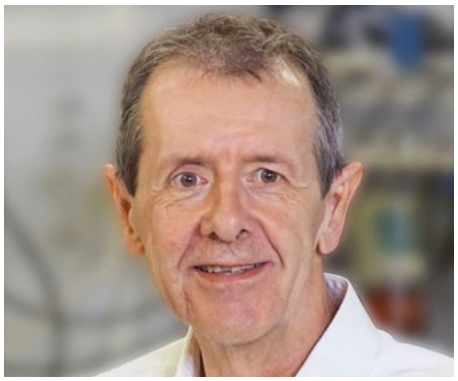
University of Basel

Swiss Nanoscience Institute

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

SNI update April 2018



Dear colleagues,

As we enjoyed the first sunny days of spring, we were also delighted to receive some excellent news.

Daniel Riedel, who was a doctoral student at the SNI PhD School until the end of 2017 and is now a postdoc in Richard Warburton's group in the Department of Physics at the University of Basel, was presented with the Quantum Future Award from Germany's Federal Ministry of Education and Research (BMBF) and the Center for Integrated Quantum Science and Technology (IQST). Soon afterwards, the European Research Council approved my application for an Advanced Grant, which carries funding of 2.9 million Swiss francs. This will enable us to investigate the special physical properties of van der Waals heterostructures in detail. We are entering completely uncharted territory with our research in this area, and I am very much looking forward to the challenges it presents.

With regard to the Nano Argovia projects that began in early 2018, the level of knowledge has already advanced significantly, to the extent that specific ideas have now emerged for industrial applications. In this edition of "SNI update", we describe the first of these new Argovia projects, which are being carried out this year in collaboration with companies from Northwestern Switzerland.

We also report on numerous events that were held in the first quarter of the year. Our doctoral students came together for their annual Winter School and also visited the Technopark Aargau. We organized a Nano-Tech Apéro in Brugg and invited people to enjoy a nano-themed afternoon at the Oris cinema in Liestal in honor of our vice director, Christoph Gerber. Then, as part of the recent SNI/Biozentrum Lecture, we had the honor of welcoming Jacques Dubochet to give a talk about his research, for which he was awarded the Nobel Prize last year. Together with our former SNI colleagues Ueli Aebi and Andreas Engel, more than 300 visitors enjoyed a fascinating afternoon with Jacques Dubochet looking at all aspects of cryo-electron microscopy.

It always gives us great pleasure to find out what students have go on to do after studying nanosciences. Our portrait for this edition is, therefore, of former nanoscience student Natascha Kappeler, who has now returned to Switzerland after many years abroad to lecture at the University of Applied Sciences Northwestern Switzerland (FHNW). She also continues to dedicate herself to scientific research with great commitment and enthusiasm.

I hope you enjoy reading our newsletter and have a wonderful spring.

Kind regards

Christian Schönenberger

Prof. Christian Schönenberger
SNI Director

ERC Grant for research project of van der Waals heterostructures

Christian Schönenberger, Director of the Swiss Nanoscience Institute (SNI) and Professor of Experimental Physics at the Department of Physics at the University of Basel, is to receive an Advanced Grant from the European Research Council (ERC). With this impressive distinction, he will have access to 2.9 million Swiss francs of funding over the next five years for his research project into the superconductivity of van der Waals heterostructures. Christian Schönenberger is one of the few scientists whose groundbreaking research has received an ERC Advanced Grant for the second time.

For the second time, Christian Schönenberger has received an ERC Advanced Grant.

Since his appointment as Professor of Experimental Physics at the University of Basel in 1995, Christian Schönenberger has been working on questions related to nanoelectronics with a view to developing the unique properties of artificial atoms and molecules for applications in quantum information.

In the newly approved project, Christian Schönenberger and his team will focus on van der Waals heterostructures, in which various two-dimensional crystals ¬– each consisting of a single layer of atoms – are arranged in vertical stacks and held together by van der Waals forces.

Specific physical properties

There are now a number of such materials, all of which exhibit specific physical properties. Graphene, for example, is an excellent conductor of electricity, while boron nitride is an excellent insulator. There are superconducting van der Waals materials, as well as those in which an electron's motion is coupled to the electron's magnetism (or spin) in an effect known as spin–orbit coupling. There are also materials that exhibit spin-dependent optical absorption.

The ERC project now aims to combine several of these materials in such a way that new physical effects emerge. For example, it has been predicted that a combination of spin–orbit coupling, good electrical conductivity, and superconductivity could create a "topological state" that does not occur naturally. Rather, this would be produced "synthetically" under controlled conditions in a suitable stack of van der Waals materials.

These novel topological states are quantum states that exhibit particular stability and are especially suited to the use of quantum information. "The exciting thing about this project is that the combination of physical properties is not simply the sum of the individual properties," explains Christian Schönenberger. "Since the atom-thin layers are so close to one another, completely new phenomena can occur. Each stack is potentially a new material with completely new properties. I want to get to the bottom of this with my team."

