

Innovation @ UNIFR

Knowledge and
Technology Transfer
Service

University of Fribourg, Switzerland



Innovation @ UNIFR

Knowledge and Technology
Transfer Service
<https://www.unifr.ch/research/en/innovation/>

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Examples

UNIFR researchers collaborate with academia and industry and are successful in applying for innovation funds, like the Swiss Innovation Agency Innosuisse, the BRIDGE program, or Eurostars. The University provides support in the application process and by protecting the intellectual property.

Support

The Knowledge and Technology Transfer (KTT) Service helps to transform research results into benefits for society. Be it through a start-up or a collaboration with an established company, the KTT Service supports you in understanding and forging a path, as well as with the drafting, negotiation and approval of research contracts and patent applications. The KTT Service manages all the intellectual property of UNIFR.

Funding

The KTT Service supports you in setting up collaborations with industrial partners by identifying funding and by providing and negotiating the appropriate agreements. Collaborations can be directly financed by the industrial partners or co-financed with funds from Innosuisse.

Eco-friendly and safe plant protection



**Microorganisms for crop disease
prevention**

WHAT IS THIS ABOUT?

We are developing microorganism-based plant protection products that will help farmers produce healthy crops in an eco-friendly way. The microorganisms in our products can prevent disease development by directly inhibiting the pathogen and/or by inducing the plant's natural defenses. Our products aim to replace hazardous pesticides that are currently used to control economically important diseases in potatoes, tomatoes, and grapevine.

WHAT'S THE INNOVATION?

We use the innate abilities of plants to recruit beneficial microorganisms to identify and select microorganisms for biocontrol. These microorganisms, on top of their disease-inhibitory activities, are naturally well adapted to the plant and pose no risk to the environment or to human health. By combining different microorganisms with complementary abilities, we aim at developing biocontrol products that are efficient, reliable, and are not subjected to restrictions of use, unlike currently used pesticides.

WHAT ARE OUR PLANS?

We are currently conducting field trials to test our most promising microorganisms. We are also preparing a funding application to develop the formulation of our best candidates. As a next step, field trials will aim at optimizing the formulation and application timing and methods, and developing a prototype product. A second series of field trials will be conducted to validate the efficacy of the prototype at a larger scale. Our goal is to develop the product as a spin-off of the University, once we have our first prototype.

WHO WE ARE?

I am Mout De Vrieze, a bioengineer by training and currently working as a postdoc in Prof. Laure Weisskopf's group in the Department of Biology at the University of Fribourg. We have assembled collections of microorganisms isolated from potato and grapevine plants and characterized their disease-inhibitory potential. For our field trials, we collaborate with Agroscope and the Institut Agricole de Grangeneuve. I have recently completed the Innosuisse Business Concept training, together with a four-member team with skills in business management, law, and chemistry.

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DEPARTMENT: Department of Biology



Green technology for sustainable agriculture: towards a new generation of organic herbicides

New strategies to fight weeds

WHAT IS THIS ABOUT?

We are developing environmentally friendly herbicides that will strongly inhibit weed growth. Our environmentally friendly herbicide could be applied in the field to suppress the growth of unwanted plants. The compounds that we focus on are naturally produced in plants to control their growth. We focus both on non-selective plant inhibitors that could be applied in the field before planting the crops, as well as on finding selective inhibitors that will suppress the weeds and not the crop species. We will also develop a pipeline to scale up the bio-production of such compounds.

WHAT'S THE INNOVATION?

Weed control is critical to keep crop plants from competing with unwanted plants for water, nutrients and sunlight. To come up with new strategies for weed control, we focus on a very conserved genetic pathway in plants that regulates growth. Plants naturally produce biologically active substances to accelerate or slow down their growth. One group of signals strongly suppresses plant growth in all flowering plants. We performed analysis and identified several signals that are produced only in grasses (monocot species) or only in wide-leaf (eudicot species). Those are unique chemical signals that inhibit plant growth in some species and not in others. We also identified other compounds that are highly conserved and show strong inhibitory effects in all tested plant species. We test their activities and their potential to serve as phytotoxic substances. These bio-herbicides will change the world of weed control and help farmers and gardeners to protect their crops.

WHAT ARE OUR PLANS?

We are currently testing plant responses to a selection of smart-herbicides in several grass and eudicot species. Based on the bioinformatics analysis and literature, we focused on two eudicots and four monocot-specific signal compounds that have a potential to be used as selective plant inhibitors. At the same time, we focus on compounds that strongly suppress growth in a non-selective manner. We test such unique signals and their inhibitory effect on plant growth with the aim to develop organic herbicides. In parallel, we will focus on obtaining a patent for this innovation and proceed with scaling up the production of these substances and applying them in the field.

WHO WE ARE?

