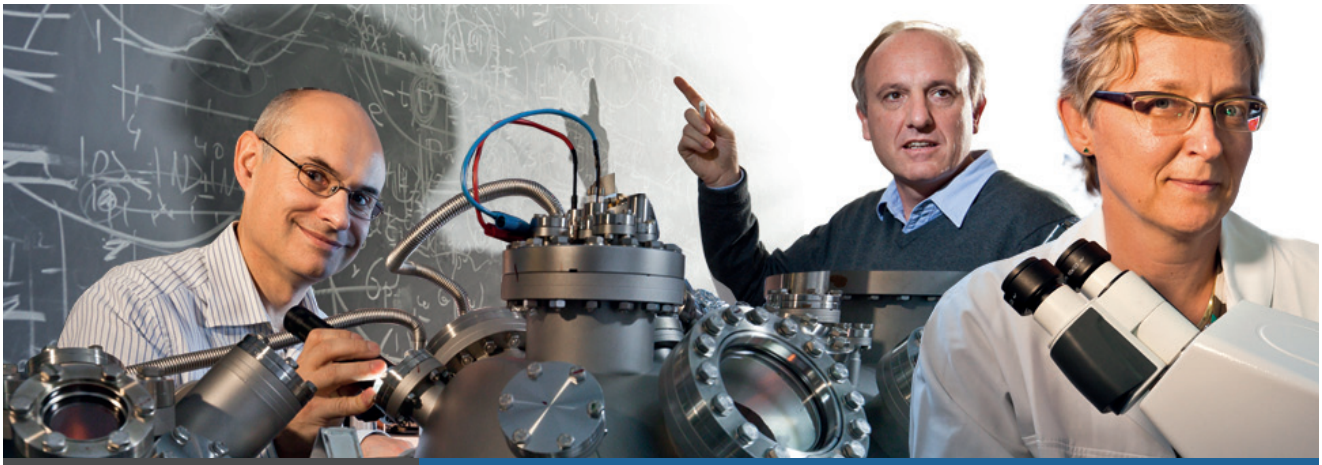

SNI
SWISS NANOSCIENCE INSTITUTE
EINE INITIATIVE DER UNIVERSITÄT BASEL UND DES KANTONS AARGAU

SNI update October 2011

Words from the Editor

Dear colleagues

The summer is definitely over and the new semester has started. Lots of young students reenergize our university once again. Fortunately, the number of physics students at the University of Basel has recuperated, whereas we expect a lower number of nano students than in previous years. Among high-school students it is still not well known that the Nano Curriculum in Basel offers a broad entry into the natural sciences and therefore provides an excellent education for young people with wide interests. The Swiss Nanoscience Institute will further advertise the Nano Curriculum and is currently producing a new flyer. However, we should all promote the advantages of this educational option within our own families and among our friends.

I am not only looking forward to the new students but also to the upcoming projects of the Argovia program. The deadline for the submission of proposals has just ended. On November 7th the reviewers will evaluate all submitted applications. In the next issue of *SNI update* we will publish the approved projects. In the future you can also apply for joint projects with the Institute of Molecular Systems Biology. With this new partner we increase the width of Argovia projects and will become an attractive partner for even more companies in Northwestern Switzerland.

Another good reason to be pleased was that Professor Christoph Gerber was given the Science Prize of the City of Basel. Most of you have met Christoph and know about his merits for the nanoscale sciences. In this second issue of *SNI update* we will portray Christoph and I am sure you will get to know a few new things about him. Furthermore, we report on the successful Argovia project *Mangacat*. In this joint project of research groups from the University of Applied Sciences,

the University of Basel and the Swiss company HeiQ Materials, scientists have developed a new environmentally safe catalyst for industrial processes. Besides these success stories I was pleased to read that the canton Aargau has repeatedly named the SNI and its nanoresearch as one of the pillars for implementing its high-tech strategy. We will also shortly cover the canton Aargau's strategy in *SNI update*.

