Jonathan Rosenbaum, a young surgeon dentist, won the “Thèse d’exercice” at the “43ème Entretiens de Garancière (Paris Diderot University - Rothschild Hospital), as well as the special award of the National Council of the Order of Dentists. He did his internship trained in the MCMC team, working on the functionalization of nanostructured Ti surfaces with Cu nanocubes (Biomater Sci 5, 455, 2017). This award was given for the potential applications of such surfaces in implantology.

Paul Lafaye, a third-year PhD student at ICMPE, in the CMTR team, qualified for the French National Final 2017 of “Ma thèse en 180 secondes”. This competition allows PhD students to present their research project, in french and simple terms, to a diverse audience. Each student must make a clear, concise and convincing statement on his research in three minutes. You can view his presentation on Youtube (at the 50° min).

Up-coming workshops and conferences

• ICMPE will host the 8th workshop “Batteries Lithium en Île-de-France” organized by J-P. Pereira-Ramos, R. Badour-Hadjéan, G. Bernari (GESMAT, ICMPE) and H. Groult (PHEIX), the 12th of December 2017. Together with advances in new storage devices such as Na-ion batteries, Li-ion and Li-sulfur systems, promising results on the intercalation of other ions (K⁺, Mg²⁺, Ca²⁺, etc.) and on insertion in aqueous medium will be presented. Contact: perereira@icmpe.cnrs.fr

• In the framework of the 3rd Energy Future Conference taking place in Sidney (Australia), 5 - 7 February 2018, an “Australia-French Energy” Symposium will be organized by Prof. F. Aguey-Zinsou (UNSW, Australia), Dr. F. Bedioui (Chimie Paris Tech) and Dr. F. Cuevas (ICMPE). This workshop aims to strengthen Australia-France collaboration on “clean” energy research and bring together existing relationships to foster the establishment of joint research programs. https://www.australfutureenergy.com/

• The next Europolymer Conference (EUPOC 2018), co-chaired by M. M. Chehimi (ICMPE) and L. Ye (Land University), will be devoted to Biomimetic Polymers by Rational Design, imprinting and conjugation. The conference will cover fundamental aspects of molecular recognition, high efficiency bioconjugation, molecular imprinting, and novel strategies in synthetic design and nano-fabrication of multifunctional materials. It will take place in Como (Como Lake), Italy, from 20th to 24th of May 2018.

ICMPE acknowledges contribution of its members in writing books, chapters and review articles:


Editorial

As we approach the end of 2017, ICMPE is proud to share its most promising scientific results with our community. New articles published in the field of advanced or antibacterial materials, energy storage, surface engineering and sustainable chemistry give you an overview of our current research activities.

In addition to basic science, our scientists have actively participated in the organization of various international and national events or contributed in the dissemination of science for the benefit of the society. We thank them warmly for their contribution to this valuable task of disseminating knowledge.

Last but not least, thanks to the CNRS, our buildings are currently refitted with new highly insulating windows and walls for a better comfort in labs and offices. This thermal renovation will also bring significant energy savings, which is a satisfactory outcome for scientists working in the field of sustainable development. The honorable man starts by applying what he wants to teach (Confucius).

Michel Latroche, Director of ICMPE.
Silicon nano-trees as high areal capacity anodes for lithium-ion batteries

Lithium-ion batteries provide laptops, smart phones, and tablet computers with reliable energy. During a discharge cycle, the lithium ions move from the anode and pass through the electrolyte until they reach the cathode. In part because of lithium’s small size, Li-ion batteries are capable of having a very high voltage and charge per unit mass and unit volume.

To answer current more and more exigent demand, numerous research are developed in order to increase energy density and power density of these systems.

Nanostructured silicon electrodes have attracted attention as a potential candidate for high capacity negative electrode in lithium-ion batteries, thanks to their high specific capacity and their ability to accommodate silicon volume changes upon cycling. However, the amount deposited by CVD-VLS on these nanostructured electrodes is generally low and leads to low surface capacities.

A new structure is proposed to increase the areal density of silicon on the electrode. A second growth of secondary nanowires on a silicon nanowires electrode leads to a “nano-tree” structure with surface capacities between 1.8 and 7.1 mAh/cm². These high loaded electrodes maintain very good rate capabilities and a rather stable cycling is observed for the intermediate loadings, with a capacity maintained above 2 mAh cm⁻² after 100 cycles at C/5.

Design of antibacterial and sustainable antioxidant networks based on plant phenolic derivatives used as delivery system of carvacrol or tannic acid

The originality of this work is to use a novel photochemistry process to design UV-cured materials by the rapid thiol-ene reaction (< 5 min). Active natural compounds i.e. carvacrol (oregano essential oil extracted) and tannic acid (tea extracted) were trapped to elaborate delivery systems with enhanced antibacterial activity. The antioxidant and the antibacterial properties against E. coli and S. aureus were investigated. Both systems provided a promising strong antioxidant activity.

