PORTRAITS OF RESEARCHERS

SPW RESEARCH PUBLISHING

[VOLUME 6]

EDIWALL

Wallonie

Alexandra LACROIX and Pierre DEMOITIÉ,
programme managers

INTRODUCTION

This sixth volume of «Portraits of researchers» ends a series of publications launched in March 2016 during the first BEWARE program.

This program, and its successor, aimed to engage researchers from all backgrounds within Wallonia's research units (universities, university colleges, research centers, companies) who wished to undertake a mixed postdoctoral stay, meaning in both academic and industrial environments.

The gamble for this unique program in Wallonia has, it can be said, paid off. In total, nearly 130 researchers have come through our doors over the past 10 years.

The work of the last 10 recruited researchers is described in the following pages.

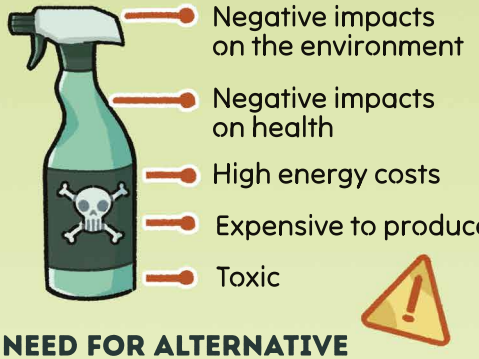
The first researchers have since returned to their home countries, moved to another lab elsewhere, or remained in Belgium, either at another university or in another company.

This three-year stay, for most of them, will have positively marked, we hope, their professional journey.

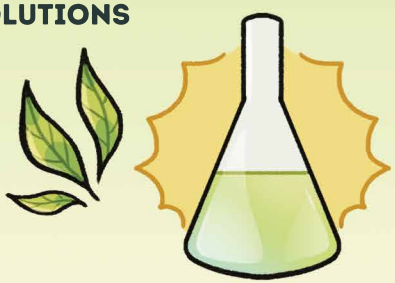
CONTEXT

The prevention of microbial contamination is essential in the agri-food industry and in other sectors of health and biotechnology.

DRAWBACKS OF CURRENT BIOCIDE PRODUCTS



NEED FOR ALTERNATIVE SOLUTIONS

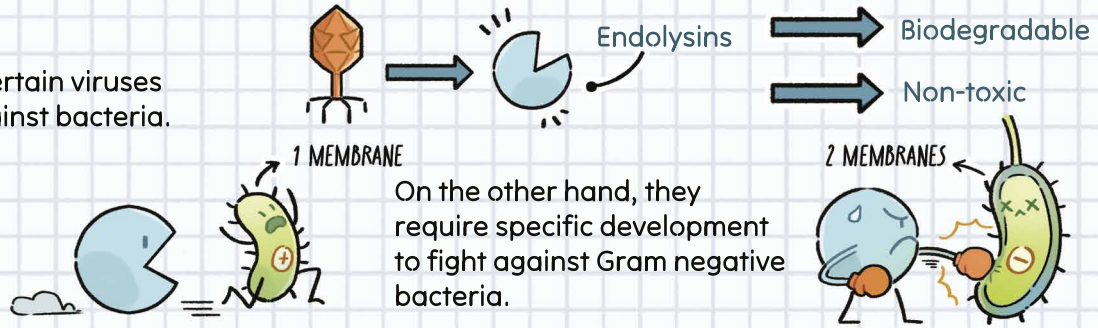


- ✓ Health respectful
- ✓ Environment respectful

THE PROJECT

Endolysins produced by certain viruses are enzymes effective against bacteria.

Purified, they destroy Gram positive bacteria very well.



