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

SNI update April 2014

Editorial

Dear colleagues

You have a packed *SNI update* in front of you that will hopefully fully inform you about the SNI activities of the recent months.

At the end of March, we awarded the SNI prize for the best master thesis in 2013 for the first time. Heidi Potts who currently is doing her PhD thesis at the EPFL, received the award. In the cover story, you can learn more about her and her award-winning thesis. In the following section, we profile Monica Schönenberger as head of the Nanotech Service Lab. Some of you might not know that this well-equipped service lab exists and that research teams and industry partners have access to scanning probe microscopy analysis from the experts of the Nanotech Service Lab.

We also discuss partners from industry in the context of the Argovia projects. With the beginning of the year, we have started seven new applied projects within the Argovia program. Again, we were able to select the best projects from the submitted proposals – the first four we will introduce in this issue of *SNI update*.

We are always interested in sharing the variety and fascination of nanoscale sciences to a broad audience. To achieve this, we had a booth at the exhibition TuN during the MUBA in Basel and we will continue to engage in the TecDays all over Switzerland. Tibor Gyalog and Meret Hornstein from the communications team always have been the driving force behind these activities. Tibor has now taken the opportunity to accept a professorship for didactic of natural sciences at the University of Applied Sciences. I want to thank him for his initiative and commitment during the last years and wish him all the best for his future.

The SNI also becomes visible through awards that SNI members receive. In this *SNI update*, we can report on several prizes. The PhD student Samuel Vogel from the University of Applied Sciences received the SAMPE Europe Student Award. Professor Bert Müller was nominated SPIE Fellow and Professor Christoph Gerber was named as one of the 100 most important Swiss citiziens by the magazine BILANZ. He was also included in the *Who is Who* of Basel.

Congratulations to all awardees and I wish an informative reading to all of you.

Best regards

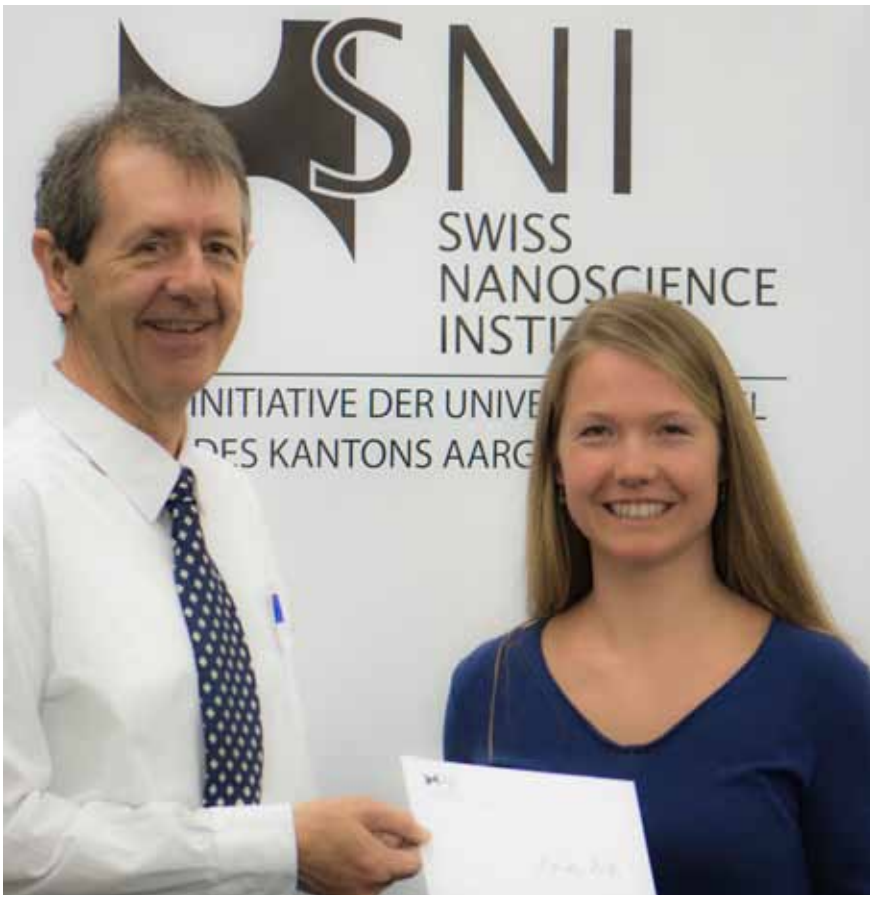
Director of the Swiss Nanoscience Institute, University of Basel