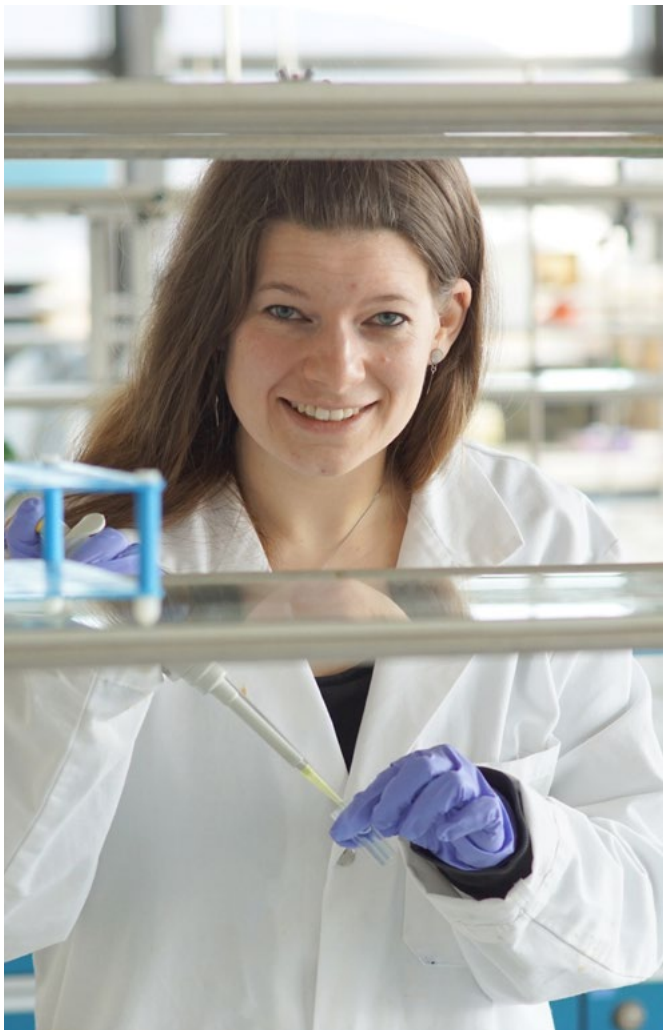
Call for PhD School projects

You are invited to submit proposals for new PhD projects until 31 May, 2018.

More information under:
https://nanoscience.ch/wp-content/uploads/sites/8/2018/04/sniphd_call20181.pdf

With great enthusiasm and passion

Former nanoscience student Natascha Kappeler returns to Switzerland after many years abroad



She originally wanted to be a vet at a zoo, but Dr. Natascha Kappeler went on to study nanosciences at the University of Basel. After completing this challenging degree, she completed a PhD at University College London, where she then worked as a post-doctoral researcher. Now, the young scientist has returned to Switzerland to lecture at the FHNW School of Life Sciences, and hopes that her research will bring fresh impetus to the fields of diagnostics and bioanalytics.

Immediately fascinated by the nanosciences

Natascha Kappeler wanted to study veterinary medicine and work at a zoo almost until the time when she was taking her school-leaving certificate (Matura). However, since the career prospects were anything but ideal, the young student from Obwalden, Switzerland, began to look at the alternatives. At a University of Basel outreach event in Lucerne, she learned for the first time about the recently introduced nanosciences degree in Basel. On discovering this new subject area, she was so taken with it that she decided to write an assignment on nanotechnology for her “Maturarbeit”. She read books, scoured

the internet, and wrote to various students and professors. Christoph Gerber, then director of scientific communication and a module leader in the National Centre of Competence in Research (NCCR) Nanoscale Science, responded to Natascha's inquiry and helped her with her assignment. This ultimately led to her organizing an exhibition entitled "Nanotechnology – The doorway to the 21th century" at her school in Sarnen.

Still enthusiastic about her degree

Since she herself wanted to play an active part in opening this doorway, Natascha began her degree in nanosciences in Basel in October 2005. "It was great," she recalls enthusiastically. "There was a fantastic team spirit among the students, which we still maintain to this day." Natascha herself has done a great deal to ensure that, even today, the students on the nanosciences program are well organized, stick together like a family, and support one another. She served as president of the nano student association and is now a member of the board of the alumni association. "Back then, I learned that nothing is possible without a close network," she says. "And that is one piece of advice that I can pass on to the students: build a network and utilize your contacts."

It began with cantilever probes

At the time, the topic that particularly interested her was sensor technology. "I was fascinated by Christoph Gerber's enthusiasm," she tells us. It will come as no surprise, therefore, that she completed her first project on cantilever probe sensors in Christoph Gerber's group. His contacts to the group of Professor Rachel McKendry, who had worked as a postdoc under Christoph Gerber, led Natascha to University College London (UCL) for her master's thesis. There, she used cantilever probe technology to study multidrug-resistant pathogens. By that point, she was hooked on the topic. Her master's thesis was followed by a doctoral dissertation in industry and a period spent working as a postdoc. "The whole topic of antibiotics and multidrug-resistant pathogens is highly topical and something I'm really enthusiastic about. On top of that, the perfect team and the city itself kept me in London a lot longer than I'd originally planned."

Time for new impressions and experiences

After 6½ years, however, the time eventually came to leave UCL in search of new experiences in 2017. After bidding an emotional farewell to the team in London, Natascha Kappeler spent some time doing research at the National University of Singapore. She was offered a postdoc position there but then stumbled across an advertisement from the University of Applied Sciences Northwestern Switzerland (FHNW).

This paper test can be used to detect legionella in water. The left line (C) indicates that the test has worked, while the thin right line is evidence that some legionella were present in the analyzed sample. (Image: Natascha Kappeler)

"To succeed Professor Daniel Gygax, the FHNW was looking for a scientist who had worked on therapeutic drug monitoring and *in vitro* diagnostics. Those were the precise topics of my dissertation and postdoc," she says. During her doctoral dissertation in industry, Natascha had developed tests to determine the concentration of antibiotics in the blood. As part of her postdoctoral research, she led a project aimed at developing a nanomechanical sensor to detect bacterial infections and determine the effectiveness of antibiotics.

