Geneva chemistry & biochemistry days 2011

MO 06 – TU 07 June 2011, 9.00–17.30

École de physique – grand auditoire
24, quai Ernest-Ansermet – 1205 Genève
No registration required

Prof. Tom Kirchhausen
Harvard Medical School

Prof. Dr Michel Orrit
Universiteit Leiden

Prof. Jeremy K. M. Sanders, FRS
University of Cambridge

Prof. A. Dieter Schlüter
Eidgenössische Technische Hochschule Zürich

Junior speakers: Sabine Abke • Christin Bissig • Claire Deville • Illya Fedotenko • Marco Finessi
Georgios Fradelos • Navin Gopaldass • Ludovic Gremaud • William Herzog • Nina Jaensch • Oksana Kel
Marco Lista • Audrey Mercier • Sandrine Morlot • Prodipta Pal • Mariya Porus • Amin Sadeghpour
Aline Santos • Ankit Sharma • Sirinporn Thamapipol • Matthieu Tissot • Franck Torricelli • Soumaila Zebret

UNIVERSITÉ DE GENÈVE
FACULTÉ DES SCIENCES
Section de chimie et biochimie

photographie : © 2007 Laurent Guiraud

International Year of CHEMISTRY 2011

Foreword:

Within the frame of the International Year of Chemistry, the Section de chimie et biochimie, University of Geneva, organises the first edition of the "Geneva Chemistry and Biochemistry Days". This event is aimed at providing our students who are close to finishing their PhD studies with the opportunity to present their research to a large audience from academia and industry.

Four renowned lecturers will enrich the programme. They have been invited by the Departments of our School (Département de chimie minérale, analytique et appliquée, Département de chimie organique, Département de chimie physique, Département de biochimie) and will help showcase the breadth and quality of chemical and biochemical research in the world today.

This 2-day symposium shall become the annual *Geneva rendez-vous* between chemists and biochemists from academia and the industry. The event will help catalise fruitful discussions between young and advanced researchers, giving our students the opportunity to further prepare for their professional careers. We hope that it will give our guests an opportunity to gauge the high quality of the different aspects of fundamental research performed in our School.

Please enjoy the lectures and interactions!

Prof. Alexandre Alexakis
Président de la Section de chimie et biochimie

Steering and organising committee:

Prof. Alexandre Alexakis alexandre.alexakis@unige.ch
Président de la Section de chimie et biochimie
Prof. Alan F. Williams alan.williams@unige.ch
Directeur du Département de chimie minérale, analytique et appliquée
Prof. Michal Borkovec michal.borkovec@unige.ch
Département de chimie minérale, analytique et appliquée
Prof. E. Peter Kündig peter.kundig@unige.ch
Directeur du Département de chimie organique
Prof. Eric Vauthey eric.vauthey@unige.ch
Directeur du Département de chimie physique
Prof. Marcos González-Gaitán marcos.gonzalez@unige.ch
Directeur du Département de biochimie

Prof. Eric Bakker, chairman eric.bakker@unige.ch
Département de chimie minérale, analytique et appliquée
Prof. Clément Mazet, chairman clement.mazet@unige.ch
Département de chimie organique
Prof. Aurélien Roux, chairman aurelien.roux@unige.ch
Département de biochimie
Prof. Thomas Bürgi, chairman thomas.buergi@unige.ch
Département de chimie physique

Dr Didier Perret; chargé de communication didier.perret@unige.ch
Mrs Gisèle Musy; administratrice gisele.musy@unige.ch
Ms Jézabel Praz; doctorante jezabel.praz@unige.ch

PROGRAMME – MONDAY 6 JUNE 2011:

Session 1 – Morning Chairmen: **Prof. Michal Borkovec + Prof. Thomas Bürgi**		
09:00- -09:15	**Prof. Alexandre Alexakis**, and **Prof. Jérôme Lacour**, vice-Dean Faculté des sciences, UniGE	Welcome message Introduction
09:15- -10:15	**Prof. A. Dieter Schlüter** ETH-Zürich	Synthetic Molecules with the Size and Dimension of Biological Objects and Internally Ordered, "Infinite" Sheets
10:15- -10:30	Coffee break	Main hall of École de physique
10:30- -10:50	**Ms Christin Bissig**	Protein-Lipid Interaction in Endosome Biogenesis
10:50- -11:10	**Mr Ludovic Gremaud**	Enantioselective Copper Catalyzed 1,4 Addition to Challenging Michael Acceptors and Synthesis of Relevant Target Molecules
11:10- -11:30	**Mr Amin Sadeghpour**	Charging and Stability Behavior of Positively Charged Latex Particles in Presence of Poly(Acrylic Acid)
11:30- -11:50	**Mr Georgios Fradelos**	Computer Modeling of the Electronic Structure of Molecules in Condensed Phase by Means of the Frozen-Density Embedding Theory Based Methods
11:50- -12:10	**Ms Audrey Mercier**	Efficient Catalytic Asymmetric Entry to Planar Chiral Complexes – Application to the Synthesis of Palladacycles

12:10- -14:00	Lunch (invited lecturers + PhD students of day 1)	Restaurant-pizzeria Sole Mio, boulevard Carl-Vogt

Session 2 – Afternoon Chairmen: **Prof. E. Peter Kündig + Prof. Eric Bakker**		
14:00- -14:20	**Ms Claire Deville**	Helical Cubane-Like Complexes Using Malic Acid Bisbenzimidazole Derivative as Ligand
14:20- -14:40	**Mr Illya Fedotenko**	Formation of Metastable Bilayers by an Artificial Phospholipid
14:40- -15:00	**Ms Sandrine Morlot**	Quantitative Analysis of Membrane Deformation and Fission Induced by Dynamin GTPase Activity
15:00- -15:20	**Mr Prodipta Pal**	Effect of Pressure and Temperature in the Energy Levels of Sm^{2+} in Matlockite Hosts
15:20- -15:40	**Ms Mariya Porus**	Multilayer Assemblies of Artificial Photosystems Analyzed by Surface Sensitive Techniques
15:40- 16:00	Coffee break	Main hall of École de physique
16:00- -16:20	**Mr Ankit Sharma**	One-Step Catalytic Asymmetric Synthesis of Tröger Bases
16:20- -16:40	**Ms Aline Santos**	Lipid Homeostasis: Assessing the Effect of Kinases and Phosphatases in the Lipidome of Yeast
16:40- 17:30	**Prof. Jeremy K.M. Sanders** University of Cambridge	Dynamic Combinatorial Chemistry
19:30-	Banquet (speakers + chairmen + organisers)	

PROGRAMME – TUESDAY 7 JUNE 2011:

Session 3 – Morning Chairmen: **Prof. Marcos González-Gaitán + Prof. Aurélien Roux**		
09:00- -10:00	**Prof. Tom Kirchhausen** Harvard Medical School	Dynamics of Endocytosis
10:00- -10:20	Coffee break	Main hall of École de physique
10:20- -10:40	**Mr Matthieu Tissot**	Copper Catalysed Conjugate Addition of Organometallic Reagents to Extended Michael Acceptors
10:40- -11:00	**Ms Sabine Abke**	SARA Endosomes Regulate Cell Fate of Spinalcord Neural Precursors
11:00- -11:20	**Mr Marco Finessi**	Interactions Between Sulfate Latex Particles With Adsorbed Linear Poly(ethylene Imine) Studied Using Colloidal Probe Technique
11:20- -11:40	**Ms Sirinporn Thamapipol**	Chiral Ruthenium Lewis Acids: Powerful Tools for the Intramolecular Diels-Alder Reaction in the Synthesis of *ent*-Ledol
11:40- -12:00	**Mr Navin Gopaldass**	Role of Dictyostelium Myosin IB in Phagosome Maturation

12:00- -14:00	Lunch (invited lecturers + PhD students of day 2)	Restaurant-pizzeria Sole Mio, boulevard Carl-Vogt

Session 4 – Afternoon Chairmen: **Prof. Eric Vauthey + Prof. Clément Mazet**		
14:00- -14:20	**Mr Franck Torricelli**	Modular Synthesis of Novel Cationic Helical Dyes
14:20- -14:40	**Mr William Herzog**	New Systems for Proton-Coupled Electron Transfer
14:40- -15:00	**Mr Soumaila Zebret**	Potentially Bimodal Sensing Systems with Rare-Earth Metals
15:00- -15:20	**Ms Nina Jaensch**	Glycosylphosphatidylinositol-Anchored Proteins En Route to the Plasma Membrane
15:20- 15:40	Coffee break	Main hall of École de physique
15:40- -16:00	**Mr Marco Lista**	Artificial Photosystems on Surfaces: Lateral Self-Sorting and Templation Effects
16:00- -16:20	**Ms Oksana Kel**	Ultrafast Spectroscopy of Artificial Self-Organizing Photosystems
16:20- 17:20	**Prof. Dr Michel Orrit** Universiteit Leiden	Optical Spectroscopy and Microscopy of Single Molecules and Metal Nanoparticles
	Prof. Alexandre Alexakis	Concluding remarks

Dynamics of Endocytosis

Prof. Tom KIRCHHAUSEN

Harvard Medical School – Department of Cell Biology

kirchhausen@crystal.harvard.edu

This talk will focus on the use of cutting-edge high resolution structural visualization combined with dynamic single molecule and live cell fluorescence imaging techniques to understand clathrin mediated endocytic processes involved in communication of cells with its environment, in pathogen invasion and viral infection, in cell growth control and cancer, and in the biogenesis of organelles. The goal is to generate molecular-resolution movies describing the function of machineries responsible for the control of these types of carefully choreographed interactions in cells. We will explore the regulation of the clathrin machinery engaged in classical endocytosis by presenting an integrated view based on recent data from snapshots (cryoEM tomography and 3-D single-particle reconstruction, x-ray crystallography) and from dynamic imaging (live cell single-object tracking and single molecule fluorescence microscopy) to show how they are used to inform cell, biochemical and mechanistic studies.