Dr. Ora Hazak is a Group Leader and trained as a plant molecular developmental biologist. Dr. Hazak has a strong track record in plant signaling and root development. Her laboratory at the Department of Biology, University of Fribourg, made important contributions in the field of plant peptide signaling. She conceived, developed, and will support the obtention of a patent for the bio-herbicides. Elliot Gobet is an assistant that currently performs the plant growth tests under the supervision of Dr. Ora Hazak.

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Enhancing the defenses of plants

Nanofertilizers

WHAT IS THIS ABOUT?

We have developed a patented, environmentally benign fertilizer based on silica. Our nanofertilizer enhances the defense of plants and makes them more resistant to disease, water, and drought stress. It can also be used as a delivery system for other ingredients.

WHAT'S THE INNOVATION?

The nanofertilizer reliably delivers beneficial orthosilicic acid to seeds and plants, thereby strengthening the plant through a variety of mechanisms. At the same time, the nanofertilizer can deliver other ingredients (including pesticides), reducing the amount of the ingredient needed for plant protection. The nanofertilizer degrades tracelessly in the environment.

WHAT ARE OUR PLANS?

We have scaled-up this technology with Innosuisse funding. Negotiations are in progress with some companies interested in licensing or supporting a start-up. If funding becomes available, we will partner with distributors, run screenings with more different crop plants, pathogens, and active ingredients, and register the product for sales on the market.

WHO WE ARE?

Dr. Fabienne Schwab is a Senior Scientist and trained Environmental Chemist (ETH Zurich) with a track record in environmental nanotechnology and plant science. She has conceived, developed, and patented the nanofertilizer, developed a business concept, and published the research in Nature Nanotechnology.

The scale-up partners are Prof. Roger Marti and Oliver Erni at HEFR (chemical engineering), and Prof. Bernhard Streit at BFH-HAFL (field trials). The project is also backed by the research group BioNanomaterials headed by Prof. Barbara Rothen-Rutishauser and Prof. Alke Fink at the Adolphe Merkle Institute.

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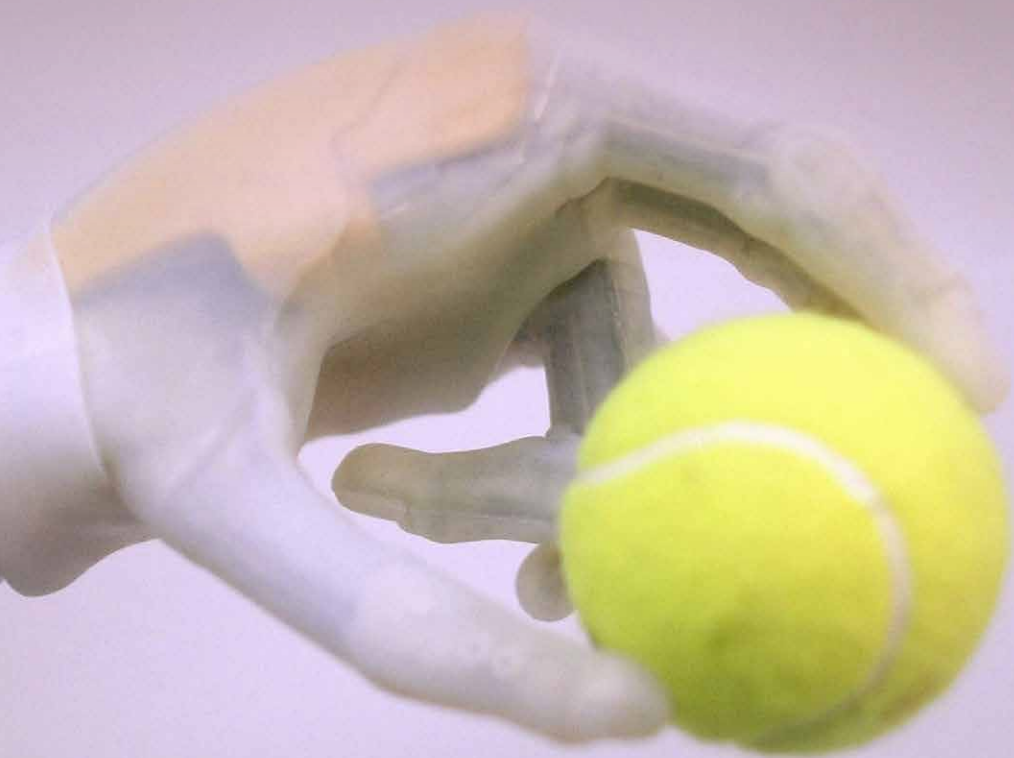
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DEPARTMENT:

Adolphe Merkle Institute, BioNanomaterials



Energy-autonomous soft robotic prosthetics



INTEGRATE project

WHAT IS THIS ABOUT?