Taking pleasure in research and teaching

A professorship at the University of Applied Sciences, however, calls for broad industry experience. Although Natascha had worked closely with industrial companies during her dissertation and her postdoc, in addition to stints at various companies over the course of her career, she lacked the breadth of experience that the professorship called for. Nevertheless, her path led her to the FHNW School of Life Sciences, where she now works as a lecturer and research associate. She is also being coached by Daniel Gygax to help her expand her professional network in Switzerland and gain the nec-

essary experience by spending extended periods of time in industry. “I really enjoy the teaching side of my work here. I have a fantastic group that inspires me, and it gives me great pleasure to pass on my knowledge,” says Natascha Kappeler.

Simplifying tests

In her current research, she has also remained faithful to the field of diagnostics. However, she now no longer relies on cantilevers but rather on simpler approaches such as paper-based testing systems, which are more robust. In one example, she is working to develop an antibody test for legionella. A test of this kind works in a similar way to a pregnancy test. Specific antibodies are fixed to a paper strip. If the matching antigen is present in the analyzed sample, it will bind to the antibody and a colored line will appear. Tests of this kind can be carried out quickly and easily, even by non-experts, while still yielding definitive results.

As part of a strategic FHNW project involving a network of universities, institutions, and private companies, the 31-year-old scientist is developing test systems that can be used by trained staff in the homes of older patients who are no longer mobile, for example. The project involves planning how the test results would be analyzed and passed on to doctors, as well as achieving smooth logistics.

Here in the Basel region especially, there are numerous opportunities not only to expand research aimed at simplifying analytical and diagnostic processes and methods but also to initiate exciting new projects. And maybe, one day, Natascha Kappeler will also be involved in a Nano Argovia project – thereby closing the loop from her nanosciences degree back to the SNI network.

Awards

Daniel Riedel receives Quantum Future Award

Daniel Riedel was awarded the “Quantum Future Award” (Image: VDI Technologiezentrum GmbH, Martin Stollberg)

Dr. Daniel Riedel was awarded the “Quantum Future Award” from the Federal Ministry of Education and Research in Germany (BMBF) and the Center for Integrated Quantum Science and Technology (IQST). Daniel, who completed his doctoral thesis at the SNI PhD School in December 2017, won second prize in the “dissertations” category.

Daniel Riedel’s doctoral research focused on optimizing the useful photon yield of single NV centers, as this is the largest hurdle for technological applications of NV centers. NV centers have huge potential in quantum information technology.

More information about the award under:
https://www.bmbf.de/de/quantum-futur-programm-2018-am-ursprung-der-zukunft-5897.html

Applied and diverse

New Nano Argovia projects launched

For the past 12 years, the SNI has been committed to applied research and has supported knowledge and technology transfer between research and industry within the context of the Nano Argovia program. Seven new Nano Argovia projects have been approved for 2018, and three projects have been extended by one year. The new projects are presented in this "SNI update" as well as in the next edition.

Messenger RNA in the crosshairs

The Nano Argovia project "ecamist" aims to improve single-cell analysis

The aim of the Nano Argovia project "ecamist" is to develop an effective method for working up messenger RNA from single cells. A team of scientists from the School of Life Sciences at the University of Applied Sciences Northwestern Switzerland (FHNW), the Department of Biosystems Science and Engineering at the Federal Institute of Technology (ETH) Zurich in Basel (D-BSSE), and the company Memo Therapeutics AG (Basel) wants to improve the yield and quality of isolated messenger RNA compared with existing methods. Among other applications, the information about the messenger RNA present in a cell can be used to derive conclusions about the development of diseases. It is also important for studying cell lines used in antibody production, for example.

Analysis of individual cells

Nowadays, messenger RNA (mRNA) is often analyzed to determine which genes are active in cells. Inside a cell, the mRNA acts as a mediator between the hereditary information stored in the DNA and the ribosomal RNA, which is needed for protein synthesis in cell ribosomes. When examining various research questions, scientists now increasingly opt to analyze the mRNA in single cells instead of analyzing mixtures of an entire cell culture. Single-cell analysis is particularly useful for understanding the development of diseases, as defective processes often begin in individual cells.

Bound to tiny beads

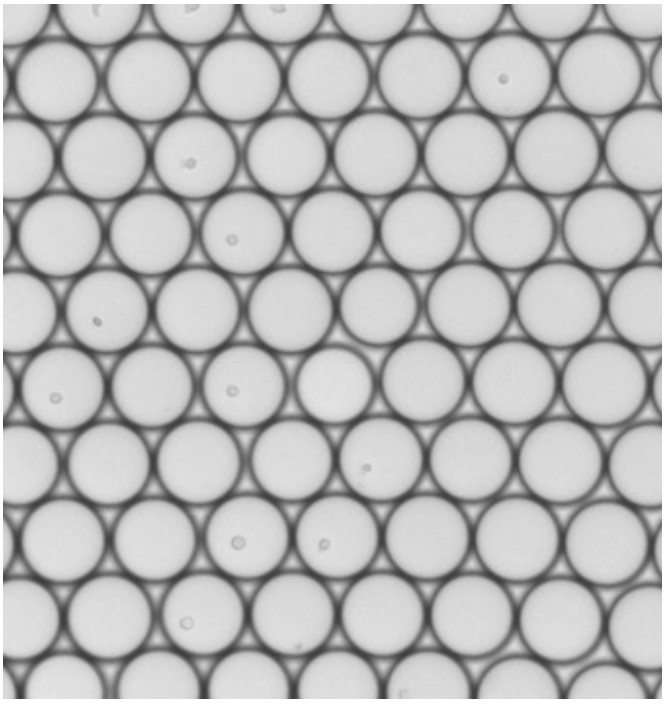
In the Nano Argovia project "ecamist", the team led by Professor Dr. Georg Lipps from the FHNW is developing a new method that is intended to make the workup of mRNA from single cells more effective. Before a cell's mRNA can be analyzed, it must first be separated from the cell lysate and preserved. Until now, this has been done using tiny microbeads fitted with a short segment of DNA, which binds to the mRNA in order to separate it from the lysate. This binding, known as hybridization, is based on purely physical processes and produces an equilibrium between hybridized and free binding sites on the microbeads. However, the free mRNA segments

