

SONS News

The Newsletter of the EUROCORES Programme in Self-Organised NanoStructures

- Issue 03- August 2007

Dear Reader,

Welcome to the third issue of the SONS Newsletter.

This Newsletter, issued once per year, provides information to the SONS Research Community and beyond about the current developments, activities and results of the SONS 1 & 2 Programmes. The SONS (first call) Programme is going to end in the next months, while the SONS (second call) Programme started later in 2006. The impact of the SONS research is clearly demonstrated by the programme's successful activities. The fruits of these past three years include our scientists setting up spin-off companies, winning eminent prizes and in a large number of papers published in high impact factor journals.

In this issue I will present an overview of the main highlights of SONS 1, and an introduction to SONS 2's activities. I am sure SONS 2 will continue on the way paved by SONS 1 and even beyond.

2006 also saw me taking up the position of Programme coordinator to these two Programmes, and I would like to thank all SONS researchers for their help and their kindness.

We would like to receive your feedback- good or bad- and your input for future issues to sons@esf.org.

Enjoy the reading!

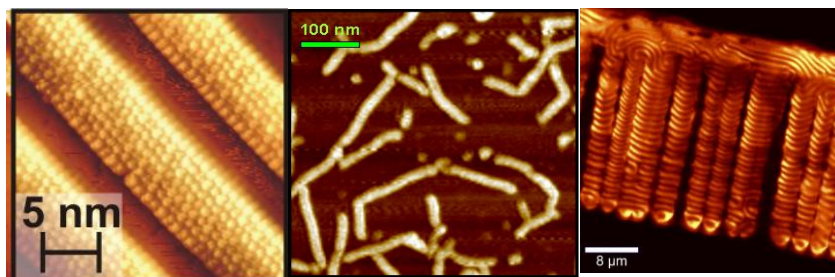
Antonella di Trapani, PhD

EUROCORES Programme Coordinator for SONS



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Left: STM image of C_{60} assemblies on Au(334) (MOL-VIC); **Centre:** AFM image of self-assembled rigid rail-like nanostructures made of DNA parallelograms (BIONICS); **Right:** The figure shows the director field of a self-organized cholesteric liquid crystal structure that appeared in a porous template. The image was obtained by fluorescence confocal polarizing microscopy and indicates the local orientation of the rod-like molecules (LC-NANOP)

EUROCORES Programme SONS is a ESF initiative supported by the European Commission, FP6, under contract No. ERAS-CT-2003-980409

Report from the 2006 SONS Conference



The **SONS Conference 2006**, organised in Pisa, 29 June- 1 July 2006, by Marcus Textor, Silvio Decurtinis, Charl Faul, Dag Hanstorp and Petr Stepanek, presented a unique opportunity and platform for all SONS Collaborative Research Projects (CRPs) to present their main and latest achievements, and was a privileged platform for scientific debate and exchange of ideas.

The conference was widely received as an outstanding event in terms of great scientific achievements and innovation, for the development of new toolboxes, high quality talks, good participation and discussions in sessions by participants, great collaborative spirit in the SONS Community and stimulation of future collaboration (also outside SONS).

The conference was attended by leading world-class scientists in their respective fields and encouraged the active participation of junior researchers through the informal platform it presented for discussion.

The level of the quality and scientific impact of the conference was set (and maintained throughout the conference) by the invited external speakers who presented the state of the art in their

respective fields covering topics ranging from the organisation of designed peptides and their responses to external stimuli to nanostructured materials for electronic applications to polymeric nanocarrier systems for targeting drug delivery and cancer treatment.

There were excellent discussions after the oral presentations throughout the conference, where both young and more established scientists actively took part.

The programme included contributions ranging from physics to chemistry and materials science to biology and device engineering and it was supported by 35 poster presentations, providing more detailed information and serving as a platform for more extended discussions, in particular also with and among young scientists.

Overall, the SONS Conference was judged by the participants as having been an extremely useful and well-organised event, making an important contribution to the formation of a "SONS Community" and fostering further networking for future activities in SONS and outside.

In particular, the conference made an important contribution to educating the participating young scientists and students, thanks to many presentations that included a tutorial-like introduction in the respective scientific and technical fields. In terms of the SONS programme concept and call for proposals, there was wide agreement that the chosen bottom-up approach with scientific quality and innovation as the main criteria combined with a low level of bureaucracy was very successful and highly adequate for a programme that covers mostly fundamental aspects and pre-competitive research.