The use of robotic prosthetic devices is a compelling strategy to reduce loss of mobility and functionality in patients suffering from amputations. Current devices are mostly designed using hard materials that are very different from biological tissues and rely on batteries that need to be continuously recharged. To overcome these limitations, we are striving to develop soft robotic prosthetics that draws on the body's own metabolic energy, no longer requiring an external recharge.

WHAT'S THE INNOVATION?

Our team will target two technological innovations. The first is the development of 3D-printed soft and biocompatible artificial muscles that precisely reproduce human muscles. The second innovation is the creation of an artificial electric organ capable of converting metabolic energy into electricity. Combining these two technologies will allow construction of robotic prosthetic devices that are soft like human muscles and do not need to be recharged.

WHAT ARE OUR PLANS?

We are laying the technological foundations for both the artificial muscles and the artificial electric organ. Our plan is to develop a lab-scale demonstrator within the next four years and subsequently apply for further (public or private) funding to bring the technology to the market.

WHO WE ARE?

The team comprises four research institutions (University of Fribourg, Eindhoven University of Technology, CNRS and University of Roma Tor Vergata) and a research association (Veltha IZV). Dr. Alessandro Ianiro of the Adolphe Merkle Institute (AMI), the scientific coordinator of the consortium, conceived the project with the collaboration of Dr. José Berrocal, Prof. Michael Mayer and Prof. Christoph Weder (all from AMI). The project received €3 million in funding in 2022 from the European Innovation Council under the prestigious Pathfinder program.

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WEBPAGE: www.integrate-pathfinder.com

DEPARTMENT: Adolphe Merkle Institute, BioPhysics



Advanced Thermal Imaging for nano- particle detection

NanoLockin

WHAT IS THIS ABOUT?

Nanoparticles are used in a large variety of applications or can occur unintentionally (e.g. environment, industrial production sites). Their characterization and detection are required to establish quality assurance protocols and assess environmental and health risks. Nowadays, these analyses have a high device and operational costs. NanoLockin's technology permits to significantly increase sample analysis throughput, leading to a strong reduction in analytical cost, and can be adapted for different needs depending on the type and occurrence of the nanomaterials.

WHAT'S THE INNOVATION?

Most nanoparticles absorb light and produce heat when subjected to light. We use the lock in thermography, a highly sensitive method for measuring very small temperature differences, to detect the heat produced by nanoparticles. Different nanomaterials can be analyzed by modifying the irradiation wavelength thanks to differences in the thermal signature. Compared to other methods, the handling of our instrument requires no special training or complicated sample preparation, reducing the time dedicated to this operation by at least a factor of 10.

WHAT ARE OUR PLANS?

In a Swiss research project with the University of Fribourg, we develop new applications for our instrument the Caliorsito VIS/NIR and we test our newly developed instrument the Calorsito UV. Furthermore, in a Eurostars Project in collaboration with a German company, we develop a miniaturized version of our instrument for the analysis of environmental particles and process control analysis for the industry. We will also attend several conferences to advertise and sell our instruments.

WHO WE ARE?

NanoLockin is a spin-off from the Bionanomaterials Group of the Adolphe Merkle Institute led by Prof. Alke Fink and Prof. Barbara Rothen-Rutishauser. The company was founded by Dr. Christoph Geers (Managing Director), Dr. Tobias Fink (Software Development), Dr. Gunter Festel (Business Development), and Dr. Mathias Bonmarin (Technical Development). The team is complemented by the collaborators Olivier Schaub (Instrumentation & Control Engineer), Ruggero Botteon (Software Development), Tim Friedrichson (Business Development), and Daniel Fehr (Application Development).

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DEPARTMENT: Adolphe Merkle Institute, BioNanomaterials



Swiss Digital Ethics Compass

Fuzzy assessment of digital services on ethical concerns

WHAT IS THIS ABOUT?

As technology becomes integrated into our life it is necessary to adopt a balanced approach to ethics. Several models have been adopted to clarify the various challenges in digital contexts. A practical and integrated tool is required to meet the demand for sustainable digital transformation in our everyday lives. We need to address the growing number of challenges in handling our digital data. Our model is designed to address these challenges in data, machine learning, and artificial intelligence that are interconnected with concerns of justice, sustainability, and climate change. Our ultimate goal is to implement a user-friendly digital ethics radar.

WHAT'S THE INNOVATION?

The objective is to evaluate the sustainability and ethical dimensions of digital services. Thereby, we focus on computational ethics, an approach that seeks to quantify and measure ethical values. Collaboration among ethical researchers, computer scientists, and business practitioners is necessary to integrally define justice-based benchmarks as evaluation standards for digital services. Ethics contributes by defining norms to be used as evaluation standards, and computer science and engineering are required to establish criteria and algorithms for assessing digital services.

WHAT ARE OUR PLANS?