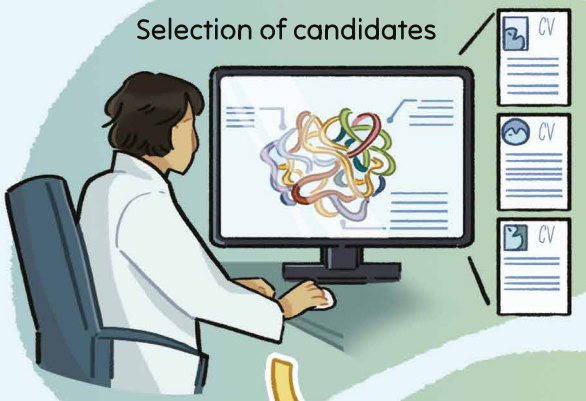
On the other hand, they require specific development to fight against Gram negative bacteria.

STEPS

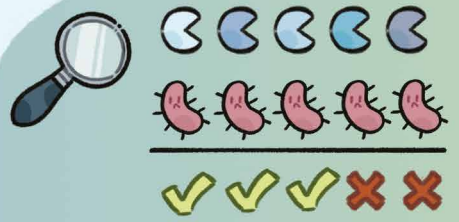
Illustration : CPiG.be

SELECTION

Selection of candidates



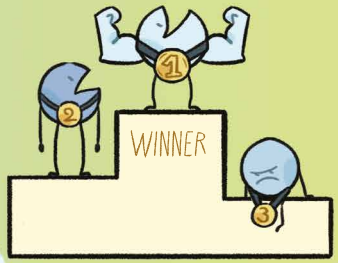
2) SCREENING



Selection of the most effective enzymes against ESKAPE bacteria

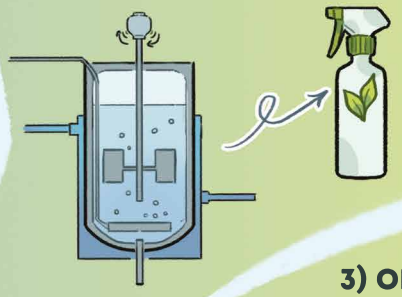
- **E**scherichia coli
- **S**taphylococcus
- **K**lebsiella pneumoniea
- **A**cinetobacter baumannii
- **P**seudomonas aeruginosa
- **E**nterococcus faecalis and faecium

3) OPTIMIZATION



Selection of the best candidates

4) INDUSTRIAL PRODUCTION



Mass production of selected enzymes

LIÈGE université

REALCO
ENZYMES FOR LIFE

Debojyoty **BANDYOPADHYAY**

COUNTRY OF ORIGIN	INDIA
COUNTRY AT TIME OF SUBMISSION	INDIA
DURATION	36 MONTHS
PROMOTORS ▾	
RÉALCO (LAURENT DELHALLE) | **REALCO.BE**	
UNIVERSITÉ DE LIÈGE (MOHAMED TERRAK) | **WWW.ULIEGE.BE**	

A NEW BREED OF BIOCIDES

PhD in Science from Jadavpur University in Kolkata, India, Debojyoty crossed borders to pursue postdoctoral research in Wallonia, more precisely in Liège.

Who are you ? *I am a highly motivated and adaptable scientist, passionate about research and deeply committed to developing innovative therapeutic strategies. My work is driven by curiosity and the desire to translate fundamental discoveries into meaningful biomedical applications. I place great importance on interdisciplinary collaboration, which allows the integration of diverse scientific expertise to generate creative solutions and overcome new challenges.*

What do you bring to the project partners ? *With over five years of experience in molecular biology research, I bring strong expertise in designing, optimizing, and implementing innovative scientific studies efficiently and precisely, while ensuring a safe and compliant laboratory environment. My previous role in technology transfer also gave me valuable insight into industrial perspectives. By combining academic rigor with a translational approach, I aim to deliver innovative results that benefit both partners and strengthen their collaborative research goals.*

What is the research about ? *This project aims to develop new, innovative enzymes to specifically target Gram-negative bacteria, particularly those in the* ESKAPE group (Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa, and Enterobacter spp.*). Through close collaboration between the Protein Engineering Center at the University of Liège and the company* Realco*, the goal is to create a broad-spectrum biocide to fight contamination in industrial and medical environments, while reducing harmful chemical products.*