Optical Spectroscopy and Microscopy of Single Molecules and Metal Nanoparticles

Prof. Dr Michel ORRIT

Universiteit Leiden – Institute of Physics

orrit@physics.leidenuniv.nl

As compared to electron microscopy and to scanning probe microscopy, the optical selection of individual molecules or nanoparticles in a far-field microscope presents distinct advantages. Laser excitation often is non-invasive, can reach much beyond the surface layers of a sample, and commands a wide range of time-resolved and frequency-resolved spectroscopic techniques. Optical signals provide unique insights into the dynamics of nano-objects and of their surroundings.[1] I shall illustrate the applications of single-molecule optics to dynamics with recent topics from our group.

i) We study single gold nanoparticles by photothermal and pump-probe microscopy. We detect their acoustic oscillations launched by a pump pulse,[2] as well as subtle changes of their absorption spectra due to chemical binding, for example. This opens up uses of individual gold nanoparticles for local plasmonic, mechanical, thermal and chemical probing.

ii) We probed the approach of the glass transition in supercooled glycerol by following the rotational diffusion of single fluorescent molecules. We found large differences in local viscosity, with exceedingly long memory times (days). We associate this heterogeneity of the supercooled liquid to a solid-like structure. Macroscopic rheology experiments[3] confirm that the glass former displays many of the well-known attributes of soft glassy rheology (yield-stress, shear-thinning, aging,...).

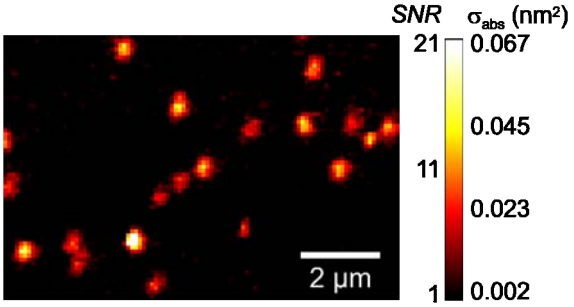


Figure 1: *Photothermal scanning images of single molecules of an azo dye (BHQ1) detected by photothermal contrast in glycerol on a glass slide. A few bleaching or blinking events can be distinguished, but the photostability of these non-fluorescent dye molecules is remarkable. Integration time 300 ms, heating power 5.1 mW at 514 nm, probing power 79 mW at 800 nm (from Gaiduk et al., Science **2010**, 330, 353-).*

iii) Photothermal microscopy opens the study of non-fluorescent absorbers such as molecular aggregates or conjugated polymers. Combining photothermal contrast with fluorescence, we gain new insight into complex relaxation phenomena, such as those causing blinking, or on the photophysical properties of the non-fluorescent (dark) states. We have recently pushed the sensitivity of the technique to the detection of single molecules (see Fig.1).

References:

1. Kulzer F., Xia T., Orrit M.; Angew. Chem. **2010**, *49*, 854-.
2. Tchebotareva A.L. et al.; Laser Photon. Rev. **2009**, *4*, 581-.
3. Zondervan R. et al.; Proc. Nat. Acad. Sci. USA **2007**, *104*, 12628-. id., **2008**, *105*, 4993-.

Acknowledgement : The work presented was done by F. Kulzer, R. Zondervan, M. Lippitz, M. A. Kol'chenko, C. Hofmann, A. Tchebotareva, A. Gaiduk, P. Zijlstra, A. Nicolet, M. A. van Dijk, T. Xia, P. Ruijgrok, M. Yorulmaz, HF. Yuan, in the author's group.

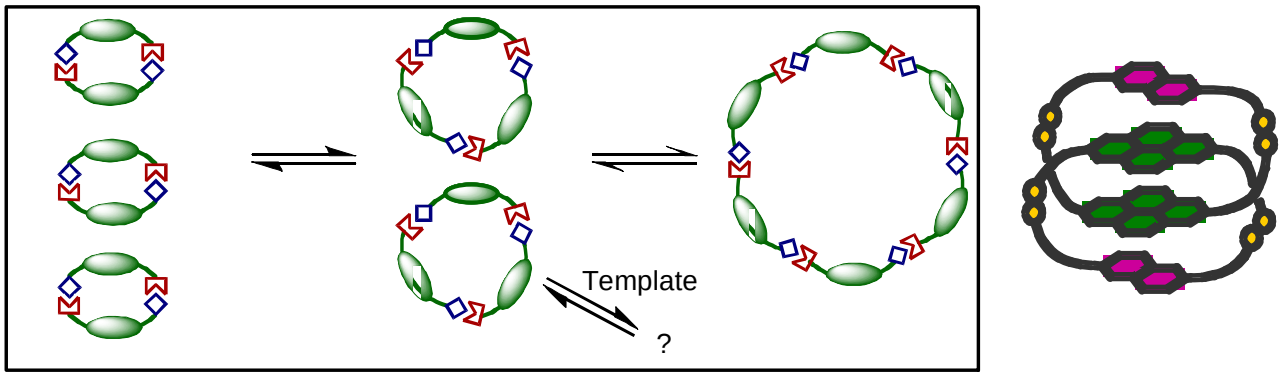
Dynamic Combinatorial Chemistry

Prof. Jeremy K. M. SANDERS, FRS

University of Cambridge – Department of Chemistry

jkms@cam.ac.uk

What is the best way to create a new receptor for a guest, or a good ligand for a host? Classical synthetic design has limitations, so we have developed dynamic combinatorial chemistry, which is inspired by biological evolution and the mammalian immune system. We create equilibrating mixtures from which a template can gather around itself a successful host despite the complexity of the reaction mixture. This host can be selected, amplified, isolated and identified: we design the *experiment*, not the *molecule*. This provides the synthetic chemist with a selection approach to molecular recognition that complements the traditional design approach. It can change the way we think about synthesis, and provide us with a way of exploring how complex systems respond to external stimuli. These ideas will be explored through recent results on a variety of systems including catenane synthesis in water and solid state dynamic chemistry.



Key References:

Dynamic combinatorial chemistry; Chem. Rev. **2006**, *106*, 3652-.
Dynamic combinatorial syntheses of catenanes in water; Proc. Natl Acad. Sci. USA **2009**, *106*, 10466-. J. Am. Chem. Soc. **2011**, *133*, 3198-.
Solid-state dynamic combinatorial chemistry; Chem. Sci. **2011**, *2*, 696-.
Discovery of linear receptors for multiple dihydrogen phosphate ions using dynamic combinatorial chemistry; J. Am. Chem. Soc. **2011**, *133*, 3804-.

Synthetic Molecules with the Size and Dimension of Biological Objects and Internally Ordered, "Infinite" Sheets

Prof. A. Dieter SCHLÜTER

Eidgenössische Technische Hochschule Zürich – Institut für Polymere

ads@mat.ethz.ch

The lecture will cover two projects in which we try to push the boundaries of synthetic chemistry in terms of size and dimension. In a first part it will be discussed how conventional polymer chains can be systematically thickened to the degree that they attain a persistent cylindrical shape and turn into molecular objects. A particular representative, a fifth generation dendronized polymer, is the largest ever synthesized macromolecule with structure precision. Emphasis will be placed upon the aspect why thickening of polymer chains makes sense and to which applications this can lead.[1] The second part has to do with the present interest in graphene, a naturally occurring two-dimensional polymer. The very existence of this polymer makes clear that there is no synthetic method available that would allow accessing a covalently bonded molecular sheet with internal periodicity and a thickness of one monomer unit only.[2] After a brief overview of "organic" and "polymer" approaches performed so far, the concepts will be presented which are presently being pursued in the author's laboratory to arrive at such a goal. They rest upon carefully designed monomers, interfacial as well as single crystalline ordering, and both metal-complexation and light-induced polymerizations. The lecture will provide a state-of-the-art picture including the not yet published first solution to the problem.

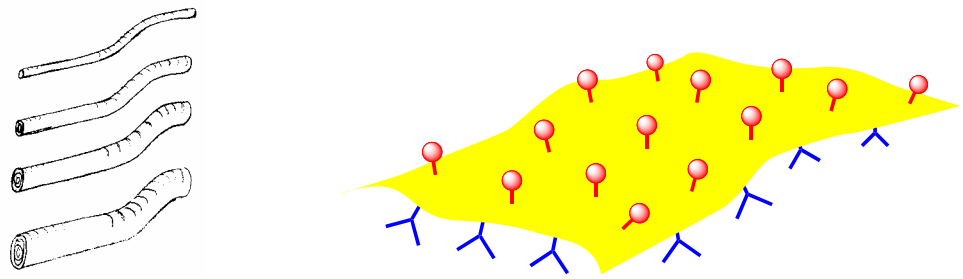


Figure 1: Cartoon representations of systematically thickened linear polymers (left) and of a laterally infinite, one monomer unit thin, internally ordered synthetic sheet (right).

Key References:

1. Guo Y., van Beek J.D., Zhang B., Colussi M., Walde P., Zhang A., Kröger M., Halperin A., Schlüter A.D.; J. Am. Chem. Soc. **2009**, *131*, 11841-. Zhang B., Wepf K., Fischer M., Schmidt M., Besse S., Lindner P., King B.T., Sigel R., Schurtenberger P., Talmon Y., Ding Y., Kröger M., Halperin A., Schlüter A.D.; Angew. Chem. Int. Ed. **2011**, *50*, 737-.
2. Sakamoto J., van Heijst J., Lukin O., Schlüter A.D. Angew. Chem. Int. Ed. **2009**, *48*, 1030-.

SARA Endosomes Regulate Cell Fate of Spinalcord Neural Precursors

Sabine ABKE

sabine.abke@unige.ch

The TGFβ-signaling adaptor protein called SARA (**S**mad **A**nchor for **R**eceptor **A**ctivation), labels a subpopulation of early endosomes. Studies in our lab have shown that those SARA endosomes ensure asymmetric segregation of NOTCH signaling pathway components in the SOP lineage in drosophila.[1]

In the zebrafish spinalcord, SARA-positive endosomes are also segregated asymmetrically during cell division, which could neither be observed for Rab5-, Rab11- nor for Rab7-positive endosomes. Moreover, we could correlate the inheritance of the SARA endosomes with proliferation.

We also assessed the impact of SARA on the cell lineage of neural precursors. Then we compared the modes of cell division that occur in WT with the division happening in SARA morphants and we detected a decrease in the size of the cell clones. Interestingly, we observed the same phenotype by blocking NOTCH signaling, whereas we observed an increase in the size of the cell clones by activating NOTCH signaling. Additionally, we could detect the Notch ligand Delta as a target of SARA endosomes. By performing transplantations from WT into mindbomb (Delta-) morphants or vice versa, we could show that the mechanisms controlling these cell divisions act cell-autonomously.

That is why we propose a model in which Notch signaling molecules traffic through SARA endosomes, meaning that directional NOTCH signaling between the two daughters determines their fates.

This study allowed us to gain insight into mechanisms that are conserved between different species.

