# Final Report of the 3rd STIPOMAT Conference

## 14-17 October 2007

## Les Diablerets, Switzerland


**Local Organizing Committee at**
**École Polytechnique Fédérale de Lausanne, Switzerland**
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## Summary

The 3rd STIPOMAT conference, as the acronym stands for, entails a broad spectrum of stimuli-responsive polymeric materials, which either require a higher fundamental understanding or have an obvious purpose in chemical, physical, biomedical sciences and industry. To serve this wide-ranging variety, an extensive range of speakers from far and wide were invited to present a topic, which was allocated in one of the six sessions. Each session consisted of five to seven lectures, where each lecture would last up to half-an-hour. In addition, each lecture was steered towards promoting the broad spectrum of principles concerning STIPOMAT. Within the lecture, time was allocated for questions and discussion from the audience.

In addition to the 39 speakers, a total of 57 young scientists including PhD students and post-doctorate researchers were able to contribute to the importance of the 3rd STIPOMAT conference through the presentation of a poster. Most importantly, the presence of enthusiasm was highly evident from the large number of applications as well as participation numbers before and at the conference from both speakers and young scientists.

The 3rd STIPOMAT conference had a very international character with cross-culture, often multilingual dialogue and very promising scientific and non-scientific networking between generations of scientists. While some speakers such as Prof. Filip Du Prez and Prof. Jean-François Gohy are very well known within the STIPOMAT community, others lecturers e.g. Prof. Thomas Russell and Prof. Timothy Lodge, who are renowned professors residing in the United States are newcomers to the STIPOMAT conference. Therefore, not only pan-European networking was feasible, but trans-Atlantic scientific collaborations as well.

This report contains a brief description of the scientific content of the lectures, which were divided into six sessions, and an assessment of the impact of the 3rd STIPOMAT conference, which conforms excellently to ideals and promotion of stimuli-responsive polymeric materials and polymer science as a whole.

## Scientific content

The 3rd STIPOMAT conference was comprised of six half-day sessions, which covered the following topics: (i) polymer brushes and thin polymer films; (ii) polymer synthesis; (iii) foldamers, defined oligomers and supramolecular assemblies; (iv) biological materials and biological-synthetic hybrids; (v) polymer nanotechnology and (vi) micelles, block copolymers and complex solution structures. In this section, the nature of the scientific content as well as the scientific discussion of the various sessions is described.

Additionally, the poster session provided the opportunity for young researchers to interact with each other and with the speakers. The character of the posters conformed well to the above mentioned lecture sessions and therefore provided a broad range of topics to be viewed. For the best two posters, a poster prize was handed out at the closure of the 3rd STIPOMAT conference.

### Polymer brushes and thin polymer films

The nature of polymer brushes and thin polymer films is understandably a complex and highly scientifically relevant topic both in fundamental studies and in our everyday lives. This session had a broad variety of speakers e.g. Prof. Thomas Russell, Prof. Wilhelm Huck and Prof. Avi Halperin had presented fascinating and highly original scientific research and techniques. The session also covered a range of chemistry, physics, biology and applications ranging from synthesis routes, surface characterization and techniques for manipulating structures so as to suit the eventual applications. For every lecture there was enthusiastic and constructive discussion justifying the degree of relevance of this session.

### Polymer synthesis

As the title of this session suggests, the central matter of this theme was the synthesis of polymers using well known routes such as atom transfer radical polymerization but also, novel and less conventional routes including the use of pressurized microwave-assisted conditions to form well-defined libraries of poly(2-oxazoline)s as was reported by Prof. Ulrich Schubert. The characterization of the thermal, surface and mechanical properties of these polymers as well as their solubility and self-assembly behavior in aqueous and organic solutions was also described. During this session it was apparent that research is also being performed on metalized supramolecular materials for applications such as photonic devices and as well as for nanolithographic purposes. The discussion after each lecture was very fruitful and provided an insight into innovative synthesized monomers and its polymers that pave the way for future polymer science and polymeric applications.

