University of Basel

Swiss Nanoscience Institute

Swiss Nanoscience Institute
Center of Excellence supported by the University of Basel and the Canton of Aargau

SNI INSight

Showcasing research and activities at the Swiss Nanoscience Institute

June 2023

Automated and lossless

First cryoWriter delivered

Applied and diverse

New projects in the Nano-Argovia program

Excellent and flexible

Timon Baltisberger wins award for best master's thesis

Far away and back again

Philippe Van der Stappen wrote his master's thesis in Australia

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Editorial

Dear colleagues and interested parties,

Before we all bid one another farewell for summer break, there's plenty of positive news and developments to report on from the network of the Swiss Nanoscience Institute.

First of all, the start-up cryoWrite, founded in summer 2020 on the initiative of our honorary member Andreas Engel, has supplied its first unit and thereby reached a key milestone. The fledgling company has developed an automated system for preparing tiny sample quantities for cryo-electron microscopy with no loss of sample material. Featuring a modular structure, the cryoWriter has its origins in several SNI-supported doctoral dissertations and Nano-Argovia projects in Thomas Braun's group at the Biozentrum.

Five new Nano-Argovia projects got underway early this year, covering topics that reflect the diverse research carried out within our network. For example, two of the projects focus on the optimization of micro-optical components and the development of a novel current sensor, respectively. In the other lines of research, interdisciplinary teams are investigating novel optical tweezers, a method of regulating specific genes, and a combination of quantum sensors and artificial intelligence with a view to developing an optimized magnetic encephalography system.

The topics addressed by students in their master's theses are generally much less applied than those in the Nano-Argovia program. Every year, we select the best of the completed projects and award a master's prize. This year's award goes to Timon Baltisberger, whose project at the Biozentrum of the University of Basel revealed that *Vibrio cholerae* bacteria inside a biofilm are more tolerant to antibiotics than those in liquid cultures.

Other SNI members have also received notable distinctions in recent weeks. Based on nominations by nanoscience students, our program coordinator Anja Car received the Teaching Excellence Award 2023 for Service to Teaching. Likewise, Michael Nash from the Department of Chemistry received a Teaching Excellence Award in the Strong Foundations category.

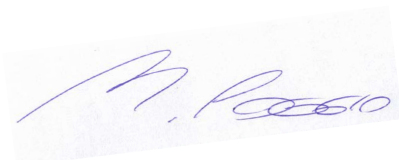
Ilaria Zardo from the Department of Physics has been awarded the Emmy Noether Distinction 2022 in the mid-career category. Ilaria received the prize from the European Physical Society (EPS) for her work on the methodology of characterizing nanoscale materials and the consequent discovery of their new functional properties.

Just a few days ago, it was announced that Christoph Gerber, one of our honorary members, will be presented with the Albert Einstein World Award of Science 2023. Christoph is to receive this distinction from the World Cultural Council in recognition of the fundamental character and broad applicability of his research in the area of the nanosciences.

As well as this good news, this edition of *SNI INSight* also reports on events and research findings in recent months. The guest article by a student comes from Philippe Van der Stappen, a young researcher from the Canton of Aargau who completed his master's thesis at Monash University in Australia and was the first nanoscience student in Basel to complete his degree with the new specialization in medical nanoscience.

I hope you all have an enjoyable and relaxing summer, and I look forward to seeing many SNI members again in September at our Annual Event – which is being held in the Canton of Aargau for the first time.

Kind regards,



Martino Poggio, SNI director

Automatic preparation for cryo-EM analysis with no loss of material

Start-up cryoWrite delivers its first unit

For several years, the name cryoWrite has cropped up within the SNI network in connection with an instrument used to prepare samples for cryo-electron microscopy. Moreover, a company has existed with this name since 2020 (and from October 2023 will be led by the SNI alumnus Dr. Patrick Frederix). The Basel-based start-up is launching an automated system that can be used to prepare tiny sample quantities for cryo-electron microscopy with no loss of material. The three members of staff at cryoWrite recently supplied their first instrument to Professor Henning Stahlberg's group at EPFL and are currently working on another unit for the pharmaceutical company Roche. At the same time, the team is working to demonstrate the capabilities of its modular sample-preparation system to various customers.

Nowadays, it's hard to imagine basic research without cryo-electron microscopy (cryo-EM), a technique that allows biological samples such as cells or proteins to be examined in their natural environment without having to be embedded, fixed or treated with a contrast agent. Thanks to continual technical improvements and optimized cameras, it is now possible to visualize and elucidate three-dimensional structures of molecules in individual cells using cryo-EM, which operates at temperatures below -180°C.

Glass-like water

One key part of this process is sample preparation. Here, it is vital to prevent the formation of ice crystals that destroy fine structures. Samples destined for cryo-EM are therefore shock-frozen at lightning speed to cause what experts call "vitrification" of the sample material. This converts the water to an amorphous, glass-like state to avoid damaging structures in the cell.

For years, Dr. Thomas Braun's team at the Biozentrum of the University of Basel has been working to miniaturize and automate the sample-preparation process for cryo-EM. Several Nano-Argovia projects and doctoral dissertations have addressed different aspects of this process with support from the SNI – and their inventions have been patented with help from Unitectra in what represents a first step toward the development of a commercial device for cryo-EM sample preparation.

The founding of the start-up Nuonex in 2019 was the first attempt to commercialize this technology, but those efforts were ultimately shelved by the two young entrepreneurs.

Founded in summer 2020

In August 2020, however, the commercialization of the cryoWriter got underway in earnest when Professor emeritus Andreas Engel teamed up with two partners to found a company known as cryoWrite. The team was already familiar with the cryoWrite system as well as the benefits of an automated sample-preparation system for cryo-EM, and the researchers had an experienced investor on board in the shape of Dr. Hans-Andreas Engel from the board of the Biovalley Basel Association.

The aim of this fledgling company is to provide new avenues for efficient and reproducible sample preparation in the form of an automated, modular system for use with cryo-EM technology.

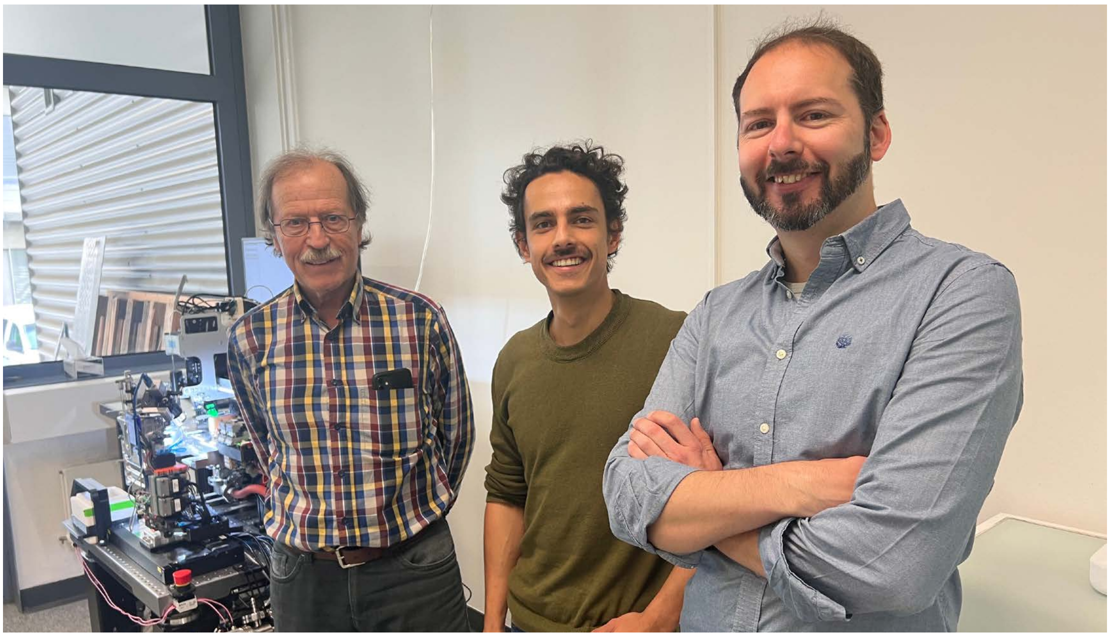
For example, the processing of biological samples begins with selecting a cell from a cell culture, breaking the cell up and extracting the cellular contents, which are written onto the grid. The cryoWrite system can also include an effective and automated purification step that isolates a specific protein. Just two nanoliters of the sample material are enough to be written onto a grid as a thin layer for examination by electron microscopy. Once the material has been applied, the grid is quickly dipped into liquid ethane to vitrify the sample, and the automation process also includes the transfer of the grid to a cooled storage system for transport.

"Our concept has a modular structure," explains Engel. "We're constantly working to develop extension modules that further broaden the system's applications. For example, as part of the Nano-Argovia project FuncEM, we're developing a module that aims to image 'live' samples

Further information:

cryoWrite
https://cryowrite.ch

Research group Thomas Braun
https://www.biozentrum.unibas.ch/research/research-groups/project-leaders-a-z/overview/unit/thomas-braun



Andreas Engel, Nicolás Candia and Alejandro Lorca Mouliaá built up cryoWrite together and are currently demonstrating the prototype to various customers.

under an optical microscope just before the freezing process. This would allow researchers to obtain relevant information on the functionality of the analyzed structures."

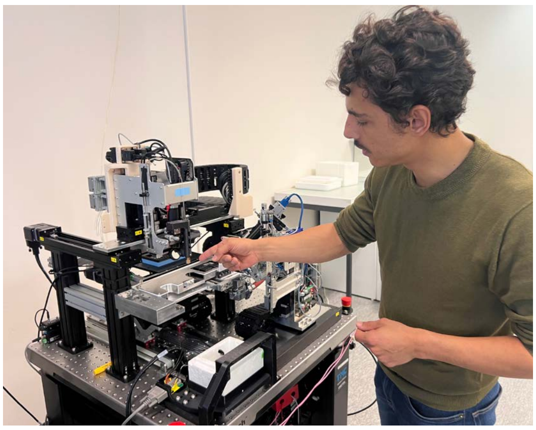
Success after some initial hurdles

Despite the team's many years of experience, it wasn't all plain sailing after the company was founded in 2020. "There were some issues due to the pandemic, and focusing narrowly on specific problems wasn't always easy for the highly creative and motivated team," says Engel in the interview.