UNI BASEL

Cover Story

Award for the best master thesis goes to Heidi Potts

For the first time, the Swiss Nanoscience Institute has awarded the best master thesis in nanoscale sciences at the University of Basel in 2013. The prize that comes with 2000 Swiss Francs prize money went to Heidi Potts who currently is doing her PhD at the EPFL in Lausanne. In the honored master thesis, Heidi Potts examined ultrathin silicon solar cells that are more cost-efficient than standard products.



Professor Christian Schönenberger awards Heidi Potts for the best master thesis in nanoscale sciences in 2013.

With ozone and heat to controlled growth

Nowadays, renewable energies are an important topic and nanoscale sciences contribute considerably to the progress in this field. The 25-year-old Heidi Potts also wanted to contribute to this topic and therefore worked on solar cells for her master thesis. She concentrated on silicon cells. Silicon has been used in photovoltaics for many years but the technology can still be optimized. Cost, for example, can be reduced by the production of extremely thin solar cells. To achieve a high efficiency, surface effects have to be considered as they play a more important role in ultrathin cells than in cells of conventional thickness. For example, charge carriers are lost at the surface due to recombination. In order to enable the fabrication of extremely thin silicon solar cells with a high efficiency, Heidi Potts has examined in her thesis how recombination issues can be prevented by passivation. She combined a very thin silicon oxide layer with a slightly thicker silicon nitride layer. Later, she characterized these new "protected" silicon substrates using different optical and electrical methods. To optimize the production process, she designed a chamber in which the required silicon oxide layer is grown in a controlled way using ozone and elevated temperatures of up to 450°C. There are many different ways to optimize solar cells; with her awarded thesis, Heidi Potts has shown one of them.

Proactive selection of the working group

For Heidi, the topic of her thesis was important and she specifically chose a group that works with solar cells. A different aspect was her wish to work in Canada for her master thesis as she has family in Canada and always wanted to live in the country that she has visited so often. She informed herself and contacted Professor Nazir Kherani of the University of Toronto. He had just started a new project that was ideal for a master thesis. Supported by the SNI travel grant and perfectly taken care of in Basel by Dr. Katrein Spieler and Dr. Thilo Glatzel, Heidi started the experimental work for her thesis in Toronto in September 2012. "It was amazing", Heidi summarizes her time in Canada. Until

then, Heidi who was born in Freiburg (Germany), had neither lived in a large metropolis nor studied on an American university campus and obviously, she enjoyed it a lot.

Nanowires as topic for the PhD

After finishing her master, Heidi Potts returned to Switzerland to start her PhD thesis at the EPFL in Lausanne in September 2013. Here as well, she has begun positively and highly motivated. Under the supervision of Professor Anna Fontcuberta i Morral, she produces and examines nanowires with novel physical properties. She feels well prepared to work on this topic by her nanoscience studies in Basel.

Heidi has fond memories to her time in Basel. “Basel is a fun city, the atmosphere at the university is very nice, and studying nanosciences was awesome. We got an excellent education and a nice insight into state-of–the-art research and applications. The teamwork among the students was always very good– we studied hard but also had a lot of fun.” Especially now after having left Basel since September 2012, she experiences how close these contacts are. “We have built up a small network – we still party together, visit each other in our labs – also when we are abroad – and share our experiences.”