References:

1. Coumailleau F., Fürthauer M.; Nature **2009**, April 23, *458(7241)*, 1051-.

Protein-Lipid Interaction in Endosome Biogenesis

Christin BISSIG

christin.bissig@unige.ch

Eukaryotic cells are enclosed by a cell membrane and communicate with the environment via molecules present on their cell surface. Types and concentration of these cell surface molecules are therefore tightly controlled via two membrane trafficking pathways: The secretory pathway, which delivers newly synthesized proteins and lipids to the cell surface and the endocytic pathway that removes molecules from the cell surface and sends them to lysosomes, where they are degraded. Both pathways consist of separate membrane-bound organelles that communicate in a non-leaky manner via membrane fission and fusion events. I am interested in the latter pathway with a focus on membrane trafficking and dynamics.

Molecules that have to be downregulated traffic through early and late endosomes to lysosomes, where they are finally degraded. Endosomes along this degradation pathway are multivesicular and molecules destined for degradation are sorted to and traffic in intraendosomal vesicles.[1] Endosomal functions and biogenesis are regulated by association of protein complexes with specific membrane lipids.[2]

I study the protein-lipid interaction between the late endosomal phospholipid lysobisphosphatidic acid (LBPA) and its effector protein Alix. LBPA is an unusual phospholipid that has only been detected in endosomes and plays a crucial role in endosomal dynamics and function.[3] *In vitro* assays with liposomes and endosomes indicate that LBPA can drive the formation of intraendosomal vesicles and that Alix negatively regulates the process.[4,5] By combining various liposome-based assays *in vitro* with studies of membrane transport *in vivo*, I am investigating the role of Alix-LBPA interaction in the formation, dynamics and back-fusion of intralumenal vesicles.

My preliminary *in vitro* results indicate that the N-terminal Bro1 domain of Alix is sufficient to interact with LBPA-containing bilayers. I have identified by site-directed mutagenesis residues in the Bro1 domain that are required for this interaction, and I am using LBPA analogues and isoforms to characterize the binding determinants on the lipid. Finally, my data indicate that LBPA-binding is necessary for LBPA functions *in vivo* and that Alix association to LBPA-containing membranes is regulated by calcium, via a novel calcium-binding motif.

References:

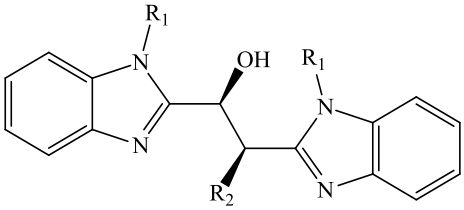
1. Gruenberg J., Stenmark H.; Nat. Rev. Mol. Cell Biol. **2004**, *5*, 317-.
2. Falguieres T., Luyet P.P., Gruenberg J.; Exp. Cell Res. **2008**, *24*, 24-.
3. Kobayashi T., Beuchat M.H., Lindsay M., Frias S., Palmiter R.D., Sakuraba H., Parton R.G., Gruenberg J.; Nat. Cell Biol. **1999**, *1*, 113-.
4. Matsuo H., Chevallier J., Mayran N., Le Blanc I., Ferguson C., Faure J., Blanc N.S., Matile S., Dubochet J., Sadoul R., Parton R.G., Vilbois S., Gruenberg J.; Science **2004**, *303*, 531-.
5. Falguieres T., Luyet P.P., Bissig C., Scott C.C., Velluz M.C., Gruenberg J.; Mol. Biol. Cell **2008**, *19*, 4942-.

Helical Cubane-Like Complexes Using Malic Acid Bisbenzimidazole Derivative as Ligand

Claire DEVILLE

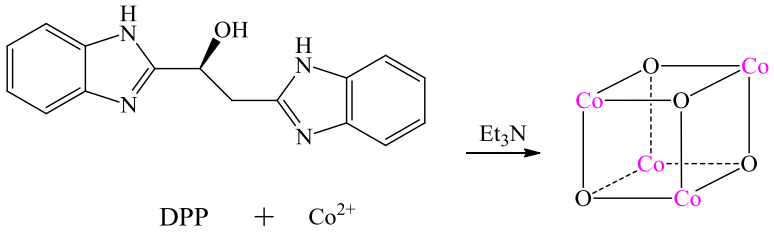
claire.deville@unige.ch

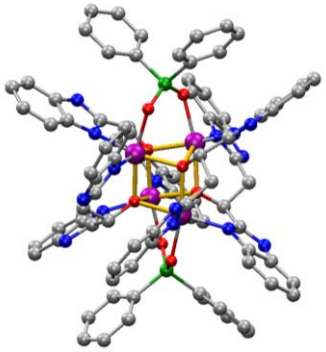
Cubane-like structures are common in transition metal chemistry and one is believed to be present at the active site of the oxygen evolving centre of photosynthesis.[1] Tartaric acid bis-benzimidazole derivatives (**L_1** and **L_2**) have been found to generate cubane-like geometry when coordinated to transition metal ions such as cobalt(II) and nickel(II).[2] In this case the coordination sphere of an octahedral metal ion is completed.



L_1	R_1=H	R_2 = OH
L_2	R_1 = CH_3	R_2 = OH
L_3	R_1 = H	R_2 = H
L_4	R_1 = CH_3	R_2 = H

We used here malic acid bisbenzimidazole derivatives (**L_3** and **L_4**) that have only one alcohol function, to generate similar products but we need a bridge to meet the coordination requirements of the metal. Diphenylphosphate (DPP), that is known[3] to bridge across the face of a cubane, will be used to complete the coordination sphere of the metal ion. Acetate will act the same way.





Results obtained with cobalt(II) and manganese(II) metal ions will be presented. In both cases, the four ligands in the complexes twist around the cubane core to give a quadruple helical structure.

References:

1. Ferreira K.N., Iverson T.M., Malghlaoui K., Barber J., Iwata S.; Science **2004**, *303*, 1831-.
2. Isele K., Gigon F., Williams A.F., Bernardinelli G., Franz P., Decurtins S.; Dalton Trans. **2007**, 332-.
3. Wu J.-Z., Angelis F.D., Carrell T.G., Yap G.P.A., Sheats J., Car R., Dismukes G.C.; Inorg. Chem. **2006**, *45*, 189-.

Formation of Metastable Bilayers by an Artificial Phospholipid

Illya A. FEDOTENKO

illya.fedotenko@unige.ch

Introduction. Glycerophospholipids and sphingolipids are natural amphiphiles typically found in the cell membranes. Their structure comprises a charged polar headgroup and long aliphatic tails connected to the glycerol backbone or the sphingosine base. Due to the combination of the hydrophilic and the hydrophobic properties phospholipids such as DPPC or POPC are able to form vesicles in water. In addition to it, the excellent biocompatibility of the phospholipids allows to use them as convenient drug carriers. To our knowledge, little attention was paid to the details of the drug release in the blood vessels induced by the shear stress.[1] In our group we found that the vesicles consisting of natural phospholipids DPPC and 16:0 sphingomyelin are stable under mechanical stress while the vesicles made of an artificial phospholipid Pad-PC-Pad are leaking under the same conditions.[2] We therefore attempted to prove the role of the chemical structure in such a release pattern.

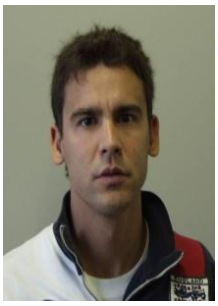
Concept. Since the beginning, our efforts were directed on the synthesis of an artificial phospholipid Pad-PC-Pad and the study of its thermodynamic and conformational properties. The concept of the artificial phospholipid is based upon the replacement of the natural glycerol backbone found in glycerophosphocholines with new interfaces, such as 1,2-diaminopropan-3-ol. Firstly, the order of the substitution of the aliphatic chains was changed in favor of 1,3 as opposed to the natural 1,2-dialkylphospholipids. Seelig and coworkers, showed that such a substitution had virtually no effect on the physical behavior of a phospholipid.[3] Secondly, to introduce an additional stability, the natural ester interface was replaced with an amide which can form additional hydrogen bonds. This feature also makes our artificial phospholipid structurally similar to sphingolipids and allows considering it as a synthetic analog of sphingomyelin.[4] The performed experiments included studies of the spontaneous release at ambient temperature which describes the intrinsic stability of the sample and the release under increased shearing.

Acknowledgements. The authors would like to thank the Département de l'Instruction Publique (State of Geneva) and the Swiss National Science Foundation for financial support, Dr A. Ziegler for DSC measurements and Dr R. Reiter for Brewster angle micrographs.

References:

1. Bernard A. L., Guedeau-Boudeville M.A., Marchi-Artzner V., Gulik-Krzywicki T., di Meglio J.M., Jullien L.J.; Colloid Interf. Sci. **2005**, *287*, 298-.
2. Saxer T., Müller B., Zumbuehl A., Holme M.L., Fedotenko I.A.; US provisional patent 61451153.
3. Seelig J., Dijkman R., De Haas G.H.; Biochem. **1980**, *19*, 2215-.
4. Fedotenko I.A., Zaffalon P.L., Favarger F., Zumbuehl A.; Tetrahedron Lett. **2010**, *51*, 5382-.

Interactions Between Sulfate Latex Particles With Adsorbed Linear Poly(ethylene Imine) Studied Using Colloidal Probe Technique



Marco FINESSI

marco.finessi@unige.ch

Interaction forces between negatively charged sulfate latex particles with adsorbed cationic linear poly(ethylene imine) (LPEI) are studied using colloidal probe technique based on the atomic force microscope (AFM). Tuning the polymer dose, the interaction forces are observed to switch from repulsive to attractive and back to repulsive again.

The repulsive ones are given by the overlap of the diffuse part of the electrical double layer around the charged surfaces of two particles. Their strength decreases as one approaches the isoelectric point (IEP) and increases away from it. Close to the IEP, the surface of the particle is neutralized by the polymer and the electrical double layer does not exist any longer. This situation is described by short range van der Waals interactions. At very high adsorbed amount, the surface saturates and the strength of the interactions remains constant.