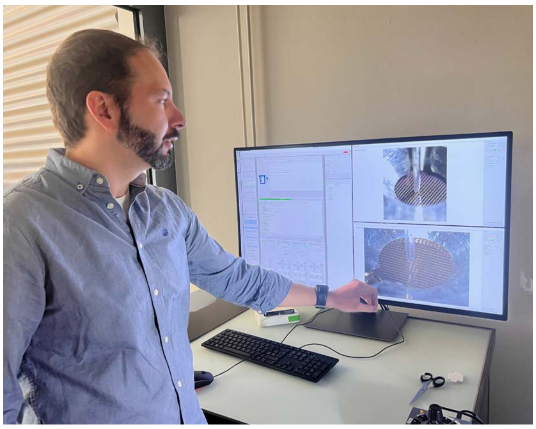
In summer 2021, however, the two engineers Nicolás Candia and Alejandro Lorca Mouliaá succeeded in finalizing a prototype – which was then demonstrated to potential customers. "Throughout the development process, we received valuable support from Sascha Martin from the mechanics workshop at the Department of Physics of the University of Basel," says Engel. "Further valuable support is provided by the Biozentrum's BioEM Lab, which is led by Dr. Mohamed Chami. It's there that the samples prepared using our system are analyzed on the electron microscope."

The first order for a device came from Professor Henning Stahlberg of EPFL, who was already familiar with the origins of cryoWrite from his time in Basel. "When we supplied this first device in March, it was a key milestone on what has been a rocky road to success," says Engel.

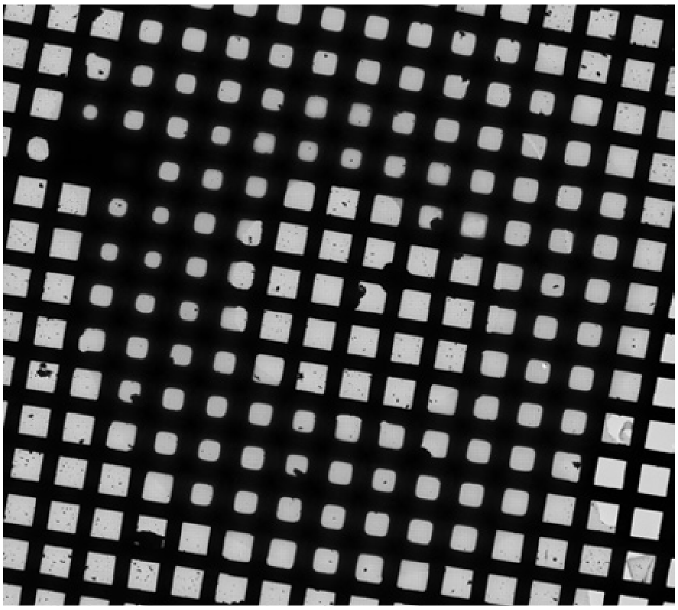
A second order came from the pharmaceutical company Roche in Basel, with which



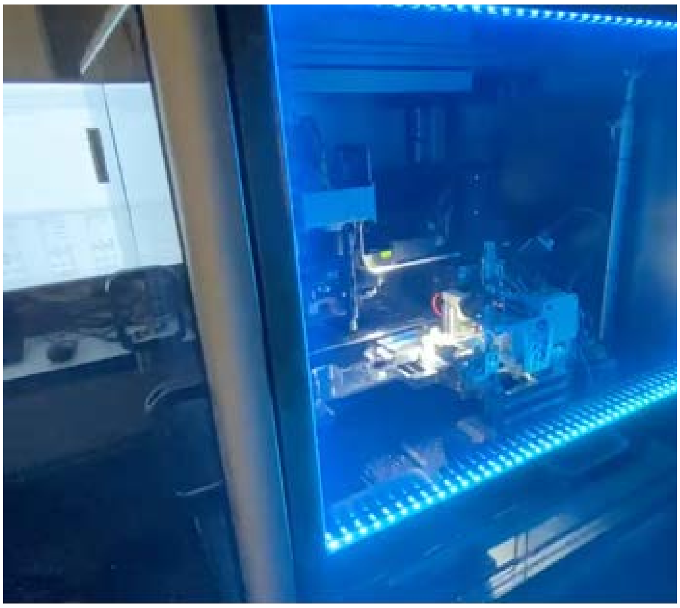
Nicolás Candia explains that the cryoWriter has over 100 sensors and 25 axes. With various expansion modules, the system serves as a mini laboratory in which samples can be cultivated, microscopically examined, prepared, applied to an EM grid, and vitrified.



Alejandro Lorca Mouliaá demonstrates how the various steps can be followed on the screen — here, a tiny quantity of sample material is being applied to the grid.



An overview of the grid clearly shows the areas where the cryoWriter applied an ideal quantity of sample material (squares with rounded corners). (Image: A. Engel, cryoWrite)



In the commercially produced cryoWriter, the lighting ensures that the working steps can be followed from the outside. (Image: A. Engel, cryoWrite)

cryoWrite has been in contact for some time. This second device will be delivered in late summer 2023 and expanded with various options by early 2024.

The cryoWrite team is currently demonstrating its device to various customers from the region. In these demonstrations, samples provided by cryoWrite are prepared for analysis before customers analyze them using their own electron microscopes.

> "The cryoWriter provides us with a completely new set of capabilities. There's no other device that allows us to examine unique samples that are only available in tiny quantities."

Professor Henning Stahlberg, Laboratory of Biological Electron Microscopy (LBEM), EPF Lausanne

"Our system is streets ahead of the competition," says Engel. "That being said, we're always coming up against problems and tasks where there's still room for improvement. Accordingly, this is an ideal opportunity to work with customers with strong technical capabilities – to whom we can then offer optimum service in a short space of time."

Plans for the future

As well as delivering the first cryoWriter, the team also achieved another key milestone this year when it moved into a larger laboratory in the Rosental area at the start of May. The new premises offer much-improved working conditions: "We have a small factory here that'll continue to provide optimum conditions even if we grow in the future," says Engel.

Of course, as well as working on his many day-to-day tasks, the cryoWrite founder gives considerable thought to the future. The aim is to sell 10 devices over the next few years, each of them costing around half a million Swiss francs. In a stable order situation, it would then be necessary to hire additional staff who could be on hand to provide customers with rapid service. "As soon as our order book gets a bit thicker, we'll also seek financing in order to push ahead with cryoWrite's development," Engel adds.

In addition, Dr. Patrick Frederix will undoubtedly be able to bring in some new ideas. As head of Applications and Service at Nanosurf for many years, the physicist is joining cryoWrite as its CEO from October this year.

> "The main goal is, of course, that we in the team make the company a success. A technical solution is already in place. Now we need to show the EM community what we have to offer and how our solution can help to get excellent results faster – which is of interest in both industry and academic research."

Dr. Patrick Frederix, CEO at cryoWrite as of October

Further information:

Nano-Argovia program
https://nanoscience.unibas.ch/en/forschung/applied-research/

New Nano-Argovia projects in 2023

In 2023, five new applied research projects were launched as part of the applied Nano-Argovia program. Researchers from the Schools of Life Sciences and Engineering at the University of Applied Sciences Northwestern Switzerland FHNW, the CSEM Allschwil and the Paul Scherrer Institute are working together with industrial companies from Northwestern Switzerland. The topics of the new projects range from the optimization of micro-optical components, developments of a new current sensor, novel optical tweezers to an optimized magnetic encephalography system and an innovative method of regulating specific genes.

Paul Scherrer Institute
https://www.psi.ch/en

FHNW School of Life Sciences
https://www.fhnw.ch/en/about-fhnw/schools/lifesciences

XRnanotech
https://www.xrnanotech.com

CAPOFOX – Smooth mirrors for X-rays

As part of the Nano-Argovia project CAPOFOX, an interdisciplinary team is working on the further development of lithographic techniques. The researchers from the Paul Scherrer Institute PSI, the School of Life Sciences at the University of Applied Sciences Northwestern Switzerland FHNW and the industrial partner XRnanotech aim to produce micro-optical components with very low surface roughness from polymers. With this in mind, they are looking for a way of producing tiny capillary mirrors that are suitable not only for ultraviolet radiation but also for X-rays.

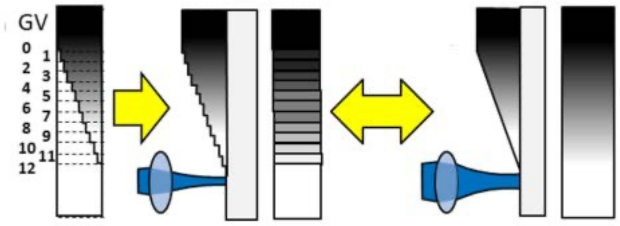
Polymer structures can be produced on a large scale with various designs and are therefore seeing increasing applications in optical components. Moreover, grayscale lithography can be used to produce elements with specific three-dimensional contours – including lenses with continuous and stepped surfaces, such as those used in smartphone cameras.

Here, following further processing, differences in lateral exposure yield different layer thicknesses of the "photoresist" – a light-sensitive material used in photolithography. Primarily for technical reasons, this method produces a small number of grayscales and therefore leads to stepping. The resulting surface roughness represents a significant limitation when it comes to applications in lenses and mirrors.

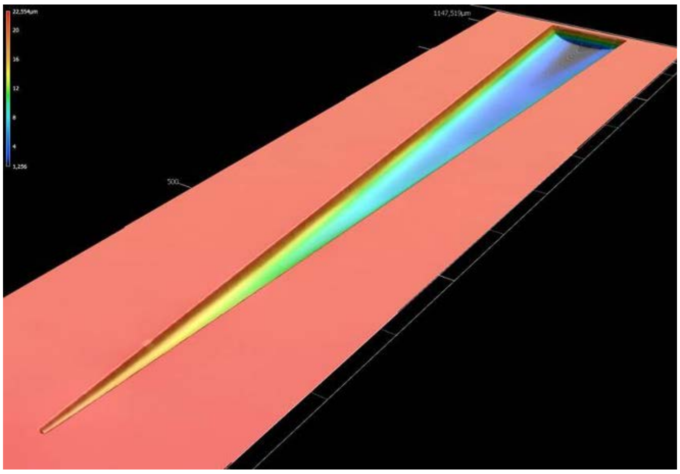
Even tiny structures cause interference

In optical components for short-wave electromagnetic waves in the range of extreme ultraviolet light (10 to 121 nm) and X-rays (under 10 nm), even tiny steps on a similar scale to the wavelengths cause interference, causing unwanted scattering as waves reflect off the surface.

In previous Nano-Argovia projects, the team working under project leader Dr. Helmut



Researchers can use lithographic techniques to produce three-dimensional contours in a "photoresist." Given that conventional methods result in stepping and therefore the unwanted scattering of light, the team working on the Nano-Argovia project CAPOFOX plans to produce structures that are smooth down to the nanometer level. (Image: PSI)



Example of a semi-capillary – a tapered funnel structure in concave (hollow) embodiment. No steps are visible in this illustration because they are so small that they are visible only on X-ray. (Image: PSI)

Schift (PSI) developed various methods for localized surface smoothening. These contactless polishing techniques level out surface roughness using localized melting, but they cannot be used for extensive structures with longer steps such as those needed in capillary optics.

