ICS
Institut Charles Sadron
NEWSLETTER

#12
JUNE
2020

EDITORIAL

For special circumstances a special edition: this newsletter was supposed to be the winter issue, but it was a bit behind schedule with our agendas being overly busy. Then the Covid-19 arrived with its two months of confinement, and this newsletter became a summer edition. What have we learned from this period of confinement? That we could be united and resilient by implementing in 24 hours a team of people responsible for monitoring the proper functioning of activities which could not be stopped, by collecting protective equipment for a health sector in dire need of resources and in adopting a new organisation of collective remote work in record time with its share of questions and unforeseen events. Now that we are in our «PRA» - planning of progressive return to activity - we will gradually find back our activities with recurring writing and evaluation cycles, focussing on HCERES and getting to know the next ICS director who will animate the scientific project of the ICS. Obviously, this letter does not forget to highlight the beautiful and fruitful science of the laboratory!

Christian Gauthier | Director of the Institut Charles Sadron

NEWS

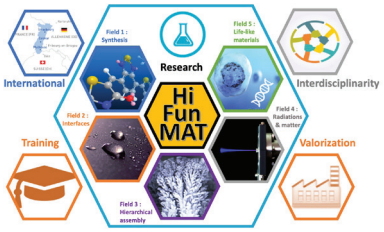
Reopening of the ICS

After two months of closure due to SARS-CoV-2, the ICS reopened on May 11, 2020. In the coming weeks, the number of people working in the laboratory will gradually increase in strict compliance with the health precautions to avoid the spreading of the virus. In addition, the activities at the ICS are reduced to those which cannot be done in telework.

Two ITIs for the ICS

In January 2020, the ICS was awarded two «Interdisciplinary Thematic Institutes (ITI)», structures which unite a number of laboratories of excellence (LabEx) and a graduate school:

(1) The ITI «Chemistry of Complex Systems» (CSC) will gather during eight years, fifteen research teams from Strasbourg that are already participating in the LabEx CSC and EUR CSC. Coordinated by M.W. Hosseini (ISIS), the ITI CSC will look to understand the self-organisation phenomena of complex matter and its implementation in emerging technologies in health, information and environmental sciences.



(2) The ITI «Hierarchical and Functional Materials» (HiFunMat) will bring together nine laboratories in Strasbourg and Mulhouse at the interface of chemistry, physics, nanoscience and biology. Coordinated by G. Decher (ICS), basic and applied research on multi-composite materials will be carried out for four years (renewable mandate), in which the individual components are hierarchically and spatially arranged.

Participation of Jean-François Lutz at the #CNRSmasterclass

The public access scientific forum, New Worlds, took place at the Cité des Sciences et de l'Industrie in Paris in October 2019. It hosted the #CNRSmasterclass, a series of general public conferences given by renowned researchers. The ICS was represented by Jean-François Lutz, recipient of the 2018 CNRS silver medal and specialist in precision polymers. His conference «Polymers: much more than plastics» focused on the progress made at the ICS in the field of digital polymers.

ArtMoMa: A new ITN for the ICS

The ArtMoMa (Artificial Molecular Machines) project, dedicated to research on nanomachines and their applications, is funded by Europe with a total budget of € 4.2 million.

This project is led by N. Giuseppone and E. Moulin at the ICS and is recruiting 15 doctoral students and a European project manager, who will work in Strasbourg, Manchester, Bologna, Oxford, Dresden and Groningen. Various industrial and publishing partners (Solvay, Xeltis, ATD Bio, Orgentis, Tarkett, Soprema, Danone, Nature, Wiley-VCH) will contribute with their expertise to help in the development and valorisation of the consortium's progress.

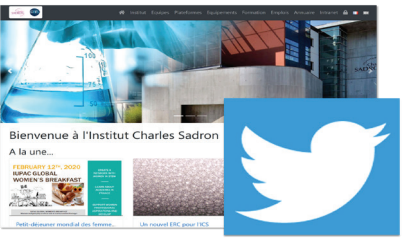
ArtMoMa
Artificial Molecular Machines

NEWS

IUPAC 2020 Global Women's Breakfast (GWB2020) at the ICS

On February 12, the IUPAC Women's Global Breakfast was held at the ICS. This event is organised annually to highlight the work of women in science and to assist young researchers in their careers. The ICS organised a program with several women scientists from different fields and at different stages of their careers. After brief introductions and a round table, everyone was invited to share a meal and continue the mission of networking and inclusion.