still present in the lysate contaminate the sample in the subsequent steps.

Enzyme selection is crucial

The researchers led by Professor Georg Lipps and Dr. Martin Held from the Department of Biosystems Science and Engineering (D-BSSE) therefore want to immobilize the hybridized mRNA segments by establishing a covalent, more thermally stable bond to the microbeads' surface. They hope that this will lead to a greater yield of bound mRNA on the microbeads, as well as fewer impurities and therefore a higher-quality mRNA yield. The project hinges on selecting a suitable enzyme that catalyzes the formation of covalent bonds to the microbeads and that works reliably even in high salt and detergent concentrations, as these conditions are necessary for lysing the cells.

"For Memo Therapeutics, the Nano Argovia project is a good opportunity to extend single-cell analytics with additional protocols and hence to further expand our activities in the area of antibody development," says Dr. Simone Schmitt, Senior Scientist at Memo Therapeutics and an industrial partner within the Nano Argovia project "ecamist".



Cells are separated in single droplets of a water in oil emulsion. Afterwards, the cell are lysated and the mRNA is purified (Image: Georg Lipps, FHNW)

Ceramic coating of bone implants

A cost-effective process is being developed in the "NanoCoat" Nano Argovia project

An interdisciplinary team at the Paul Scherrer Institute (PSI) and the University of Applied Sciences Northwestern Switzerland (FHNW) is working with three industry partners on the Nano Argovia program. The researchers are developing a protocol for coating titanium implants with calcium phosphates ceramics, which will improve the integration of implants into new bone growth, and therefore ensure a better stability of the implant.

Integration in the bones essential

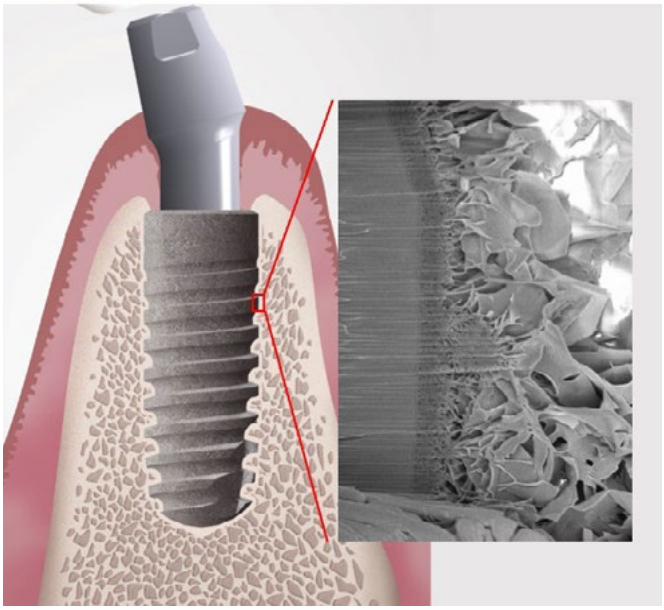
Thanks to new technologies, increased prosperity, and an ever-ageing population, the demand for bone implants is continually growing. Implants are primarily comprised of metallic materials; titanium is particularly popular due to its excellent mechanical properties and its optimal biological compatibility, and is often used in dentistry, plastic surgery and orthopedics.

In order to guarantee the long-term integration of a titanium implant into the bone, bone-building cells (osteoblasts) must be able to settle on the implant's surface. They form new bone cells and the implant is then gradually incorporated into the existing bone. In the past, different methods were developed to encourage the forming of bone cells on the implant surface as well as the implant's incorporation into the bone. Coating with

hydroxyapatite has proven to be a promising method. Hydroxyapatite is a calcium phosphate compound and a main constituent of bone. In the market of orthopedic implants, plasma spray has been established as coating process.

An energy-saving method is being developed

In the "NanoCoat" Nano Argovia Project, a team of scientists under the lead of Dr. Andrea Testino from the Paul Scherrer Institute is now investigating a more cost- and energy-efficient method for coating titanium surfaces with calcium phosphate. Alongside Dr. Andrea Testino, the team comprises Dr. Elisabeth Müller (PSI), Professor Michael de Wild (FHNW) as well as Philipp Gruner (Medicoat AG, Mägenwil, Aarau), Dr. Burkard Höchst (Hager & Meisinger GmbH, Neuss, Deutschland) and Dr. Walter Moser (Atesos Medical AG, Aarau).