With best regards,

Christian Schönenberger

Director of the Swiss Nanoscience Institute, University of Basel

UNI BASEL

Cover Story

With Teamwork to Environmentally Safe Catalysts

Within the Nano-Argovia project *Mangacat* a team of researchers from the Swiss Nanoscience Institute (SNI) demonstrated that flame spray pyrolysis (FSP) is a suitable method for the ecologically harmless, industrial production of oxidants and multifunctional catalysts in chemical processes. In the project, that started in 2009, scientists under the leadership of the Professors Uwe Pieles and Gerhard Grundler from the University of Applied Sciences worked together with the group of Professor Edwin Constable from the University of Basel and the Swiss company HeiQ Materials – a spin-off of the ETH Zurich.

Wanted - environmentally safe oxidants

Oxidation plays an important role in numerous processes in our daily life. Combustion is an oxidation process, the degradation of organic materials by microorganisms happens through oxidation and the corrosion of metals is a reaction with oxygen as well. Oxidation processes also play a crucial role in the industrial chemical synthesis of various different compounds. Alcohols, for example, are specifically oxidized into aldehydes or ketones, which among others are applied for the production of polymers, desinfectants, dyes and drugs. On a laboratory scale a fairly large number of different oxidation methods have been developed. Because of their toxic reactants or side products these are not suitable for industrial production of larger quantities. Therefore it is desirable to find ecologically harmless oxidants that selectively and effectively catalyse the oxidation of different organic compounds.

More effective as a nanoparticle

Manganese oxide (MnO_2) has long been used as a mild oxidant. However, the production out of potassium permanganate, its shelf life, and the handling of MnO_2 are not optimal. Therefore, MnO_2 is only rarely used on an industrial scale. Due to its good environmental compatibility, the investigation of a more stable form of Manganese oxide that reproducibly, selectively, and in low quantities catalyses oxidation processes looks very promising. This was also demonstrated in recent publications where manganese oxide nanoparticles were presented as effective material for the purification of air and drinking water.

Sprayed with high pressure

The SNI team investigated flame spray pyrolysis as a possible method for the production of manganese oxide nanoparticles. During flame spray pyrolysis the base substance (Manganese-Nitrate-Tetrahydrate) is dissolved in a flammable liquid (ethanol) and sprayed into a flame with high gas pressure. Thereby, tiny droplets of the solution are formed like in a fog. The base substance is oxidized and agglomerates of the nanoparticles are formed. The team of researchers first optimized the concentration of the base substance and gas flow as well as the

Co-workers of the SNI team working with the burner.

nozzle geometry of the burner so that they could synthesize the required amounts of MnO_2-nanoparticles with a consistent size of 20 and 50 nm. However, it soon became obvious that the desired MnO_2 was not formed, but rather the weaker oxidant Mn_3O_4. Employing a further oxidation step in sulphuric acid and a subsequent neutralization, the researchers were then able to produce the favoured MnO_2 in acceptable quantities.

Accelerated with microwaves

Thereafter the scientists investigated the application of the produced manganese oxide nanoparticles as oxidants. For this purpose they studied the conversion of different alcohols into aldehydes and compared the results with those achieved using conventional MnO_2. Conversion rates as well as yield of end product could be significantly increased by the application of nanoparticles. In order to reduce the reaction time until full transformation to the aldehyde, the scientists optimized the catalysis by performing the oxidation under microwave irradiation. Reaction time was shortened from several days to only one hour, although the yield of the end product was slightly reduced.

Based on these positive results, the group is now analyzing further substrates. Additionally, they are investigating the production of multifunctional catalysts using flame spray pyrolysis by combining various substances that catalyze different chemical reactions in one composite material. Initially, the efforts within the *Mangacat* project are focused on nanocomposites made from manganese oxide and palladium, which for example is applied in catalysts to clean exhaust emissions in cars. On a laboratory scale, first hybrid reactions have been carried out successfully.

Within the two years term of *Mangacat*, researchers have demonstrated that flame spray pyrolysis can be applied to produce ecologically harmless catalysts. The properties of these catalysts are comparable to those of commercially available products. In some instances, such as reproducibility and work-up of reactions, they are superior. Additionally, these promising results indicate that multifunctional composite catalysts can be synthesized. In the coming period these catalysts need to be specified in detail. Their production in larger quantities (multi kilogram) needs to be assured. Finally, it is a goal to expand the applications for multifunctional catalysts.