### Foldamers, defined oligomers and supramolecular assemblies

This session commenced with a lecture from Dr. Albert Schenning who gave a remarkable talk on the uses of supramolecular chemistry and the self-assembly of oligomers to construct nanometer range

components for electronic applications. Nanometer range manipulation is a hot topic in electronics that provides the construction of (stimuli-responsive) materials as was evident from the lectures by Prof. Andreas Kilbinger and Dr. Holger Frauenrath whom presented not only synthesis strategies, which are complementary to the polymer synthesis session, but also impressive visual confirmations which were obtained using atomic force microscopy (AFM) and transmission electron microscopy (TEM). The scope of nanoarchitectures obtained from supramolecular self-assembly provides useful insight in folding mechanisms that often is a central subject in peptide and protein science. In contrast to the strong visual evidence provided by the majority of the work presented in this session, Christian Holm gave an equally interesting lecture on the recent advances in simulations of charged polymeric systems which included biomolecules such as DNA. Applying knowledge from simulations and biology gives valuable insight into the behavioral nature of oligomers and polymers alike as was apparent from the lecture by Prof. Greg Tew and Prof. Timothy Lodge. Just as notable as these lectures were, the discussions provided the opportunity for polymer sciences and biochemists to interact on the subjects within this session.

## Biological materials and biological-synthetic hybrids

This session incorporated the synthesis of peptides, their functionalities, properties and their use in stimuli-responsive biomimetic nano-carriers. Hans Börner gave a biological-hybrid as well as a biologically-inspired lecture on the synthesis of peptide-silica nanotapes, which could be tuned in terms of elasticity and mechanical strength. Prof. Jan van Hest used an elastin-like peptide to design temperature sensitive materials demonstrating that properties from a natural protein could be efficiently translated to a hybrid material. Furthermore, both of the herefore mentioned examples emphasize the versatility of applying a biological molecule such as a peptide in functional stimuli-responsive materials that can be tuned for specific needs. Prof. Dek Woolfson described the synthesis of coiled coil peptides for the design and fabrication of fibrous materials and matrices from a biologically inspired approach from naturally occurring fibers in cells. In addition to the lectures above involving peptide and polymer hybrids, Prof. Andreas Herrmann gave a distinctive lecture on the synthesis and micellar formation of DNA-polypropylene block copolymers which can possibly be applied as DNA transport vehicles. Throughout the sessions it appeared that knowledge on the characterization techniques was an apparent universal tool providing a platform for integration between the scientists at

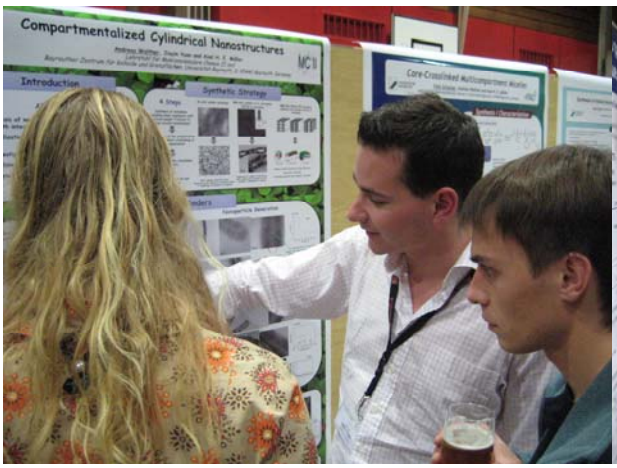
the conference. For this reason, the discussion at each lecture was as the title of the session suggests, highly interdisciplinary.

## Polymer nanotechnology

One of the important reasons for the conference was not only to see, hear and learn about the scientific work of other European scientists, but also to discover what can be done with all the fundamental and applied research is being pursued across Europe and the United States. This session incorporated the uses of polymers in industrial applications such as photovoltaics, fuel cells and ion conductors as well as in medicine and biosensors. While this session contained some very interesting applications of polymers, the highlight was work that was presented by Prof. Ulrich Wiesner who had shown the applications of polymer silica hybrids in the form of fluorescent Cornell Dots (or C-dots) which could potentially be used as pH sensors for pharmaceutical quality screening.