The impact has been substantial as this has been the first meeting where detailed progress reports have been communicated to and discussed among all participants of the SONS programme. Many discussions for future collaborative projects within the SONS activities as well as outside took place. The conference impact is therefore

substantially larger than “merely” the specific output of the running CRPs.

Secondly, the conference greatly contributed to the networking and formation of a highly interdisciplinary SONS community and spirit that will have a not-easy-to-measure but, we believe, great impact on the European Science Community in this important field of self-assembly and nanotechnology, fostering further scientific activities on both the national and European level.

Thirdly, the conference had important significance in terms of education of participants, in particular the young scientists, and providing opportunities for them to build up their own networks with colleagues. They will be the ones carrying the flag of this important field into the future.

Further information can be found at www.esf.org/sons2006

New Executive Committee Membership

At the Scientific Committee meeting which took place in Pisa on the 28th June 2006, the new Executive Group was elected. The members are: Enrique Ortega (MOLVIC), Mario Ruben (FUN-SMARTs), Silvio Decurtinis (NANOSYN), Karen Edler (SPENSA), Dag Hanstorp (SPANAS), Peter Stepanek (AMPHI), Marcus Textor (NANO-SMAP).

SONS (first Call) Networking Activities

Events in 2006

- **SONS/EuroDYNA Brainstorming session** took place on the 27th September in Brussels. Participants included Charl Faul, Karen Edler, Marisela Velez, Colin Logie, John van Noort, Andres Arnau, Niels Galjart.
- Workshop on '**Structure and Properties of self-organized amphiphilic copolymers**', organised by Petr Stepanek, took place in Prague, on 4-7 October 2006.
- Summer School on '**Metal Clusters and Surfaces**' organised by Alessandro Fortunelli, took place in Pisa, Italy, following the SONS 2006 Conference.
- Workshop on '**Functional Molecular Nanostructures**' organised by Klaus Kern took place in Kloster Irsee, Germany, from 26-28 April 2006.

Events in 2007

- Workshop on '**Molecular Nanoelectronics**' was organised by Dirk Guldi, in Erlangen, Germany, 28-31 March 2007
<http://www.chemie.uni-erlangen.de/pctc/pc1/guldi/NANOSYN.html>
- **EUROCORES Workshop on Self-Organised NanoStructures**, was organised in collaboration with the EMRS Spring Meeting 2007, from 31 May-1 June 2007.
http://www.emrs-strasbourg.com/index.php?option=com_content&task=view&id=195
- Workshop on '**Polymers, Amphiphiles and Nanostructured Materials**' was organised in Bristol, 12-15 June, by Charl Faul and Karen Edler.
http://www.chm.bris.ac.uk/inorg/isa/PANM_index.html

Max Cavallini from FUN-SMARTs is EURYI winner!

Max Cavallini, 39 years old, has been working on the SONS Project FUN-SMARTs for the past three years. He is also one of 2006 EURYI award winners.



Dr. Massimiliano Cavallini receiving the EURYI award from Nobel Prize winner Prof. Torsten Wiesel at the EURYI Awards Ceremony in Prague, 13 October 2006

We asked him a few questions.

Q. What does winning the EURYI award mean to you?

A. Winning the EURYI recognises the work I did these past years, and that I worked well. It means an improvement in my current research position, because I can start my own group, with the hope of being a permanent researcher in Italy one day.

Q. What research project will you support with it?

A. My project, DYMOT (Dynamics of Molecules on Organic Transistors), aims to develop the next generation of sensors with the ultimate goal to screen a wide variety of diseases. In this project we will investigate a new method for the study of interactions of molecules with FET (Field-Effect Transistors). These molecules can be important for biological purposes, and form the basis of a new generation of biological sensors, such as sensitive molecules involved in health, blood analysis and screening of some metabolites.

All of these are long-term applications. Other applications could be screening for chemicals responsible for the environment

pollution. In the first phase we will study the surface's response to physical, chemical and biological species.

