Life Sciences
Newsletter 2

Soft Matters
October´08

REVIEW

LIFENET Seminar with Robert F. Murphy October 8th, 2008

"Automated proteome-wide determination and modeling of subcellular location for system biology"

The first lecture within the LIFENET Seminar was held by the first LIFENET external senior fellow Bob Murphy, who holds a professorship at the Carnegie Mellon University (Pittsburgh, USA).
During the last years professor Murphy's work has centred on combining fluorescence-based cell measurement methods with quantitative and computational methods. His group at Carnegie Mellon developed the first systems for automatic recognition of all major organelle patterns in 2D and 3D images. At the moment he is especially interested in the modeling of spatiotemporal subcellular patterns of proteins. Using images of the same patterns from many different cells, one can train the computer to identify these patterns and to develop an automated analysis of these images. Another approach to characterize proteins is to group them according to their localization pattern similarities However since cells have different morphology, numeric features have to be used to describe these patterns.. However, another challenge for the automated analysis of these protein pictures is that the same proteins can be located at different places in a cell, thus belonging to different pattern families. Murphy continued his presentation with the description of "unmixing"-strategies to circumvent this problem.
All these methods Murphy described are the basis of computer analyses which allow the categorization of proteins with an accuracy of about 80%, a rate hardly ever reached by individual visual inspection. In addition, by using generative models for these patterns, one can produce cell shape models, artificial images which depict all characteristic features of a cell showing all expressed proteins in their proper locations. >>

Although the analyses Murphy performed were the basis for models of one single cell type, he ultimately wants to develop models which fit all different cell types, as well as all different organisms.

NEW FELLOWS

KATJA ARNDT
DEPARTMENT OF BIOLOGY
FREIBURG, GERMANY

JÖRN DENGJEL
ZENTRUM FÜR BIOSYSTEMANALYSE
FREIBURG, GERMANY

HAUKE BUSCH
ZENTRUM FÜR BIOSYSTEMANALYSE
FREIBURG, GERMANY

TO COME

LIFENET LECTURES

28.10.2008 12:00h - **Prof. Wolfgang Driever:** "Studying complex systems in a simple model: from stem cells to dopaminergic neural system in zebrafish"

28.10.2008 18:15h - **Nobel Laureate Prof. Erwin Neher:** "Rate-limiting Steps during sustained activity at a glutamatergic synapse"

6.11.2008 14:15h – **Dr. Julio R. Banga:** "Computational Optimization in Systems Biology"

13.11.2008 18:10 – **Prof. José Alonso's** lecture at the "Plant Signalling Systems" symposium

10.12.2008 18:15h - **Prof. Gyorgy Buzsaki:** "Internally generated cell assembly sequences in the brain: a neuronal substrate for recall and planning?"

(more Information: www.frias.uni-freiburg.de/lifenet/veranstaltungen)

NEW FELLOWS

PROF. DR. PEP ESPANOL
PROFESSOR OF FUNDAMENTAL PHYSICS
MADRID, SPAIN

PROF. DR. JOSEPH KLAFTER
PROFESSOR OF CHEMISTRY
TEL AVIV, ISRAEL

PROF. DR. MICHAEL KRISCHE
PROFESSOR OF CHEMISTRY AND BIOCHEMISTRY
AUSTIN, TEXAS

TO COME

SOFT MATTER RESEARCH SYMPOSIUM

21.10.2008 8:00-18:00h - Current Status of Soft Matter Research

HERMAN STAUDINGER LECTURE

03.12.2008 15:15h – **Nobel Laureate Prof. Jean-Marie Lehn:** "Perspectives in Chemistry: From Molecular to Supramolecular Chemistry towards Adaptive Chemistry"

SOFT MATTER RESEARCH LECTURES

23.10.2008 11:15 - **Dr. Andreas Manz:** ""Lab on a Chip" - or how to play the scaling laws"

6.11.2008 16:15h – **Dr. Sauro Succi:** " Multiscale lattice-Boltzmann Molecular Dynamics simulations: translocation of biopolymers through nanopores and beyond"