## Micelles, block copolymers and complex solution structures

The phenomenon of self assembly of block copolymers and its complex structures in solution was the core subject of this session. This session incorporated experimental as well as theoretical lectures, highlighting the integration of the scientific research groups of different disciplines. Taylor-made nanoreactors in the form of micelles or vesicles were one of the lectures presented at this conference. Prof. Michael Maskos, explained that by varying nature of the cosolvent, block copolymers form micelles that assume different morphologies ranging from spherical, rod-like, cylinders or as vesicles. Subsequently, by cross-linking the core, the morphology of the micelle can be reserved even in the presence of different solvents. Prof. Jean-François Gohy also presented work on micelles through complexation of the divalent metal ion ruthenium with terpyridine terminated polymers. These micelles were further used to generate nanoporous thin films with defined chemical functionalities at the pore walls.



## Poster session

In line with the multi- and interdisciplinary character of the lectures, 57 posters were presented by young researchers, which are either pursuing a PhD or are in a post-doctoral phase. Representatives from Austria, Belgium, Germany, France, Russia, Switzerland, The Netherlands, United Kingdom and from the United States were present showing the awareness of the conference across Europe and beyond.

Two poster prizes were awarded to two promising PhD students, namely Kurt Stubenrauch of the University of Graz, Austria whose poster was entitled "Polyelectrolyte Block Copolymers prepared using ROMP" and Anja Goldmann of the University of Bayreuth, Germany whose poster was entitled "Route for Synthesis of Ring-Shaped Polymers by Combination of RAFT and Click-Chemistry".

## Assessment of results and impact of the event on the future direction of the field

As described in the previous paragraphs the delegates of the 3rd STIPOMAT conference had chances to interact through the poster session, the lectures and during meals bringing powerful discussions in all aspects of polymeric science to light.

Scientific discussions were not linked to the conference center but continued in a more informal manner during the coffee breaks, meals and poster sessions. The interaction between the younger researchers and the lecturers was particularly noticed during the poster sessions as can be seen from the photos.

After the conference the STIPOMAT organizing committee received numerous e-mails from the lecturers as well as the young researchers who presented a poster at the 3rd STIPOMAT conference. We have selected a few of these responses and inserted them below.

> *"I was delighted to have had the opportunity to participate in your meeting. As I told Jean-Francois in Les Diablerets, this was the best polymer meeting I have been to for a long time because of the large number of refreshing young speakers and the extremely timely topics choices of the presentations.*
>
> *I really loved it.*
>
> *Thanks again whole-heartedly for having invited me to this meeting*."
>
> Ulrich Wiesner, Cornell Univ., United States

> *"Thank for this message, and many thanks for the kind invitation for me to speak at the meeting.*
> *I had a great time and learnt a lot."*
>
> Dek Woolfson, Bristol Univ. United Kingdom

*"I am sorry you missed the conference so much, because it was spectacular! Excellent science, good discussion, wonderful location, good food, etc. Congratulations on the reason, however!"*

Tim Lodge, Univ. of Minnesota, United States


Evident from the above quotes, we can predict a prospective future in stimuli-responsive polymeric science and materials. The STIPOMAT principle not only involves the characteristic polymer design, synthesis and characterization techniques, but also the strong resemblance and functionality to biological molecules and systems. It was also evident that the design for stimuli-responsive materials is complementary with simulation approaches e.g. as adopted by Prof. Avi Halperin and Prof. Alexei Khokhlov.

To conclude, the STIPOMAT conference provided a perfect framework for the various research groups specialized in all the above mentioned techniques to interact among themselves, share the techniques and develop them further, and make them fruitful for various specific systems and experimental applications, helping the synthetic chemists and experimental physicists as well as the biologists to develop new types of stimuli-responsive polymeric systems and to understand their behavior and properties.