Step-free surfaces

Now, in the Nano-Argovia project CAPOFOX (CAPillary Optics for FOcusing of X-rays), which was launched in early 2023, researchers are combining tool-, laser-, design- and material-related aspects to develop a method for producing an extended 3D polymer structure such as that needed in the case of narrowing capillaries. The team's initial focus is on producing stepless semicylindrical depressions and developing the basis for measuring nanoroughness by various techniques. At a later stage, they aim to produce a concave mirror for extreme ultraviolet wavelengths by equipping a polymer film with multiple layers to form a reflective mirror. These results will facilitate the development of ultrasmooth mirrors for X-ray focusing, with potential applications in areas such as material processing.

"The CAPOFOX project brings together outstanding expertise in the preparation and examination of ultrasmooth surfaces. The chosen methodology is innovative and is also remarkable due to its numerous high-impact future applications. We're very much looking forward to accompanying and supporting these developments."

Dr. Florian Döring, CEO and founder of XRnanotech

Further information:

FHNW School of Engineering
https://www.fhnw.ch/en/about-fhnw/schools/school-of-engineering

FHNW School of Life Sciences
https://www.fhnw.ch/en/about-fhnw/schools/lifesciences

TLD Photonics
https://tld-photonics.odoo.com/de

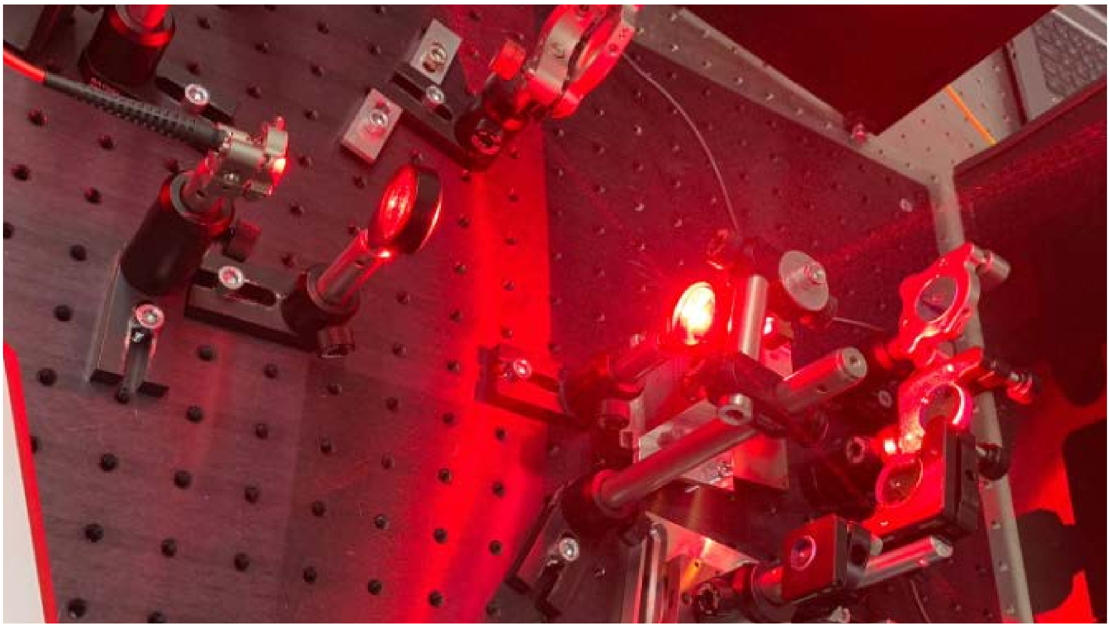
NanoFemto Tweezers – Optical tweezers for 3D printing of cells using an efficient femtosecond laser

In the Nano-Argovia project NanoFemto Tweezers, an interdisciplinary team is developing optical tweezers that can be used to assemble different cell types, including neurons, in a tiny area. For this purpose, the teams from the School of Engineering and School of Life Sciences at the University of Applied Sciences Northwestern Switzerland FHNW as well as the industry partner TLD Photonics, are using femtosecond lasers and nano-optical elements to build optical traps (tweezers). With the developed setup, the researchers plan to 3D print cells and to build organs on a micrometer surface (body-on-chip) in order to be able to study, for example, the effects of drugs on different organ systems on a chip.

The effects of pharmaceutical substances can be studied quite early on in their research and development phase, on biomedical probes (chips) where reactions of entire organs can be simulated. To investige side effects, however, it is also desirable to place not only cell types of one organ system, but of completely different organs on a chip (body-on-chip) and to reflect a broader spectrum of pharmacological effects. Given the increased development of personalized medicine, such studies could be carried out with patient-specific cells. In addition, such biochips promise the further reduction of animal experiments.

Traps for different cell types with novel efficient femtosecond lasers

The team in the Nano-Argovia project NanoFemto Tweezers, led by Professor Bojan Resan (FHNW School of Engineering), plans



The project team is developing a novel laser based on red laser diode pumped alexandrite that generate pulses in the femtosecond range (1 femtosecond = 10^{-15} seconds). The laser can gently trap cells without heating the surrounding area. (Image: B. Resan, FHNW School of Engineering) to develop optical tweezers that can be used to build body-on-chip systems.

Optical tweezers use a focused laser with a specific intensity profile. The laser light exerts a force on microscopic objects that causes the object – in this case, cells – to be repeatedly drawn into the focus of the laser beam, allowing it to be trapped, fixed or controllably moved.

In order to arrange different cell types on an area of just a few micrometers, the different cell types must first be "trapped" using nano-optical traps. They can then be assembled into a three-dimensional complex tissue while the process is monitored and navigated with a multiphoton microscope using the same femtosecond laser.

The researchers are initially investigating different nanolithographic methods to produce tailor-made nano-diffractive optics for traps for different cell types. Another focus is on using a laser that, with sufficiently short pulses, does not generate a lot of heat around the cell and thus does not damage the cells.

The project team is therefore developing a novel laser based on red laser diode pumped alexandrite that generate pulses in the femtosecond range (1 femtosecond = 10^{-15} seconds). The laser used feature high wall-plug efficiency, are compact, reliable and inexpensive. They can also gently trap cells without heating the surrounding area.

In a case study, the researchers plan to use a prototype of the optical tweezers to assemble a neural tissue.

"The Nano-Argovia project NanoFemto Tweezers allows us to investigate and commercialize one of our novel lasers for multiple new applications – optical tweezers, multiphoton imaging and micro-scale 3D printing of biomedical tissues."

Stephan von Wolff, CEO TLD Photonics AG

NanoHighSens – Novel current sensor fulfills the latest quality standards

In the Nano-Argovia project NanoHighSens, researchers from the Schools of Life Sciences and Engineering at the University of Applied Sciences Northwestern Switzerland FHNW are collaborating with the company Camille Bauer Metrawatt AG to develop a novel current sensor. The team is using an array of eight small magnetometers that surround the current conductor, each based on 100 Magnetic Tunnel Junctions. The sensor aims to outperform existing technologies in terms of bandwidth and resolution and is expected to meet new standards for power quality measurement devices.

In the Nano-Argovia project Nanocompass, launched in 2021, the interdisciplinary team led by project leader Professor Joris Pascal (School of Life Sciences FHNW) has already successfully demonstrated that nanoscale Magnetic Tunnel Junctions are ideally suited as measuring devices for magnetic fields.

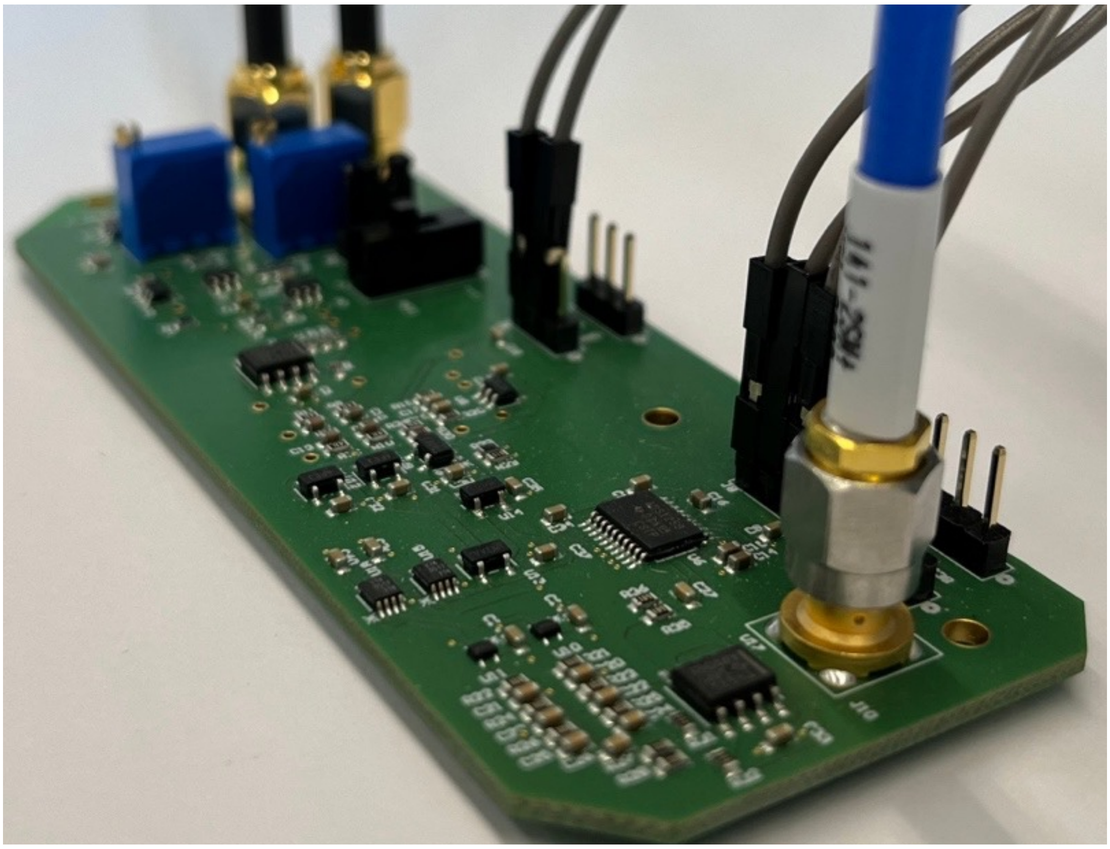
Magnetic Tunnel Junctions consist of two ferromagnetic layers separated by a thin insulating layer. When the magnetization of the two ferromagnetic layers is parallel, electrons can "tunnel" through the insulating layer more easily than when the magnetizations are in the opposite direction. This mechanism is influenced by the strength

Further information:

FHNW School of Life Sciences
https://www.fhnw.ch/en/about-fhnw/schools/lifesciences

FHNW School of Engineering
https://www.fhnw.ch/en/about-fhnw/schools/school-of-engineering

Camille Bauer
https://camillebauer.com



In the Nano-Argovia project NanoHighSens, researchers are developing a novel current meter based on a large number of magnetic tunnel junctions. (Image: J. Pascal, FHNW)

of the magnetic field that is applied to the junction. This makes the magnetic field measurable. Since current also generates a magnetic field, measuring the magnetic field generated by the current flowing in a conductor allows the strength of the current to be determined.