The ICS starts sharing its activities



This year, the ICS renews its presence on the internet and on social networks ! With a new website (https://www.ics-cnrs.unistra.fr) and a Twitter account (**@CharlesSadron**), the ICS intends to better share its scientific know-how and progress. Join over 250 subscribers to follow all the news from the ICS and its partners !

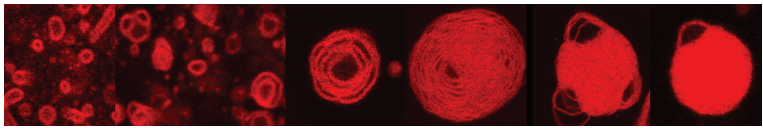
Contribution made by the ICS to the hospitals in Strasbourg

In order to lend a hand during the health crisis in our country, several ICS members offered their services and equipment. Along with other laboratories of the Cronenbourg campus, we were able to collect and ship more than 1700 boxes of gloves, 1000 masks, and around 4500 pieces of additional personal protective equipment (coats, hygiene caps, overshoes and overalls) to the hospitals. Thank you all for this wave of solidarity in favor of the hospitals.

RESEARCH

Transition from flat bilayer to sponge phase observed in real time

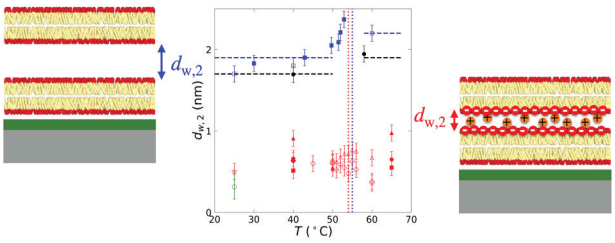
Surfactants naturally assemble in water to form various structures (spherical, tubular (micelles), bilayers (membranes), etc.). It is the geometry of the molecule that governs the final structure of the aggregates. Concentrated surfactant solutions have been extensively studied, in particular the phase transitions from one type of structure to another. The geometry of C10E3, a nonionic surfactant, changes with temperature, inducing a transition between a lamellar phase (stacking of flat bilayers) and a sponge phase, an interconnected bilayer structure with «saddle shaped» nodes. In collaboration with Ulf Olsson of Lund University, researchers from the ICS MCube team were the first to observe this transition on the scale of a single membrane scale in a highly diluted sample. They identified the topological changes that transform flat bilayers at 20 °C into drops at 35 °C (Schroder, A. *et al.*, *Sci. Rep.* **2019**).



From left to right: phase transition induced by temperature rise between vesicles and foam phase droplets (high speed confocal microscopy). Scale: from 2 to 20 µm. (Authorization A. Schroder)

When equally-charged surfaces become attractive !

Charges of the same sign attract, while charges of opposite sign repell each other! If this is true for elementary charges, electrically charged objects in solution such as membranes, colloids or proteins, can exhibit more complex behaviours due to the presence of counterions.
Recent work carried out by the M3 team (Mukhina, T. *et al.*, *J. Phys. Chem. Lett.* **2019**), in collaboration with the Laue-Langevin Institute confirms the existence of a strong short-range attraction between highly negatively charged membranes in the presence of monovalent counterions that go well beyond the predictions of continuum theories. Established in the framework of T. Mukhina's PhD thesis, these results highlight the importance of taking into account not only the correlations between counterions, but also the orientation of water molecules in strong confinement.



Thickness of water layer between two neutral supported membranes (in blue, image on the left) and between two highly charged membranes (in red, image on the right). A strong attraction between the charged membranes is observed.