# Final Programme

## Sunday October 14th

### Polymer brushes and thin polymer films

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|---|---|
| 15:30 – 16:15 | **Capillary Wrinkling of Thin Floating Films**<br>T. P. Russell (*Univ. of Massachusetts, MA, United States)* |
| 16:15 – 16:45 | **Polymer Brushes as a Platform for 'Soft' Nanotechnology**<br>W. T. S. Huck (*Univ. of Cambridge, United Kingdom)* |
| 16:45 – 17:15 | **Writing Small with Macromolecules**<br>R. Jordan (*TU München, Germany)* |
| 17:15 – 17:45 | **Dewetting of Thin Polymer Films Close to the Glass Transition**<br>G. Reiter (*Univ. of Mulhouse, France)* |
| *17:45 – 18:15* | *BREAK* |
| 18:15 – 18:45 | **Micro and Nanostructured Surfaces through Polymer Brushes**<br>J. Rühe (*Univ. of Freiburg, Germany)* |
| 18:45 – 19:15 | **Structure Formation in Polymer Brushes and Copolymer Films: A Single-Chain-in-Mean-Field Simulation Study**<br>M. Müller (*Univ. of Göttingen, Germany)* |
| 19:15 – 19:45 | **PEO Brushes and their Interactions with Proteins**<br>A. Halperin (*Univ. J. Fourier, Grenoble, France)* |
| *20.00* | *DINNER and DRINKS* |

# Monday October 15th

## Polymer synthesis

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|---|---|
| 8:30 – 9:00 | **Non-Covalent Self-Assemblies of Amphiphilic Star Block Copolymers**<br>V. Aseyev *(Univ. of Helsinki, Finland)* |
| 9:00 – 9:30 | **Functional Metallized Supramolecular Materials via Block Copolymer Self-Assembly and Living Supramolecular Polymerizations**<br>I. Manners *(Univ. of Bristol, United Kingdom)* |
| 9:30 – 10:00 | **Reactive Polymers and Block Copolymers**<br>P. Theato (*J. Gutenberg Univ., Mainz, Germany)* |
| 10:00 – 10:30 | **Dendronized Polymers: State-of-the-Art in Zürich**<br>A. D. Schlüter *(ETH Zürich, Switzerland)* |
| *10:30 – 11:00* | *BREAK: COFFEE and POSTERS* |
| 11:00 – 11:30 | **Functional Poly(2-oxazoline)s**<br>U. S. Schubert (*TU Eindhoven, The Netherlands)* |
| 11:30 – 12:00 | **Star-shaped Polymers with Reactive End Groups for the Creation of a New Type of Nanoparticles**<br>F. Du Prez (*Ghent Univ., Belgium)* |
| *12.30 – 14:00* | *LUNCH* |

## Foldamers, defined oligomers and supramolecular assemblies

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|---|---|
| 14:00 – 14:30 | **Self-Assembled π-Conjugated Oligomers**<br>A. Schenning *(TU Eindhoven, The Netherlands)* |
| 14:30 – 15:00 | **Protein-sized Synthetic Folded Architectures**<br>I. Huc (*Univ. Bordeaux 1, France)* |
| 15:00 – 15:30 | **Oligo(*p*-benzamide)s – Useful Building Blocks for Nanoscale Organization of Polymers**<br>A. F. M. Kilbinger *(J. Gutenberg Univ., Mainz, Germany)* |
| *15:30 – 16:00* | *BREAK: COFFEE and POSTERS* |
| 16:00 – 16:30 | **Hierarchically Structured Conjugated Polymers via Supramolecular Self-Assembly**<br>H. Frauenrath *(ETH Zürich, Switzerland)* |
| 16:30 – 17:00 | **Recent Advances in Simulations of Charged Polymeric Systems**<br>C. Holm *(J. W. Goethe Univ., Frankfurt, Germany)* |
| 17:00 – 17:45 | **Designing Polymers with Strong Similarities to Biology**<br>G. N. Tew *(Univ. of Massachusetts, MA, Unites States)* |
| *18:00 – 20:00* | *DINNER* |
| 20:00 – 20:45 | **Block Copolymers for Functional Nanostructures in Ionic Liquids**<br>T. P. Lodge *(Univ. of Minnesota, MN, United States)* |
| *20:45 – 22:00* | *DRINKS and POSTERS* |