The team of the Nano Argovia project "Nanocoat" will develop a new, alternative method for coating of implants. A calcium phosphate phase grows onto the implant and inside a porous layer.
(Image: PSI and Meisinger)

In the first phase of the project, the researchers are using a chemical and thermal treatment to transform the smooth titanium surface of the implant into a raw and porous one. In the subsequent coating stage, the implant is placed into a coating reactor where a special solution, containing the calcium phosphate precursors, was poured. The researchers were able to prove that, under controlled conditions, the calcium phosphate phase grows both onto the implant and inside a porous layer, ensuring an optimal grafting of the thin calcium phosphate phase on titanium. As a results, the titanium implant is already coated with a synthetic bone.

"In the Nano Argovia project, we are optimistic that we will develop a new cost-efficient, alternative method for coating of implants which support integration into natural bone material. We hope to open new market fields that our plasma spray technique cannot access" says Philipp Gruner, one of the "NanoCoat" project's three industry partners.

Nanoparticles for mega power

The "MEGAnanoPower" project aims to optimize an innovative energy storage device

In the Nano Argovia project "MEGAnanoPower", scientists from the FHNW School of Life Sciences, the CSEM in Muttenz, and the industrial partner Aigys AG (Othmarsingen, AG) are seeking to optimize the PowerCell® battery, which was invented by Aigys. Using environmentally friendly materials, the researchers hope to develop a sustainable and affordable energy storage device for large-scale applications.

New storage media needed

Renewable energies such as wind and solar power are becoming an increasingly important part of our energy supply. As these energy sources continue to expand, there is a need for new storage media that can not only absorb peaks in energy production but also make energy available quickly in the event of prolonged periods of time without wind or sunshine.

Until now, research into storage media has centered around lithium-ion batteries. Instead, the "MEGAnano-Power" project is focusing its attention on a flow cell battery in order to avoid the key disadvantages that lithium-ion batteries exhibit. Since it was founded in 2011, the company Aigys AG has been actively involved in the search for alternatives and has patented a special flow cell battery known as the PowerCell®. The project partners, Professor Uwe Pieles from the School of Life Sciences at the University of Applied Sciences Northwestern Switzerland (FHNW), Dr. Sören Fricke from the CSEM (Centre Suisse d'Electronique et de Microtechnique) in Muttenz, and Dipl.-Ing. Andreas Schimanski, CEO of Aigys, are studying various approaches to further optimize the battery.

Energy supplied by an electrochemical reaction

As in a conventional flow cell battery, the PowerCell® stores electrical energy in the form of chemical compounds, which are held in two separate circuits. One circuit contains ions that have a high electronegativity and therefore readily accept electrons (e.g. Zn^{2+}). A second, separate circuit contains ions with a lower electronegativity, which readily donate electrons (e.g. Cer^{3+}). Ions are exchanged between the two circuits across a membrane, resulting in electron donation on one side of the membrane and electron acceptance on the other side. These oxidation and reduction processes release electrical energy.

Unlike in a conventional flow cell battery, however, the charge carriers in the PowerCell® are not held in solution. Instead, high-pressure technology is used to disperse them into the electrolytes in the form of small spheres measuring just a few micrometers in diameter.

MEGAnanoPower to increase storage capacity

These small particles in the dispersion need to be stabilized over a prolonged period of time and a higher charge density needs to be achieved. "We want to reduce the particle size of the solid electrolytes in order to achieve a higher energy density," says Aigys CEO Andreas Schimanski on the project's objectives. "In order to exploit the full potential of our PowerCell®, we're relying on the expertise of the interdisciplinary team behind the Nano Argovia project MEGAnanoPower."

The overall aim is to increase the solid electrolyte content in order to expand the storage capacity. In addition, the researchers are studying how the electrodes can be improved and how the membrane must be adapted to nanoparticles with a view to improving the efficiency of the electrochemical reaction. In all modifications, the interdisciplinary team is taking care to use abundant, environmentally friendly materials and compounds that solve the energy storage problem in a genuinely sustainable manner without causing problems in industrial operations.

Annual Report 2017

The SNI's Annual Report is now available for all interested parties on the SNI website.

The first part describes some of the highlights of the past year in clear language aimed at a general audience, as well as collating a series of facts and figures.
https://nanoscience.ch/wp-content/uploads/sites/8/2018/03/2017_annual-report_english-1.pdf

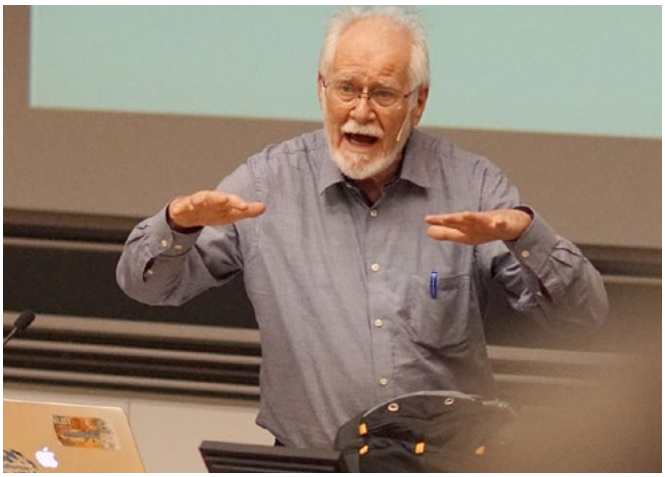
The second part of the report contains scientific results from PhD projects at the SNI PhD School and from Nano Argovia projects.
https://nanoscience.ch/en/media/brochures/

Please do not hesitate to contact us if you would like to order a printed version.
c.moeller@unibas.ch

Events

SNI/Biozentrum Lecture all about cryo-electron microscopy

On the initiative of Dr. Markus Dürrenberger, head of the Nano Imaging Lab, a mini-symposium was held in April with Nobel laureate Professor Jacques Dubochet, Professor Ueli Aebi, and Professor Andreas Engel. The symposium was organized jointly by the SNI and the Biozentrum.



