable for studying individual atoms on the surface of a solid. Unfortunately, it is not fully transferable to individual atoms that make up a molecule. Some groups in the world have been trying to apply this method to diverse surfaces such as metal oxides. The aim is to deepen understanding of the significance of different defects on surfaces, for catalytic applications, for instance.

Introducing a Scientific Infrastructure



RCPTM's low-temperature scanning microscope from the company Createc operates in an ultrahigh vacuum environment at 5 K temperature. It allows parallel measurements of the tunneling current (STM - Scanning Tunneling Microscopy) and atomic forces (AFM - Atomic Force Microscopy) with atomic resolution, as well as the detection of vibrational modes of molecules by nonelastic tunneling spectroscopy, and imaging of electrostatic potential distributions in molecules on the surfaces of solids.

It is possible to achieve submolecular resolution of individual molecules on the surface of a solid by suitable functionalization of the microscope's tip, where just one atom (xenon, chlorine) or a molecule (e.g., CO) is placed. In many cases the acquired images directly show the chemical structure of the studied molecule. The microscope enables not only individual molecules to be displayed, but also their targeted manipulation and switching to different conformations.

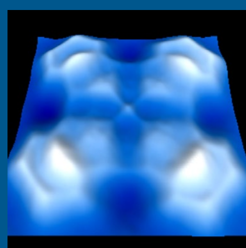


Image of an iron phthalocyanine molecule (FePc) on the surface of silver (111) obtained using an atomic force microscope with a tip ending with just one CO molecule. This functionalized tip makes it possible to directly distinguish the chemical structure of a molecule.

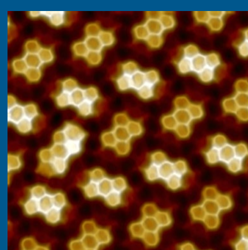


Image of a self-organized layer of PTCDA (3, 4, 9, 10-perylenetetracarboxylic dianhydride) molecules on the surface of gold (111) obtained by an atomic force microscope with a tip ending with a single CO molecule.

Selected references:

Sugimoto Y. et al. *Nature* 446, 64–67, 2007; Stetsovych O. et al. *Nat. Chem.* 9, 213–218, 2017; Sugimoto Y. et al. *Science* 322, 413–417, 2008.

Our Graduates

"The importance of the BIG AHA! MOMENT"

This year, in June, Kateřina Holá finished her doctoral studies and successfully defended her thesis, entitled *Functional groups on carbon nanomaterials: the matter that matters*. In RCPTM she primarily focused on preparation of new carbon materials, and during her doctoral studies she co-authored 17 publications in outlets including *Nature Communications* and *Chemical Reviews*. She went to Greece and Spain for internships, and she was awarded second place in a competition organized by the French Embassy in the Czech Republic (the Jean-Marie Lehn Awards) for her work, which largely concerned carbon quantum dots.

Nevertheless, she does not like talking about her successes. "Isn´t this question more important: What is the reality of science which is not seen from outside? In fact, scientists are not superheroes, they are rather masochists. Frustration from experiments always failing, never-ending evaluation of results that do not make sense, constant criticism of your work by reviewers, then you won´t be given the grant support and add to this the perpetual paperwork. Simply masochists! And the better the scientist, the greater the masochist! But the reason why all scientists put up with this is THE BIG *AHA!* MOMENT. Simply the moment when your curiosity takes you to places where no one has been before, or the moment when everything finally starts to make sense and you have the feeling that you are participating in something great. Myself, I would compare it to the sudden feeling of being in love when your stomach is weak just because of the experiment. This is exactly the reason why scientists are masochists. This is the drug for which we endure all the constant frustration. The only important question is if you enjoy it and if your drug is strong enough. And if I am to write something about myself then only this - I am a masochist in love with science!"

Coming Next...

Rudolf Zahradník Lecture Series will host an expert in catalysis Paolo Fornasiero

Another guest speaker in the Rudolf Zahradník Lecture Series will be Paolo Fornasiero from the University of Trieste. A leading expert in the materials science, he will give his lecture in Olomouc on October 16, 2017. The aim of the series, which RCPTM has organized and hosted from 2013, is to introduce the outstanding personalities of the chemical and materials research at the Palacký University grounds.

Professor Fornasiero (*1968) specializes in materials chemistry, especially the design and development of multifunctional nanosystems of metal oxides for advanced applications in energetics, heterogeneous catalysis and environmental protection. He is also a scientific researcher at the Italian National Research Council (CNR) and one of the editors of the journal of the American Chemical Society *ACS Catalysis*. He has received many awards for his work, most significantly the IACS Heinz Heinemann Award for the development of new nanostructural catalysts. Paolo Fornasiero has authored, or co-authored, more than 220 publications, including several works in *Science* (e.g., Cargnello M. et al. *Science* 341, 771–773, 2013; Cargnello M. et al. *Science* 337, 713–717, 2012) and the *Nature* family of journals (e.g., Zhang S. et. al. *Nat. Commun.* 6, 7778, 2015). His H-index is 58.