We work on developing two tools. One is a «digital ethics compass», which will help assess how well Swiss citizens can control their digital activities. The second tool is a «digital ethics radar», which public service providers will use to make sure their practice aligns with ethical standards. The project's outcomes are expected to increase the value of our key partner, Swiss Post, which is interested in integrating our tools into the processes. Furthermore, the design is intended to be scalable for other types of companies and public service network industries (e.g., Swisscom, SBB, CKW). This project is supported by Innosuisse and Swiss Post.

WHO WE ARE?

The project is advanced by Narek Andreasyan, a PhD student at the Department of Informatics. Conceptualization and supervision of the project are performed by Prof. Edy Portmann, the co-director of the Human-IST Institute and head of the soft and cognitive computing group, and Dr. Luis Terán, lecturer at the Lucerne University of Applied Sciences and Arts and senior researcher in cognitive computing at the Human-IST Institute. The project is supported by Buson Daniele, research assistant, and Christina Meyer, the digital ethics specialist at Swiss Post.

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DEPARTMENT:

Department of Informatics



The Digital Cooperative

Handling user data for the future

WHAT IS THIS ABOUT?

We aim to create a concept and implement a Minimum Viable Product to incentivize user to share their personal data with a company. We would like to do so by providing virtual shares of the business to those contributing to it with their data. There is almost an unlimited number of use cases but we expect the creation of a digital twin of traffic flows as being a good one to start with.

WHAT'S THE INNOVATION?

Current approaches using customer data (e.g. google maps) do not incentivize users to share their data. The importance for companies to gather qualitative data might be a key supplement in smaller scale business models, as the ones expected to be present in the relatively small Swiss market. We plan to provide this incentive by providing virtual shares of the business model to those contributing to it with their data.

WHAT ARE OUR PLANS?

Jointly with Swisscom, BBV AG and the city of Lucerne, we are currently developing the concept for the «Digital Cooperative» The project is Innosuisse funded and is expected to end with a minimum viable product. In case of a successful test results, we are planning to roll-out across whole Switzerland.

WHO WE ARE?

The project involves five parties: University of Fribourg and University of Lucerne are doing the integrative design research work. Swisscom provides the infrastructure and is an important implementation partner in case of a swiss-wide rollout. BBV is responsible for user testing and any potential software development. And City of Lucerne provides know-how and the playing field for the tests. Also, we would like to thank Innosuisse for the funding!

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Visual modeling of augmented reality applications



**Augmented reality workflow
modeling language**

WHAT IS THIS ABOUT?

Augmented reality is a technology that overlays digital information onto real-world objects using devices such as smartphones, tablets or head-mounted displays to enrich human comprehension and interaction with the physical environment. The creation of augmented reality software applications requires advanced programming skills, particularly when aiming to realize complex, multifaceted scenarios. With the development of a visual modeling language for the definition of augmented reality workflows, we aim to make the development of augmented reality applications easier for non-programmers.

WHAT'S THE INNOVATION?

To design augmented reality workflows, we propose a new visual modeling language. In contrast to traditional approaches, the augmented reality application can be defined entirely without programming knowledge. A use case for such a workflow could be an augmented reality application for helping with furniture assembly. The language considers main concepts like the visualization of different virtual objects (augmentations), changing the appearance of these augmentations («statechanges»), and triggering such «statechanges», for example, based on time, place, or detected objects (conditions).

WHAT ARE OUR PLANS?

Traditional modeling languages are mainly used in two-dimensional modeling tools. Since the newly proposed modeling language considers the specification of augmented reality applications, the third dimension must be considered. To easily define such three-dimensional models, a new modeling tool with three-dimensional support is needed. Such a modeling tool is currently under development. Based on this modeling tool, the augmented reality workflows can then be defined in a three-dimensional environment, and the user can execute the workflows directly on an augmented reality device such as a smartphone.

WHO WE ARE?

This is a project of the DIGITS group (Digitalization and Information Systems) which belongs to the Department of Informatics of the University of Fribourg and is partially funded by the Smart Living Lab (SLL). The research topics of the group focus on the design, implementation and application of IT-based modeling methods to enable the digitalization of organizations. Thus, the group carries out research projects in the field of enterprise and conceptual modeling as well as projects that explore the challenges of today's enterprises and support stakeholders through innovative IT-based approaches.

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Smartphone-based fluorescence microscope for early diagnosis

Sensitive, affordable, and portable point-of-care device

WHAT IS THIS ABOUT?

Affordable and portable point-of-care devices are in high demand, particularly in the context of pandemics or in the field. Benchtop fluorescence microscopes are highly sensitive but costly and require trained operators. In contrast, Smartphone-based ones are accessible but are less sensitive and often designed for a single-phone model. We have successfully developed a smartphone-based fluorescence microscope that is inexpensive, portable, usable with multiple smartphone models, and capable of detecting a single fluorescent molecule like a benchtop microscope.

WHAT'S THE INNOVATION?