And what about the mix of academia and industry ? *The EnzyLytic project offers me an excellent opportunity to gain international experience outside my home country. I am particularly motivated by the dual academic and industrial framework of the project. Working within the partnership between the University of Liège and* Realco *excites me greatly and will strengthen my ability to translate academic research results into concrete industrial innovation.*

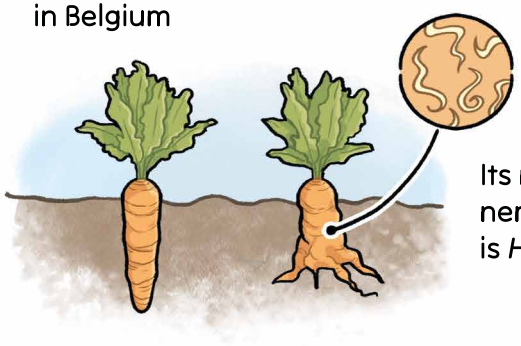
THE ENZYLYTIC PROJECT

Microbial contamination prevention is essential in the agro-industry and other health and biotechnology sectors. Traditionally, it has been managed using chemical biocides. However, the rise in resistance to these antimicrobial agents, growing concerns about their environmental and health impacts, and the high costs associated with their production– including energy consumption, CO_2 emissions, and the need to treat potentially toxic residue –are driving a paradigm shift toward alternative solutions that are safer for health and the environment.

The partnership between the University of Liège and *Realco* aims to develop recombinant endolysins (enzymes from bacteriophages) targeting major bacterial pathogens, to be used as biocides for hygiene management in the agro-industry and other sectors. In this project, we specifically aim to develop innovative enzymes to target Gram-negative bacteria from the ESKAPE group.

CONTEXT

Carrots are an important crop in Belgium



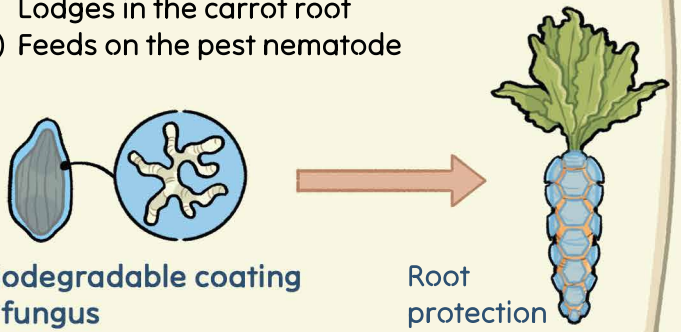
Its main nematode pest is *Heterodera carotae*

Since 2009, a European directive has aimed to reduce the use of chemical pesticides in agriculture

OBJECTIVES OF THE PROJECT

Develop an eco-innovative seed coating technology using a nematophagous fungus that:

1) Lodges in the carrot root
2) Feeds on the pest nematode

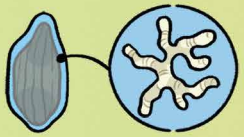


Biodegradable coating + fungus

Root protection

Illustration : CPiG.be

PROJECT PHASES (LAB AND GREENHOUSE)

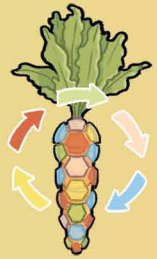


Inoculation of the nematophagous fungus (NF) on carrot seeds using a technology called "Biotization"

Study of the impact of the biotization on carrot plant growth

In vitro study of the NF's effect on nematode control

Study of the NF's effect on beneficial fungi naturally present in carrot roots (mycorrhizal fungi, MF)

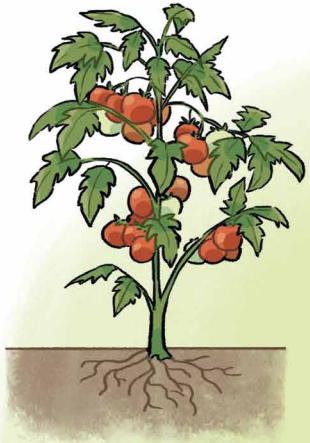


Synergistic effect between the NF and the MF

AGRICULTURAL ADAPTATION

Adaptation of the product for agricultural application and valorization by the company

medinbio
MORE NATURE, MORE SCIENCE



PERSPECTIVES

Transfer the results to other crop seeds, such as tomato, which is also affected by pest nematodes