Jiří Šponer will talk about his participation in RCPTM and nucleic acids research

In the Interview section we will introduce the research of Professor Jiří Šponer, one of the most frequently cited Czech scientists who works in RCPTM and the Institute of Biophysics of the CAS in Brno. He is a member of the Learned Society of the Czech Republic and he has been honored for his research in the field of nucleic acids by a number of awards, including the Otto Wichterle Prize of the Czech Academy of Sciences, a Czech minister of Education, Youth and Sports Award and the Praemium Academiae of the Czech Academy of Sciences. Professor Šponer will talk about his latest works published under the aegis of RCPTM (e.g., Bottaro S. et al. *J. Phys. Chem. Lett.* 7, 4032–4038, 2016; Figiel M. et al. *Nucleic Acids Res.* 45, 3341–3352, 2017), as well as about developments in studies of the mechanism of the origin of life on the planet Earth.

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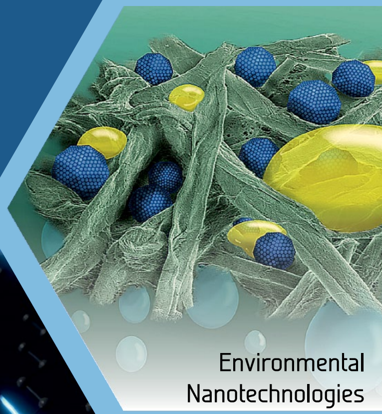
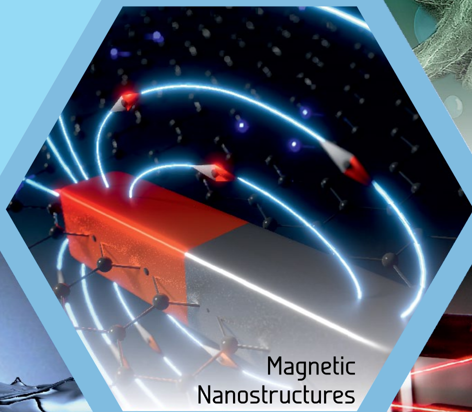
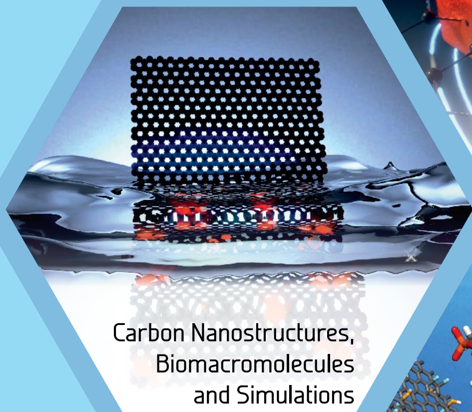
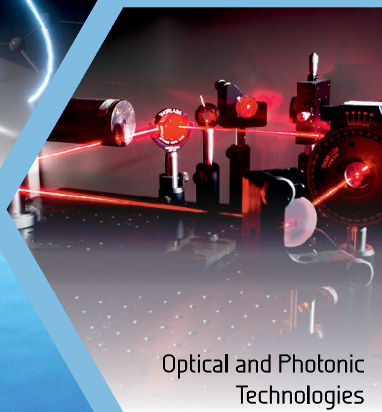
REGIONAL CENTRE OF ADVANCED TECHNOLOGIES AND MATERIALS

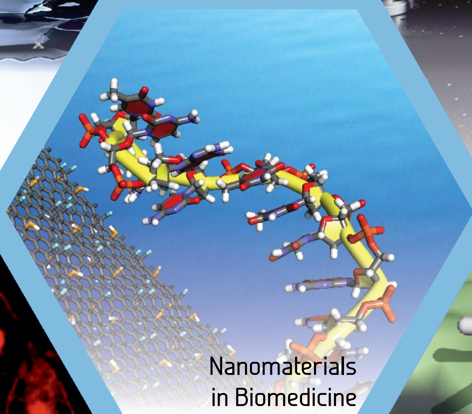
RESEARCH GROUPS

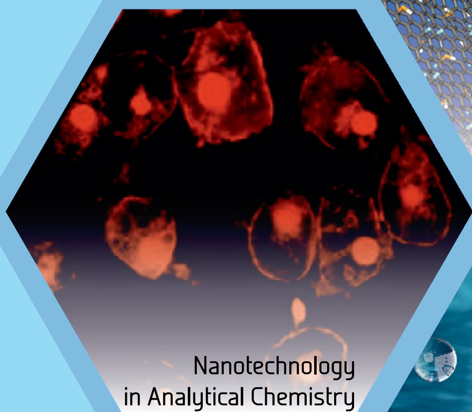


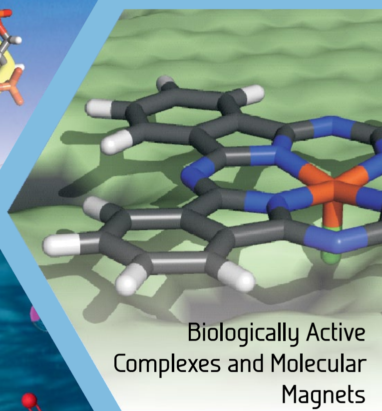


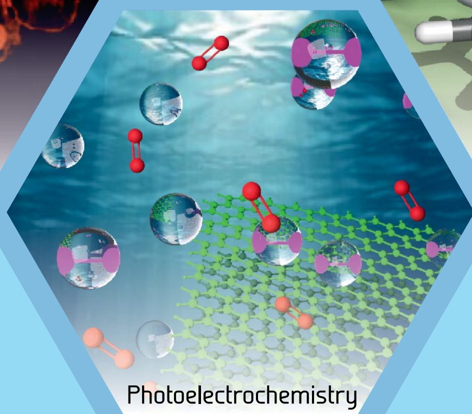












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