Versatile and positive

Heidi decided to study nanoscale science because she had a broad interest in science and at first did not want to decide on only one discipline. After her time at high school, a neighbor in her hometown Staufen told her about the newly founded nano curriculum at the University of Basel. She immediately knew what to choose. During the interview it became obvious, that the positive young scientist does not regret this decision. Heidi seems to have found the right discipline and is confidently looking forward to the new challenges related to her PhD. Besides work, Heidi enjoys the mountains for skiing and in summer will learn to sail on the Lac Leman. She will celebrate her SNI award together with friends and colleagues from Basel, will refurbish her new apartment in Lausanne and maybe invest in new skis – because the fresh snow that fell the day before the interview makes you want to go skiing although spring has already arrived.

Call for new PhD projects

Until 30th May 2014, new project proposals for the SNI PhD school can be submitted. Researchers of all academic institutions of Northwestern Switzerland can apply for funding.

More information about this third call for new PhD projects under:

http://phd.nanoscience.ch

We introduce...

Dr. Monica Schönenberger

is leading the Nanotech Service Lab at the Swiss Nanoscience Institute at the University of Basel. People who are interested in this service will find out on the internet page that Monica is a pharmacist by training. But how does a pharmacist get to head a nanotechnological service lab? Pretty simple – with enthusiasm for working in the lab and curiosity of previously unknown things!

Monica Schönenberger enthusiastically meets challenges in the Nanotech Service Lab.

Interest in lab work

The 41-year old Monica Schönenberger grew up in the Basel area. She visited the gymnasium in Liestal and decided to study pharmacy after getting her high-school diploma. Originally, she had planned to work in a pharmacy. However during her studies, Monica got more and more fascinated by work in the lab and therefore started aiming for a position in industry. So after finishing her studies, she did an internship at Novartis Consumer Health in Nyon and applied for a PhD thesis with F. Hoffmann-La Roche in Basel. This was the first time that she came into contact with nanoscale sciences. In her PhD, she examined the adsorption of proteins at glass surfaces by atomic force microscopy (AFM). The Roche scientists had found out previously that in liquids some proteins were less concentrated than expected, because they partially adhered to glass surfaces. The Roche researchers had contacted Professor Güntherodt from the Department of Physics at the University of Basel and had asked him to analyze the issue. Dr. h.c. Peter Reimann and Vreni Thommen from the Güntherodt team had started first examinations when Monica joined the team to investigate the topic in detail. Finally, she recommended the use of siliconized glasses as these prevent the adsorption.

Head of the Nanotech Service Lab

Monica returned to more pharmaceutical tasks after her PhD thesis as she started a position as project leader at Mepha AG, a generics company in Aesch. She had a small team and was responsible for galenics and analytics of new products until, in 2005, her son Philip was born. As the job could not be done part-time, Monica left the company and joined the group of Professor Ernst Meyer. During this time at the Department of Physics in Basel, she examined and manipulated nanoparticles under the AFM und supervised a PhD student. In 2008 when her second son was born, Monica took a break. Later, she rejoined the Meyer team before Nanosurf hired her as Application Scientist. After one year, Peter Reimann inquired if she would be interested in taking over the responsibility for the Nanotech Service Lab.

Flexibility and engagement

Monica's professional development clearly demonstrates where her strengths lie. She is flexible and able to adapt to new challenges. Qualities that help to fulfill her duties in the Nanotech Service Lab, since here she needs to respond to different customer requests. Scientists from the Physics and Chemistry Depart-

ment, for example, contact her to have atomic force microscopy analyses carried out. The surface structure of diamonds, fractures of nanostructures and arrangements of ruthenium molecules are among the topics they want to have investigated. Besides this, she educates master and PhD students in the use of different scanning probe microscopes and deals with inquiries from industry. In collaboration with the University of Applied Sciences, she investigates the coating of paper for a local paper mill, analyzes elasticity of contact lenses or discovers why fibers rip and flat springs break in a textile factory. This last issue is the latest project of the Nanotech Service Lab and was arranged by the Hightech Center Aargau.

The Nanotech Service Lab is located in the Department of Physics at the University of Basel where Monica is surrounded by physicists. “For me as a pharmacist, this is sometimes quite a challenge because for some projects I first have to work on the background knowledge before I can start ”, she notes during the interview. “However, it’s a pleasure to collaborate with my colleagues and it’s always exciting to learn new things.”