Our fluorescent microscope can directly detect a single molecule without the use of additional enhancement elements. Such sensitivity is similar to a state-of-art of benchtop microscope. Reaching this sensitivity would help provide early disease diagnosis even before the development of symptoms. Moreover, our device can be used with different smartphone models without any modification or the need for realignment of optical components.

WHAT ARE OUR PLANS?

Our plan is to prove the concept of our microscope, through a diagnostic assay, and show that our device can achieve at least a sensitivity comparable to current state-of-the-art tests. Subsequently we will apply for funding, from BRIDGE or INNOSUISSE to create a fully functionally point-of-care device. Eventually, we aim to establish a spin-off and commercialize the device.

WHO WE ARE?

The development of this microscope is a project of the Photonic Nanosystems group in the Physics department of Fribourg University. The portable and inexpensive version of the microscope is developed by Morgane Lorétan in the framework of her PhD thesis under the supervision of Prof. Guillermo Acuña, and with the help of Nathan Fuchs. The project was first started as a benchtop version at LMU of München by Prof. Guillermo Acuña and continued at the University of Fribourg by Morgane Lorétan, and Dr. Mathias Lakatos.

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Sustainable paint using biocompatible materials

Structural coloration replacing
pigment-based paints

WHAT IS THIS ABOUT?

Many colors fade with time. Among those that do not, we often find toxic substances based on metal oxides. We aim to create a novel type of long-lasting and environmentally-friendly paint based on light interference, without using pigments. With this type of 'structural colour' we can start from the same raw materials to make a range of different colours. This can be achieved by assembling the raw materials in different ways, thereby changing the way light is scattered by them. Our goal is to create prototypes of structurally colored objects that can be used in everyday life.

WHAT'S THE INNOVATION?

Instead of using pigments, we employ 'structural color', which is the color that arises from the interaction of light with a material's micrometric structure. Through this approach, we can create different colors using identical starting materials built with several distinct structural arrangements. We will focus on biocompatible materials. The absence of pigments will not only eliminate toxic substances from the production process but will also simplify recycling, because all colors will be composed of the same basic components, preventing the need for sorting during disposal.

WHAT ARE OUR PLANS?

Our strategy involves creating prototypes of structurally colored objects that are present in daily life. We have received support from the Centenary Research Fund of the University of Fribourg, which we will use to test the concept on a small scale. We further plan to apply for an Innosuisse grant with the aim to develop and refine the paint formulation, production and its application. We are engaged in discussions with representatives of several companies to develop collaborative projects centered around concrete problems and products.

WHO WE ARE?

The project is led by Dr. Sofia Magkiriadou, a postdoctoral researcher in the Soft Matter and Photonics Group under the leadership of Prof. Scheffold at the Department of Physics. The group has expertise in optical materials, both in terms of theoretical understanding as well as in their hands-on preparation; these qualities are central to this project. As a physicist with a long-lasting interest in structural coloration, Sofia's goals are to better understand the optical phenomena that determine color quality and to find new ways of making structural color.

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Membranes for gas separation

Reducing the emissions to achieve
net zero

WHAT IS THIS ABOUT?

We have developed graphene-based membranes that allow separating gas mixtures based on their affinities. Our first prototype allows the separation of low-content hydrogen from various mixtures at room temperature and with 100% efficiency. Our membranes can be adapted for any gas.

WHAT'S THE INNOVATION?

Traditionally, low-content hydrogen gas separation is challenging and it is achieved either by burning hydrogen and subsequent cryogenic cooling or using membranes at elevated temperatures (400–600 °C). These processes are highly energy-intensive and bear the risk of explosion. Our patented technology (Patent application: WO2022/136447) reduces the energy needs for this process at least 100 times and makes the process much safer.

WHAT ARE OUR PLANS?

We received a prestigious Bridge Proof-of-Concept Grant to develop a membrane separation unit for capturing hydrogen leaks from fuel cells by increasing their efficiency. For this, we need to develop a scalable fabrication of the membranes. Once we optimize this step, we will establish a start-up company and start field tests with industrial partners.

WHO WE ARE?

I am Dr. Timur Ashirov, a postdoctoral researcher at the University of Fribourg, Department of Chemistry. I have developed this project under the guidance of Prof. Ali Coskun. The results of this project were published in one of the highly prestigious materials science and chemistry journal, Chem, and was also highlighted as a front cover for the September 2021 issue. To protect our invention, we filed an international patent application and submitted a BRIDGE proof of concept grant application.

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DEPARTMENT:

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Impossible Materials



**Replacing harmful white pigments
with cellulose**

WHAT IS THIS ABOUT?

Nowadays, white materials are present everywhere. Examples range from food, pharma, cosmetics, printing, paint, paper to coating industries. Current white enhancers are often metal-based, non-degrading materials and have recently raised serious health and environmental concerns leading to an EU wide ban.

WHAT'S THE INNOVATION?