Well over 300 visitors listened to Nobel laureate Jacques Dubochet and his colleagues Ueli Aebi and Andreas Engel who talked about different aspects of cryo-electron microscopy.

The three scientists, whose academic careers began under Professor Eduard Kellenberger at the Biozentrum, offered an insight into the fascinating world of cryo-electron microscopy for well over 300 visitors in a packed lecture hall.

Thanks to the development of shock freezing, for which Dubochet was awarded a Nobel Prize last year, biological samples can be frozen instantly in their natural environment to avoid the formation of ice crystals, which would destroy the sample. Even in the vacuum present in an electron microscope, the shock-frozen samples remain intact and can be analyzed in detail.

After Ueli Aebi had presented a historical view of the development of cryo-electron microscopy, Jacques Dubochet captivated listeners of all ages with a talk on the research that earned him the Nobel Prize. As well as entertaining and informing the audience, however, he also gave them food for thought. “We’re very good at acquiring knowledge – but not at using it for the common good,” he said. He ended his lively and exciting talk with the song “Imagine” by John Lennon, urging the audience to make scientific findings a public good and to pursue the vision to use this knowledege for the well-being of all.

This entertaining and wide-ranging presentation was a hard act for Andreas Engel to follow. Nevertheless, everyone listened eagerly as he explained where the development of cryo-electron microscopy (cryo-EM) has led us today. His explanations highlighted how the achievement of a perfect sample, as well as the development of better microscopes and cameras, has contributed to the success of cryo-EM, providing structural biologists with an ideal tool for depicting the three-dimensional structure of proteins.

“It was wonderful to witness the enthusiasm of Jacques Dubochet, Ueli Aebi, and Andreas Engel and to see how they inspired the many students and scientists present in the audience,” said Professor Christian Schönenberger, who acted as the event’s host and moderator and also learned a thing or two himself.

More information about cryo-electron microscopy and the Nobel Lecture by Jacques Dubochet at:

https://www.youtube.com/watch?v=026rzTXb1zw

https://www.youtube.com/watch?v=9FOnGv38oqM

Nano on the big screen

On February 26, 80 guests from the worlds of politics and sciences went on a voyage of discovery into the nano world in the Oris cinema in Liestal. The evening was organized by the University of Basel and the Swiss Nanoscience Institute in honor of Professor Christoph Gerber. More than 30 years ago, Professor Gerber developed the atomic force microscope with two of his colleagues and was awarded the prestigious Kavli Prize, regarded as the Nobel Prize for nanoscience. His invention allowed scientists to examine the nano cosmos for the first time.

Professor Schenker-Wicki, President of the University of Basel, welcomed the invited guests and thanked the Cantons of Basel-Landschaft and Basel-Stadt, which support the university, and the neighboring Canton of Aargau for its significant commitment to nanoscience research. She emphasized how honored the University of Basel is to count a Kavli Prize winner among its researchers. After greeting the audience, Monica Gschwind, head of the department of education, culture, and sport for the Canton of Basel-Landschaft, provided an overview of areas that have the potential to progress with the aid of nanotechnology.

Professor Christian Schönenberger, Director of the Swiss Nanoscience Institute, which is supported by the Canton of Aargau and the University of Basel, explained in more detail what makes the nanosciences so special. Using several examples, he demonstrated how important the size of particles and structures can be – the size of particles can determine their color; and even the lotus effect is based on structures mere nanometers in size. Professor Christoph Gerber then took the audience back more than 30 years to when he and his colleagues built the first atomic force microscope with very basic materials. He showed how quickly his invention has developed and the areas in which atomic force microscopy is used today.

This was followed by several short and highly illuminating presentations on current research made possible by the development of the atomic force microscope. Dr. Urs Matter from Nanosurf AG, which is based in Liestal, demonstrated how a nanoscale balance can be used to calculate the mass of individual cells in a cell culture and how scientists use this data to obtain information about the health of cells. Nanosurf has been one of the leading manufacturers of atomic force microscopes for many years now and is bringing this nanoscale balance (which Christoph Gerber helped to develop) to market.

Professor Ernst Meyer from the Department of Physics at the University of Basel uses the atomic force microscope to observe individual molecules. This enables him and his team to watch a minute catalyst at work, step by step. Research of this type helps to improve understanding of catalytic reactions and develop more efficient catalysts. Argovia Professor Roderick Lim from the Biozentrum at the University of Basel works at the interface between physics and biology. Using illustrative examples, he showed how he can use a high-speed atomic force microscope to display the pores in a nucleus membrane. His research reveals how such nano machines steer and control the transport of molecules.

The president of the University of Basel, Andrea Schenker-Wicki and the head of the department of education, culture, and sport for the Canton of Basel-Landschaft, Monica Gschwind, emphasized how honored the University of Basel is to count Christoph Gerber among its researchers.

This informative evening was brought to a close by Dr. Marija Plodinec of Nuomedis, a start-up of the University of Basel that uses atomic force microscopy technology in cancer diagnosis. Dr. Plodinec showed that elasticity can differ between the cells in a tumor and that the soft cells in particular are able to metastasize. Working on this basis, the ARTIDIS device developed by Nuomedis can determine the risk presented by a tumor.