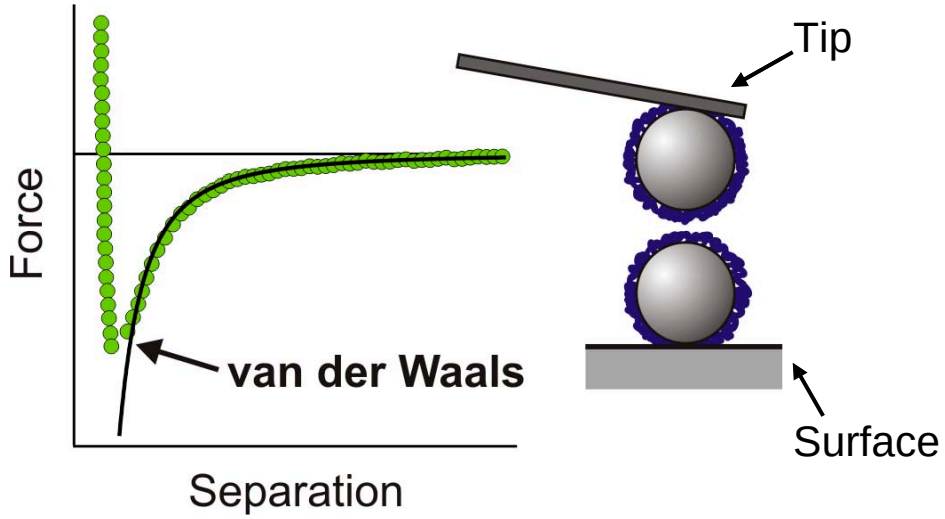


Figure 1: Example of experimentally measured attractive force (symbols) and the calculated van der Waals force (line), at the left side. Sketch of colloidal probe technique when one particle covered by polymer is attached to the edge of the tip and the other stuck on the surface (right side).

Computer Modeling of the Electronic Structure of Molecules in Condensed Phase by Means of the Frozen-Density Embedding Theory Based Methods

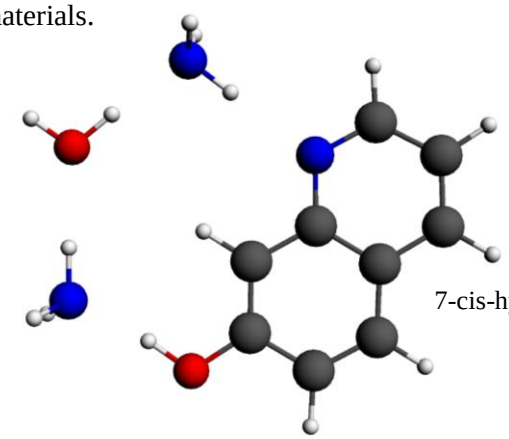
Georgios FRADELOS

georgios.fradelos@unige.ch

Our works on applications of Frozen-Density Embedding Theory (FDET) based methods (see Ref. 1 and subsequent works by Wesolowski *et al.*) in studies of the electronic structure of molecules in condensed phase concerns : a) determination of the intrinsic accuracy of the calculated properties,[2,3] b) investigation of the adequacy of the approximations used in FDET based multi-level simulations,[4,5] and c) interpretation of the experimental data[6].

Our recent studies[2,3] of the effect of hydrogen-bonded environment on the electronic excitations of 7-cis-hydroxyquinoline show that the reduction of computational costs reaches two orders of magnitude compared to the reference level methods and the accuracy is similar. This validation of the FDET methodology reinforces the conclusions of our previous FDET studies concerning the origin of the non-additive effects of the individual hydrogen bonds on the electronic spectra of an embedded chromophore.[6] Moreover, it validates the use of the FDET embedding potential in multi-level simulations which, however, must involve additional approximations in FDET equations such as the ones concerning the generation of the frozen density, neglect of certain terms and the use of truncated basis sets.

Such approximations were investigated[4,5] leading us to the establishment of a computational protocol for future studies of EPR spectra of radicals hydrogen-bonded to proteins and chromophores in hydrogen-bonded liquids or other materials.



7-cis-hydroxyquinoline

References:

1. Wesolowski T.A. et al.; J. Phys. Chem. **1993**, *97*, 8050-.
2. Fradelos G. et al.; J. Chem. Theory Comput. **2011**, in press.
3. Fradelos G. et al.; Progress in Theoretical Chemistry and Physics, Vol. XXX; Advances in the Theory of Quantum Systems in Chemistry and Physics, **2011**, in press.
4. Fradelos G. et al., J. Chem. Theory Comput. **2010**, *7*, 213-.
5. Fradelos G. et al., J. Phys. Chem. A **2011**, submitted.
6. Fradelos G. et al., J. Phys. Chem. A **2009**, *19*, 9766-.

Role of Dictyostelium Myosin IB in Phagosome Maturation

Navin GOPALDASS

navin.gopaldass@unige.ch

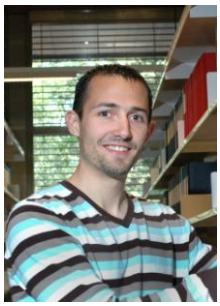
Dictyostelium discoideum is an amoeba that lives in the soil and feeds on bacteria. This model organism can be used as a surrogate macrophage to study highly conserved processes such as cell motility, phagocytosis, membrane traffic and host-pathogen interactions . Here we will describe the role of a class I myosin (MyoB) during phagosome maturation in *Dictyostelium*.

Myosins are molecular motors that use ATP as fuel and actin filaments as tracks. The first myosin, the so called conventional myosin or class II myosin, was discovered as being responsible for the force produced during muscle contraction. Soon after, many other members of this large protein family were discovered, giving rise to at least 18 different classes of myosins. These proteins are involved in a broad range of cellular processes from transcription, maintenance of cortical tension and membrane traffic. Among them, class I myosins have been described as important players in membrane deformation during endocytosis. Several studies also point to a role along the endocytic pathway but this is far from understood.

Here we use phagosome maturation as a paradigm for the endocytic pathway. We take advantage of the fact that we can purify phagosomes at different maturation stages to homogeneity and easily perform biochemical analyses with them. We can also monitor *in vivo* parameters such as pH and proteolitic activity. We show that knock out of MyoB delays phagosome reneutralisation, a step that happens in *Dictyostelium* at a late stage prior to exocytosis. As a read out for actindependent processes during maturation, we monitored the capacity of purified phagosomes to bind F-actin *in vitro*, and correlated this with the presence of actin-binding and membrane trafficking proteins. Phagosomes isolated from *myoB*-null cells showed increase binding to Factin, especially late phagosomes. We also observed a prolonged association of Dynamin A, a protein involved in membrane scission, with phagosomes of myoB-null cells during maturation. Interestingly, knock out of Dynamin A leads to an increase in MyoB recruitement to late phagosomes and enhances endosome tubulation.

We propose that MyoB plays a role in a membrane scission process similar to that of class I myosins at the plasma membrane, but at a late stage of phagosome maturation.

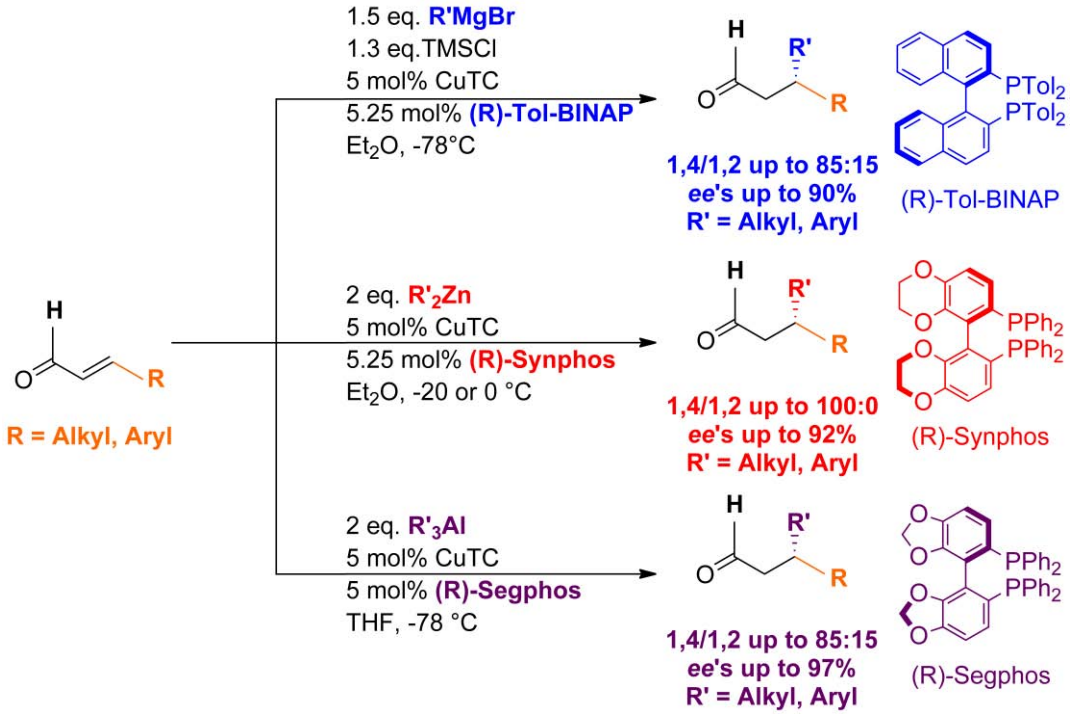
Enantioselective Copper Catalyzed 1,4 Addition to Challenging Michael Acceptors and Synthesis of Relevant Target Molecules



Ludovic GREMAUD

ludovic.gremaud@unige.ch

The copper-catalyzed asymmetric conjugate addition (A.C.A) of organometallic reagents to Michael acceptors is among the most important methodologies to form a C-C bond in enantioselective manner. In this field, a variety of α,β-unsaturated compounds such as α,β-unsaturated carbonyl derivatives, nitroalkenes and sulfones have been successfully used.[1] On the other hand, sensitive α,β-unsaturated Michael acceptors are more challenging substrates because of their high reactivity toward the undesired 1,2 addition. In 2010, we developed the first example of enantioselective Cu-catalyzed conjugate addition of organozinc or Grignard reagents to α,β-unsaturated aldehydes.[2]



Scope, limitations and potential synthetic applications will be presented for relevant target molecules.

References:

1. (a) Alexakis A., Benhaim C.; Eur. J. Org. Chem. **2002**, 3221-. (b) Alexakis A., Backväll J.E., Krause N., Pamies O., Dieguez M.; Chem. Rev. **2008**, *108*, 2796-. (c) Harutyunyan S.R., den Hartog T., Geurts K., Minnaard A.J., Feringa B.L.; Chem. Rev. **2008**, *108*, 2824-.
2. Palais L., Babel L., Quintard A., Belot S., Alexakis A.; Org. Lett. **2010**, *12*, 1988-.