UCLouvain

Maria-Lorena GIACHERO

COUNTRY OF ORIGIN	ARGENTINA
COUNTRY AT TIME OF SUBMISSION	ARGENTINA
DURATION	36 MONTHS
PROMOTORS ▾	
MEDINBIO (THIERRY PICAUD) | **WWW.MEDINBIO.COM**	
UNIVERSITÉ CATHOLIQUE DE LOUVAIN (STÉPHANE DECLERCK) | **WWW.UCLOUVAIN.BE**	

A FUNGUS WITH PHYTOSANITARY PROPERTIES

Maria Lorena Giachero is from Argentina. She is a Research Scientist at the Instituto de Tecnología Agropecuaria (INTA). She defended her Ph.D. thesis in 2015 at the Universidad Nacional de Córdoba, located in the heart of the country, in the province of the same name, after completing a Master degree in Biotechnology at the *Universidad Internacional de Andalucía* in Spain.

In 2011, she had the opportunity to complete a six-month internship within Professor Declerck's research unit. «*I received training in in vitro culture at the Mycology Laboratory in Louvain, and afterwards we continued working together remotely. This collaboration resulted in the publication of five joint articles, demonstrating the excellence of the partnership between our two laboratories*», explains Dr. Giachero.

«*The current MYCOPHYTO project allows me to learn new laboratory techniques, collaborate with a team of world-renowned scientists in the biocontrol of plant pathogens, conduct experiments, collect and analyze data, and contribute to research publications*», she continues. Indeed, the researcher has a particular professional interest in generating knowledge about beneficial interactions between soil microorganisms and plant roots, and their role in protecting against pathogens.

The BEWARE mandate is important for the researcher: «*It offers me the opportunity to broaden my horizons through international work experience, in a multicultural environment, which not only improves my adaptability but also enriches my understanding of different cultures*», she emphasizes. «*This experience strengthens my ability to collaborate effectively with people from diverse backgrounds, as I view it as a valuable opportunity to build meaningful relationships that contribute to my growth both personally and professionally.*»

She also likes to highlight that this postdoctoral position allows her to broaden her vision of research toward solving real-world problems and opens doors not only to future scientific collaborations but also to opportunities in the business world.

THE MYCOPHYTO PROJECT

Control methods for diseases and pests in agriculture are still largely limited to the use of chemical plant protection products, despite the environmental and human health issues associated with their use. To address these problems, Europe requires Member States to develop a national action plan, such as Belgium's National Action Plan for Pesticide Reduction (2013–2017, 2018–2022, and 2023–2027).

To overcome this challenge, the MYCOPHYTO project aims to develop an eco-innovative product based on the formulation of endophytic fungal strains with biocontrol activity against pests (in this project, phytopathogenic nematodes) and plant-biostimulatory properties, incorporated into crop seed coatings. This approach would allow either the replacement of existing plant protection products or a reduction in their dosages or application frequency.

In the MYCOPHYTO project, carrot is used as a «proof of concept». It is an important crop in Belgium, and its main nematode pest is *Heterodera carotae*. The results could then be transferred to other economically important crops and would also enable the development of a high-value-added product with positive impacts on job creation in Wallonia.