High resolution and wide bandwidth

In the NanoHighSens project, Joris Pascal's team now plans to use the Magnetic Tunnel Junctions (MTJ) to develop precise measuring devices for power grids. To do this, the researchers are using eight magnetometers based on MTJs, which are arranged around a primary conductor that carries the alternating and direct current to be measured.

Each of the eight magnetometers consists of an array of 100 nanoscale MTJs, including their interconnection, arranged on an area of 100 µm x 100 µm. Since the respective measurements are based on an average of 100 magnetic field measurements, this results in very good resolution with an improved signal-to-noise ratio compared with conventional devices.

The high bandwidth of MTJs – the amount of data that can be transmitted – also promises advantages over other approaches.

As part of the Nano-Argovia project, the project team will test different Magnetic Tunnel Junctions and the design of the new current meter and validate them at Camille Bauer Metrawatt's facilities.

"The NanoHighSens project is an essential basic building block for a holistic energy efficiency assessment taking into account the power quality footprint."

Max Ulrich, Managing Director, Camille Bauer Metrawatt AG

QSBI – Quantum sensor for diagnostics in the brain

In the Nano-Argovia project QSBI, an interdisciplinary research team is investigating the possibility of using quantum sensors based on nitrogen vacancy centers in diamonds to study brain activity. The team, which includes researchers from the Paul Scherrer Institute PSI, CSEM Allschwil and the industrial partner Qnami, plans to use the project to optimize the existing method of magnetoencephalography. In addition, the researchers aim to develop an algorithm so that a three-dimensional map of brain activity can be created from the measurement data.

When nerve cells communicate with each other, weak electrical currents flow and magnetic fields are generated that can be measured. Magnetoencephalography (MEG) uses magnetic field sensors to analyze these magnetic fields in the brain. The method contributes to the better understanding of brain activity, as billions of nerve cells interact with each other, and opens the door for treatment possibilities.

Innovative combination

The team, led by Prof. Kirsten Moselund of the Paul Scherrer Institute PSI, together with Dr. Moritz Kirschmann from CSEM and Dr. Tobias Sjölander from the quantum sensing company Qnami now aims to develop a new generation of magnetoencephalography systems that combine quantum sensors and artificial intelligence.

The researchers plan to use diamonds with nitrogen-vacancy centers (NV centers) as quantum sensors. NV centers are formed when a carbon atom in the diamond's crystal lattice is replaced by a nitrogen atom and a carbon atom is missing at the adjacent lattice position. Single electrons orbit in these vacancy centers and their spin changes when they are exposed to an electric or magnetic field. The electrons can be excited and then emit individual light particles (photons), which provide information about the state of the spin and thus provide information about the electric and magnetic fields. Qnami has already commercialized this technology for material science microscopy applications. The existing product uses NV center probes to scan over the surface of 2D materials to map out magnetic fields on the nano-scale.

However, the brain's magnetic fields are very weak and are easily disturbed by magnetic fields in the environment. Therefore, to achieve this ambitious goal the researchers combine their interdisciplinary skills to use the PSI nanofabrication facility to produce diamond based photonic crystal structures that improve the signal-to-noise ratio of the signals generated by the NV centers. They also plan to exploit the established expertise at CSEM to develop machine learning algorithms that can process the data and eventually lead to the reconstruction of a 3D brain activity map with high accuracy and robustness.

Key advantages

The envisioned quantum sensors would have major advantages over conventional systems. They can operate in room temperature and don't require cryogens. Further they could measure signals from the brain without being in a magnetically shielded room. They could be integrated into headgear, could also measure brain activity during various activities and would be suitable for children.

"We believe that due to their combination of robust operation, easy logistics and high sensitivity, NV diamond magnetometers will revolutionize biomagnetism."

Dr. Tobias Sjölander, Quantum Engineer at Qnami AG

Further information:

Paul Scherrer Institute
https://www.psi.ch/en

CSEM
https://www.csem.ch

Qnami
https://qnami.ch

Further information:

FHNW School of Life Sciences
https://www.fhnw.ch/en/about-fhnw/schools/lifesciences

Paul Scherrer Institute
https://www.psi.ch/en

Palto Therapeutics
https://paltotx.com

SmartCoat – Innovative approach in the treatment of cancer

In the Nano-Argovia project SmartCoat, researchers are investigating a novel method to downregulate specific genes that drive proliferation and malignancies in cancer. The researchers from the School of Life Sciences FHNW, the Paul Scherrer Institute PSI and industry partner Palto Therapeutics are using nanoparticles to transport specific short fragments of RNA (siRNA). The nanoparticles also ensure that the siRNA is only taken up by targeted cancer cells, where it can reduce the activity of specific genes.

Biotechnological pilot production plant at the FHNW. (Image: FHNW)

The use of siRNA (small interfering RNA) is currently being investigated as a highly specific method to treat diseases characterized by overproduction of certain proteins.

There are, however, some challenges in the therapeutic use of siRNA, some of which have not yet been solved. The siRNA has to reach and enter the diseased target cells without being blocked by organ barriers in our body, nor being enzymatically degraded or excreted. In addition, healthy cells should not take up the siRNA to avoid undesirable side effects.

Nanoparticles into cancer cells

The team in the Nano-Argovia project SmartCoat, led by Professor Johannes Mosbacher (FHNW), is now testing a novel approach to shuttle siRNAs to specific target genes that play a crucial role in various aggressive tumor types such as ovarian and pancreatic cancer.

The researchers are using bioengineered nanoparticles called SmartCoats to deliver the siRNA. The SmartCoats act as a physical barrier. They protect the siRNA from enzymatic degradation and from interactions with immune cells. Their specific design also ensures that the siRNA is taken up only by targeted cancer cells. These cancer cells have specific structures (shuttling receptors) on their surface that enable binding and subsequent uptake of the SmartCoat-siRNA complexes into the cell. In this way, the RNA fragments only enter the degenerated cells and can exert their regulatory effect there.

The project team will produce the SmartCoat-siRNA complexes in the team of Professor Georg Lipps (FHNW) using a method developed by Palto Therapeutics and subsequently characterize them structurally and biophysically in the team of Dr. Roger Benoit (PSI) with the goal of improving their physico-chemical properties and stability.

The researchers also plan to use *in vitro* cellular assays with timelapse imaging to optimize the efficacy of the SmartCoat-siRNA complexes. Palto Therapeutics will use these results to turn these complexes into effective drugs.

"The ongoing project with FHNW and PSI is a cornerstone of the innovation of Palto Therapeutics."

Dr. William L. Wishart, Director Palto Therapeutics Inc.

Annual Report

This year, we also published an animated flipbook of the annual report with embedded videos. If you'd like a printed version, we'll be happy to send you a copy (c.moeller@unibas.ch).

Otherwise, you can find the annual report on our website at: https://nanoscience.unibas.ch/en/outreach/broschueren/.

There is also a short video showcasing some highlights of 2022: https://youtu.be/i-tau6cuY6s

Nano-Argovia program

Submit your project proposals

In the Nano-Argovia program, the SNI promotes applied nanotechnology research projects. Companies from Northwestern Switzerland work together with partners from at least two different academic institutions.

Submit your project proposals by September 30, 2023.

Information about the Nano-Argovia program and proposal requirements can be found at:

www.nano-argovia.swiss

Less vulnerable as a community
Timon Baltisberger wins master's prize for analysis of biofilms

Timon Baltisberger is to receive the prize for the best master's thesis in nanosciences at the University of Basel in 2022. In the prizewinning thesis, he proved that *Vibrio cholerae* bacteria inside a biofilm are more tolerant to various antibiotics than cultures grown in agitated liquid medium. The results help to improve our understanding of biofilms, which play a major role in nature and can lead to stubborn infections in humans.

In nature, bacteria are not generally present as individual organisms. Instead, they often live in communities, embedded in an extracellular matrix that allows them to exchange metabolic products and provides better protection against environmental influences.

What is beneficial for bacteria turns out to be a problem when it comes to fighting them. If an implant is colonized by a biofilm, for example, it makes it hard to bring the bacteria under control. As a community, the microorganisms are less vulnerable to various antibiotics. At present, however, it remains to be clarified whether this increased tolerance is due to the limited metabolic activity of dormant cells inside the biofilm, limited diffusion of the antibiotics, or complex communication between bacteria in the biofilm.

Comparison of planktonic form with a biofilm

In his master's thesis in Professor Knut Drescher's group at the Biozentrum of the University of Basel, Timon Baltisberger investigated antibiotic tolerance in the model bacterium *Vibrio cholerae* in greater depth by comparing planktonic bacteria in an agitated liquid medium with those in a biofilm.