KlarText! KlarText! KlarText! KlarText!

Klaus Tschira Preis für verständliche Wissenschaft

Comprehensive Texts in Science

The Klaus Tschira Foundation awards the Klaus Tschira Prize for comprehensive sciences called *KlarText!* for young scientists who descriptively explain their research topics. PhD students from Biology, Chemistry, Informatics, Mathematics, Neurosciences and Physics who have finished their PhD in 2011 and explain their work in a generally understandable text can apply until February 2012. The winners will receive 5000 Euro and can participate in different training courses on science communication. The awarded texts will be published in a special issue of *Bild der Wissenschaft*. As in previous years, Professor Dr. Peter Gruss, president of the Max Planck Society, is the patron of the competition.

If you would like to participate and need support, please contact the editorial team of SNI update (Christel Möller and Tibor Gyalog).

More information at:
www.klaus-tschira-preis.info.

We introduce…

Christoph Gerber

Almost everybody within the SNI knows Professor Dr. Christoph Gerber. He had a great impact on the founding of the National Centre of Competence in Research Nanoscale Sciences (NCCR Nano). From the first day he was Director of Scientific Communication and project leader and has considerably contributed to the fact that the NCCR and the follow-up organisation SNI are well-networked with other research organisations and that they both enjoy an excellent reputation in the scientific community. Professor Gerber was recently awarded the Science Prize of the City of Basel. This is reason enough to introduce him a bit more in detail.

Fascinated by books

Christoph Gerber was born in 1942 in Basel. Already as a child he had a close affinity to the University of Basel because the little park on Petersplatz in front of the Kollegienhaus was his playground. In his early years, he furthermore discovered his passion for books and often spent nights with a torch and a book under his blanket. Beside the common literature for young people, it was predominantly biographies about scientists that fascinated him. Characters like Michael Faraday, who as a bookbinder not only bound books for famous scientists but also read and experimentally explored them, impressed Christoph Gerber enormously. At first, however he did not aim to become a scientist himself. Instead he started an education as precision engineer. After completing these studies he applied successfully to the Swiss company Contraves, which made its mark with instruments and measuring systems in precision engineering, optics and electronics. Shortly after his employment, Christoph Gerber was sent to Sweden in order to take over a position as group leader.

Successful teamwork

In 1966 he came back to Switzerland and started his career at the IBM Research Centre in Rüschlikon. For Christoph Gerber a fascinating and intensive time started. He worked closely together with the Nobel Prize winner Professor Heinrich Rohrer – first on various topics of low temperature physics and structural phase transitions. When Professor Gerd Binnig joined the team, Christoph Gerber fully concentrated on the development of the scanning tunnelling microscope (STM). Night after night he worked meticulously on technical problems, which were related to this microscope. In 1981 they achieved a break-through. The team of Rohrer, Binnig, Gerber and Weibel demonstrated that between the tiny tip of the microscope and the sample, a current can be measured that exponentially decreases with increasing distance. They showed that it is really possible to image the electrical condition of single atoms in conductive materials.

The scientific world responded differently to the news. Whereas at IBM doors for further research funding opened, the renowned scientific journal *Physical Review Letters* rejected the publication of the paper. As the tunnel effect was known for several years, the new microscope was regarded as a technical jewel but not as a scientific innovation.

Highly cited publication

However, the researchers did not give up and further pushed their research forward. In 1986 Binnig and Rohrer were awarded the Nobel Prize for the design of the scanning tunnelling microscope. In the same year Christoph Gerber published together with Professors Gerd Binnig and Carl Quate the development of the Atomic Force Microscope (AFM). In contrast to the STM that can only be used for conductive materials, the AFM is capable of imaging biological and other non-conductive materials. The AFM measures forces acting on the tiny tip of the microscope while it scans the sample. This approach has proven to be a true success story. The paper that described the invention of the AFM was published in 1986 in *Physical Review Letters (PRL)*. Until today, it is the most cited paper in PRL that covers an experimental problem. Nowadays, the technique is so technically mature that biological processes can be observed *in vivo* in a se-

quence of images with high resolution such that single atoms and molecules can be seen.
The AFM has become an elementary tool for researchers in biology and medicine. It has opened new insights and supports scientists in their efforts to understand natural processes.