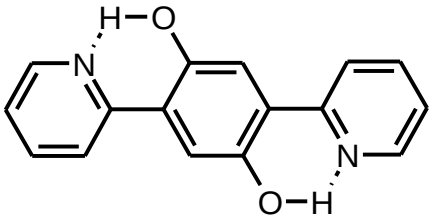
New Systems for Proton-Coupled Electron Transfer

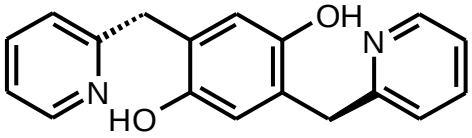
William HERZOG

william.herzog@unige.ch

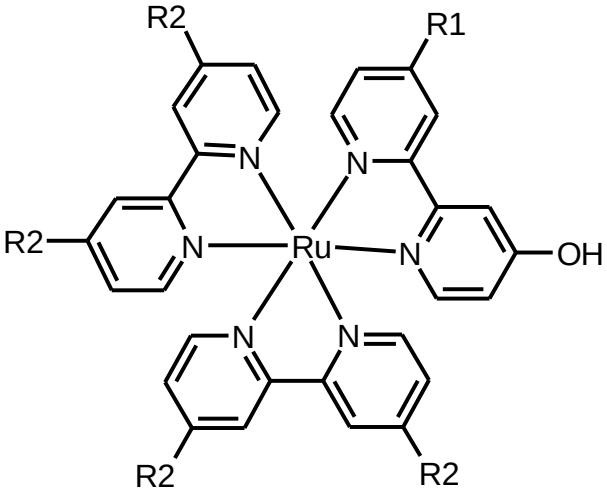
Following up our recent studies of iridium (III) based system,[1] we are now exploring ruthenium (II) based models for proton-coupled electron transfer.

Two ways are currently explored. First, organic molecules able to transfer both proton and electron with the help of a photo-excited ruthenium complex.





Second, ruthenium complexes wearing hydroxylated bipyridine are considered.



R_1=H, OH ; R_2 = H, iPr, OMe, OH

References:

1. Freys J.C., Bernardinelli G., Wenger O.S.; Chem. Commun. **2008**, 4267-.

Glycosylphosphatidylinositol-Anchored Proteins En Route to the Plasma Membrane

Nina JAENSCH

nina.jaensch@unige.ch

The secretory pathway is a major transport process in eukaryotic cells with a role in the synthesis, sorting, processing and secretion of a large variety of proteins.[1] The fidelity and efficiency of the secretory pathway depends on numerous transport and sorting steps as well as on molecular machineries executing these steps. The core machineries of the various steps within the secretory pathway have been well described. However, eukaryotic cells have to deal with a wide variety of secretory proteins with different structures and characteristics. Among them, we are particularly interested in the transport and sorting of glycosylphosphatidylinositol-anchored proteins (GPI-APs).

GPI-APs are a class of lipid-anchored proteins located in the plasma membrane with various functions such as receptors, enzymes or adhesion molecules. One of the major characteristics of GPI-APs is their ability to partition into detergent resistant membranes (DRMs),[2] which are microdomains enriched in cholesterol and sphingolipids and are thought to act as platforms for various cellular functions such as signaling or protein sorting.[3] In the ER and the Golgi apparatus, GPI-APs are lumenally exposed which makes them inaccessible for basic transport or sorting machineries localized in the cytosol. This leads to the hypothesis that GPI-APs use a unique mechanism for being recognized and properly sorted to the plasma membrane.

In my thesis, I am studying the role of DRM association of GPI-APs at the Golgi apparatus for their sorting and transport to the plasma membrane. We are currently using cell surface biotinylation assays to measure the arrival at the cell surface. By either manipulating the GPI-anchor or by depleting sphingolipids we can interfere with the DRM association of GPI-APs and therefore we can address the involvement of this process in the sorting and transport. So far our results show that interfering with the DRM association does not impair the transport kinetics of GPI-APs to the plasma membrane. The mechanism of how GPI-APs are sorted at the level of the Golgi and how it differs from transmembrane proteins still needs to be identified.

With a new *in vivo* approach which allows us to track cargo proteins en route to the plasma membrane in living cells, we are hoping to gain more insight on sorting mechanisms of GPI-APs.

References:

1. Palade G.; Science **1975**, *189*, 347-.
2. Simons K., Ikonen E.; Nature **1997**, *387*, 569-.
3. Brown D.A., Rose J.K.; Cell **1992**, *68*, 533-.

Ultrafast Spectroscopy of Artificial Self-Organizing Photosystems

Oksana KEL

oksana.kel@unige.ch

The development of smart artificial photosystems is an issue of increasing importance. Multichromophoric compounds consisting of amino naphthalene diimides (NDI) covalently attached to a p-octiphenyl (POP) scaffold have been shown to self-assemble as supramolecular tetramers in lipid bilayer membranes and to generate a transmembrane proton gradient upon photoexcitation. The photophysical and electrochemical properties of these NDI systems can be tuned by varying the substituents on the NDI core (Figure A). Moreover, NDIs covalently attached to POP and oligophenylethynyl (OPE) scaffolds can be self-organized as zipper assembly on a gold surface (Figure B), thereby providing materials with a spatially ordered and oriented redox gradient.

Using femtosecond transient absorption (TA) and fluorescence up-conversion techniques, we evidenced the population of a charge-separated state upon excitation of NDIs systems with different substituents covalently attached to a POP or OPE scaffold (Figure C). Depending on the type of scaffold, NDI substituents, and excitation wavelength, two charge separation (CS) pathways have been demonstrated: symmetry-breaking CS between two NDI units and CS between scaffold and NDI.

The photophysical processes occurring upon photoexcitation of these systems, going from the "building blocks" – monomeric NDI – to highly organized architectures, will be discussed in detail.

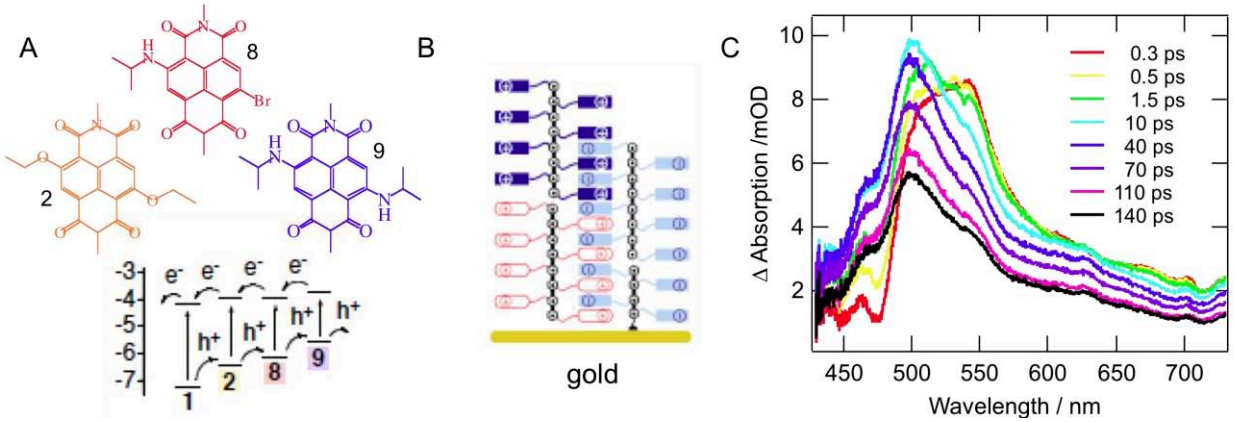


Figure. A) Structure and HOMO and LUMO energies of NDI with different substituents; B) Concept of zipper assembly on gold surface; C) Transient absorption spectra of NDI-2 attached to p-octiphenyl after 400 nm excitation.

Artificial Photosystems on Surfaces: Lateral Self-Sorting and Templation Effects

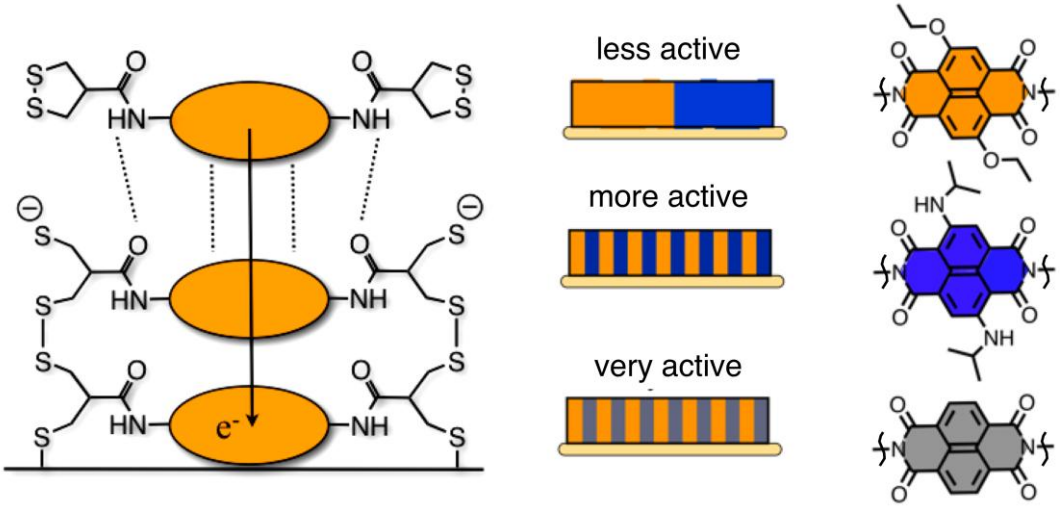
Marco LISTA

marco.lista@unige.ch

One of today's key challenge in supramolecular chemistry was addressed: access to oriented and ordered 3D structures on surfaces. Self-organizing surface-initiated polymerization (SOSIP) was introduced as a new versatile route to grow ordered stacks of n-conducting naphthalenediimides (NDIs)[1] with tunable electronic properties due to the different substituents attached to the aromatic core.[2] Thanks to supramolecular interactions such as π-stacking and hydrogen bonding the monomers self-organize and polymerize in covalent NDI stacks growing perpendicularly from a surface equipped with a free thiol initiator monolayer.[3]

Co-SOSIP of different propagators showed an increase in photocurrent generation activity up to 40 times compared to single color devices. Moreover we were able to control to some extent the self-sorting, thus the activity, of the different NDIs varying the alkyl tail length in their structurizing part.[4]

In order to achieve a better control on the polymerized film, surface templation was explored. Co-SOSIP of two NDI propagators using electrodes with two NDI initiators showed a direct correlation between the initiators molar fraction and the polymerized film composition.[4]



References:

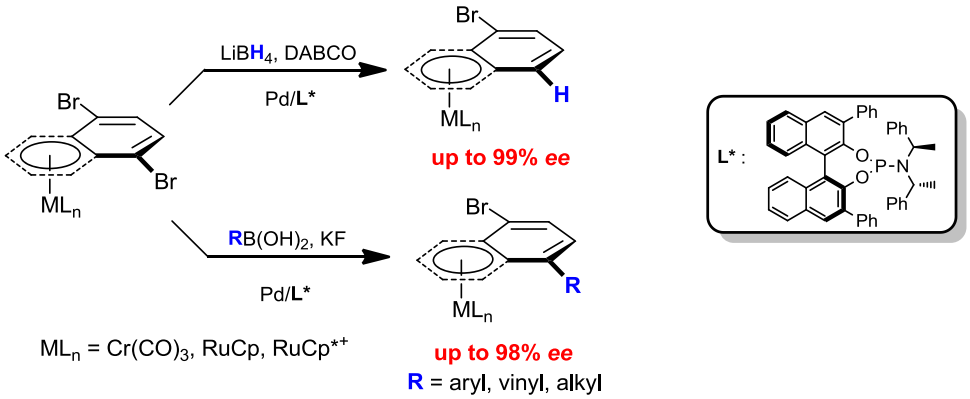
1. Bhosale R., Perez-Velasco A., Ravikumar V., Kishore R.S.K., Kel O., Gomez-Casado A., Jonkheijm P., Huskens J., Maroni P., Borkovec M., Sawada T., Vauthey E., Sakai N., Matile S.; Angew. Chem. Int. Ed. **2009**, *48*, 6461-.
2. Sakai N., Mareda J., Vauthey E., Matile S.; Chem. Comm. **2010**, *46*, 4225-.
3. Sakai N., Lista M., Kel O., Sakurai S., Emery D., Mareda J., Matile S.; submitted.
4. Lista M., Areephong J., Sakai N., Matile, S.; submitted.