(more Information: www.frias.uni-freiburg.de/matter_research/veranstaltungen)

REVIEW

Soft Matter Research Lecture with Professor Michael J. Krische, September 4th, 2008

"Formation of C-C Bonds via Catalytic Hydrogenation and Transfer Hydrogenation"

On September 4th the Freiburg the School of Soft Matter Research welcomed a world-renowned chemist, Professor Michael J. Krische. Professor Krische, who will become a FRIAS fellow in 2009, holds a Robert A. Welch Chair in Science at the Department of Chemistry, University of Texas at Austin.
In the Chemistry Lecture Hall Krische presented his work which focuses on the development of new synthetic methods with attendant applications in natural product synthesis. His research interests involve the identification of new reactivity patterns, the evolution of related catalytic processes and, ultimately, the development of new synthetic strategies. With research interests in organic synthesis, catalysis, organometallic chemistry, and supramolecular chemistry, his group develops new synthetic schemes in a truly creative way. In this context his lab has been developing a broad family of catalytic C-C bond formations which was the focus of his lecture. He showed how hydrogenation and transfer hydrogenation can be used to couple diverse Π-unsaturated reactants to carbonyl compounds, imines and even alcohols, thus offering a by-product-free alternative to stoichiometrically preformed organometallics. This complete atom economy marks an important step in the synthetic repertoire in the light of green chemistry. The presented work showed a vast amount of applications exemplifying the general applicability of this efficient approach. The talk closed with a lively discussion confirming the high interest in the presented work.

FRIAS
FREIBURG INSTITUTE FOR ADVANCED STUDIES
ALBERT-LUDWIGS-UNIVERSITÄT FREIBURG

Life Sciences
Newsletter 2

Soft Matters
October´08

NEW FELLOW

On October 15th 2008, Katja Arndt joined the Freiburg Institute for Advanced Studies, School of Life Sciences - LIFENET, as a Junior Fellow for an initial period of 3 years.
Katja Arndt studied biochemistry at the University of Hannover where shegraduated in 1995. In 2000, she received her Ph.D., which was acknowledged with a price, under the supervision of Professor Andreas Plückthun, University of Zurich and Professor Tom Alber, University of California at Berkeley. During this time, she also was a visiting scientist at the Biochemistry Department of the University of Montreal. She continued as a post-doctoral research associate at UC Berkeley and at the University of Freiburg. In 2003, Arndt started her own research group funded in the Emmy-Noether Excellence program of the German Research Foundation (DFG).
At the beginning of her carreer, Arndt was interested in protein engineering and design. By altering the structure and properties of specific proteins, and combining antibody fragments with other functional moieties, she aimed to generate miniantibodies to intervene in cellular and immunological processes. Now, her work is focused on proteins, which are deregulated in a variety of diseases such as cancer. To inhibit upregulation of these proteins, she and her group developed peptides, which bind and block e.g. transcription factors responsible for the overregulation of proteins. In contrast to large proteins, peptides are smaller and thus easier to design and handle. She and her group established two cell culture models in her laboratory to study the effect of oncoproteins and their inhibitory peptides on the cellular level. Today, Arndt and her team are at a point where they can apply and share their screening technologies for protein-protein interactions as well as their expertise in protein engineering. They are >>

FRIAS
FREIBURG INSTITUTE FOR ADVANCED STUDIES
ALBERT-LUDWIGS-UNIVERSITÄT FREIBURG

not only interested in specific interactions of the malfunctioning proteins in one specific pathway, but also aim at understanding the cross-talk between different pathways and ultimately predicting the cell's response to such a "perturbation". However, such a Systems Biology approach also requires new techniques, new equipment, new knowledge. By joining the FRIAS Junior Fellowship Program, she sees the opportunity to fulfill all these needs. Especially exciting for her is the idea of having all these resources and expertise under “one roof” at the University of Freiburg. Collaborating with other local research groups from the biological, medical, engineering and theoretical side as well as having access to specific facilities like proteomics, cell imaging, and data management will support her work immensely. Arndt´s aim during her Junior Fellowship is to illuminate the influence of deregulated, cancerogeneous proteins on the systems level, find counter-measures, and be able to predict cell responses.
In addition to being a successful scientist, Arndt is also mother of a large family. She and her husband, Kristian Müller, who also works as a principal investigator at the Department of Biology III, have four young children. Having a family and in parallel a career in science were always her goals. For the success of both, excellent organization skills are a precondition – a talent which most likely will also help Katja Arndt to turn her FRIAS project into success.