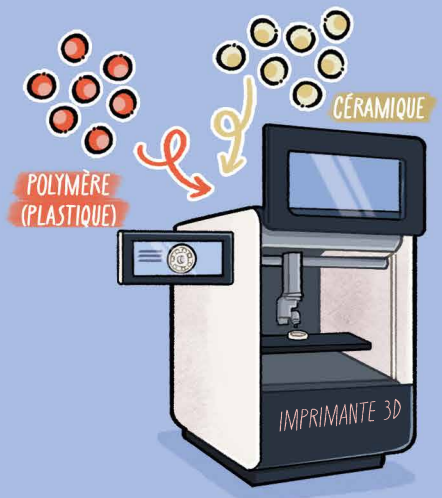
Illustration : CPiG.be

PROJECT OBJECTIVE

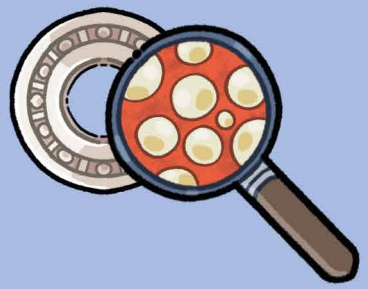
Develop a rapid ceramic manufacturing chain by integrating two key technologies:
a 5 axis hybrid fabrication process and an accelerated debinding/sintering process named QuickSint.

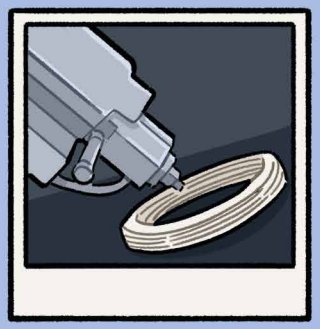
UMONS University of Mons
BCRC Belgian Ceramic Research Centre
pollen your chemistry inside

5 AXIS HYBRID FABRIC

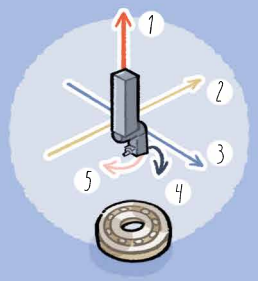


This technology combines additive manufacturing — PAM method (Pellet Additive Manufacturing) ...



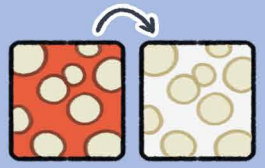


... with a multiaxial positioning system that allows excellent accuracy and surface quality of ceramic parts.

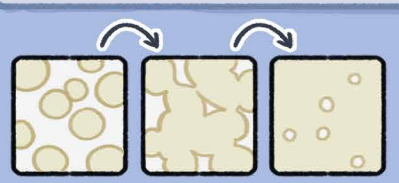


This system also makes it possible to fabricate pieces with complex shapes by improving accessibility during configuration or geometry control.

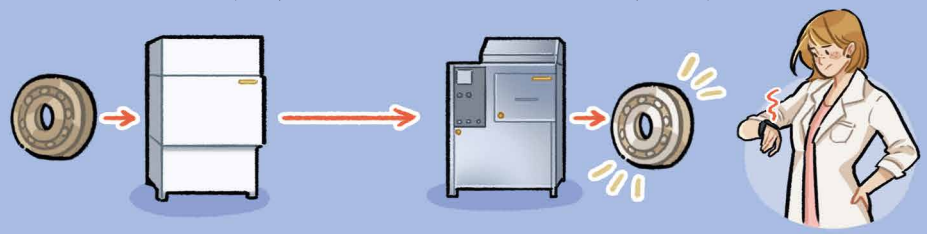
2. QUICK SINT



DEBINDING
Remove the polymer

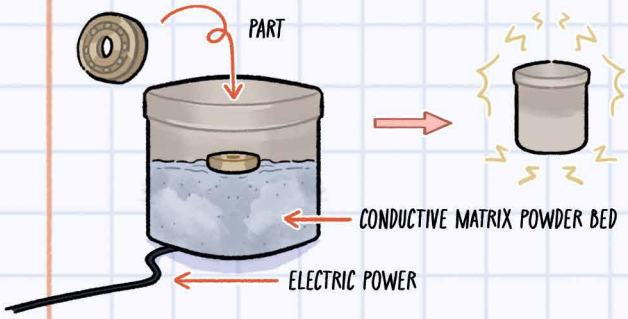


SINTERING
Solidify the part



But these steps can take several hours or even several days!