Efficient Catalytic Asymmetric Entry to Planar Chiral Complexes – Application to the Synthesis of Palladacycles

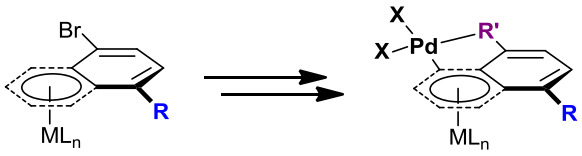
Audrey MERCIER

audrey.mercier@unige.ch

Enantiomerically pure planar chiral complexes are of interest for both asymmetric synthesis and catalysis. We here report on an easy access to highly enantioenriched neutral [$Cr(CO)_3$(naphthalene)], [RuCp(indenyl)] and cationic [RuCp*(naphthalene)] complexes *via* desymmetrization of prochiral dihalide complexes using a bulky chiral palladium catalyst.[1,2] Ligand optimization and mechanistic analyses result in a clear picture of the reaction and the asymmetric induction.



The potential utility of this reaction is illustrated in the synthesis of a wide range of highly enantioenriched planar chiral complexes. Particularly, the access to *peri*-palladacycles is of high interest in view of their evaluation in asymmetric catalysis.



References:

1. Cr-complexes: (a) Urbaneja X., Mercier A., Besnard C., Kündig E.P.; Chem. Commun. **2011**, 47, 2739-. (b) Mercier A., Urbaneja X., Yeo W.C., Chaudhuri P.D., Cumming G.R., House D., Bernardinelli G., Kündig E.P.; Chem. Eur. J. **2010**, *16*, 6285-. (c) Kündig E.P., Chaudhuri P.D., House D., Bernardinelli G.; Angew. Chem. Int. Ed. **2006**, *45*, 1092-.
2. Ru complexes: (a) Mercier A., Yeo W.C., Chou J.Y., Chaudhuri P.D., Bernardinelli G., Kündig E.P.; Chem. Commun. **2009**, 5227-. (b) Mercier A., Yeo W.C., Urbaneja X., Kündig E.P.; Chimia **2010**, *64*, 177-.

Quantitative Analysis of Membrane Deformation and Fission Induced by Dynamin GTPase Activity

Sandrine MORLOT

sandrine.morlot@unige.ch

Dynamin is required to sever lipid bilayers during endocytosis. During this process a helical dynamin polymer assembles around a membrane tubule and reduces its radius and pitch upon GTP hydrolysis. This deformation is thought to be crucial for dynamin's severing action and results in an observable twisting of the helix.[1]

Here we quantitatively study the factors determining the dynamics of this deformation. We perform *in vitro* experiments where we attach small beads to the dynamin helix and track their rotation in real time, thus collecting information about the space and time dependence of the deformation. Longer helices deform more slowly as predicted by a generalized hydrodynamics theoretical model.[2] Further agreement between experiments and theory indicates that the concerted deformation dynamics is dominated by the draining of the membrane out of the helix, allowing us to quantitatively characterize helix-membrane interactions.[3]

We also study the dynamics of tube fission induced by dynamin GTPase activity. Membrane nanotubes are pulled from Giant Unilamellar Vesicles (GUV) using optical tweezers and membrane tension is set by aspirating the GUVs within a micropipette. Dynamin and GTP are injected near the tube. Tubes always break few seconds after dynamin starts polymerizing around the tube. We show that the probability of fission depends on GTP concentration and that membrane geometry and tension affects fission.

References:

1. Roux A., Uyhazi K., Frost A., De Camilli P.; Nature **2006**, *441*, 528-.
2. Lenz M., Prost J., Joanny J.-F.; Phys. Rev. E **2008**, *78*, 011911-.
3. Morlot S., Lenz M., Prost J., Joanny J.-F., Roux A.; Biophys. J. **2010**, *99*, 3580-.

Effect of Pressure and Temperature in the Energy Levels of Sm^{2+} in Matlockite Hosts

Prodipta PAL

prodipta.pal@unige.ch

Transition metal ions and rare-earth ions doped in inorganic solids have many optical applications in various fields.[1,2]

In this work, we explore, at a fundamental level, the effects of the surroundings on the absorption and emission properties of Sm^{2+} using high pressure (up to 8 GPa) and chemical substitution.

The absorption and emission properties of Sm^{2+} doped in SrFBr and BaFBr and the related alkaline earth fluorohalides (MFX) have been studied in detail. Crystal field parameters have been obtained for Sm^{2+} doped in SrFBr and BaFBr host using the program written by S. Edvardsson et al.[3] They reproduce the experimental energy levels within an error of less than 10 cm^{-1}.

Absorption spectra from low temperature (4K) to room temperature of Sm^{2+} doped crystals show strong Fano resonances.

Pressure dependent emission spectra show important red shifts of the sharp $^5D_{0,1,2} \rightarrow {}^7F_j$ (where j=0-4) transitions. These shifts are about 3 times stronger than the shift of ruby R_1 line which is generally used as pressure sensor in the Diamond Anvil Cell.

Pressure dependent sublevel crossing within the $^7F_1$ manifold observed for SrFBr at 5.5 GPa. Pressure dependent emission spectra at low temperature enable us to determine the crystal field parameters as a function of pressure.

The lifetime of the $^5D_{0,1,2} \rightarrow {}^7F_0$ emissions were found to be strongly pressure and temperature dependent. The temperature dependent study of the $^5D_1$ lifetime was used to determine the energy of the lowest excited state configuration of $4f^5 5d^1$.

Pressure dependent experiments have also been performed on compounds like Eu^{2+}:$SrAl_2O_4$ and $[Rh_{1-x}Cr_x(bpy)_3][NaM_{1-y}Cr_y(ox)_3]ClO_4$.

References:

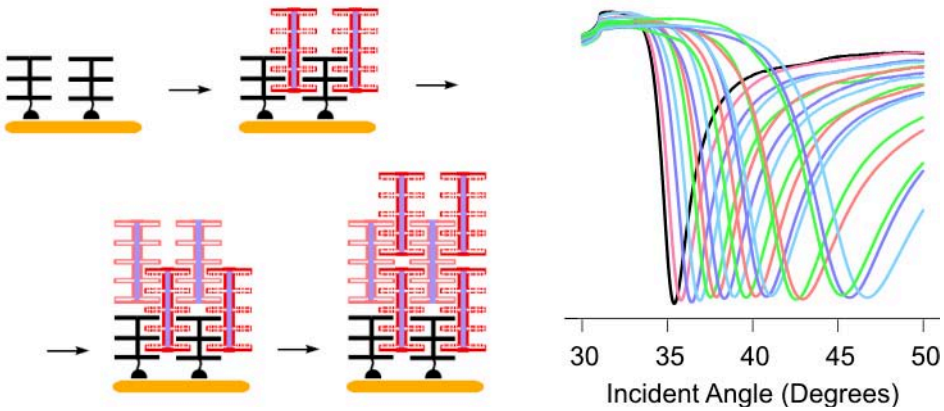
1. Shen Y.R., Gregorian T., Holzapfel W.B.; High Press. Res. **1991**, *7*, 73-.
2. Jaaniso R., Bill H.; Europhys. Lett. **1991**, *16*, 569-.
3. Edvardsson S., Aberg D.; Computer Phys. Comm. **2001**, *133*, 396-.

Multilayer Assemblies of Artificial Photosystems Analyzed by Surface Sensitive Techniques

Mariya PORUS

mariya.porus@unige.ch

Quartz crystal microbalance (QCM) and surface plasmon resonance (SPR) were used to study zipper and layer-by-layer multilayer assemblies of artificial photosystems based on naphtalenediimides (NDIs) attached to an olygophenylethynyl (OPE-NDI) or p-olygophenyl (POP-NDI) backbone in dry and wet state. It was demonstrated that the dry thickness of a monolayer in OPE-NDI zippers corresponds to a half of the length of the OPE scaffolds in agreement with the proposed structure of the zipper. Combination of SPR and QCM techniques allows to estimate the water content in the layer which is equal to 36% for OPE-NDI that confirms their compact structure. The dry monolayer thickness for the POP-NDI films however appears to be shorter than a half of the length of the POP scaffold, which may indicate the tilt of the scaffold during adsorption. In addition, POP-NDI films swell much more, suggesting a poor organization of the layers. All these observations explain well the difference in photochemical activity between OPE-NDI and POP-NDI assemblies.



Charging and Stability Behavior of Positively Charged Latex Particles in Presence of Poly(Acrylic Acid)

Amin SADEGHPOUR

amin.sadeghpour@unige.ch

The charge reversal of positively charged latex particles in presence of poly(acrylic acid), (PAA), as a weak polyelectrolyte, has been investigated. Amidine functionalized latex particles has been titrated by wide range of molecular mass of PAA, studying electrophoretic mobility and suspension stability by different light scattering methods. The presence of different interparticle/particle-polymer interactions like steric forces and polymer bridging has been considered.

It has been agreed that weak polyelectrolyte PAA shows significant pH and molecular mass dependent charge reversal. Further consideration approved the patched polyelectrolyte layer formation on the particles surface which causes the acceleration of the aggregation rate of latex particles. It has also been accepted that the bulk/solution partitioning of polyelectrolyte occurs in certain conditions.