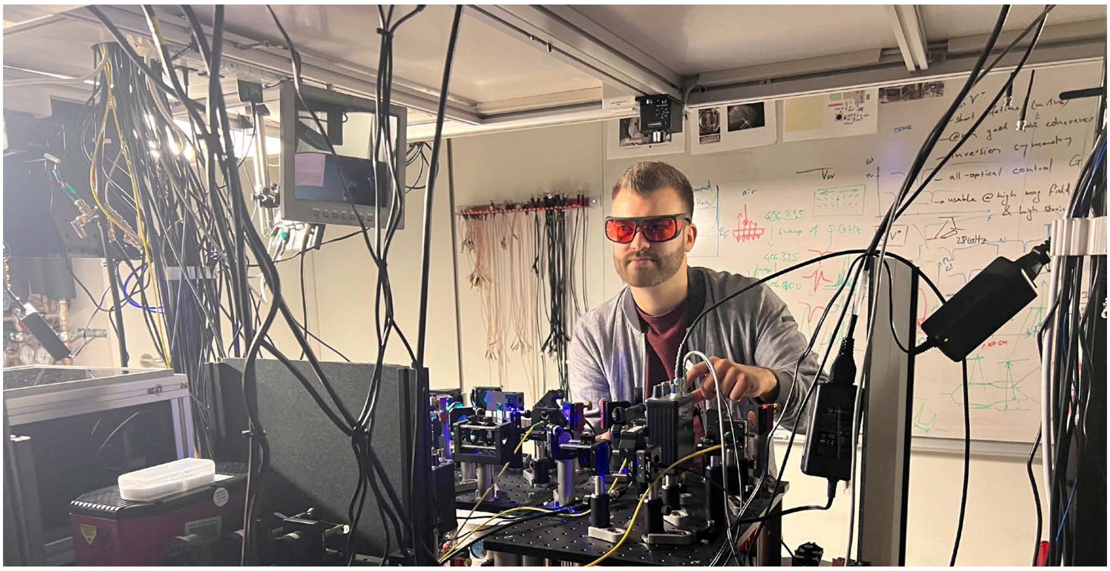
To analyze the planktonic bacteria, he first cultured the microorganisms in agitated multi-well plates and monitored their multiplication based on changes in optical density. "I then used seven different antibiotics to investigate how quickly the bacteria were killed off," Baltisberger says. Given that numerous parallel cultures and dilution series were needed in order to provide statistical confirmation of this data, Baltisberger carried out the pipetting work using a robot that he had also programmed himself as part of his work.

As a result of these analyses using planktonic bacteria, Baltisberger established that, six hours after the antibiotic was administered, six of the seven tested antibiotics had caused over 99% of the bacteria to die off – provided that the dose was above the minimum level.

Vibrio cholerae

The gram-negative bacterium *Vibrio cholerae* is encountered above all in aquatic environments, where it occurs not only as an individual cell in "planktonic" form but also coats structures in water with a multicellular community in the form of biofilms. The bacterium is known above all for causing cholera, a diarrheal disease in humans that arises due to a toxin it excretes in the intestine. Not all strains of the species are pathogenic, however.

Timon Baltisberger checks whether colonies have grown on the agar plate.



When Timon Baltisberger thinks back to his student days, he is immediately reminded of the many interesting topics he studied and the great friends he made over the course of his studies.

Further information:

Video with Timon Baltisberger
https://youtu.be/4zZjnvX-qUQ

Research group Knut Drescher
https://www.biozentrum.unibas.ch/research/research-groups/research-groups-a-z/overview/unit/research-group-knut-drescher

Research group Richard Warburton
https://nano-photonics.unibas.ch

Biofilms in microfluidic channels

With the biofilms, however, the situation was completely different. Here, bacteria inside the biofilm survived similar quantities of antibiotics for a longer period of time.

For these analyses, Baltisberger cultured the Vibrio bacteria in microfluidic channels, ten of which were arranged on a chip and connected to pumps. This pump system continuously fed culture medium through the channels and could then also be used to administer antibiotic solutions.

"To monitor the effect of these solutions, we positioned the system under a confocal microscope and first measured the signal from a red fluorescent protein produced continuously by the cells. After the antibiotics were administered, we induced production of a different, green fluorescent protein in the Vibrio bacteria, so that only those cells that were still alive were marked," says Baltisberger, who carried out the work involving biofilm bacteria in collaboration with doctoral students from the Drescher laboratory. "This method offered an elegant way of observing whether – and where in the biofilm – bacteria exhibit certain tolerance to the tested antibiotics."

Higher tolerance

The results confirmed the hypothesis that the center of the biofilm is home to less vulnerable subpopulations of the bacterium that can survive the administration of antibiotics for longer. Theoretically, these Vibrio bacteria can then also recolonize dead regions once antibiotic administration is complete.

"These are not examples of resistance but rather of increased tolerance at the center of the biofilm – and were common to all of the tested antibiotics," summarizes Baltisberger. "Further investigations are needed to clarify the underlying mechanisms and to develop suitable measures for tackling biofilms."

A change of plan

Baltisberger really enjoyed working in Knut Drescher's group and was fascinated not only by the different methods but also by the topical nature of the subject matter.

When he began his studies, however, he would have been surprised to learn that he'd end up doing his master's thesis in a biophysics laboratory at the Biozentrum. After all, in his time at the cantonal school in Zofingen, he was primarily interested in chemistry. "I was even planning to study chemistry at university," he recalls.

When he heard about the nanoscience degree at the University of Basel, however, he decided to embark on this interdisciplinary degree course after a series of conversations at the bachelor's information day. "I particularly liked that the nanoscience degree program was so broad-based and that I didn't need to commit to a single subject right from the outset," says Baltisberger, who is originally from the Canton of Aargau. He didn't regret his choice:

“Timon’s master’s thesis has laid the groundwork for how we can study the efficacy of antibiotics in bacterial communities.”

Prof. Knut Drescher, Biozentrum, University of Basel

“Coming to Basel to study nanoscience was undoubtedly the right decision.” It’s clear from his choice of subjects during the program that he has a very broad interest in the natural sciences. As well as chemistry, he realized during the block courses as part of the bachelor’s degree that biology and physics were also fascinating fields.

When it came to completing his project work as part of the master’s program, he therefore chose one physical and one biological topic in the teams led by Professors Stefan Willitsch and Daniel Müller before choosing the project in Professor Knut Drescher’s group for his master’s thesis.

“For the next four years, however, I’ll once again be devoting my time to quantum physics,” says Timon Baltisberger with regard to his immediate future. In May 2023, he took up a PhD position in Professor Richard Warburton’s group at the Department of Physics, where he’ll optimize a single-photon source and seek to use it as a source of entangled particles. As in his various previous projects, he is enthusiastic about the topic and confident about the challenges that lie ahead.

We’d like to congratulate Timon on receiving the master’s prize and thank him for his help and support with numerous SNI outreach activities in recent years.

“I particularly liked that the nanoscience degree program was so broad-based and that I didn’t need to commit to a single subject right from the outset.”

Timon Baltisberger, former nanoscience student and winner of the award for the best master’s thesis

Women in the SNI network

There are some strong women within our network. In the first few months of this year, we interviewed a few of them and asked them about their career history.

In the next few months, we will continue this series to show how varied careers can be in the natural sciences.

Anja Car: https://youtu.be/mgfWGBSfYCg

Andrea Hofmann: https://youtu.be/2Mr7DgBq8p4

Annika Huber: https://youtu.be/8JxTRe8rRPo

Oya Tagit: https://youtu.be/ogr6oboEPDk

Changes at the Nano Imaging Lab
Marcus Wyss takes over as new head

Further information:

Nano Imaging Lab
https://nanoscience.unibas.ch/en/services/nano-imaging-lab/

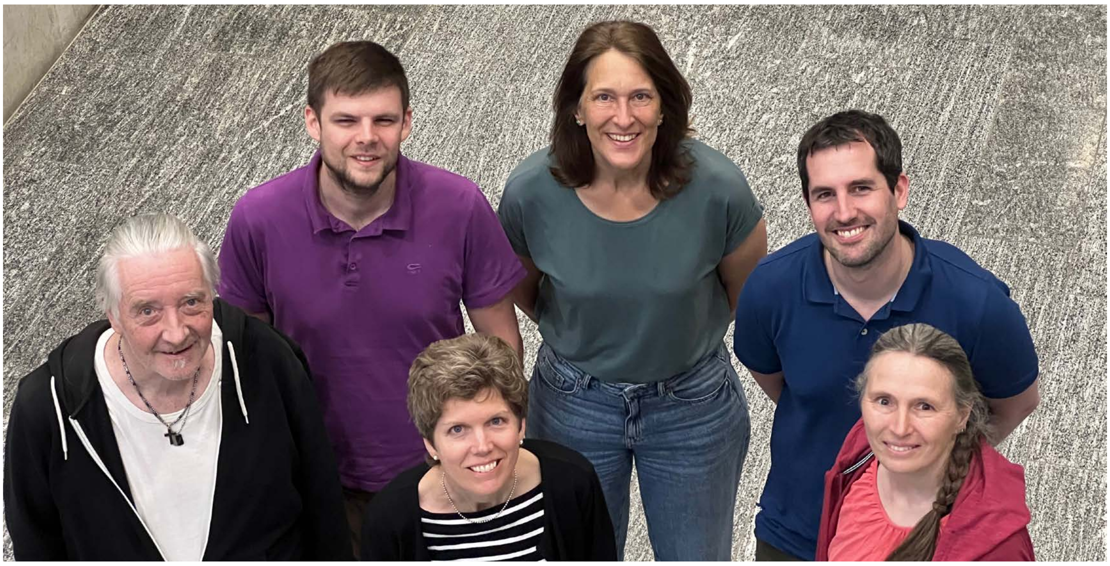
On 1 June, nanoscientist Dr. Marcus Wyss became the new head of the Nano Imaging Lab. He takes over from Dr. Markus Dürrenberger, who entered well-earned retirement at the end of May – although he isn't leaving the SNI altogether. From July onward, Markus Dürrenberger will be supporting the outreach team by using his enthusiasm for science and his technical expertise to get children and young people interested in the natural sciences.

The new head of the NI Lab, Dr. Marcus Wyss, studied nanosciences at the University of Basel and completed a doctorate on magnetic imaging techniques, specializing in nanoscale sensor technology. Having joined the Nano Imaging Lab in the capacity of deputy head in 2021, he will now be leading the team.

Dr. Alexander Vogel has been a member of the group since early May. Vogel studied physics at ETH Zurich and, during his time as a doctoral and postdoctoral student at Empa, investigated the properties of ferroelectric thin-film layers.

The newly configured six-person team of the Nano Imaging Lab is now looking forward to providing customers from academia and industry with outstanding service and expert advice when it comes to surface imaging and processing.

At Markus Dürrenberger's farewell ceremony, his successor Marcus Wyss thanked him for his dedication and wished him all the best for the future.


Also in the new composition, Daniel Mathys, Alexander Vogel, Monica Schönenberger, Susanne Erpel, Marcus Wyss and Evi Bieler (from left to right) offer their customers an excellent service.

Guest article by Philippe Van der Stappen

Six months in Australia

A stay abroad is a fantastic opportunity not only to gain scientific experience but also to familiarize yourself with other cultures and to travel. You can get to know incredible places and meet amazing people!

For my master's thesis, I worked in Professor Alex de Marco's group at Monash University (Clayton, Australia), where we developed a method for isolating specific regions of a cell. These "subcellular regions" can be utilized for subsequent investigations – for example, to analyze gene expression (transcriptomics) or the entire set of proteins (proteomics).