The scientists' short presentations provided a very good insight into the microscope developed by Christoph Gerber, Gerd Binnig and Carl Quate, its wide range of applications, and how it aids understanding of the enthralling nano world. The reception that followed gave all participants plenty of time to ask questions and learn more about the fascinating research being conducted at the University of Basel and the Swiss Nanoscience Institute.

The talks by Ernst Meyer, Marija Plodinec, Roderick Lim, Monica Gschwind, Andrea Schenker-Wicki, Christoph Gerber, Christian Schönenberger and Urs Matter took guests on a voyage into the nano world which would not have been possible without the development of the atomic force microscope by Christoph Gerber and his colleagues (Image: Universität Basel).

SNI at the Lenzburg May market

The Swiss Nanoscience Institute (SNI) will be at the Lenzburg May market on May 9 to provide visitors with insights into the nano world.

The SNI team will use a small experiment to show how microfluidic systems work. Today, researchers use these systems in a variety of ways. Visitors can use simple materials to create their own fluidic system, which works in a similar way to a pregnancy test and can be used to detect the presence of starch, for example. There will also be puzzles to solve from the fascinating nano world and prizes to be won.

We would be delighted to see you at our stand at Torgasse 71 in Lenzburg.

Nano-Tech Apéro in Brugg

On February 15, more than 40 nanotechnology experts met at BRUGG Flex in Brugg for an interdisciplinary exchange. Organized by the Swiss Nanoscience Institute and the Hightech Zentrum Aargau (HTZ), the event brought scientists from universities and research institutions together with industry representatives to discuss successful SNI applied research projects within the Nano Argovia program.

Presentations and discussions about Nano Argovia projects were a key element of the Nano-Tech Apéro which was organized by the SNI and the HTZ at BRUGG Flex in Brugg.

Michael Siegfried from BRUGG lifting AG presented the "MicroSlide" project, which examines how to make flat belts – such as those used in elevators – glide better and wear less. The researchers involved are taking their cue from nature; many animals have special surface structures that promote motion with minimal friction. Philipp Gruner from Medicoat AG also reported on his collaboration with scientists from the SNI network to increase the mechanical stability of bioceramic bone substitutes. The team is using a 3D printing process with a ceramic "nano ink", which boosts the density of the material during further processing and thus increases the stability of certain areas of the implant.

The afternoon continued with further talks, a poster exhibition about all ongoing Nano Argovia projects presented by the project leaders, and a tour of the BRUGG showroom. Over 40 participants had plenty of fascinating nanoscience and nanotechnology topics to discuss that are highly relevant to Aargau's industry and research activities.

SNI doctoral students at the Technopark Aargau

Doctoral students at the SNI PhD School generally work on questions of basic science. However, they are also interested in applied research and in the transfer of knowledge and technology into industry. On a visit to the Technopark Aargau in Brugg in February 2018, the doctoral students gained an insight into the world of start-ups that have established themselves there.

First, Christina Loosli, CEO of the Technopark and a lecturer at the University of Applied Sciences Northwestern Switzerland (FHNW), presented her organization and the innovation landscape of the Canton of Aargau, as well as providing an overview of key points to take into account when founding a start-up. Dr. Martin Bopp, managing director of the Hightech Zentrum Aargau (HTZ), gave a presentation about the activities through

which the HTZ supports innovation at companies in the Canton of Aargau.

In particularly interesting talks for the young SNI scientists, staff from two start-ups at the Technopark shared their success stories. Dominik Meier, founder and head of research and development at naneos particle solutions GmbH, spoke about the world's smallest measuring device for nanoparticles, which was developed by naneos. Gabor Koppanyi, head of marketing and sales at Sintratec AG, presented Sintratec's high-precision 3D printer, giving a live demonstration in the company's showroom.

"On our visit to the Technopark, we gained concrete insights into the start-up phases of companies. We saw the work that the Technopark and the HTZ do to promote them," says Dr. Andreas Baumgartner, coordinator of the SNI PhD School, who initiated the visit.

Doctoral students visited the Technopark Aargau in Brugg in February 2018.

Nanoscience in the Snow

Since the SNI PhD School was founded in 2012, the "Nanoscience in the Snow" (NiS) Winter School has been a regular part of the program. This three-day meeting offers doctoral students an ideal opportunity to exchange ideas about their research, broaden their horizons, network with scientific guests, and enjoy both the snow and each others' company.

During the SNI's Winter School "Nanoscience in the Snow", doctoral students present their projects to enhance interdisciplinary exchange. "I was impressed by the SNI PhD students' ability to discuss science across various disciplines and the social cohesion of the consortium," Christof Sparr comments after the meeting. (Image: Wojciech Szmyt)

This was the first year that the coordinator of the SNI PhD School, Dr. Andreas Baumgartner, had organized the Winter School, which was originally established by his predecessor, Dr. Michel Calame. For the event, Andreas Baumgartner invited the 30 participants to the Hotel Regina in Mürren.

Against the impressive backdrop of the Schilthorn mountain, the young researchers addressed the various topics they are working on as part of their doctoral dissertations. The talks covered everything from new materials such as graphene and composite materials with nanotubes to the study of friction, ultracold atoms, electron transfer, protein crystals, nuclear pore complexes, and the development of measures to prevent the spread of malaria.