Diverse interests

Monica Schönenberger likes diversity and the possibility to get an insight into many different fields. “I enjoy becoming acquainted with all these different topics”, she comments on this aspect of her work. “Sometimes, I would love to dig deeper into some areas – not only to fulfill the service work but to do some more research.” She sees one possibility in her activities with contact lenses. “With a couple of extra analyses, we could write a paper about the differences between various contact lenses.” Until now, Monica has plenty of ideas, but never enough time. It seems to be similar in her private life because she has a lot of different interests. She likes to spend time with her family, is engaged in the local sports club, goes skiing, likes biking and has a big garden. Here as well, versatility and flexibility are required. Monica certainly has these attributes and they facilitate her work as a pharmacist and head of the Nanotech Service Lab.

SNI Annual Event

On September 11th and 12th, the Annual Event of the SNI takes place at Lenzerheide, Switzerland. During the event, SNI members will report on their research and there will be plenty of opportunities for discussions and networking.

Did you already register for a poster or a talk? For questions please contact:

meret.hornstein@unibas.ch

Swiss NanoConvention 2014

The Swiss NanoConvention 2014 takes place from 21st – 24th May in the Campussaal on the new FHNW campus in Windisch.

The Swiss NanoConvention has established itself as the prime showcase for nanoscale sciences and nanotechnology in Switzerland and offers an excellent opportunity for exchange between representatives from research, industry and politics.

The Swiss Nanoscience Institute is a sponsor of the event and can offer a number of free tickets. In case the number of applicants exceeds the number of free entries, the SNI will reimburse the registration fees for its members. Students and PhD students can register for a reduced price of 50 Swiss Francs. The SNI will also reimburse these fees.

More information about the SNC2014 at: swissnanoconvention.ch/2014

New Argovia projects

Beginning of 2014, seven new Argovia projects have started. We shortly introduce the first four of them in this issue of *SNI update*. The next three will follow in the next issue.

Better filters for the environment

The NANOFIL team during the kick-off event.

The project NANOFIL has the ambitious goal of developing new filter systems that remove fine particles and heavy metals from flue gas and contribute to the reduction of environmental damage. Project leader Professor Christian Ludwig from the Paul Scherrer Institut works together with colleagues from the University of Applied Sciences in Muttenz and Windisch and the Swiss company ALSTOM.

Micro- and nanoparticles are abundant in flue gas but are difficult to filter with conventional filter systems. The same holds true for heavy metals such as mercury, arsenic or cadmium. They pollute the environment dramatically but are difficult to remove. Especially, in rapidly growing emerging countries in Asia and South America, these fine particles and heavy metals represent a growing burden for the environment and already now are accountable for many health problems. In industrial nations these issues are also becoming important topics.

The scientists that are involved in NANOFIL have now developed a novel concept to filter nano- and microparticles as well as heavy metals from air. They use fabric grafted with a nanofibre network that mechanically removes the very fine particles. These nanofibres are chemically functionalized and therefore allow the efficient absorption of heavy metals and their removal from air. This step is challenging as heavy metals can appear in different chemical forms with different chemical properties. In this Argovia project, researchers will select suitable functionalized nanofibres, examine the manufacturing of filter samples and

proof the concept under simulated test conditions.

With nanotechnolgy to new textiles

In the project em-Select, led by Professor Uwe Pieles from the University of Applied Sciences (FHNW), scientists study new fabrics with antistatic properties.

Modern textiles made from natural or synthetic fabrics often charge themselves electrostatically. They cannot transport electrical charges and therefore these charges accumulate on the surface of the textiles. Under certain conditions, the electrostatic discharge can cause fire and explosions and can lead to a malfunction of electronic devices. Especially in sensitive areas of hospitals with life sustaining electronic equipment, the electrostatic charge of textiles and the connected discharge should be prevented and needs to be addressed. Metal or carbon fibers in the fabric or chemical coatings can reduce this problem. However, these treatments come along with reduced wear comfort, durability or optical appearance.