A focus on highly specific regions

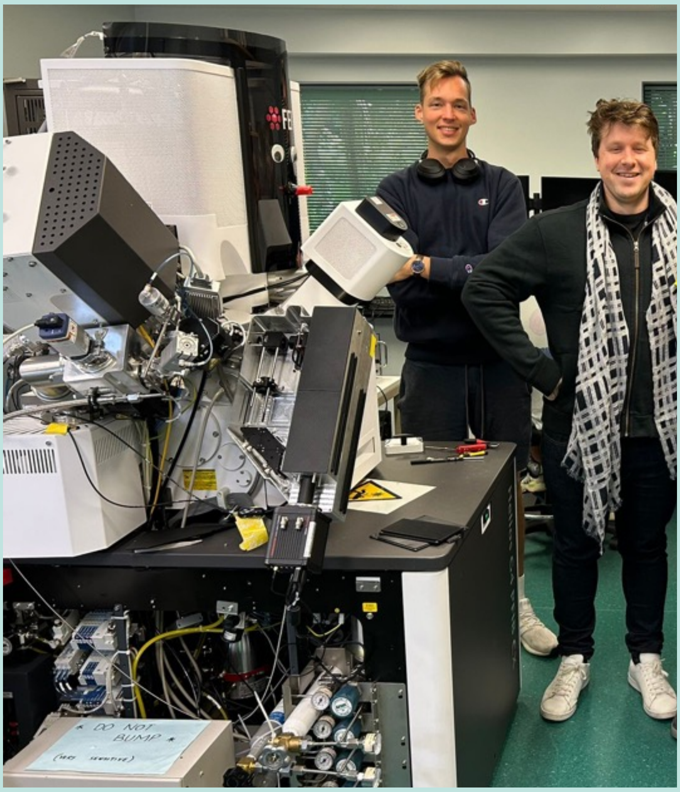
We began by using a plasma-focused ion beam scanning electron microscope (cryo-FIB/SEM) with a built-in optical microscope to cut out and isolate individual cells or subcellular regions. The FIB/SEM is normally used to dilute biological samples and then carry out cryo-electron tomography (cryo-ET), producing high-resolution three-dimensional images of the cell architecture.

Instead, I developed a workflow that uses the instrument to isolate highly specific cellular regions – such as those responsible for cell movement. To this end, I first tracked down and cut out the relevant subcellular regions, before extracting them with a small needle and transferring them to a suitable buffer solution for storage. Based on these regions – which amount to about a quarter of the cell – I was able to analyze the RNA using real-time quantitative polymerase chain reaction (RT-qPCR) technology and gain an impression of the level of gene expression in that part of the cell.

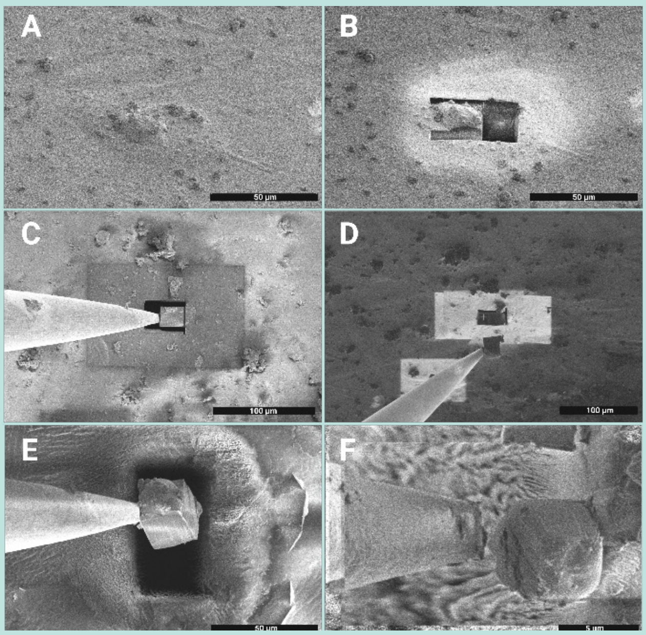
My results represent a significant contribution to our ability to track down, isolate and analyze subcellular regions in their native state. For example, the research is relevant to the study of cancer and degenerative and inflammatory diseases.

An unforgettable experience

My exciting and varied work included everything from molecular biology and engineering to programming and data analysis. I'm eternally grateful for this opportunity, and I'd like to say a huge thank-you to the Swiss Nanoscience Institute and Monash University for their support. Alex de Marco was a great supervisor and helped me make the move down under. With a fantastic working environment, his group is a fun place to work.



Philippe Van der Stappen with his colleague Patrick Cleeve in front of the FIB/SEM at Monash University. (Image: P. Van der Stappen



Images showing the process of isolating and extracting the subcellular regions. (Image: P. Van der Stappen)

I also really liked Melbourne as a place to live – and, of course, Australia has no shortage of incredible destinations to discover.

Highlights of my stay included a month-long trip to the east coast of Queensland, which is home to some unique and incredible plants and animals. Snorkeling, diving and surfing at the Great Barrier Reef were an absolutely spectacular experience – and the biodiversity is unparalleled. That's certainly thought-provoking, given the problems we're currently facing. Large sections of the reef have been "bleached" as a result of anthropogenic climate change and global warming. I'm grateful I had the chance to see this still relatively untouched corner of nature and biodiversity. I've no idea what it'll look like in 50 years, but it's clear that we – as a scientific community – have a duty to take a stand and educate people in order to bring about change.

Next step already underway

Although I still have many fond memories of my time abroad, I've been back in Basel for a while now and have already embarked on the next step in my career. Having completed my degree in nanosciences with a focus on medical nanosciences, I can certainly say that I had a great few years – in which I not only learned a great deal but also met many wonderful people along the way.

For the next few years, I'll be staying within the network of the Swiss Nanoscience Institute, having begun my doctoral dissertation at the Biozentrum in May 2023.

I'm working in the research groups led by Professors Ben Engel and Maria Hondele, where we use cryo-electron microscopy to investigate "biomolecular condensates." These membrane-less organelles are responsible for fixing CO_2 in green algae and processing and regulating RNA in our human cells. I'm very much looking forward to the exciting research that lies ahead over the coming years.

Philippe Van der Stappen thoroughly enjoyed the diverse nature on the east coast of Australia, but he also saw with his own eyes how global warming is putting these unique habitats at risk. (Image: P. Van der Stappen)

Further information:

Monash University
https://www.monash.edu

Research group Alex de Marco
https://www.monash.edu/discovery-institute/de-marco-lab

Research group Ben Engel
https://www.biozentrum.unibas.ch/research/research-groups/research-groups-a-z/overview/unit/research-group-ben-engel

Research group Maria Hondele
https://www.biozentrum.unibas.ch/research/research-groups/research-groups-a-z/overview/unit/research-group-maria-hondele

SNI PhD School
https://nanoscience.unibas.ch/en/forschung/phd-programm/

Further information:

Nanoscience Study Program
https://nanoscience.unibas.ch/en/studium/

SmallTalk – Impressive performance by nanoscience students

Every year in May, nanoscience students organize their own small conference, called "SmallTalk".

This year, Tania Behringer won both the award for the best poster and the best talk. A prize for the best poster design was given to Nadya Stebler and David Rothen.

In the 5th and 6th semesters of the bachelor's program, nanoscience students complete block courses in eight different working groups within the SNI network.

This gives the students an excellent insight into the current research of very different research groups. Since they have a wide selection of courses to choose from, they are also able to test which subject area they are particularly interested in.

At the end of the semester, they each present a poster on one of the block courses to an interdisciplinary panel of professors and project leaders and give a short scientific talk on a second topic they have worked on.

"I am always impressed by the excellent quality of the talks and posters presented by our Nanoscience students at the "SmallTalk".

Prof. Martino Poggio, SNI director and member of the SmallTalk panel for several years

The students organize a conference at the end of their Bachelor`s studies. This year, Tania Behringer won the prize for the best poster and for the best presentation. Nadya Stebler and David Rothen had the best poster design.

On rails and on campus

New formats for public relations work

The outreach team has launched two pilot projects in recent months in order to foster an interest in the natural sciences among the general public and to explain the SNI's involvement in the nanosciences. Moreover, the SNI team is continuing its wide-ranging activities with a view to reaching different target groups.

Further information:

STEM on the move
https://youtu.be/ti2fH3BVHD8

Women in the SNI network
https://nanoscience.unibas.ch/en/outreach/videos/women-in-the-sni-network/

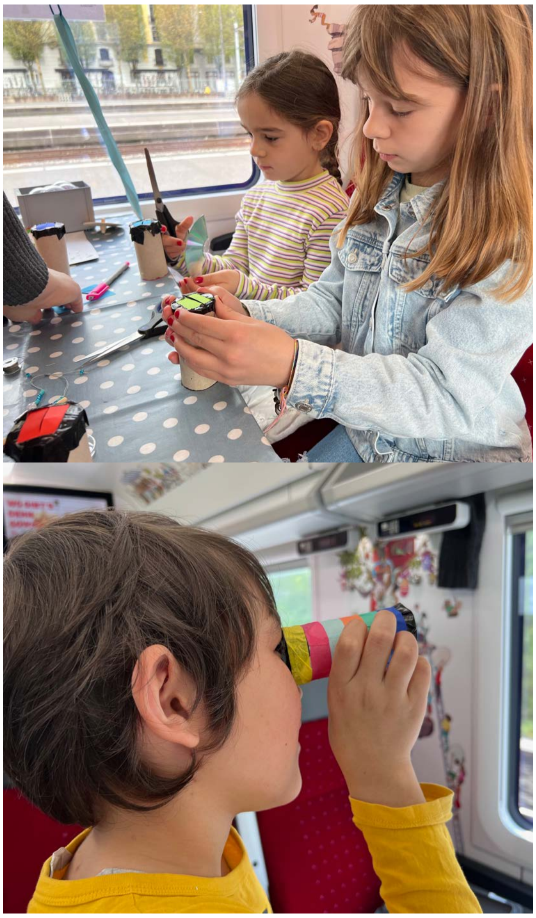
SimplyNano
https://simplynano.ch

STEM on the move

In the first of the projects, the SNI team were aboard trains for two days to offer a program of crafts and experiments to interested passengers. In the family section of a Treno Gottardo operated by Schweizerische Südostbahn, the team delivered a diverse program of activities to children, young people and adults alike. Visitors had the opportunity to use microscopes, perform experiments with light and lenses, or make bracelets and necklaces using UV-sensitive beads. For the youngest visitors, wooden spinning tops were available to decorate with paint and stickers.

"What made the 'STEM on the move' event so special was that visitors really had the time to get involved in our activities," says Dr. Kerstin Beyer-Hans, who initiated the project and planned the activities in collaboration with the team from Schweizerische Südostbahn. "Participants included children and adults alike, and they were delighted to learn about the SNI's wide-ranging activities."