We have developed a process to extract cellulose that can be used as white pigments or opacifiers. Cellulose is widely available, biocompatible and easy to process. Our patented, brilliantly white pigments from cellulose can be scaled with industry-proven processes and are safe to humans.

WHAT ARE OUR PLANS?

Currently we characterize our material properties, scale the production from milligram to kilogram scale in collaboration with HEIA. We are funded by Innosuisse and BRIDGE. In the future we want to start a company in Switzerland. Initially the spinout company will be selling cellulose-based white pigments to health sensitive industries, focusing on food, pharma and personal care, where biocompatibility drives buying decision, and will thereafter expand into mass-market segments.

WHO WE ARE?

Our technology has been developed by cellulose expert Prof. Silvia Vignolini at the University of Cambridge and was taken towards an innovation project by Dr. Lukas Schertel. He moved to the UNIFR through an SNSF BRIDGE project in the group of Prof. Frank Scheffold, an expert in optical materials. The team further includes a cellulose chemist and a chemical engineer.

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Innovative antibacterial coatings



Preventing infections and ensuring a fast recovery

WHAT IS THIS ABOUT?

Despite modern advances in medical devices, implant-associated bacterial infections remain a significant issue for some patients and are costly for society. While these bacterial infections are difficult to diagnose and treat due to bacterial biofilm formation and antibiotic resistance, our innovative antimicrobial coatings can prevent infections over months to ensure a healthy and fast recovery.

WHAT'S THE INNOVATION?

We developed antimicrobial coatings based on silver-filled inorganic nanocapsules and mesoporous capsules made of biocompatible silica, ceria, or titanium dioxide. After being tested in vitro and in vivo, silver release activities from capsules show that they can prevent infections of staphylococci strains during the healing phase and last for mid-to long-term use. Our biocompatible coatings can be adapted for different antimicrobial metals.

WHAT ARE OUR PLANS?

Financed by different Innosuisse, SNSF, and NCCR grants, we plan to fine-tune our active antibacterial coatings and upscale them with long-term performances. In collaboration with industrial partners, we plan to implement our technology for orthopedic, dental, and cardiovascular medical devices.

WHO WE ARE?

The team is composed of Prof. Katharina M. Fromm and senior and junior scientists with chemists, biochemists, and biology backgrounds. Prof. Fromm is internationally known for her work in bioinorganic chemistry of silver, silver compounds, and nanoparticles and their application as antimicrobial materials.

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Luminescent sensor for wine cork taint detection

High-sensitive TCA detection

WHAT IS THIS ABOUT?

One important challenge that the Europe wine sector faces is the alteration of wine aroma caused by the well-known 2,4,6 trichloroanisole (TCA) molecules which threatens its competitiveness. By using our luminescent sensor, producers of wines and corks as well as consumers would be able to detect TCA in a fast manner. This technology has higher sensitivity compared to traditionally instrumental gas chromatography techniques, which are expensive, time-consuming and require skilled personnel.

WHAT'S THE INNOVATION?

We have developed functional active mesoporous coordination polymers based on anthracenes chromophores and transition metal ions as efficient luminescent sensors. Their physicochemical properties are tuned by modifying the surface area and the porosity to capture as much as possible TCA and other targeted molecules such as pesticides, explosives, and air pollutants.

WHAT ARE OUR PLANS?

We plan to implement industrial collaborations acting in different fields (Food, Environment, and Medtech) to better develop our luminescent sensor according to industrial needs. We also intend to submit Innosuisse projects for prototyping our smart sensor.

WHO WE ARE?

Prof. Katharina M. Fromm with her seniors and juniors' scientists have developed several inorganic coordination compounds with different applications in different fields. They have published multiples articles and reviews and presented their research at various international conferences.

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A photograph of a waste collection worker in an orange high-visibility uniform operating a truck. The worker is looking towards the right side of the frame. The truck is orange and has a large black trash bin mounted on it. The background shows a clear blue sky and a building.

Interactive decision-support tool to choose the best waste collection strategy

Towards more efficient and sustainable waste collection strategies

WHAT IS THIS ABOUT?

In many Swiss municipalities, a door-to-door collection is often used to gather the non-recoverable waste. This comes with negative effects such as high fuel consumption, emissions and noise. We aim at making the non-recoverable waste collection process more efficient and more sustainable with the development of an interactive decision-support tool that helps municipalities to choose the strategy that best suits their needs.

WHAT'S THE INNOVATION?

To define a new collection strategy, we design and implement algorithms to optimize the related decisions, such as the location of collection points and the routes performed by the collection vehicles. The interactive tool enables municipalities to specify their characteristics (such as the street network and the expected generated waste). Then, it displays several efficiency, sustainability and cost indicators of the various strategies to assist the municipality in choosing one.

WHAT ARE OUR PLANS?