The first Scanning Tunneling Microscope.

The first Atomic Force Microscope.

Cantilever as new research area

For Christoph Gerber these were exciting years. He spent two years at the IBM Research Centre in California and instructed numerous colleagues in the handling of the new microscopes. He shared all the tricks and insights that he had acquired during the whole development time. His knowledge of scanning probe microscopy allowed him to follow further routes. It soon became obvious to Christoph Gerber that the surface of the cantilevers, that are used in Atomic Force Microscopes, and the forces affecting them could be used for diagnostic analysis. If, for example, molecules are bound to a cantilever, it can be measured when other substances in a test solution bind to these molecules. Herewith a tiny diagnostic tool was born that can quickly and cost-effectively detect small amounts of different substances. The applications of this cantilever technology are diverse. Specific compounds can be detected, but also proteins, genes and microorganisms. Even in the quantum world, scientists use cantilevers in their research.

Move to Basel

At the end of the nineties a new era began for Christoph Gerber. Soon after the invention of the AFM he was in contact with Professor Hans-Joachim Güntherodt from the University of Basel who was planning to use the new microscopes for the analysis of metallic glasses. Very early in the development process, Güntherodt was confident about the benefits of the new technology and became very much interested in a collaboration. He developed together with Christoph Gerber the idea of a nanocentre in Basel. The call for NCCRs by the Swiss National Fund came exactly at the right time. Colleagues from the University of Basel were easily convinced that the future belonged to nanoscale sciences. In 2001 the NCCR Nanoscale Sciences with the University as Leading House was established. Hereupon Christoph Gerber retired from IBM and focused all his energy and motivation in his new role as project leader for cantilever projects and Director for Scientific Communication.

Teamwork, dedication and perseverance as success factors

Through his pioneering work in the nanoscale sciences, Christoph Gerber himself became a well respected and internationally known scientists. He is among the most cited physicists worldwide, was awarded with various different academic titles and memberships, and has received numerous prizes and honours. In February 2012, he will receive the Lifetime Achievement Award of the scientific journal *Nature*. He was also recently awarded the Science Prize of the City of Basel. For Christoph Gerber the credit for these honours also belongs to his team of colleagues. Without the teamwork, team spirit and exchange with his enthusiastic colleagues and co-workers, these success stories would not have been possible. “For success in science, dedication and perseverance are elementary”, Christoph Gerber replied when asked about the credo of his career. “Besides that, it is important to challenge dogmas, to find your own way, and to work hard on your vision.”

For the future, Christoph Gerber still has enough energy and motivation to stay active and to further act as a driving force in the nanoscale sciences. However, he also admitted during an interview that he is overdue to dedicate himself to the activities that he has always balanced with science. So in winter there are several deep snow slopes that are waiting and in the warmer seasons he aims to improve his golf handicap. He would like to emulate the Nobel Prize winner John Bardeen who found his *Hole in One* more important than his Nobel Prizes. And then there is always a pile of books that wait for Christoph Gerber ...

Events

With scientists through different worlds

On November 18th, the Swiss Nanoscience Institute will organize together with the University of Basel and the University of Applied Sciences the event *Weltenreise – vom Kosmos zur Nanowelt*. During the event researches from the SNI and from the University of Basel invite visitors to accompany them on an exciting virtual tour. They will experience the birth of a star, get to know the building blocks of the universe, and will look into black holes. The trip then goes from the huge cosmos to the tiny nanoworld. There, participants will experience how the smallest building blocks enable life, perfectly interact with each other and how they separate and protect themselves. Human beings, however, not only want to know how things work. We also would like to make proper use of our knowledge. Therefore, the scientists will take the visitors further, letting them experience possible applications and daring to glance into the future.

The trip through different worlds starts on November 18th at 19.30 in the Schauspielhaus in Basel. If you are interested please keep this evening free; more information will follow.