Q. What research projects are you working at the moment?

A. My group's research activities are based on fabrication and characterisation of multifunctional materials with nanometer scale resolution, and the use and development of new unconventional nanolithographic methods.

I am working on the FUN-SMARTs Project, which is part of the EUROCORES SONS Programme. In FUN-SMARTs we developed new methods for bottom-up nano-lithography. In collaboration with CSIC (J. Veciana's group) we patented a new method based on control of demixing of molecular magnets dispersed into a polymeric matrix. I am also involved in EU-IP NAIMO where I am studying self-organising properties of functional materials and how it is possible to control self-organisation by unconventional lithographies. I am also the PI in a Marie Curie network named CHEXTAN where we study chiral molecules and the effects of chirality in self-organisation.

Q. Why have you become involved in this area of research?

A. After my PhD (in electrochemistry) I moved from Florence University to CNR in Bologna. In Bologna I started to study thin films and self-assembled monolayers. The control of these phenomena are the basis of bottom-up nanofabrication, thus to be involved in this area of research was the natural evolution of my activity.

Q. Do you think the SONS Project was important in your research career? And why?

A. My involvement with EUROCORES SONS was very important for my research career because it gave me the opportunity to interact with eminent scientists and important research groups in Europe. Also one of the colleagues highly supported me

for the EURYI award. It gave me the opportunity to collaborate with important groups, without too much bureaucracy.

It gave me visibility because as SONS is an international projects and the possibility to be invited in conferences.

My SONS interaction resulted the publication of papers in high-quality journals, reviews with high-impact factors and the production of a patent in collaboration with ICMAB-CSIC. This patent has now been licensed to a spin-off company, SCRIBA Nanotecnologie.

Q. What was the most important discovery that the FUN-SMARTs project has achieved?

A. The molecular magnets were very interesting, as well as the method that we patented; a new lithographic method based on mixing of polymers with the substrate. This was published in *Angewandte Chemie International Edition*, 2005, 44, 888-892.

Q. What is the European added value of the SONS EUROCORES Programme? And of FUNSMARTs?

A. I work in a group that has a very multidisciplinary approach to research, with chemists, physicists and engineers all working together and my project reflects this characteristic. In SONS and in particular in FUN-SMARTs there are several groups with different backgrounds. This is fascinating and enthusiastic, because to carry out research with people that have a different points of view is something fantastic, and helps to solve problems in a easier way.

Q. Do you think this kind of collaboration in Europe is important for the development of science? (the future of science lies in multidisciplinary research)

A. When you are young and you work in a multidisciplinary group it is easy to loose the focus, because if you are not lucky and you are not specialised it can be difficult to have targets and to publish papers, and in the end you can loose your identity.

Q. Would it have been possible to achieve the same results without the collaborations with the other partners?

A. No, these important results were due to the fact that I met very important scientists and I started interacting with them, and if you have good collaboration with scientists you will achieve very god results.

Q. What were the highs and lows of the SONS Project and of FUN-SMARTs?

A. I have already mentioned the highs. Regarding the lows, there is still a lot of bureaucracy, compared to other EC projects, and this can be improved. The financial report is very difficult to do for a researcher, without any help from a specialist.

Q. What discovery or research in SONS, outside your own CRP FUN-SMARTs, you have found particularly fascinating?

A. When I started working in SONS, I was introduced to very good scientists who were able to synthesize new material with fantastic properties and functionality. I particularly found the molecular magnets very fascinating. The study of magnetism is not my field but I found the idea to have ferromagnetism in a single organic molecule fantastic.

Q. Do you think you have created good links with other European partners? In your future research what other partnerships and links with other researchers will you develop? Is there any new line of research you would like to develop through your SONS collaboration?

A. To have good collaboration is the basis of my activity. To have something good you need the collaboration of several good people and in EUROCORES there are very good scientists. I need to continue collaborating with the people in SONS

because the collaboration is very productive.

Q. What are your research goals?

A. Several important publications. As the project is ambitious, and since I want to open a new area of research, I would like to have good publications in high impact journals and some patents. There are several possibilities in real applications for biological sensors, but they are more long-term applications, but I believe that some sensors for inorganic molecules could be realised in short-term.