NEW FELLOW

Stefan Schiller received his diploma in organic chemistry in 1998 from the Johannes Gutenberg University. After working on a research project at the main BASF AG laboratory, he joined the MPI for Polymer Science where he completed his Ph. D. on biomimetic supramolecular membrane architectures. During this time he performed research amongst others at the IBM Research Center Almaden, San Jose and Stanford University. From 2004 to 2008 he was a postdoctoral fellow at the Scripps Research Institute, La Jolla, California, working on incorporating genetically encoded unnatural amino acids into proteins. In 2008 Schiller joined the Freiburg Institute for Advanced Studies (FRIAS), where he holds a junior research fellowship position at the School of Soft Matter Research.
Stefan Schiller’s FRIAS Project is about “Makro- and Supramolecular Pathways in Biohybrid Nanoscience“ and related to the research area of “Nanobiotechnology and Materials”. His research focuses on the design of biohybrid materials consisting of multi-functional bio-molecules. Hence, it combines the scientific fields of macromolecular chemistry and synthetic biology, including genetic engineering of proteins. Modified proteins serve as structural and functional molecular LEGO building blocks in nanobiotechnology. This allows access to new biohybrid materials and expansion of the structural and functional toolbox of artificial and natural macromolecules. The implementation of new functionality into proteins beyond nature´s capability is accomplished via genetically encoded unnatural amino acids. The spectrum of these research applications includes the design of multi-functional building blocks for dynamic self-guiding nano-circuit assemblies in molecular electronics, as well as dynamic multivalent dendrimer libraries, DNA-barcode readout of epitope presentation, and drug/gene delivery. Another subject of his multifaceted work is enzyme engineering for green polymer chemistry, for example, the development of renewable monomers and bio-fuel.

REVIEW

Soft Matter Research Lecture with Professor Ulrich Steiner, August 21st , 2008

"Structure and Function: The Role of Patterns on Surfaces and in Thin Films".

Steiner started his presentation by explaining his fascination for surface structures.Part of these patterns in fluid films can be explained by physical rules. The formation of surface patterns, for example, are triggered by the intrinsic movement of atoms or other particles (Braunian Motion) which competes with the surface tension, resulting in undulatory fluid surfaces.
Steiner continued his presentation by comparing the use of pattern formation – the result of non-linear dynamic processes - for physics and for the life sciences. Surprisingly he came up with the statement that for physics “pattern formation is usually pretty, but useless”. In contrast, in the life sciences pattern formation has its function. Ullrich Steiner corroborated this thesis by some biological examples, shifting his presentation from physics to the exciting field of Biomimetics.
Ullrich Steiner concluded his presentation with examples from his lab in Cambridge, where his colleagues are occupied with reverse engineering of these biological archetypes. Steiner focussed on the growing of calcite crystals – the material out of which also mother-of-pearl or sea urchin spines are made. In contrast to normal crystals, calcite crystals grown near an organic matrix can experimentally be influenced in such a way that they grow into a similar structure characteristic for mother-of pearl. This way crystal growth can build up a porous material in a special desigend form.
Ultimately all these experiments precede inventions of new materials or known materials with new properties like Teflon, coatings or solar cells. Taken together it is the application-orientated nature of this field of research which makes it especially interesting.
For the next two years Ullrich Steiners projects will be carried out in collaboration with Sabine Ludwigs (Institute for Macromolecular Chemistry, Freiburg) and with Günter Reiter (Physics department, Freiburg).