# Tuesday October 16th

## Biological materials and biological-synthetic hybrids

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|---|---|
| 08:30 – 09:00 | **Directed Assembly of Polymer-peptide Hybrids**<br>J. C. M. van Hest *(Radboud Univ. Nijmegen, The Netherlands)* |
| 09:00 – 09:30 | **Mimicking Biosilicification: Programmed Co-assembly of Peptide-Polymer-Nanotapes and Silica**<br>H. G. Börner *(Max Planck Institute, Golm, Germany)* |
| 09:30 – 10:00 | **Combining Nucleic Acids with Polymers: Synthesis, Morphologies and Interactions with Living Systems**<br>A. Herrmann *(Univ. of Groningen, The Netherlands)* |
| 10:00 – 10:30 | **Bioinspired Synthetic Polymers**<br>H. Schlaad *(Max Planck Institute, Golm, Germany)* |
| *10:30 – 11:00* | *BREAK: COFFEE and POSTERS* |
| 11:00 – 11:30 | **The Rational Design of Peptide-based Materials: from Nanoscale Objects to Fibrous Materials and Matrices**<br>D. Woolfson *(Univ. of Bristol, United Kingdom)* |
| 11:30 – 12:00 | **Stimuli-Responsive Polypeptide-based Biomimetic Nano-Carriers**<br>S. Lecommandoux *(Univ. Bordeaux 1, France)* |
| 12:00 – 12:30 | **Surface-Initiated Polymerization from Self-Assembled Peptide Nanotubes**<br>M. Biesalski *(Univ. of Freiburg, Germany)* |
| *12:30 – 14:00* | *LUNCH* |

## Polymer nanotechnology

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|---|---|
| 14:00 – 14:30 | **Controlled Pattern Formation in Polymer-Inorganic Hybrid Materials**<br>U. Steiner *(Univ. of Cambridge, United Kingdom)* |
| 14:30 – 15:00 | **A Generic Chemical Platform for the Design of Versatile and Smart AFM Probes**<br>A.-S. Duwez *(Univ. of Liège, Belgium)* |
| 15:00 – 15:30 | **Amphiphilic Diblock Copolymers from Chiral Monomers Using Reversible Addition Fragmentation Chain Transfer Polymerisation (RAFT)**<br>R. O'Reilly *(Univ. of Cambridge, United Kingdom)* |
| *15:30 – 16:00* | *BREAK: COFFEE and POSTERS* |
| 16:00 – 16:30 | **Tuning of Polypeptide Properties by Surfactant Complexation**<br>O. Ikkala *(Helsinki Univ. of Technology, Finland)* |
| 16:30 – 17:00 | **Functional Nano-Structured Polymeric Materials Prepared by Template Synthetic Methods**<br>S. Demoustier-Champagne *(Univ. Catholique de Louvain, Belgium)* |
| 17.00 – 17:30 | **Nanoporous Membranes from Block Copolymers and Nanoparticles**<br>G. Jutz *(Univ. of Bayreuth, Germany)* |
| *18:00 – 20:00* | *DINNER* |
| 20:00 – 20:45 | **Polymer Nanotechnology through Self- and Co-Assembly**<br>U. Wiesner *(Cornell Univ., NY, United States)* |

# Wednesday October 17th

## Micelles, block copolymers and complex solution structures

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|---|---|
| 09:00 – 09:30 | **Synthesis & Switching of Smart Amphiphilic Block Copolymers**<br>A. Laschewsky *(Fraunhofer Institute, Potsdam, Germany)* |
| 09:30 – 10:00 | **Smart Nanomaterials from Metallo-Supramolecular Block Copolymers**<br>J.-F. Gohy *(Univ. Catholique de Louvain, Belgium)* |
| *10:00 – 10:30* | *BREAK: COFFEE and POSTERS* |
| 10:30 – 11:00 | **Polybutadiene-*b*-Poly(ethylene oxide) based Nanoparticles**<br>M. Maskos *(J. Gutenberg Univ., Mainz, Germany)* |
| 11:00 – 11:30 | **Bioinspired Oligothiophene-Oligopeptide Hybrid Nanostructures: An Atomistic Simulation**<br>A. Khokhlov *(Moscow State Univ., Russia)* |
| 11.30 – 12:00 | **Structure Formation in Polymer Solutions via Phase Separation: Computer Simulations**<br>K. Binder *(J. Gutenberg Univ., Mainz, Germany)* |
| *12:00 – 12:30* | *FINAL REMARKS and CLOSING* |
| *12:00 – 14:00* | *LUNCH and DEPARTURE* |