Q. What kind of timeframe?

A. A few years for a patent is possible but to arrive at a production state is another story, like it was for organic LED (OLED). The first LED paper based on organic thin film was published about 25 years ago, but the first OLED production

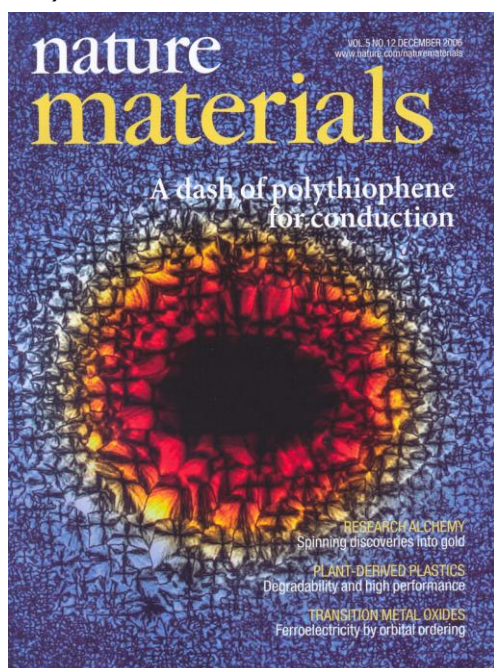
was only a few years ago. I do not expect to have production in a short time, but I want to put down the basis for a new generation of sensors.

Q. Where do you see yourself in 10 years time?

A. Thanks to the EURYI I could have a permanent position. This is one of the drawbacks of the EURYI, not being guaranteed a permanent position. I think this should be introduced in the next EURYI awards, that the national institution should give permanent positions to the winners. In fact, having a permanent position means working in a better way as you have job security. In addition, during the five years of the EURYI award, you only have to work on one project. This limits your CV, and you really have to prove that you have good results and that you are a team leader.

SONS (First Call) Research Focus

- The Groups of Rene A.J. Janssen, Martin N. Nielsen, Henning Sirringhaus and Paul Smith of the CRP **NETSOMA (Nanoscale Electrical Transport in Self-Organized Molecular Assemblies)** have recently published a paper entitled '*Multicomponent semiconducting polymer systems with low crystallization-induced percolation threshold*' which was a cover story in Nature Materials (Dec. 2006, Vol 5., 950-956)



The paper present the latest achievements reached by the CRP, through a wide collaboration that include the University of Cambridge, the ETH Zurich, TU Eindhoven and Riso National Laboratory.

This CRP research focus on exploring new electronic and optical phenomena arising in well-defined nanoscopic self-assemblies of bi-functional conjugated block copolymers. The proposal brings together four internationally leading groups with complementary expertise in conjugated polymer synthesis, polymer processing, structural characterisation of polymers and conjugated polymer device fabrication and device physics. Within this highly interdisciplinary and collaborative programme the partners will design, prepare, process, and characterise

electrically, optically and structurally novel conjugated block copolymer architectures and self-assembled supramolecular block copolymers, and incorporate them into novel nanoscale electronic devices. We regard conjugated block copolymers as an ideal model system to study some of the fundamental interactions that control molecular self-assembly as well as to achieve sufficient control over the length scales and degree of self-organisation such that controlled electrical transport measurements and optical characterisation can be performed to study the electronic and optical properties of such molecular nanoscale assemblies.

This paper is the result of three years of work collaboration made possible through the SONS funding.

In this paper they investigate bicomponents blends comprising semicrystalline regioregular poly(3-Hexylthiophene) (P3HT) and selected semicrystalline commodity polymers, and show that they can obtain vertically stratified structures in a one-step process. Incorporating these as active layers in polymer field-effect transistors (FET) the concentration of the semiconductor can be reduced to values as low as 3 wt% without any degradation in device performance.