The QuickSint process aims to optimize the debinding and sintering times of parts produced by PAM.



- ☑ Quick
- ☑ Efficient
- ☑ Cost reduced

Pierre GRIMAUD

COUNTRY OF ORIGIN	FRANCE
COUNTRY AT TIME OF SUBMISSION	FRANCE
DURATION	36 MONTHS
PROMOTORS ▾	
POLLEN (DIDIER FONTA) | **WWW.POLLEN.AM**	
CENTRE DE RECHERCHE DE L'INDUSTRIE BELGE DE LA CÉRAMIQUE (FABRICE PETIT) | **BCRC.BE**	

REINVENTING CERAMICS: WHEN 3D MEETS SPEED

As a child, Pierre Grimaud was already drawn to ceramic materials – a curiosity born with his hands in clay, through pottery. Originally from Brittany, he likes to joke that his interest in materials resistant to heat and humidity might not be a coincidence…

It was only natural that, after a general training in materials science, he specialized in ceramics during his engineering degree at ENCSI in Limoges. He then deepened his knowledge by pursuing a PhD at the Polytechnic University of Hauts-de-France.

During his thesis, Pierre had the opportunity to complete a three-month internship at the Belgian Ceramic Research Center (BCRC) in Mons, just across the border.

«*Although the weather wasn't always on our side, the warm welcome and the level of expertise I discovered there convinced me to continue my professional journey with them*» smiles the researcher.

Today, the engineer-doctor is continuing his career at BCRC through a project carried out with *Pollen AM Belgium*. Together, they design and develop equipment dedicated to additive manufacturing of ceramics, with the ambition of integrating machining technologies to create a hybrid machine capable of combining 3D printing and precision machining.

«*This project perfectly aligns with my background and passions. It motivates me particularly because it aims to push the current limits of manufacturing: achieving parts that are more precise, more beautiful, and more efficient, while exploring new ways of producing.*»

His appetite for learning and innovation also continues through his collaboration with the University of Mons, as part of the project, which allows him to deepen his expertise on advanced characterization and sintering equipment.

THE CERAMORPH PROJECT

These efforts are part of an applied research project aimed at advancing ceramic manufacturing processes toward faster and more efficient approaches..

Concretely, the project focuses on developing a rapid production chain for ceramic parts by combining an innovative manufacturing process with an advanced sintering method:

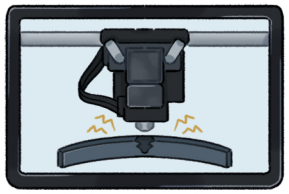
1. **Hybrid 5-axis manufacturing:** This method combines 3D printing by pellet extrusion (PAM – Pellet Additive Manufacturing technology) with a 5-axis machining system. It enables the production of more precise parts with better surface quality, while overcoming the limitations of conventional 3D printers—such as the need for support or difficulties with complex shapes. Thanks to this flexibility, geometries previously considered inaccessible can now be achieved.

2. **QuickSint thermal treatment process:** QuickSint is an innovative method that dramatically accelerates the debinding and sintering steps (thermal treatment of parts). While these steps usually take several hours or even days, QuickSint completes them in just a few dozen minutes. This represents a breakthrough for rapidly densifying ceramic materials while reducing energy consumption, costs, and production times.

The overall goal of the project is to leverage these two complementary technologies to meet the precision and speed requirements of demanding industrial sectors, where high-quality ceramic components are essential. By integrating them into a single production chain, the process becomes more versatile, more efficient, more sustainable, and more cost-effective than traditional methods.

CONTEXT

Additive manufacturing is transforming how components are built in many industries, but ensuring the structural integrity of printed components remains a major challenge.

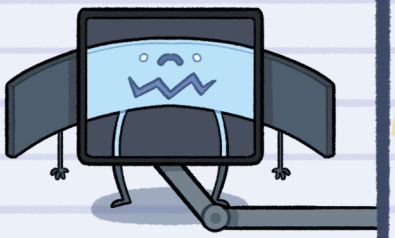


Indeed, these parts can have defects that are invisible to the naked eye, affecting their performance and safety.