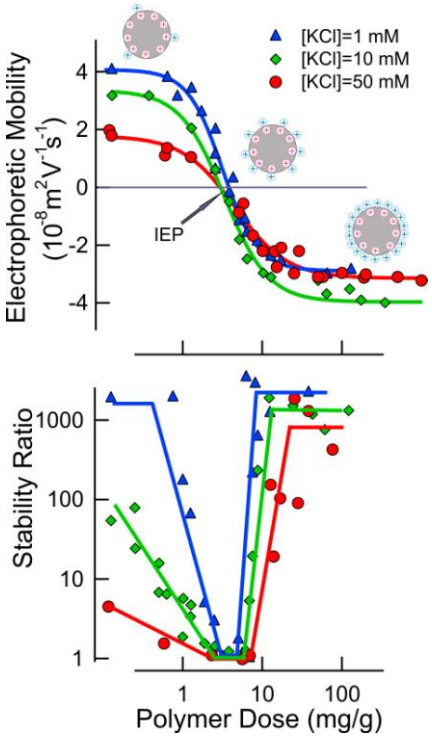


Figure 1. Mobility and stability of latex particles versus polymer dose(88 kg/mol) at pH=5.8

Lipid Homeostasis: Assessing the Effect of Kinases and Phosphatases in the Lipidome of Yeast

Aline SANTOS

aline.santos@unige.ch

Lipids are essential eukaryotic cellular constituents with multiple roles in membrane biogenesis, vesicular trafficking, energy storage and signaling. The major membrane lipid components of all eukaryotic cells are glycerophospholipids, sphingolipids and sterols. Their structure and metabolic pathways are highly conserved are conserved between yeast and mammals. Regulation of lipid homeostasis is elemental to cell proper functioning; therefore, we aimed to perform a systematic large scale investigation of the genetic control of kinases and phosphatases in the lipid homeostasis in yeast.

Using mass spectrometry, we analyzed over 200 lipids (covering the major lipid classes in yeast) in 130 kinase and phosphatase yeast knockout strains. Trough a comparative analysis of these lipid profiles we observed a complex and diverse patterns of changes, showing that loss of most kinases or phosphatases indeed perturbed the large part of a lipidome.

Our results provide global starting points toward understanding the complexity of control of lipid homeostasis by kinases and phosphatases in yeast and other organisms.

References:

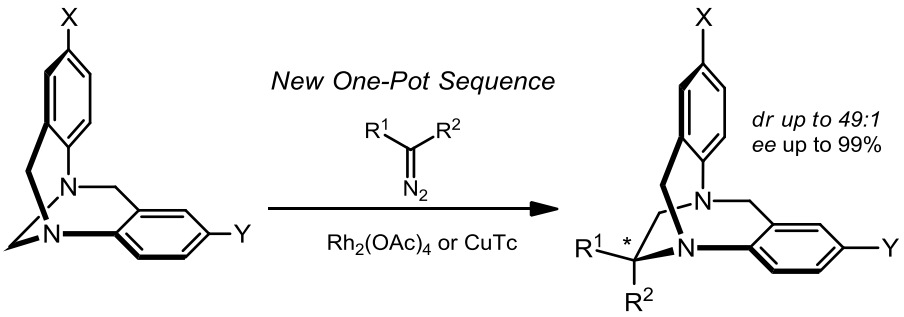
1. Daum G., Lees N., Bard M., Dickson R.; Yeast **1998**, *14*, 1471-.
2. Guan X.L., Wenk M.R.; Yeast **2006**, *23*, 465-.
3. Ejsing C.S., Sampaio J.L., Surendranath V., Duchoslav E., Ekroos K., et al.; Proc. Natl. Acad. Sci. USA, **2009**, *106*, 2136-.
4. Guan X.L., Souza C.M., Pichler H., Dewhurst G., Schaad O., Kajiwara K., Wakabayashi H., Ivanova T., Castillon G.A., Piccolis M., Abe F., Loewith R., Funato K., Wenk M.R., Riezman H.; Mol. Biol. Cell **2009**, *20*, 2083-.
5. Bodenmiller B., Wanka S., Kraft C., Urban J., Campbell D., Pedrioli P.G., Gerrits B., Picotti P., Lam H., Vitek O., Brusniak M.Y., Roschitzki B., Zhang C., Shokat K.M., Schlapbach R., Colman-Lerner A., Nolan G.P., Nesvizhskii A.I., Peter M., Loewith R., von Mering C., Aebersold R.; Science Signal. **2010**, *3*, rs4-.

One-Step Catalytic Asymmetric Synthesis of Tröger Bases

Ankit SHARMA

ankit.sharma@unige.ch

Tröger bases have been extensively studied for their interesting properties, reactivity and a host of diverse applications.[1] In stereochemistry, Tröger bases are unique being the first chiral compounds with stereogenic nitrogen atoms to be resolved.[2] However, classical *methano*-bridged Tröger bases undergo facile racemisation under acidic conditions.[3] One way to overcome this drawback is by synthesizing *ethano*-bridged derivatives.[4] Herein, we report on the one-step metal-catalyzed reaction of *methano*-Tröger bases and diazo carbonyl compounds yielding highly enantioenriched configurationally-stable *ethano*-Tröger derivatives. The process is general, enantiospecific (*ee* up to 99%, retention of configuration), diastereoselective (quaternary carbon center introduction, *dr* up to 49:1) and it allows to draw important mechanistic conclusions.[5] We also present a dichotomy in the reactivity of Cu(I) and Rh(II) catalysts towards the synthesis of *ethano*-Tröger bases.



References:

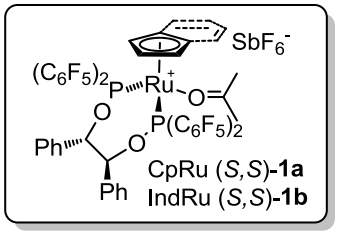
1. For a recent Review, see: Sergeyev S.A.; Helv. Chim. Acta **2009**, *92*, 415-.
2. Prelog V., Wieland P.; Helv. Chim. Acta **1944**, *27*, 1127-.
3. Trapp O., Trapp G., Kong J., Hahn U., Vögtle F., Schurig V.; Chem. Eur. J. **2002**, *8*, 3629-.
4. Hamada Y., Mukai S.; Tetrahedron: Asymmetry **1996**, *7*, 2671-. Michon C., Sharma A., Bernardinelli G., Francotte E., Lacour J.; Chem. Commun. **2010**, *46*, 2206-.
5. Sharma A., Guénée L., Naubron J.-V., Lacour J.; Angew. Chem. Int. Ed. **2011**, *50*, 3677-.

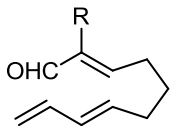
Chiral Ruthenium Lewis Acids: Powerful Tools for the Intramolecular Diels-Alder Reaction in the Synthesis of *ent*-Ledol

Sirinporn THAMAPIPOL

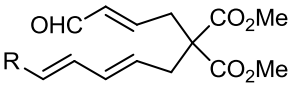
sirinporn.thamapipol@unige.ch

Chiral single-point binding Ru Lewis acids **1** incorporating a C_2-symmetric electron poor ligand BIPHOP-F can activate enal[1,2] and enone[3] dienophiles and catalyze inter- and intramolecular Diels-Alder reactions[4,5] giving cycloaddition products with high asymmetric induction.



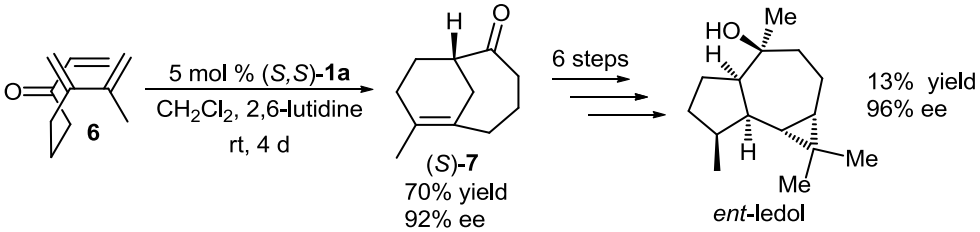


2, n = 1, R = H
3, n = 1, R = Me



4, n = 1, R = Me
5, n = 1, R = H

This methodology was applied for the preparation of the highly enantioenriched bridgehead adduct **7**, and used as a key step in the total synthesis of *ent*-ledol. The overall yield of *ent*-ledol was 13% in 6 steps with 96% ee.



References:

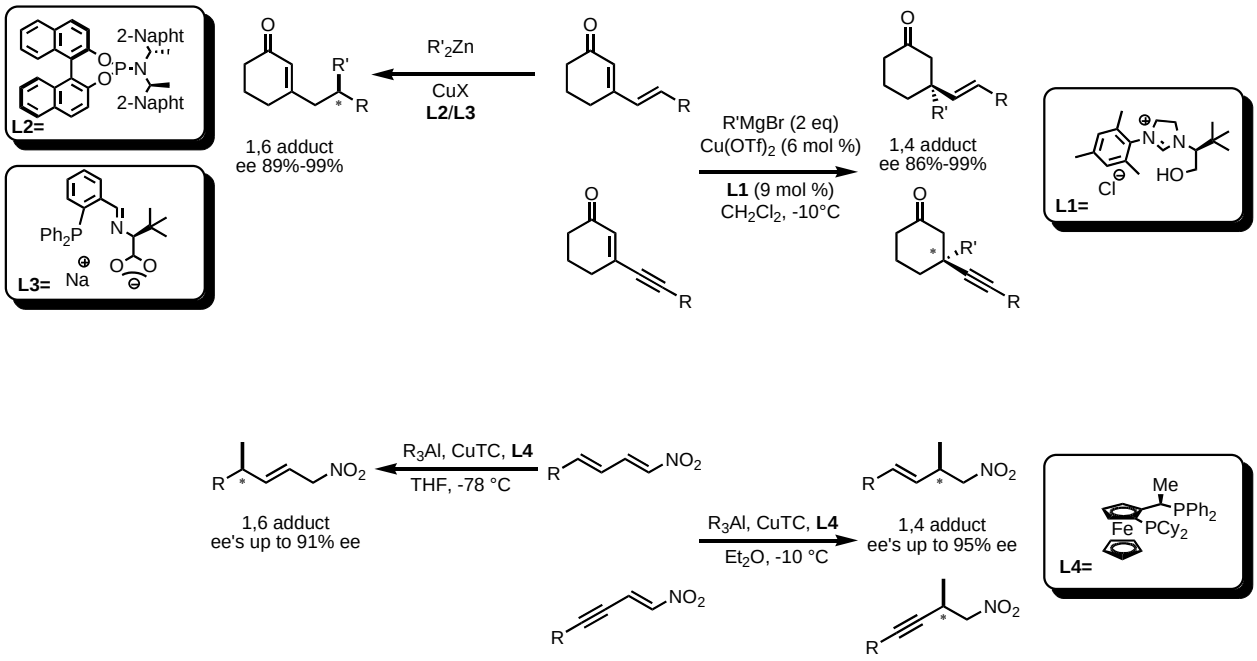
1. Kündig E.P., Saudan C.M., Alezra V., Viton F.; Adv. Synth. Catal. **2001**, *343*, 51- and ref. cit.
2. Alezra V., Bernardinelli G., Corminboeuf C., Frey U., Kündig E.P., Merbach A.E., Saudan C.M., Viton F., Weber J.; J. Am. Chem. Soc. **2004**, *126*, 4843- and ref. cit.
3. Rickerby J., Vallet M., Bernardinelli G., Viton F., Kündig E.P.; Chem. Eur. J. **2007**, *13*, 3354-.
4. Thamapipol S., Bernardinelli G., Besnard C., Kündig E.P.; Org. Lett. **2010**, *12*, 5604-.
5. Thamapipol S., Kündig E.P.; Chimia **2011**, *65(4)*, accepted.