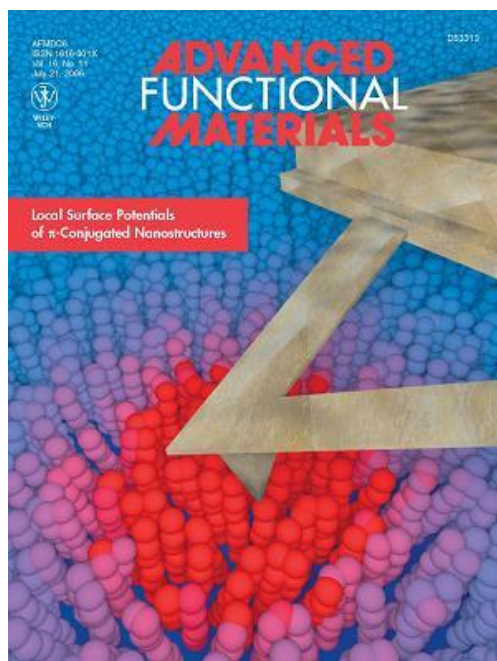
For blends made of P3HT and semicrystalline PE (Polyethylene) FET device performance was excellent for a concentration of P3HT as low as 3 wt%, and a value of mobility μ_{FET} of up to $6 \times 10^{-2} \text{ cm}^2 \text{ V}^{-1} \text{ s}^{-1}$ was obtained.

Studies of temperature indicated also that the performance is temperature-dependent.

Clearly, excellent electronic performance can be obtained in crystalline-crystalline bicomponent semiconductor-insulator polymer systems comprising less than 5 wt% of the semiconductor. Anyway, to achieve better performances the order in which the two components crystallise is fundamental.

More details of this research can be found in *Nature Materials* 5, 950 - 956 (2006). Nature Materials is the highest impact factor journal in the physical sciences.

- Researchers at the ISOF-CNR and at the Max-Planck Institute for Polymer Research have investigated the local



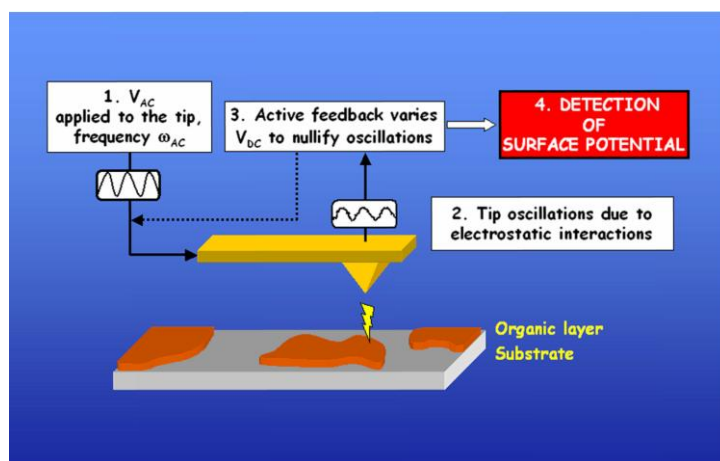
electronic properties of self-organized semiconducting nanostructures by quantitatively estimating their local surface potential using Kelvin Probe Force

Microscopy (KPFM). By comparing the topographical and surface potential images obtained by KPFM they were able to unravel the interplay between structural and electronic properties of molecule-based materials and devices.

The two groups have been working together within the SONS BIONICS Project, which aim is to exploit supramolecular approaches to develop new multifunctional hybrid architectures for organic and plastic electronics.

Paolo Samorì, researcher at ISOF-CNR, said that the results highlighted in this paper are important as they pave the way towards the optimisation of the electronic properties of electroactive nanomaterial-scale architectures for organic (nano) electronic applications.

Full details of this research can be found in Andrea Liscio, Vincenzo Palermo, Desiree Gentilini; Fabian Nolde, Klaus Müllen, Paolo Samorì, *Advanced Functional Materials*, 2006, 16, 1407-1416.



Schematic representation of KPFM. V_{AC} : alternating-current voltage; V_{DC} : direct-current voltage; ω_{AC} : alternating-current frequency; h : tip-sample distance.

SONS (second call) at a glance

The SONS (second call) launch meeting was held in Strasbourg on the 8th December 2006.