NON-DESTRUCTIVE TESTING (NDT)

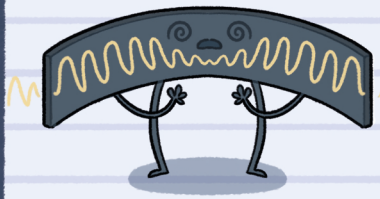
1) Computed Tomography

enables detailed visualization of the internal structure, revealing defects such as voids or cracks, as well as variations in material density and composition.



2) Terahertz

can penetrate deeply into materials and reveals internal variations that would otherwise be invisible.



3) Thermography

surface and sub-surface defects can be revealed by the temperature variation generated by such defects after thermal excitation of a component under test.

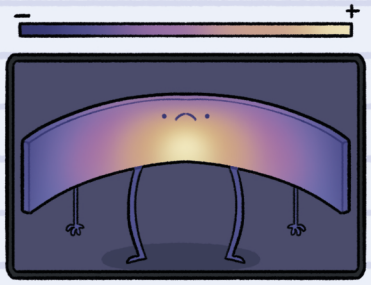
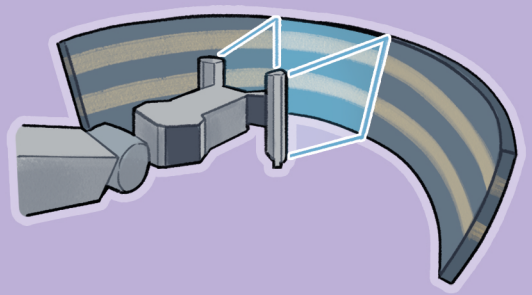


Illustration : CPiG.be

DATAFUSION

This research project proposes an innovative approach based on data fusion, which combines multiple non-destructive methods to provide a more complete information on the structural state of additively manufactured parts.

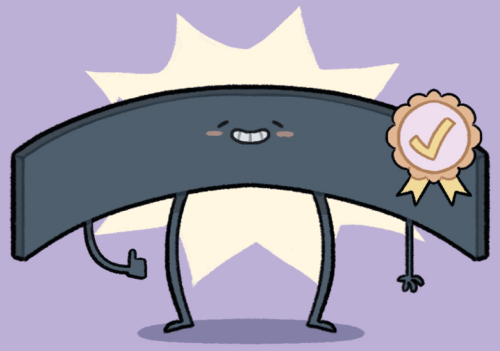
The goal is to combine three complementary NDT technologies: tomography, terahertz and thermography.



These analyses will be automated through robotics to ensure precise and repeatable evaluations, even for complex parts.

This integrated approach aims to reduce the risk of errors while offering a more comprehensive assessment of the structural integrity of additively manufactured components.

Thanks to the complementarity of the technologies and automation, this project provides an advanced solution to ensure the quality of 3D-printed parts, while meeting the strict standards in non-destructive testing.



MPP AERO & INDUSTRIAL SOLUTIONS

Province de Hainaut — HAUTE ÉCOLE CONDORCET

Bata Nkirda HENA

COUNTRY OF ORIGIN	NIGERIA
COUNTRY AT TIME OF SUBMISSION	CANADA
DURATION	24 MONTHS
PROMOTORS ▾	
MPP (PIERRE SERVAIS) | **MPP.BE**	
HAUTE ÉCOLE PROVINCIALE DU HAINAUT - CONDORCET (ANTHONIN DEMARBAIX) | **WWW.CONDORCET.BE**	

3D PRINTING: CHECK THE INTERNAL AND EXTERNAL CONDITION

Who are you ? *I hold a Bachelor's degree in Radiography from the University of Maiduguri (Nigeria), a Master of Science (MSc) in Non-Destructive Testing (NDT) from Dresden International University (Germany), and a Ph.D. from Université Laval (Canada). These programs have provided me with a solid foundation in materials science, measurement techniques, mechanics, numerical methods, signal processing, and quality management. They also include specialized modules on electromagnetic, radiological, optical, thermal, and microscopic methods, which have enabled me to develop an integrated and rigorous scientific approach to research and innovation challenges.*