In the Argovia project em-Select, the research team aims to study an entirely new approach to address antistatic properties of textiles, avoiding the mentioned disadvantages. They produce nanometer-sized fibers from a mixture of conductive and non-conductive water-soluble polymers. The scientists apply this mixture in the textile finishing process so that the surface of the fabric is finally covered with a network of conducting polymer fibers. They allow the transport of electrostatic charges and prevent an accumulation or sudden discharge.

In the Argovia project em-Select, researchers from the FHNW in Muttenz and Windisch work closely together with colleagues from the Paul Scherrer Institut and the Swiss company HeiQ Materials in Bad Zurzach.

Novel biocatalysts thanks to nanotechnology

In the project NANOZyme, researchers from the University of Applied Sciences (FHNW), the Department of Chemistry at the University of Basel and the Swiss company INFOFEA develop new biocatalysts that regenerate cofactors *in situ* and therefore can be applied cost-efficiently in many different areas.

Enzymes play an important role in biotechnology as they are catalysts for chemical reactions. Many enzymes possess so-called cofactors that are often unstable and are modified during the chemical reaction. They have to be replaced or regenerated before the enzyme can be reused. Because of this instability and the required regeneration, the application of these enzymes is too costly for many industrial processes. Researchers in the project NANOzyme would like to tackle these issues. On one hand, they facilitate the regeneration by combining a natural and an artificial enzyme in one catalyst. The natural enzyme catalyzes the desired chemical reaction, the artificial one undertakes the regeneration. To address instability, scientists among project leader Professor Patrick Shahgaldian have developed a method to protect immobilized proteins at the surface of silica nanoparticles with an organosilica layer. The researchers hope that their approach will lead to an easier application of enzymes that catalyze oxidation processes in biotechnological and pharmaceutical industries.

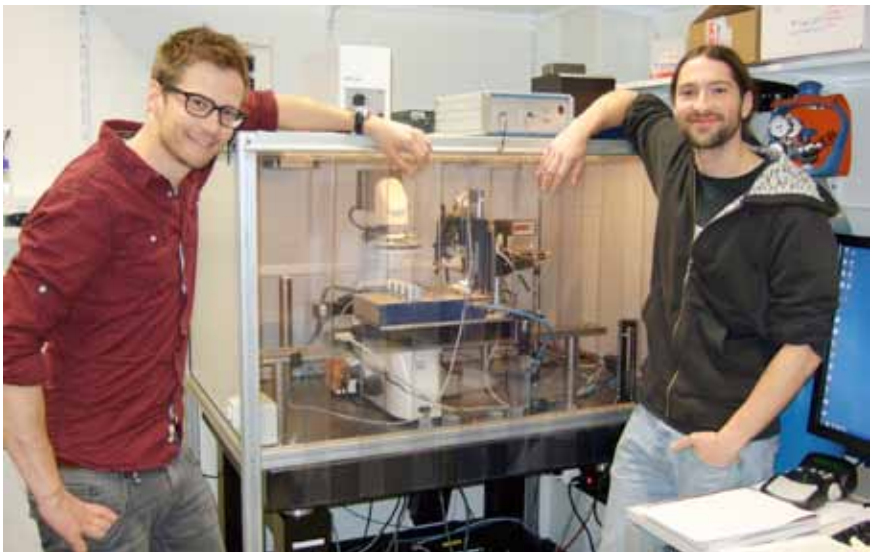
In the project NANOzyme, the scientists examine two different model systems to establish a strong proof of concept. They analyze enzymes that might play an important role in the biotechnology and pharmaceutical industry and use their approach to test antibiotic resistance of bacteria. The expertise of the three project partners complement each other perfectly.

On track to the secrets of single cells

In the project SCeNA (Single Cell NanoAnalytics), an interdisciplinary team of researchers from the University of Basel, the University of Applied Sciences and Hoffmann-La Roche under the leadership of Dr. Thomas Braun (C-CINA) examines different methods of analyzing single cells. The scientists aim to explore how active the individual cells are, which proteins are synthesized and which

low molecular weight metabolites are abundant.