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RESEARCH

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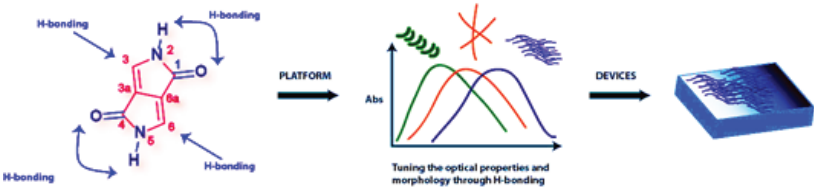
Molecular machines change dimension

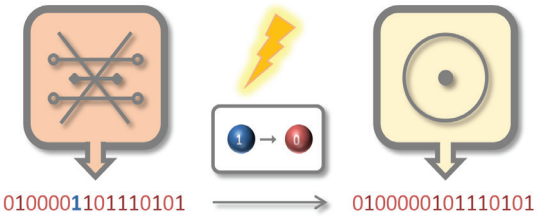
The fundamental principles that allow us to obtain a controlled movement at the nanometer scale have been debated for more than 60 years by different scientific communities (physicists, chemists and biologists). The recent development of artificial molecular machines makes it possible to contemplate a series of applications in fields as varied as medicine, robotics, information and environmental sciences. In two complementary invited articles, the SAMS team summarises the current state of the art of how to generate collective movements of nanomachines all the way up to macroscopic scale (Dattler, D. *et al.*, *Chem. Rev.* **2020**), and how to use these principles in the creation of new functional materials for the detection and liberation of medication, electronics, optics or mechanics (Moulin, E. *et al.*, *Adv. Mat.* **2020**, https://youtu.be/ lugm8MslKa4).



An « Emerging Investigator » at the ICS

The *Journal of Materials Chemistry A* features an annual thematic issue that highlights materials chemistry researchers early in their careers. Each contributor has been recommended by experts in their field for their work that is likely to influence future directions in materials chemistry. The work of Amparo Ruiz Carretero was presented in this special issue (*J. Mater. Chem. A*, **2019**). Written in collaboration with Philippe Mésini, a ICS research director, and two PhD students, Ricardo Ávila and Swann Militzer. The article brings together the most relevant progress on hydrogen-bonded diketopyrrolopyrrole, a powerful semiconductor, as well as its applications in organic electronics. The exploitation of supramolecular chemistry in organic electronic materials is one of the main research topics of the authors.

Copper transformed into gold by digital transmutation



The development of synthetic polymers to store information is one of the main themes of the Macromolecular Precision Chemistry team hosted at the ICS. This team has published a significant advance in this area in *Nature Communications* (König *et al.* **2019**). In collaboration with researchers from the University of Aix-Marseille, digital polymers containing photosensitive monomer units have been prepared and characterised by mass spectrometry. This new molecular design allows the information sequences stored in the polymer chains to be controlled using a simple light stimulus. Three types of information control have been identified: deleting a message, revealing it or modifying it. For example, in the latter case, the researchers transformed «copper into gold» by changing the chemical symbol for copper «Cu», written in a polymer to «Au», the chemical symbol for gold.

PORTRAITS

Aurélie Hourlier-Fargette, hired to work on foam fibre systems

Aurélie joined the MIM team of the ICS in October 2019 as a research scientist (chargé de recherche) in Section 5 (condensed matter physics) of the CNRS (French National Center for Scientific Research). From 2013 to 2017, Aurélie completed her thesis at the interface between elasticity and the physics of liquids at the Institute «Jean Le Rond d'Alembert» in Paris under the supervision of Sébastien Neukirch and Arnaud Antkowiak. In parallel to her research, she worked as an associate physics teacher at the ENS Paris. The quality of her research was recognised by the thesis award from the Chancellery of the Universities of Paris and the Saint-Gobain Young Researcher award from the French Physical Society. Following this, she worked in John Rogers' group at Northwestern University (USA) on issues related to the biomedical field. Her research at the ICS will focus on the combined effects of elasticity and capillarity in foam-fibre composite systems, with the aim of obtaining new foam structures associated with new mechanical properties.