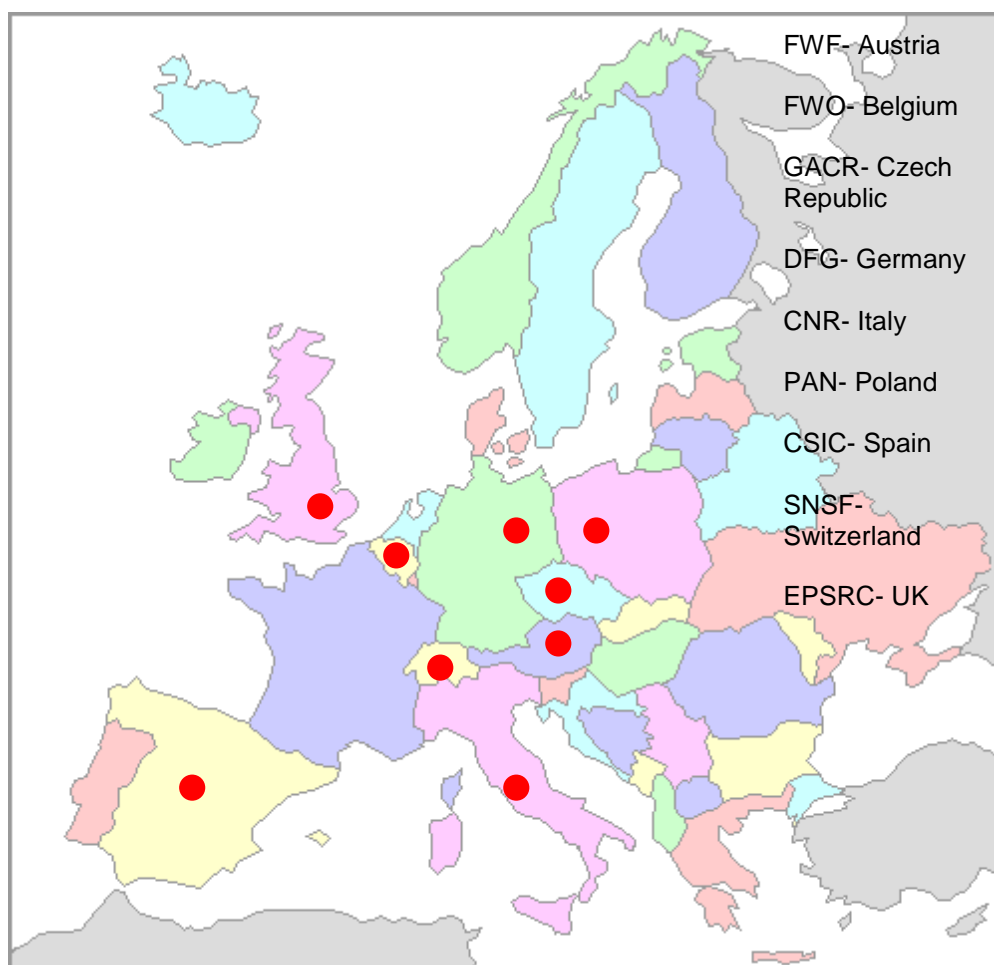
The Project Leaders of the funded projects took part in the event.

At this meeting the future Networking activities of SONS 2 were planned which

included a SONS Workshop together with scientists of SONS (First call).

The SONS (second call) brings together seven CRPs which makes up a total of 51 researchers from 15 countries. The budget of SONS (Second Call) is about 8 Mio € and it will run until December 2009.

Funding agencies supporting the SONS (Second Call) Programme



Who's who in SONS 2?



Dr Paolo Samori'
(SUPRAMATES)



Dr. Dirk Vanderzande
(SOHYD)



Dr. Mario Ruben
(FUN-SMARTs)



Dr. Goran Ungar
(SCALES)



Prof. John W. Goodby
(LC-NANOP)



Dr. Carlo Carbone
(SANMAG)



Prof. Wolfgang Meier
(BIOSONS)

News in Brief

Frederic Nallet has joined the BIONICS CRP as Co-Operating Partner.

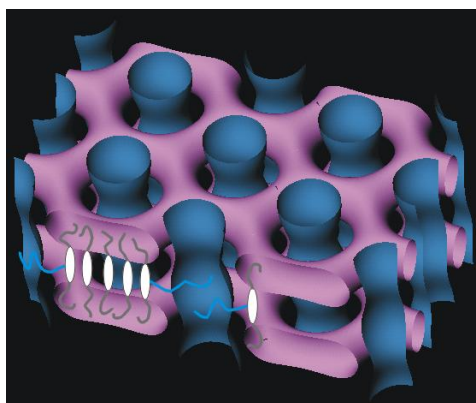
Johannes Bart has moved from Canada to take up a position in Germany, and has changed his status in the FUN-SMARTs Project from Associated Partner to Principal Investigator.