Bioanalytical examinations of cells are mostly carried out with cell cultures that contain thousands of cells and therefore deliver average numbers. Heterogeneity of cells and the interactions between cells play an important role in these measurements. Many of the analyses require labeling and are complex. In contrast, analyses of single cells have the advantage that they provide a clearer picture and can be carried out cost-effectively with tiny amounts of material. However, single cells are difficult to handle. Scientists in the project SCeNA tackle this issue. They have developed a novel system for the cultivation, lysis and analysis of individual cells. With a technique that combines classical with novel approaches, cells can be observed, lysed and analyzed at specific times. Here, the team is mostly interested in four different parameters. The scientists examine the activity of the cells with respect to protein synthesis by analyzing the m-RNA content. They determine the amount of specific proteins and visualize these by electron and atomic force microscopy for their identification. Additionally, they determine the metabolic state of the cell lysate using mass spectroscopy. This diverse information about single cells provides another piece in the big puzzle to get a better understanding of biological processes. In the project SCeNA, researchers verify if their technologies posses potential for a broad application.



Stefan Arnold und Andrej Bieri explore the screts of individual cells.

Annual Report in new format

The SNI presents its latest Annual Report in a new format. In the first part, we describe some highlights of the year 2013 and explain different aspects of our activities in German and English. An extra booklet contains the scientific descriptions and results of all Argovia projects and the current PhD projects of the SNI PhD school.

Are you interested? Please contact:

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Events

Nanoscience in the Snow

At the end of January 2014, the winter school of the Swiss Nanoscience Institute, *Nanoscience in the Snow*, took place for the 8th time. This year, more than 30 interested participants met in Kandersteg in the Berner Oberland to get to know each other and to exchange thoughts on different aspects of nanoscale sciences in a relaxed atmosphere. Besides several ski runs and curling training, four tutorials, six specialized talks and a poster session were part of the program. The speakers covered a broad range of topics. Professor Vanessa Wood from the ETH Zurich, for example, spoke about optoelectronic applications of colloidal nanocrystals and Dr. Thomas Braun from the University of Basel gave insights into new experimental biomedical tools for the study of neurodegeneration.

More information at:
nanoscience.ch/nis2014/

Abstract booklet at:
nanoscience.ch/nis2014/NIS2014_Abstracts.pdf

Small life made big

After the success of SNI workshops at Swiss public fairs (OLMA, MUBA, Züspa, and BEA) in recent years, the SNI took part in the special exhibition TuN at the MUBA in Basel in February 2014. The SNI presented *Small life made big* at its booth. Visitors could set out on a journey into the fascinating nanoworld. They could look at animals and plants under different microscopes and discover the building blocks of our world.

The TuN presents natural sciences in interactive workshops to a predominantly young audience. More than 160 school classes visited the different workshops this year. Even during times when schools were closed, numerous visitors of all ages used the chance to become active and discover the nanoworld.

In the media

Praise of the nanocurriculum in Basel

Recently, *Nature Nanotechnology* asked what effect the developments in nanoscale sciences and nanotechnology had on the curricula being taught in universities and what sort of education nanotechnologists of the future need to succeed. Natascha Kappeler, a former nanostudent at the University of Basel and currently PhD student at the University College in London, was one of the interviewees.

She reported in the article on the fascination of the interdisciplinarity that she was able to experience in Basel daily and praised the excellent network among the students. For Natascha Kappeler, the education at the University of Basel "has been an excellent preparation for doing research in the field". The nano-curriculum has given her the confidence to fearlessly tackle interdisciplinary problems.

More information at:
Nature Nanotechnology 8, 794 – 796 (2013),
nature.com/nnano/journal/v8/n11/full/nnano.2013.239.html

Awards

Bert Müller appointed SPIE Fellow

In March, the International Society for Optics and Photonics (SPIE) promoted Professor Bert Müller from the University of Basel as SPIE Fellow. The society honors new fellows in recognition of their significant scientific and technical contributions in the multidisciplinary fields of optics, photonics, and imaging. Müller was selected for

his contribution to the fields of three-dimensional imaging of human tissues, medical implants, and interfaces. He has taken advantage of physics to solve medically-relevant scientific questions relating to cardiovascular and neurodegenerative diseases as well as treatments of cancer and the musculoskeletal system.