Moreover, the system based on 20 wt % of carvacrol worked as an effective diffusion controlled system and allowed a complete inhibition of the bacteria growth and an almost total reduction in bacterial adhesion whatever the bacteria strain.

The most efficient system was obtained with the tannic acid since only90 wt % led to a complete reduction of the S. aureus adhesion and a reduction of 77.9% of the E. coli adhesion. Moreover, the formation of a tannic acid network during the reticulation led to a sustainable antibacterial and antioxidant activities (over 2 months).

Antibacterial and antioxidant properties against S. aureus were investigated.

3D patterning of silicon by contact etching with anodically biased nanoporous gold electrodes

Silicon (Si) etching is a key process for several devices used in microelectronics, photonics, photovoltaics or lab-on-chips. Efficient Si microstructuring technologies exists nowadays but require several lithography and etching steps that are unsuitable for industries where reduced cost and process time are key aspects. Eliminating the use of masks would dramatically simplify the fabrication of microstructures but is extremely challenging.

A novel strategy to achieve 3D pattern transfer into Si in a single step and without using lithography is presented. Etching is performed electrochemically in HF media by contacting Si with a positively biased patterned metal electrode. Dissolution is localized at the Si/metal contacts and patterning occurs as the electrode digs into the substrate. Previous attempts with bulk metal electrodes have evidenced limitations due to electrolyte blockage. Here, the problem is solved by using for the first time a nanoporous metal that allows the electrolyte to access the entire Si/metal interface, irrespective of the electrode dimensions. As a proof of concept, imprinting of arrays of inverted pyramids has been performed with sub-micrometer spatial resolution over 1 mm² using a nanoporous gold electrode.

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Surface engineering

Silicon (Si) etching is a key process for several devices used in microelectronics, photonics, photovoltaics or lab-on-chips. Efficient Si microstructuring technologies exist nowadays but require several lithography and etching steps that are unsuitable for industries where reduced cost and process time are key aspects. Eliminating the use of masks would dramatically simplify the fabrication of microstructures but is extremely challenging.

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Sustainable chemistry

Cobalt-catalyzed reductive multicomponent synthesis of β-hydroxy- and β-aminocarbonyl compounds under mild conditions

Multicomponent reactions (MCRs) currently represent an important trend in organic synthesis because they tend to address problems of atom and step economy hence constituting a relevant response to growing environmental concerns. They also represent efficient tools for the straightforward generation of molecular diversity. In this context, multicomponent synthesis of β-hydroxy- and β-aminocarbonyl compounds is of current interest.

In this article, we describe the cobalt-catalyzed multicomponent reaction between u2-hybridized organic halides, Michael acceptors and unsaturated electrophiles. The reaction proceeds via a formal conjugate addition/aldol or aza-aldol (Mannich) tandem reaction initiated by the in situ metalation of the organic halide by cobalt-catalysis. The essentially new reaction conditions that have been developed are very mild and atom-economic. Under these conditions, a broad range of β-hydroxy- and β-aminocarbonyl compounds are obtained in good to high yields.

Article highlighted in Synfacts 2017, 13, 0193

Figure 1. The three-component reaction and selected examples of products

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Past events

- ICMPE and SIMAP (Grenoble) organized the 46th Calphad meeting in Saint-Malo, 11 - 16 June 2017. This international conference gathered 200 researchers from all around the world. Experimental determination of phase diagrams, DFT calculations of phase stability and Calphad modeling of systems useful for materials science were the main topics. Thanks to a very sunny and warm weather, the conference was a complete success.
  https://calphad2017.scienceconf.org/

- ICMPE (V. Langlois) and INSA-Toulouse organized the 9th European Symposium on Biopolymers (ESBP 2017) in Toulouse, 5 - 7 July 2017. This international symposium gathered 100 research groups from all over Europe and the world. ESBP focused on recent developments in biopolymer production, processing and functional properties in various fields (medical devices, smart materials and structural material). ESBP main spotlight has been on Biopolymers produced by bacteria like polyhydroxyalkanoates (PHAs), some promising materials that are one of ICMPE’s expertise.
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- The ESO group (E. Le Gall, M. Presset, J. Paul and P. Renevet) organized the 15th edition of the “Rencontres de Chimie Organique” Meeting in Thiais, 4 May 2017. The RCO is a one-day symposium on Organic Chemistry supported by the Parisian section of the French Chemical Society. This conference brought together 120 young chemists from the Paris area around posters, oral communications and conferences of two internationally-renowned researchers, Jieping Zhu (EPFL) and Tanja Gaich (Konstanz).

- ICMPE and LSPM organize the National Workshop on Spark Plasma Sintering (PSPS) in Saint-Malo, 11 - 16 June 2017.

International Newsletter

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ICMPE News

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