SONS (Second Call) Research Focus

A recent discovery, brought about by the collaboration between the groups at the University of Halle (Chemistry) and the University of Sheffield (Engineering Materials), was that of a phase which for the first time combines the features of columnar liquid crystal (2-d packing of cylinders) and smectic liquid crystal (1-d stacking of layers). The 3-d electron density map, reconstructed from synchrotron X-ray data, is shown in the figure together with three superimposed schematic molecules. The T-shaped molecules have an aromatic rod-like core,

a paraffinic tail at each end, and a polar ethyleneoxide chain attached to the side of the aromatic rod. Due to the polar channels, this "hexagonal channelled layer" phase offers an opportunity to create chemically-responsive ionically conducting nanowire arrays for application in smart redox devices.

The groups of Prof. Goran Ungar and Carsten Tschierske belong to the SONS Project **SCALES** (Complexity across lengthscales in soft matter).



Reconstructed electron density map of the channelled layer liquid crystal phase: the blue isoelectron surfaces enclose the polar channel-like domains (high electron density) and the pink surface encloses the low-density aliphatic regions. The layers in between are composed of aromatic rod-like units. B Chen, XB Zeng, U Baumeister, S Diele, G Ungar and C Tschierske, "Liquid Crystals with Novel Complex 3D Superstructures" Angew. Chem. Int. Ed. 2004 43 4621 –4625.

Cross-EUROCORES Activities

The **EUROCORES Workshop on Self-Organized NanoStructures** was held at the Palais de la Musique et des Congres in Strasbourg from the 31 May to 1 June.

Over 85 delegates from the two SONS Scientific Communities attended this two day event and presented the latest results achieved by the SONS EUROCORES Programme. Invited Speaker included Prof. John Anthony (University of Kentucky, USA), Prof. Franz Himpfel (University of Wisconsin Madison, USA), Prof. Giovanni Marletta (University of Catania, Italy), Prof. Hans-Jörg Schneider (University of Saarbrücken).

The two days event was concluded with Scientific and Management Committee meetings. Review Panel members were

also present at the Conference as observers. This meeting provided an excellent opportunity for the two communities to exchange results and to start new collaborations.



External view of the Palais des Congres in Strasbourg.

Best Poster Award Winners

At the SONS Workshop in Strasbourg an independent panel formed by members of the Review Panel selected the three best posters presented during the poster session.

The three winners are: Fikri Alemdaroglu from BIONICS, Andreas Walther from SONS-AMPHI and Maurizio Righini from NOMSAN.



From left to right: Fikri Alemdaroglu, Andreas Walther and Maurizio Righini

Short-Term Visits

A new initiative has been launched with the aim of exchanging samples and knowledge across CRPs and also across EUROCORES Programmes. Young researchers are highly encouraged to apply.

There is no deadline for application. More information, application forms and guidelines can be requested from sons@esf.org.

Diary of Events

- *Upcoming meetings organized by the SONS Research Community*

SONS/EuroDYNA Round Table Meeting

4-5 December 2007, Lisbon, Portugal

EMRS Symposium 'Functional supramolecular architectures for organic electronics and nanotechnology'

26-30 May 2008, Strasbourg, France

- *Conferences, summer schools and workshops of interest to the SONS Scientific Community*

EMAG 2007: Characterisation, Manipulation and Fabrication at the Nanoscale

3-7 September 2007, Glasgow Caledonian University & University of Glasgow, UK

http://www.iop.org/Conferences/Forthcoming_Institute_Conferences/EMAG07/event_8375.html

EUROMAT 2007

10-13 September 2007, Nurnberg, Germany

<http://www.euromat2007.fems.org/>

MS&T'07: Materials Science and Technology 2007,

16-20 September 2007, Detroit, USA

<http://www.matscitech.org/2007/home.html>

E-MRS Fall Meeting 2007

17-20 September 2007, Warsaw, Poland

<http://www.e-mrs.org/meetings/fall2007/index.html>

NANO-RIO: 9th International Conference on Nanostructured Materials

1-6 June 2008, Rio de Janeiro, Brazil

<http://www.cbpf.br/~nano2008/NANO2008.htm>



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