Honors for Christoph Gerber

In the January issue of the Swiss journal *BILANZ*, Professor Christoph Gerber was mentioned as one of the 100 most important people in the Swiss business world. In the chapter science/medicine, Christoph Gerber was named as being among the world`s 100 most cited researchers and therefore, the Swiss scientist with the greatest worldwide influence.

Additionally, Christoph Gerber was included in the *Who is Who* of Basel (ww-magazin.ch) and recently was honored with the *I*AS Benjamin Meaker Visiting Professorship by the Institute of Advanced Studies (IAS) of the University of Bristol. The purpose of this award is to bring distinguished academic visitors to Bristol in order to enhance the research activities of the University.

Samuel Vogel awarded with the SAMPE Europe Students Award

Samuel Vogel from the Institut für Kunststofftechnik at the University of Applied Sciences was awarded with the SAMPE Europe Students Award for his PhD thesis that he is currently preparing in collaboration with the University of Basel and the Paul Scherrer Institut. He convinced

the jury with his proof of promising properties of carbon nanotubes that grow on carbon fibers. The Society of Aersospace Material and Process Engineering (SAMPE) awards the student prize yearly at the SAMPE Europe International Conference in Paris. Samuel Vogel was able to prevail over other candidates from all over Europe. He will present his work at the SAMPE Composites and Advanced Materials Conference in Orlando/FL (USA) in October.

Press releases/uninews

Basel, 04.03.2014. Pulling Polymers Leads to New Insights into their Mechanical Behavior

In collaboration with colleagues from Berlin and Madrid, researchers at the Department of Physics at the University of Basel have pulled up isolated molecular chains from a gold surface, using the tip of an atomic force microscope (AFM). The observed signal provides insight into the detachment force and binding energy of molecules. The results have been published in the renowned scientific journal PNAS.

Basel, 11.02.2014. Helical electron and nuclear spin order in quantum wires

Physicists at the University of Basel have observed a spontaneous magnetic order of electron and nuclear spins in a quantum wire at temperatures of 0.1 kelvin. In the past, this was possible only at much lower temperatures, typically in the microkelvin range. The coupling of nuclei and electrons creates a new state of matter whereby a nuclear spin order arises at a much higher temperature. The results are consistent with a theoretical model developed in Basel a few years ago, as reported by the researchers in the scientific journal Physical Review Letters.

Basel, 10.02.2014. University of Basel at the Muba 2014

The University of Basel is present at the Muba 2014: the media platform of the Muba will become the stage for the Uni-Talks and the Swiss Nanoscience Institute invites a young audience during interactive workshops into the nanoworld.

Basel, 8.01.2014. New operating principle of potassium channels discovered

Neurons transmit information with the help of special channels that allow the passage of potassium ions. Defective potassium channels play a role in epilepsy and depression. The scientists working with Prof. Henning Stahlberg at the Biozentrum of the University of Basel have now identified the complete 3D structure of a particular potassium channel, a HCN channel. This enabled them to draw conclusions about its mechanism of action, which they describe in the current issue of “Nature Communications”.

Basel. 20.12.2013. Three natural scientists appointed associate professors

The University Council of the University of Basel named the biophysicist Prof. Roderick Lim, the physicist Prof. Martino Poggio and the chemist Prof. Stefan Willitsch associate professors.

Roderick Lim and Martino Poggio started as assistant professors with tenure track in 2009 and were the first Argovia professors. With this partnership, the canton Aargau supports the Swiss Nanoscience Institute at the University of Basel with five million Swiss Francs per year. The Aargau intends to strengthen excellent basic research and to provide access to state-of-the-art technologies for industries.

The complete news and press releases at:
www.nanoscience.ch/nccr/media/recent_press_releases

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