Copper Catalysed Conjugate Addition of Organometallic Reagents to Extended Michael Acceptors

Matthieu TISSOT

matthieu.tissot@unige.ch

We will discuss unexpected results in terms of regioselectivity with respect to copper catalysed conjugate addition of various organometallic reagents (RMgBr, R_2Zn, R_3Al) to different extended Michael acceptors (dienones[1,3], enynones[4], nitrodienes[2], nitroenynes[2]). Substrate design or fine tuning of the reaction conditions can selectively lead to the 1,4 or the 1,6 adduct with high enantioselectivities.



References:

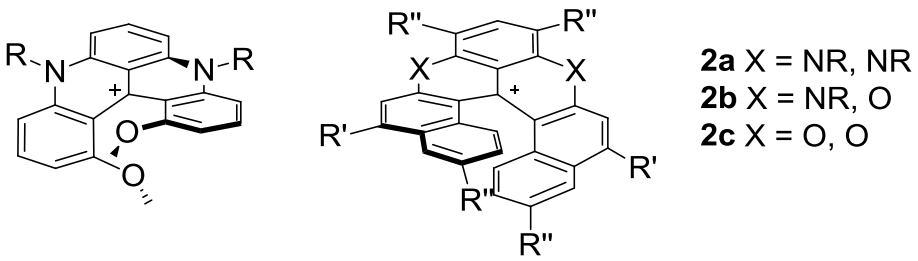
1. Henon H., Mauduit M., Alexakis A.; Angew. Chem. Int. Ed. **2008**, *47*, 9122-.
2. Tissot M., Müller D., Belot S., Alexakis A.; Org. Lett. **2010**, *12*, 2770-.
3. Wencel-Delord J., Alexakis A., Crévisy C., Mauduit M.; Org. Lett. **2010**, *12*, 4335-.
4. Tissot M., Pérez Hernandez A., Müller D., Mauduit M., Alexakis A.; Org. Lett. **2011**, *13*, 1524-.

Modular Synthesis of Novel Cationic Helical Dyes

Franck TORRICELLI

franck.torricelli@unige.ch

Helicenes are ortho-condensed polyaromatic compounds which are chiral due to the helical conformation of their backbone.[1] Whereas hundreds of neutral helicenes can be found in the literature, only few cationic derivatives have been reported.[2] Previously, we have shown that the enantiomers of cationic [4] diazahelicenes of type **1** can be separated; these moieties displaying very high barriers of racemization.[3]



(*M*) - **1** (*P*) - **2a-c**

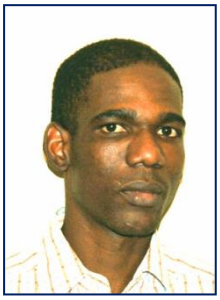
2a X = NR, NR
2b X = NR, O
2c X = O, O

Herein, we report on novel cationic diaza (**2a**), aza oxa (**2b**) and dioxa (**2c**) [6] helicenes which are all readily prepared using a single modular 5-steps synthetic sequence. The diaza derivative is furthermore readily resolved and selectively functionalized on the phenyl or the naphthyl rings through orthogonal substitution processes. This late stage functionalization allows the facile tuning of different properties.

References:

1. Urbano A.; Angew. Chem. Int. Ed. Engl. **2003**, *42*, 3986- and ref. therein.
2. Arai S., Ishikura M., Yamagishi T.; J. Chem. Soc., Perkin Trans I **1998**, *9*, 1561-. Laali K.K., ChunJ.-H., Okazaki T., Kumar S., Borosky G.L., Swartz C.J.; Org. Chem. **2007**, *72*, 8383-. Adriaenssens L., Severa L., Salova T., Cisarova I.C., Pohl R., Saman D., Rocha S.V., Finney N.S., Pospisil L., Slavicek P., Teply F.; Chem. Eur. J. **2009**, *15*, 1072-.
3. Laursen B.W., Kreb F.C.; Angew. Chem. Int. Ed. Engl. **2000**, *39*, 3432-. Herse C., Bas D., Krebs F.C., Bürgi T., Weber J., Wesolowski T., Laursen B.W., Lacour J.; Angew. Chem. Int. Ed. Engl. **2003**, *42*, 3162-. Laleu B., Mobian P., Herse C., Laursen B.W., Hopfgartner G., Bernardinelli G., Lacour J.; Angew. Chem. Int. Ed. Engl. **2005**, *44*, 1879-3.

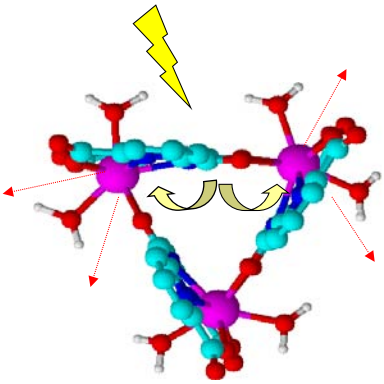
Potentially Bimodal Sensing Systems with Rare-Earth Metals



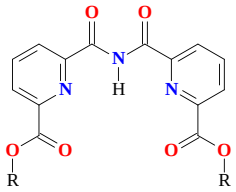
Soumaila ZEBRET

soumaila.zebret@unige.ch

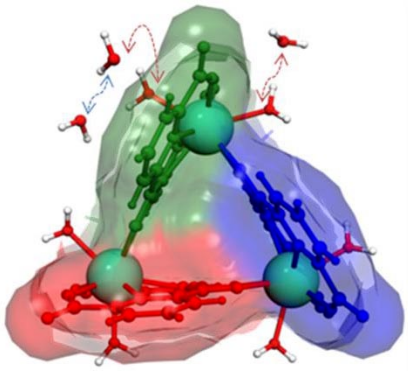
The design of multidentate receptors for developing stable Ln(III) luminescent and paramagnetic devices is one of the most important fields of actual supramolecular inorganic chemistry. In this context, we report on the properties of lanthanides complexes with two ditopic ligands $\mathbf{L^1}$ and $\mathbf{L^2}$. The self-assembly of $\mathbf{L^i}$ with Ln^{3+} (Ln = Eu, Tb, Gd) results in the formation of discrete trinuclear complexes: $\mathbf{[Ln_3(L^1\text{-}H)_3]^{6+}}$ and $\mathbf{[Ln_3(L^2\text{-}3H)_3(H_2O)_6]}$.[1,2] X-ray crystallography shows that three nine-coordinated cations are interlinked with dicarbonyl binding sites of the ligands to provide triangular complexes.



$\mathbf{[Eu_3(L^2)_3(H_2O)_6]}$



L^1: R = Me
L^2: R = H



$\mathbf{[Gd_3(L^2)_3(H_2O)_6]}$

The peculiar structures are maintained in solution, as it is proved by NMR and ESI-MS studies. Despite two water molecules coordinated to each europium cation in $\mathbf{[Eu_3(L^2\text{-}3H)_3(H_2O)_6]}$, these topologically unusual complexes exhibit remarkable luminescent properties evidenced by photophysical studies. In addition, analogous gadolinium paramagnetic complexes (see figure) show interesting relaxivity behavior in water. These properties of the described trinuclear systems make them excellent candidates for developing multimodal probes for analytical and biomedical purposes

References:

1. Zebret S., Dupont N., Bernardinelli G., Hamacek J.; Chem. Eur. J. **2009**, *15*, 3355-.
2. Zebret S., Torres E., Terreno E., Guenee L., Senatore C., Hamacek J.; Dalton Trans. **2011**, *40*, 4284-.

The School of chemistry and biochemistry:

The Section de chimie et biochimie, University of Geneva, offers a top tier training environment that results in a highly competitive expertise. An increasing number of diplomas (now *ca.* 65 per year) at the Bachelors, Masters and Doctoral level in chemistry and in biochemistry are being delivered to foreign and swiss students.

The Section de chimie et biochimie plays host to the newly established National Centre of Competence in Research "Chemical Biology" and produces about 200 publications per year. The research themes encompas most essential areas of fundamental molecular and biomolecular sciences:

- Development of highly selective and environmentally benign methods of organic synthesis.
- Elucidation and modelling of the behaviour of complex molecules on ever shorter time scales.
- Elaboration of new supramolecular architectures on the nanometer scale with promising microscopic and macroscopic properties.
- Development of analytical techniques surpassing today's frontiers of precision, in order to identify ultra-trace species in complex environments.
- Work towards an in-depth understanding of the biomacromolecules involved in the processes governing the living world at the interfaces between chemistry, biology and medicine.
- Development and optimisation of alternatives to fossil fuels as sources of energy.

Directions to the Geneva chemistry & biochemistry days:

Subscribe to *ChemConfs*, our agenda of conferences and events:
www.unige.ch/sciences/chimie/?conferences.php

Browse through the list of PhD theses of our School:
www.unige.ch/sciences/chimie/?theses.php

Find our School on Google Maps:
maps.google.com – coordinates: 46.198117,6.132474

Section de chimie et biochimie
Université de Genève
Sciences II
30, quai Ernest-Ansermet
CH-1211 Genève 4

Tel +41-22-3796024
Fax +41-22-3796023
Mail info-chimie@unige.ch
Web www.unige.ch/sciences/chimie/