We have conceived a prototype of the interactive decision-support tool that accommodates the waste collection strategies and the algorithms that allow to characterize them. This has enabled us to gain valuable experience in the conception and development of a decision-support tool from scratch. Our idea is now to apply this knowledge to other transportation and logistical contexts.

WHO WE ARE?

This project is funded by Innosuisse and involves three parties. From the University of Fribourg, the Decision Support & Operations Research Group (DS&OR) handles the implementation of the interactive tool and its backend optimization algorithms, and the International Institute of management in technology (iimt) deals with the communication aspects of the tool from an innovation point of view. Schwendimann AG, the implementation partner, is responsible for the development of the innovative collection concepts and practical tests.

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DEPARTMENT:

Decision Support & Operations Research Group (DS&OR), Department of Informatics



AirSpec

A wearable comfort perception platform

WHAT IS THIS ABOUT?

How do we know what's wrong with indoor and outdoor environments when we sense discomfort? How would our environments influence our attention and cognition? To address these questions at a close level that a person would experience, our research team developed AirSpec, an extensible research and development smart glasses platform that evolved from an existing open-source system with custom software toolkits that allow users to interact with the device and collect data remotely.

WHAT'S THE INNOVATION?

AirSpec counts with a variety of sensors that sample physiological and environmental signals and stream that data in real-time to the AirSpec App on an iPhone and an Apple Watch, where users can interact with it and report their comfort. All the sensors are embedded within the frames of the eyeglasses and sense face temperature, eye blink dynamics, head motion, ambient temperature and humidity, ambient gasses, sound levels, and ambient light levels. Participants in three countries in different climatic regions interact with this system to tell us more about their comfort in the wild.

WHAT ARE OUR PLANS?

As human-computer interaction researchers, we strive to continue to develop novel hardware and software to improve people's well-being. In terms of the continuation of the AirSpec project, there are a few research teams who are interested in adapting this system for studies in the neuroscience, medical and architecture fields and we plan to support their studies. Our focus is to continue with the development of the AirSpec project by supporting different research teams exploring its applications to adapt our prototype in the neuroscience, medical, and architecture fields. By fostering interdisciplinary collaboration, we aim to drive innovation and holistic progress.

WHO WE ARE?

This is an international collaborative project from three research institutions where Patrick Chwalek, David Ramsay, and Nathan Perry from the MIT Media Lab created the AirSpec smart glasses as well as the backend logging system. Sailin Zhong from the University of Fribourg designed and developed the AirSpec mobile and smartwatch App. Professor Clayton Miller from the National University of Singapore, professor Denis Lalanne from the University of Fribourg and professor Joseph Paradiso from the MIT Media Lab are the PIs of the user studies in three countries.

PARTNERS: MIT Media Lab, National University of Singapore

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Digital interventions to improve health



Neuria Digital Therapeutics

WHAT IS THIS ABOUT?

We propose digital interventions to improve health by restoring healthy eating behaviors. We design professional-level videogames that incorporate new, patented, brain training mechanisms allowing us to reduce people's craving to targeted unhealthy foods.

WHAT'S THE INNOVATION?

In contrast to conventional effortful dieting approaches based on maintaining self-control, our interventions improve eating habits without the person even realizing it. In our digital interventions, practicing the games implementing our mechanism of action automatically induce targeted brain and behavioral changes.

WHAT ARE OUR PLANS?

We are currently working on the prevention and treatment of excessive sugar intake in diabetes, offering our technology to insurance companies, pharmaceutical firms and research institutions. In the future, we plan to develop new modules targeting smoking or alcohol consumption. We are constantly working to improve our solutions, whether through research projects or product development.

WHO WE ARE?

We are an interdisciplinary team with expertise in neuroscience, psychology, programming and arts. Originating from the Medicine Section of the University of Fribourg, our core value is to improve populations health at a large scale, with evidence-based digital therapeutics interventions. We are committed to providing high-quality, Swiss-made software and services. We are supported by FriUp since 2021 as well as by the Innosuisse grant.

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Repairing nervous system lesions

**Epigenetic modulators
to rebuild myelin**

WHAT IS THIS ABOUT?

Myelin is essential for nervous system function and protection. In patients suffering from multiple sclerosis (MS), the most frequent degenerative disease of the central nervous system, myelin is progressively lost. There is currently no treatment that helps rebuild myelin. We have identified a treatment that promotes myelin reformation in animal models of multiple sclerosis, Charcot-Marie-Tooth disease (CMT), a large group of peripheral neuropathies, and after a traumatic injuries.

WHAT'S THE INNOVATION?

We found that activators of the epigenetic regulator histone deacetylase 2 (HDAC2) promote myelin reformation in animal models of MS, CMT, and after traumatic injuries. Theophylline is a potent activator of HDAC2 at low dosage. It has been so far used at high dosage as a phosphodiesterase inhibitor for the treatment of lung diseases. Our first remyelinating drug is Theophylline used at a low dosage. We have two main patents for this re-purposed treatment, one currently at the national phase in Europe and the US and a very recent remyelination-specific formulation patent application.