The four guest speakers – Professor Anatole von Lilienfeld and Professor Christof Sparr (both of the Department of Chemistry, University of Basel), Dr. Rainer Jäggi (Roche Diagnostics), and Professor Christian Schönenberger

(Department of Physics, University of Basel) – supported the interdisciplinary exchange of ideas by presenting aspects of their research fields. Anatole von Lilienfeld spoke about how computer programs use algorithms to generate knowledge autonomously and can be used to predict chemical processes and reactions. Christof Sparr explained new methods for synthesizing chiral compounds, which are used as structural building blocks in a variety of applications. Rainer Jäggi provided attendees with an insight into *in vitro* diagnostics and corresponding research at Roche Diagnostics, and Christian Schönenberger reported on ten years of research into entangled electron pairs and the ups and downs that this entailed. He describes how perseverance has paid off: "Today, we can produce entangled electron pairs almost with an efficiency of 100%."

On the first day, a poster session running late into the night was a chance for all participants to present their research and to learn about the diverse fields of research at the interdisciplinary SNI PhD School. In the meantime, there were plenty of opportunities for everyone to enjoy a few quick runs on the pistes, a round of chess, networking, and of course the delicious meals laid on for guests by the Hotel Regina team.

On our website, you will find a short video clip offering a few impressions of the intensive Winter School.

https://nanoscience.ch/de/forschung/phd-programm/impressionen/

For the SNI's doctoral students, the "Nanoscience in the Snow" (NiS) Winter School has been a regular part of their program. This year, the three-day meeting took place in Mürren (Image: Wojciech Szmyt).

SNC 2018

Registration has recently opened for the Swiss NanoConvention 2018, which will be held at ETH Zurich on June 6–7, 2018.

Entrance is free for all SNI members, who can register by entering the SNI code.

More information at: http://swissnanoconvention.ch/2018/registration/

Your feedback is important!

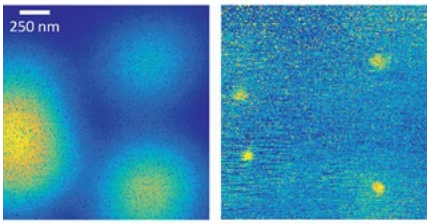
Please submit information for "SNI update" and feedback to:

c.moeller@unibas.ch.

Media releases and Uni News from SNI members

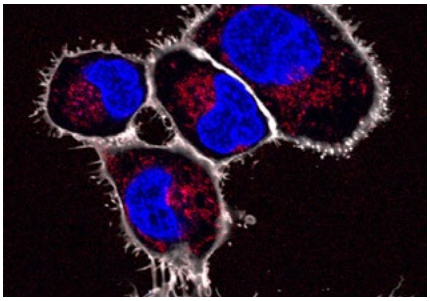
University of Basel, 23 January, 2018. Optical nanoscope allows imaging of quantum dots

Physicists have developed a technique based on optical microscopy that can be used to create images of atoms on the nanoscale. In particular, the new method allows the imaging of quantum dots in a semiconductor chip. Together with colleagues from the University of Bochum, scientists from the University of Basel's Department of Physics and the Swiss Nanoscience Institute reported the findings in the journal Nature Photonics.



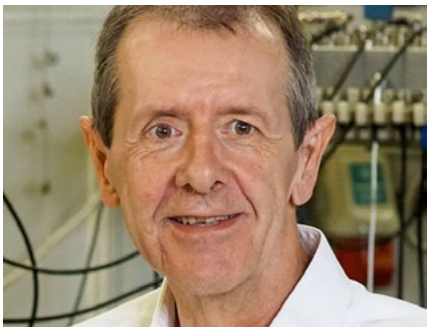
University of Basel, 19 March, 2018. Tiny implants for cells are functional in vivo

For the first time, an interdisciplinary team from the University of Basel has succeeded in integrating artificial organelles into the cells of live zebrafish embryos. This innovative approach using artificial organelles as cellular implants offers new potential in treating a range of diseases, as the authors report in an article published in Nature Communications.



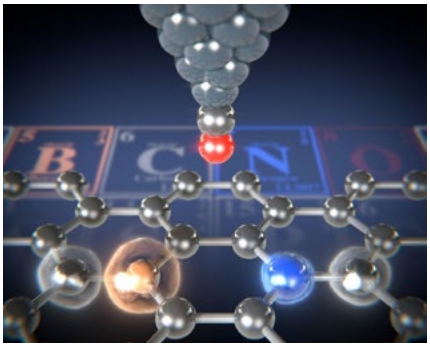
University of Basel, 11 April, 2018. Millions of EU funding for two researchers from the University of Basel

Two scientists from the University of Basel have been awarded the prestigious ERC Advanced Grants by the European Research Council (ERC): Neuroscientist Prof. Fiona Doetsch and physicist Prof. Christian Schönenberger each receive 2.5 million euros of funding. Christian Schönenberger is one of the few scientists whose groundbreaking research has received an ERC Advanced Grant for the second time.



University of Basel, 13 April 2018. Individual impurity atoms detectable in graphene

A team including physicists from the University of Basel has succeeded in using atomic force microscopy to clearly obtain images of individual impurity atoms in graphene ribbons. Thanks to the forces measured in the graphene's two-dimensional carbon lattice, they were able to identify boron and nitrogen for the first time, as the researchers report in the journal Science Advances.



All media release can be found at:

https://nanoscience.ch/en/media/recent-press-releases-2/

Examples of media coverage can be found at:

https://nanoscience.ch/en/media/in-the-media/