On 12 and 13 July, the SNI team will be on board again to offer a similar program to what will hopefully be large numbers of interested visitors.



The children eagerly participated in the experiments and crafts.

Working environment from an artistic perspective

Another pilot project, entitled "A change of perspective", was carried out in collaboration with Oberrhein high school from Weil am Rhein (Germany). As part of an art course, 11th grade students visited the Department of Physics, where they received a brief introduction to research of several groups at the department and had some time to take pho-

Student artwork was on display in the foyer of the Physics Building.

tos. In their art class, the students then each created an artistic rendering of the photographed devices or setups. Their drawings and acrylic paintings were displayed as part of a small exhibition at the Department of Physics and will also be exhibited, along with brief explanations, at Oberrhein high school both on prom night and in the weeks running up to summer break.

Various professional backgrounds
On the International Day of Women and Girls in Science, we launched a video series entitled "Women in the SNI network." This is intended to appeal to women and girls in particular and to show them examples of different careers in the natural sciences. On a monthly basis, we now publish a video in which one of the women working in the SNI network talks briefly about their career history and their personal motivation.

Support for SimplyNano
In March, the SNI hosted a SimplyNano 2 continuing education course for the first time. As part of this program, teaching staff had the chance not only to try their hand at experiments from the SimplyNano 2 experiment box provided by SimplyScience Stiftung, but also to get an overview of how these teaching materials can help to achieve the objectives and competence areas set out in the Lehrplan 21 curriculum. The box includes 37 experiments relating to nanotechnology for lower and upper secondary levels. Through fascinating experiments and inquiry-based learning, the aim is to get young people excited about technical occupations with a view to fostering the next generation of skilled workers.

For several years, the SNI has supported the initiative promoted by SimplyScience Stiftung, which plans to make SimplyNano available to all secondary schools in German-speaking Switzerland by 2025.

News from the SNI network

Christoph Gerber to receive Albert Einstein World Award of Science 2023

Professor Christoph Gerber from the the Swiss Nanoscience Institute and Department of Physics at the University of Basel is to receive the Albert Einstein World Award of Science 2023. The World Cultural Council is awarding Gerber this distinction in recognition of the fundamental character and broad applicability of his research in the area of the nanosciences.

Further information:
https://nanoscience.unibas.ch/en/news/details/christoph-gerber-erhaelt-den-albert-einstein-world-award-of-science-2023/

Christoph Gerber is to receive the Albert Einstein World Award. (Image: Swiss Nanoscience Institute, Florian Moritz)

The SNI PhD School celebrates its birthday

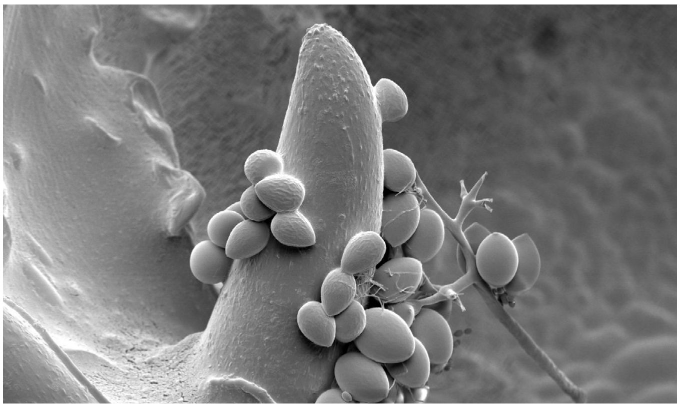
10 years ago, the first doctoral students started their research at the SNI PhD School – reason enough to invite all current and former doctoral students as well as their project leaders to celebrate this anniversary together.

Further information:
https://nanoscience.unibas.ch/en/forschung/phd-programm/

Participation in trinational research project: Nano Imaging Lab contributes its expertise

The SNI's Nano Imaging Lab is participating in the recently approved Interreg research project WiVitis to support viticulture in the Upper Rhine region. In collaboration with viticulture experts on both sides of the Rhine, a network of research centers is investigating selected wine varieties resistant to climate change in a three-year study.

Further information:
https://nanoscience.unibas.ch/en/news/details/beteiligung-an-trinationalem-forschungsprojekt-das-nano-imaging-lab-bringt-seine-expertise-ein/



In the precursor project, Vitifutur, the Nano Imaging Lab investigated infestation of wood and leaves of grapevines – here on a leaf surface. In the newly approved WiVitis project, the focus is on the grapes. (Image: Nano Imaging Lab, SNI, University of Basel)

At the interface between teaching and research: Anja Car receives Teaching Excellence Award 2023 for Service to Teaching

On 25 May, the nanosciences study coordinator, Dr. Anja Car, was presented with the Teaching Excellence Award 2023 for Service to Teaching, which is awarded by the University of Basel. Car was nominated for the award based on considerable positive feedback from nanoscience students and subsequently chosen as the prizewinner by deans of studies at the university.

Michael Nash from the Department of Chemistry received a Teaching Excellence Award in the Strong Foundations category.

Video:
https://youtu.be/mgfWGBSfYCg

Further information about Anja Car:
https://nanoscience.unibas.ch/en/news/details/an-der-schnittstelle-zwischen-forschung-und-lehre-anja-car-erhaelt-den-teaching-excellence-awards-2023-dienst-an-der-lehre/

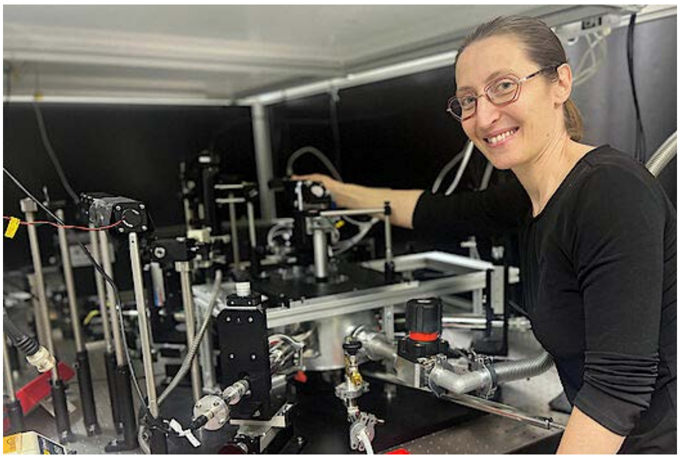
Uni News, University of Basel:
https://www.unibas.ch/en/University/Administration-Services/Vice-President-s-Office-for-Education/Teaching-Excellence-Award.html

Study coordinator Anja Car has received the 2023 Teaching Excellence Awards Service to Teaching for her excellent mentoring of nanoscience students.

Emmy Noether Distinction for Ilaria Zardo

Professor Ilaria Zardo from the Department of Physics and the Swiss Nanoscience Institute of the University of Basel is being awarded the Emmy Noether Distinction 2022 in the mid-career category. The physicist is receiving this prize from the European Physical Society (EPS) for her work on the methodology of characterizing nanoscale materials and the consequent discovery of their new functional properties.

Further information:
https://nanoscience.unibas.ch/en/news/details/emmy-noether-preis-fuer-ilaria-zardo-1/



Ilaria Zardo is being awarded the Emmy Noether Distinction.

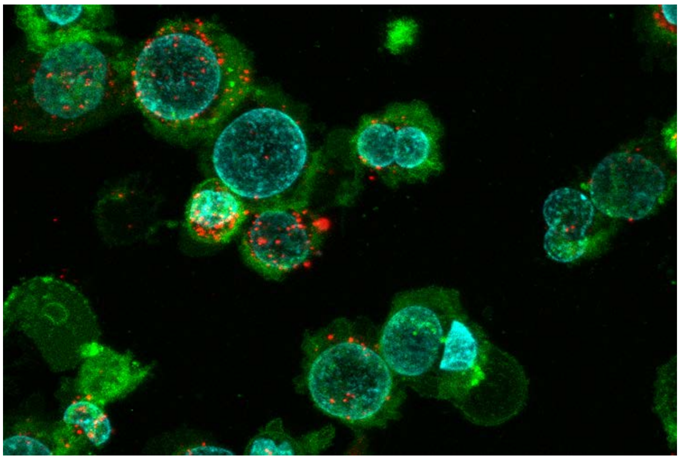
New production process for therapeutic nanovesicles

Researchers at the University of Basel have developed an efficient method for the preparation of therapeutic nanovesicles, thereby fulfilling a key prerequisite for industrial production. The method also paves the way for research into areas such as immunotherapy treatments for cancer.

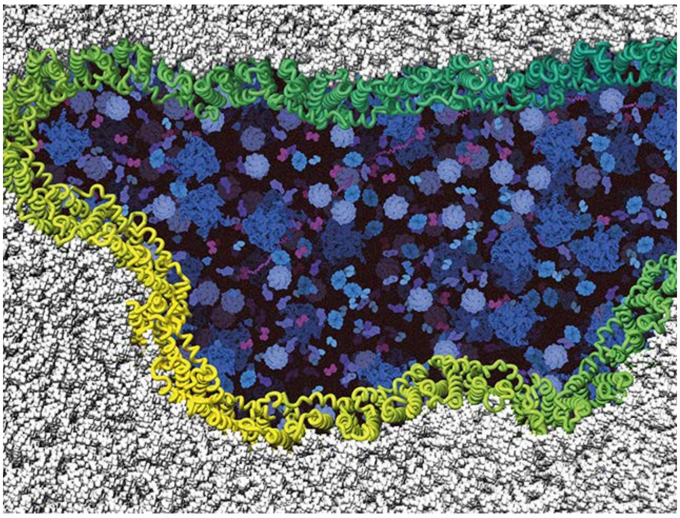
Video:
https://youtu.be/xR6OzF1z6Sg

Media release:
https://nanoscience.unibas.ch/en/news/details/neuer-herstellungsprozess-fuer-therapeutische-nanovesikel/

Original publication:
https://www.nature.com/articles/s42003-023-04859-2



The extracellular vesicles (red) produced using the new technique are absorbed *in vitro* by immune cells (green; nucleus in turquoise) and can therefore influence an organism's immune response. (Image: C. Alter, Department of Pharmaceutical Sciences, University of Basel)



Ninjurin-1 proteins assemble (green/yellow) into filaments and rupture the cell membrane (gray) until the cell disintegrates completely. Intracellular components are shown in blue. (Image: Biozentrum, University Basel)

Under control to the very end – how our cells kill themselves

Every day, millions of cells die in our body. Other than generally assumed, cells do not simply burst at the end of their lives but rather, a specific protein serves as a breaking point for cell membrane rupture. Researchers at the University of Basel have now been able to elucidate the exact mechanism at the atomic level. They have published their results in *Nature*.