WHAT ARE OUR PLANS?

So far, no drug for remyelination is approved. Our startup will offer a long-sought-after treatment paradigm for MS, CMT, and traumatic injuries. Phase II clinical trial results will be available within 4 years, allowing for an attractive clinical phase III financing round or a lucrative exit strategy for investors. Four additional molecules for axonal regeneration and remyelination should be under patent within 4 years.

WHO WE ARE?

Prof. Claire Jacob and Mr. Thomas Meier will be the founders of the startup. Prof. Jacob was SNSF Professor at the University of Fribourg (Dept. Biology) and is now a Professor in Cellular Neurobiology at the University of Mainz in Germany. Prof. Jacob has received two prestigious Prizes for her research on Epigenetics and nervous system Regeneration and is a recognized expert in the field of remyelination and axonal regrowth. Mr. Meier is the CEO of Bachem, a peptide-manufacturing company, and a pharma industry expert with 28 years of experience.

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A microscopic view of several cells, likely yeast, showing internal organelles and fluorescent markers in green and orange. The cells are arranged in a cluster, with some showing more intense fluorescence than others.

Precision monitoring of autophagy via a targeted proteomic approach

**Illuminating the pathways of cellular
renewal**

WHAT IS THIS ABOUT?

Understanding the process called autophagy, the biological removal of superfluous components, has become increasingly important due to its direct implications in diseases, such as Alzheimer's and cancer. To address the complexity of autophagy regulation and activity in an unbiased manner, we have developed a targeted proteomic approach amenable to high throughput. This new technology will allow shedding light on this essential pathway, offering invaluable insights for developing targeted therapies and advancing human health.

WHAT'S THE INNOVATION?

Our invention introduces a cutting-edge approach employing mass spectrometry-based targeted proteomics. By using synthetic peptides as benchmarks, our method enables precise and absolute quantification of specific proteins known to be involved in diverse autophagy pathways. This technology provides researchers and pharmaceutical companies with accuracy in monitoring autophagy activity and selectivity. By unlocking the intricacies of this process, our innovation lays the foundation for significant advancements in the field of autophagy research and drug development.

WHAT ARE OUR PLANS?

The assay will be benchmarked, standardized, and licensed to interested analytical or pharmaceutical companies which plan to target or monitor autophagy in (pre)clinical settings. This invention will be used by these companies to effectively understand the impact of new type of drugs that target autophagy in several diseases. We hope that the licensing will help in reaching the market faster, improving the invention and help in implementing it.

WHO WE ARE?

The project was established by Alexandre Leytens and Dr. Michael Stumpe in the group of Prof. Jörn Dengjel at the Department of Biology, University of Fribourg. For 20 years we have been working on autophagy and its role for human health. The discovery of selective autophagy pathways opened the opportunity to specifically target autophagy subtypes in diverse disease settings. Employing our extensive mass spectrometry expertise, we developed this assay in the last five years and are actively using it in academic research.

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A blood test for breast cancer detection and monitoring

Exploiting the inflammatory response of the body to detect cancer

WHAT IS THIS ABOUT?

Breast cancer is the most frequent cancer in women worldwide. Mammography screening has significantly contributed to decrease breast cancer mortality; however, it has some limitations including risk of overdiagnosis and overtreatment, limited sensitivity and specificity and it is not recommended for young women (<50 years). Furthermore, no tests to monitor patients after therapy to detect possible relapses are currently available. To fill these gaps, we propose a first-in-class blood test for the early detection of breast cancer and active monitoring after treatment.

WHAT'S THE INNOVATION?

Our test exploits patient's systemic immune/inflammatory response to the tumor. The response is detected by monitoring changes in the white blood cells (leukocytes) circulating in the blood. This approach is more sensitive and specific compared to traditional tumor-derived biomarkers tests.

WHAT ARE OUR PLANS?

At UNIFR, we have conducted a clinical biomarker discovery and validation study in collaboration with CHUV, HFR, HNe, and other centers. A combination of diagnostic biomarkers has been identified and a second validation study is in progress. The development and commercialization of a test kit will be done by XEMPERIA, a spin-off company of the UNIFR. In parallel we are designing a new generation of nanosensors for biomarker detection.

WHO WE ARE?

Project team members are: Curzio Rüegg, Medical Doctor with 25+ years experience in cancer research and biomarker discovery; Sarah Cattin, Master of Science with 10+ years experience in cellular and molecular analytics; Frédéric Fer, Master of Science, biostatistician with 10+ years experience in biomarker discovery and artificial intelligence; Ivana Domljanovic, PhD in Medical Sciences with 5+ years experience in diagnostics DNA nanotechnology.

The project is being supported by UNIFR, ISREC foundation, Innosuisse, Association Payot and an anonymous donor through the Fondation de l'Université.

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