Madeline Vauthier, new lecturer of polymer engineering

In 2019, Madeline was hired by the ECPM as lecturer (Maître de Conférences). For her research activities she joined the CMP team of the ICS, where she develops stimuli-responsive polymeric nanoparticles. For this purpose she functionalises (bio)polymers and particles with the goal to control their properties by simple modification of their environment (temperature, electro-magnetism, etc.). Targeted applications include chemical sensors and theranostics. Madeline obtained her engineering degree at the ECPM in 2015, and completed her PhD thesis in material chemistry at the University of Haute Alsace (UMR 7361) under the supervision of Pr. V. Roucoules and Dr. F. Bally-Le Gall. Her research concerned the development of smart coatings with thermo-reversible properties and led in particular to the production of reversible covalent adhesives between solid substrates. Since her PhD defense in 2018, Madeline worked at the ICS as assistant of teaching and research (ATER).

The ICS staff at the Liebfrauenberg Castle

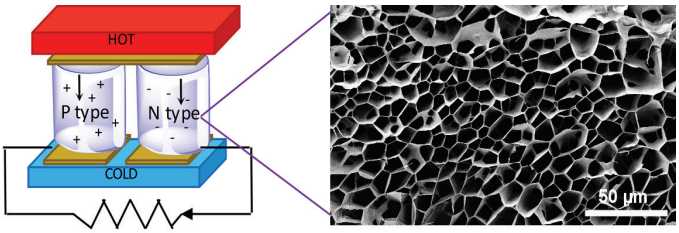
The ICS days took place from 5 to 6 September 2019. The permanent members, researchers, associated professors and technical staff met at the Liebfrauenberg Castle in the Northern Vosges. Scientific presentations stimulated live exchanges of ideas in a welcoming atmosphere. Beyond science, the future of the institute was discussed under the leadership of Christian Gauthier. Conviviality was ensured: good food, an animated evening and a night walk in the forest. Cannot wait for the next one!

NEW PROJECT

An electrifying young researcher's project from the ANR (National Research Agency)

Designing polymeric aerogel materials to generate electricity from body heat: This is the challenge that Laure Biniek will tackle over the next four years (ANR JCJC BODYTEG).

With our arsenal of touchscreen phones and tablets and portable medical monitors, we are always on the lookout for electrical outlets to charge them. Body heat is the most ubiquitous source of energy available to us and converting it to electricity could be a very effective and economical strategy to power a new generation of portable devices. The technology to convert heat flow into electricity is known as thermoelectricity. This project aims to explore the potential of new electrically conductive polymeric materials used in the form of aerogels.



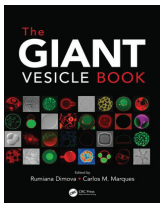
Thermoelectric device based on polymeric aerogel materials. The scanning electron microscopy image highlights the porosity of the aerogel (minimizing the thermal conductivity of the material). The walls of the honeycomb structure are made of conductive polymer. (ICS Microscopy Platform)

NEW EQUIPMENTS

New recycling chromatography device at the ICS

The SYCOMMOR team purchased a Recycle High Performance Liquid Chromatography (RHPLC) device. This device allows the separation of the molecules present in a complex mixture, while preserving the principles of the HPLC and recycling the solvent in the column. The sample to be separated is pushed by a liquid (mobile phase) into the column filled with a stationary phase. The molecules are separated by their difference in affinity to the solvent used, allowing the separation of isomers, which is a complex task to carry out using a traditional system. In addition to the advantage of reducing the amount of solvent used, a better separation of the molecules present in the mixture is obtained over a number of cycles.

PUBLICATION



Giant vesicles book

Edited by Carlos Marques (ICS) and Rumiana Dimova (IMP Golm), this collective work of 700 pages on giant vesicles unites 30 chapters written by more than 70 collaborators. Published by Taylor & Francis, this book will become a reference for a growing community of scientists from different disciplines.

Photo © Sébastien Andrieux

Kézako ?

Light reflected from a solidifying soap film using a food gelling agent (alginate). Stable « black » holes are formed where the film is thinnest !

Institut Charles Sadron
23 rue du Lœss
67034 Strasbourg cedex
tél : 03 88 41 40 00
www.ics-cnrs.unistra.fr

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