Video:
https://youtu.be/Smvc06udcS0

Media release:
https://nanoscience.unibas.ch/en/news/details/bis-zuletzt-alles-unter-kontrolle-wie-unsere-zellen-sich-selber-toeten/

Original publication:
https://www.nature.com/articles/s41586-023-05991-z

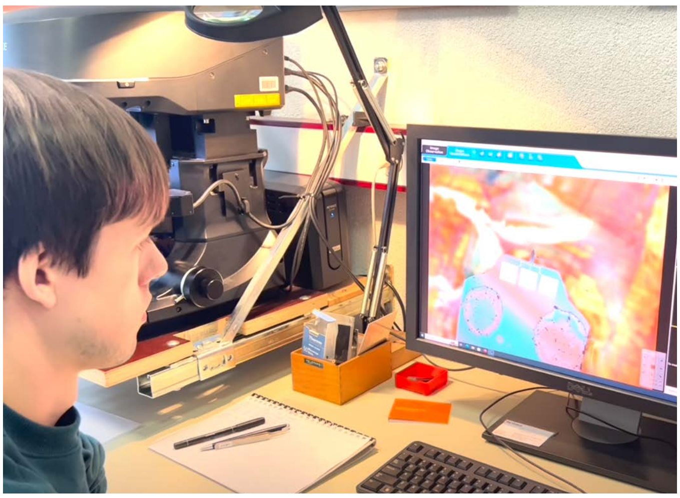
Electron beam lithography also possible on uneven surfaces

Researchers from the SNI network have developed a new method for applying electron beam lithography to uneven surfaces. They are working with a floating resist that enables uniform coating. The work was recently published in the scientific journal *AIP Advances*.

Video:
https://youtu.be/UBcYtnmA9Hc

Media release:
https://nanoscience.unibas.ch/en/news/details/elektronenstrahllithografie-auch-auf-unebenen-flaechen-moeglich-1/

Original publication:
https://aip.scitation.org/doi/10.1063/5.0127665



Luca Forrer explains in a video how the new method is applied.

Lens combination for apochromatic X-ray focusing

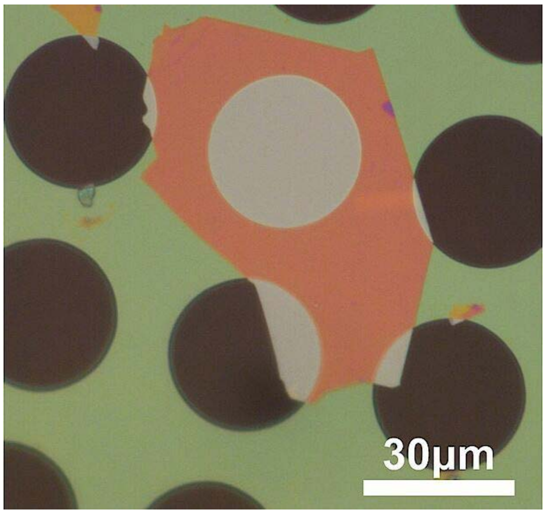
For the first time, a team of researchers from the Paul Scherrer Institute PSI, the University of Basel and DESY have achieved apochromatic X-ray focusing using a tailor-made combination of a refractive lens and a Fresnel zone plate. This innovative approach allows the correction of chromatic aberrations that occur in both refractive and diffractive lenses over a wide range of X-ray energies. The researchers were supported in this work by a Nano-Argovia project, among other programs, and recently published the results in the journal *Light: Science & Applications*.

Further information:
https://www.psi.ch/en/lxn/scientific-highlights/apochromatic-x-ray-focusing

Original publication:
https://www.nature.com/articles/s41377-023-01157-8

Nano-Argovia program:
https://www.nano-argovia.swiss

Photograph of the refractive X-ray lens (left bottom corner) compared to a head of matchstick. Such 3D printed microstructure was combined with a Fresnel zone plate to realize the apochromatic X-ray optics (Photo: Paul Scherrer Institut / Umut T. Sanli and Joan Vila-Comamala).



A two-dimensional boron nitride layer is suspended above holes in a silicon nitride membrane. The device could be used as an optomechanical sensor. (Image: D. Jaeger, Department of Physics, University of Basel)

Promising combination

Researchers from the SNI network have fabricated a tiny optomechanical device consisting of a two-dimensional, free-hanging hexagonal boron nitride (hBN) layer suspended above holes in a silicon nitride membrane. The tiny hBN drum can be excited and then begins to vibrate, acting as a mechanical resonator.

Further information:
https://nanoscience.unibas.ch/en/news/details/vielversprechende-kombination-1/

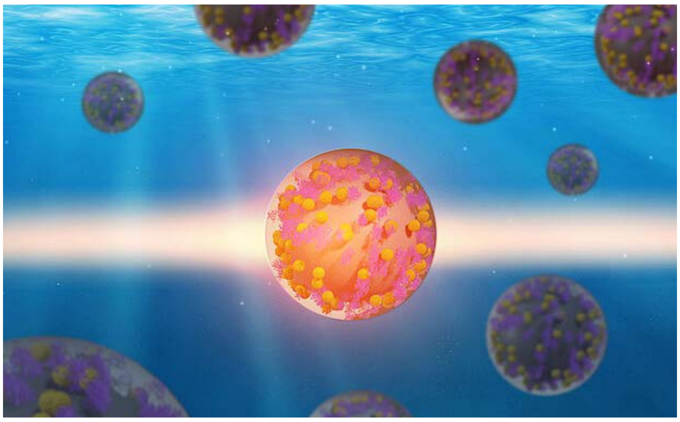
Original publication:
https://pubs.acs.org/doi/10.1021/acs.nanolett.3c00233

Nano-heating enables enzymes to work at sub-zero temperatures

Researchers from the SNI network have developed a strategy to enable the activity of a natural biocatalyst at low temperatures, down to -10°C.

Further information:
https://nanoscience.unibas.ch/en/news/details/nano-heizung-ermoeglicht-arbeit-von-enzymen-bei-minusgraden-1/

Original publication:
https://pubs.rsc.org/en/content/articlelanding/2022/na/d2na00605g



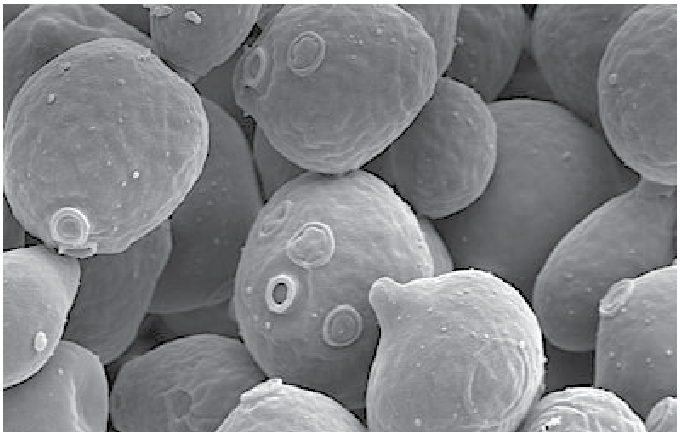
The nano-heating enables enzymes to work at sub-zero temperatures. (Image: FHNW)

Method to improve the yeast cell display

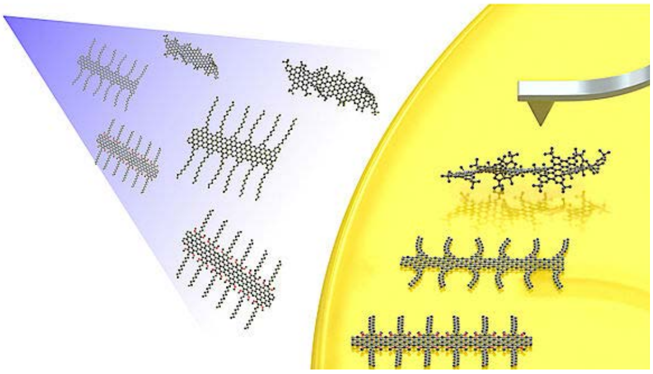
Researchers from the SNI network have developed a method to improve the so-called yeast surface display. Yeast surface display is a fundamental tool for protein engineering and targeted protein evolution.

Further information:
https://nanoscience.unibas.ch/en/news/details/methode-zur-verbesserung-des-hefeoberflaechendisplays-1/

Original publication:
https://pubs.acs.org/doi/full/10.1021/acssynbio.2c00351



Genetically modified cells of baker's yeast (*Saccharomyces cerevisiae*) synthesize proteins of interest on their cell walls using yeast surface display, a tool that enhances engineering and directed evolution of proteins. (Image: © M. Oeggerli/Micronaut, supported by University Hospital Basel and Biozentrum, University of Basel)



With high-vacuum electrospray deposition, extended graphene nanoribbons with special properties can be accessed for high-resolution studies. (Image: S. Scherb, Department of Physics, University of Basel)

Electrospray method expands range of different graphene ribbons

Researchers from the SNI network have accessed various graphene nanoribbons using high-vacuum electrospray deposition.

Further information:
https://nanoscience.unibas.ch/en/news/details/elektrospray-methode-erweitert-spektrum-an-verschiedenen-graphenbaendern/

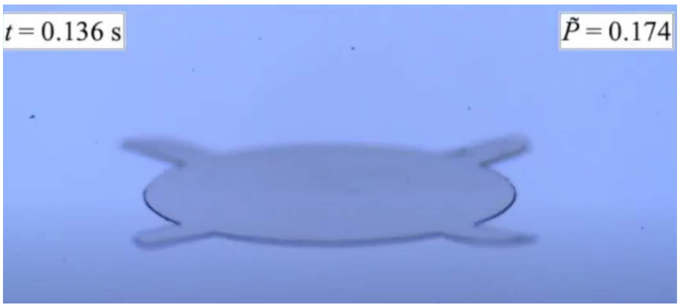
Original publication:
https://pubs.acs.org/doi/10.1021/acsnano.2c09748#

Floating thanks to sound waves

Researchers from the SNI network are investigating methods to keep particles in the air using sound waves (acoustic levitation) – for example for crystallographic studies of proteins. In a recent paper in *Applied Physics Letters*, they investigate ultrasonic rotors as sample holders. They show the influence of the size and shape of the rotors, which help to achieve controlled rotation of the samples held acoustically in suspension.

Further information:
https://nanoscience.unibas.ch/en/news/details/schwebend-dank-schallwellen/

Original publication:
https://pubs.aip.org/aip/apl/article/121/25/254102/2834889/Size-and-shape-dependent-rotation-characteristics



The shape and size of a rotor affect how samples can be held in suspension. (Image: PSI)

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