Nanotech-Apéro 2011

Following the tradition of numerous fruitful meetings between researchers from academia and representatives of local industry, the SNI together with i-net Basel Nano and the Basel chamber of commerce, organizes the first Nanotech-Apéro in Liestal. All members of the SNI are cordially invited to this event which will take place on November 2nd 2011, 16.00 - 18.30, at Hotel Engel in Liestal. The program starts with a political overview, presented by RR Urs Wüthrich-Pelloli, education minister of the canton of Basel-county. Entrance and drinks are free! Participants will have the opportunity to meet representatives from the local nanotech industry. It is an ideal meeting for networking, either regarding future collaborations or job opportunities.

For further information and registration, please follow the link:
www.nanoscience.ch/nanotechapero

The Nanotech-Apero is an excellent opportunity for networking.

SNI as Pillar in the High-Tech Strategy of the Canton Aargau

The canton Aargau came in third in the Credit Suisse ranking of location quality. However, the average per capita income of citizens in the canton Aargau is below the national average. Therefore, the canton Aargau aims to strengthen its competitive position and to prepare for the future. For this purpose value-added industries will be particularly supported. The canton Aargau has now developed a high-tech strategy in order to foster know-how and technology transfer between small and medium-sized companies, global players, universities, and research institutions. Additionally, the canton expects that the implementation of the strategy will enhance further innovations in Aargau.

In the strategic paper, the enhanced knowledge transfer in the area of nanotechnology is pointed out as a central measure. Herewith the SNI takes a leading role. Already in 2009 the universities and research institutions that are engaged in the SNI have started to work on joint research projects with small and medium-sized enterprises (SME) in Northwestern Switzerland. These Argovia projects normally run for 1 -2 years. Previous projects have demonstrated that know-how and technology transfer between research and industry can be effectively supported in the framework of Argovia projects. To further extend the support of SMEs, the canton Aargau is planning to implement a Know-how and Technology Transfer Centre that is oriented towards SMEs and should act as a mediator to universities.

Wanted – Project Proposals

The Swiss National Science Foundation (SNSF) has launched a second call for full proposals for the National Research Programme *Opportunities and Risks of Nanomaterials* (NRP 64) in the following areas of application: food products and food packaging, consumer products, energy, construction and high risk/high potential projects on innovative nanomaterials.

Full proposals should be submitted via the SNSF Web platform mySNF by 1st December 2011 latest. Two million Swiss francs are available for this second call.

More information at **www.nfp64.ch.**

Awards

Christoph Gerber Receives Science Prize of the City of Basel

On September 20th, Professor Dr. Christoph Gerber received the Science Award of the City of Basel. He is awarded in recognition of his outstanding and worldwide recognized pioneering work in nanotechnology, especially for the development of ultra-sensitive sensors with applications in Biology, Chemistry, Medicine and Physics based on cantilever technology.

The price worth 20´000 CHF is awarded yearly. It recognizes scientists who are connected to the University of Basel. The awardees are chosen alternating from the seven faculties.

More about Christoph Gerber at:
www.nanoscience.ch/nccr/people/awards/award_000004/award_long

Recent Press Releases

Artifical Nano-NPC Model Imitates Selective Transport System

Basel, 20th June 2011. Cellular machines exhibit an exquisite functional sophistication that is technologically unprecedented. The research team of Professor Roderick Lim, Argovia Professor for Nanobiology at the Biozentrum and the Swiss Nanoscience Institute, and colleagues from Delft University of Technology report on a bio-inspired de novo "minimalist nuclear pore complex (NPC)" that sheds new light on how biological NPCs regulate selective transport between the cytoplasm and nucleus in eukaryotic cells. The scientists also demonstrated that the NPC's modus operandi can be imitated to sort specific biomolecules from biological fluids to synthetic nanoscale targets.

These results were recently published in the scientific journals *Nature Nanotechnology* and *ACS Nano*.

Full texts of press release in German at: **nanoscience.ch/nccr/media/recent_press_releases**

Please contribute

We are looking forward to your feedback, ideas, success stories and news that might be of interest for the SNI community to the editorial team:

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