Is this your first time in Belgium ? *I had the privilege of engaging with the Belgian scientific community during two research visits in April 2023 and March 2024. My desire to continue my journey in Belgium only grew stronger. These visits, funded by the Belgian and Quebec governments as part of the FINO project, were not only milestones in my research career but also crucial experiences that deepened my appreciation for Belgium's rich research culture.*

The opportunity to work alongside renowned researchers in the aerospace field and to participate in cutting-edge projects significantly enriched my professional expertise and helped shape my research trajectory.

You seem very motivated ! *I am! As part of continuing my research journey in Belgium through this project, I plan to undertake a comprehensive program of internships and training designed to enhance my expertise in advanced non-destructive inspection techniques, particularly in the context of additive manufacturing.*

To fully integrate into the environment and scientific community, I intend to improve my language skills through intensive French courses. This training will not only give me the chance to strengthen my command of the French language but also facilitate my daily communication.

THE ANDI4ADD PROJECT

3D printing is transforming the way component are manufactured, especially in industry. However, one major challenge remains: ensuring the strength and reliability of components on the inside, even when they look perfect on the outside.

Indeed, some printed components may contain defects invisible to the naked eye, which can lead to safety or performance issues. To check their quality without damaging them, we use methods known as non-destructive testing (NDT).

This project aims to improve these inspections by combining several NDT techniques:

- **Tomography**, which allows us to "see inside" parts like a medical scanner, to detect cracks or voids
- **Terahertz technology**, which penetrates materials and reveals differences in material density or composition
- **Active thermography**, which uses heat stimulation to assess surface temperature variations caused by surface or subsurface abnormalities

By merging the information from these different techniques (a process called data fusion), we obtain a more complete and reliable picture of the part's condition.

This approach helps reduce errors and ensures that 3D-printed components meet the highest standards of quality and safety.

OBJECTIVE

Automatic editing of images and videos considering their visual effectiveness.

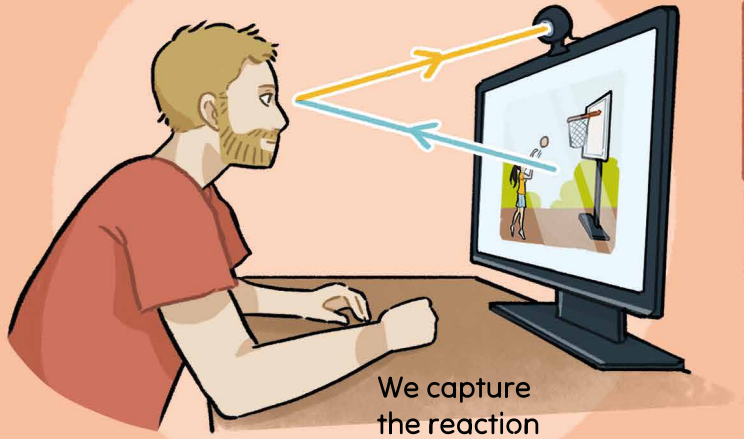
Illustration : CPiG.be

APPLICATION

Understanding and predicting human attention to create advertisements that stand out.

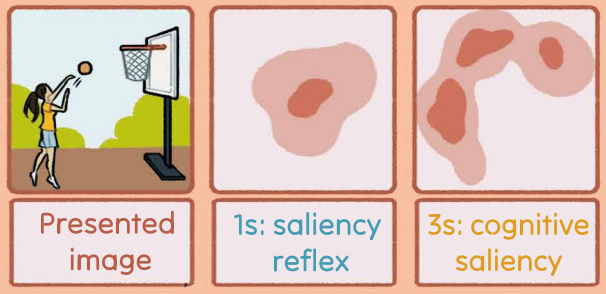
APPROACH

The screen displays series of images.



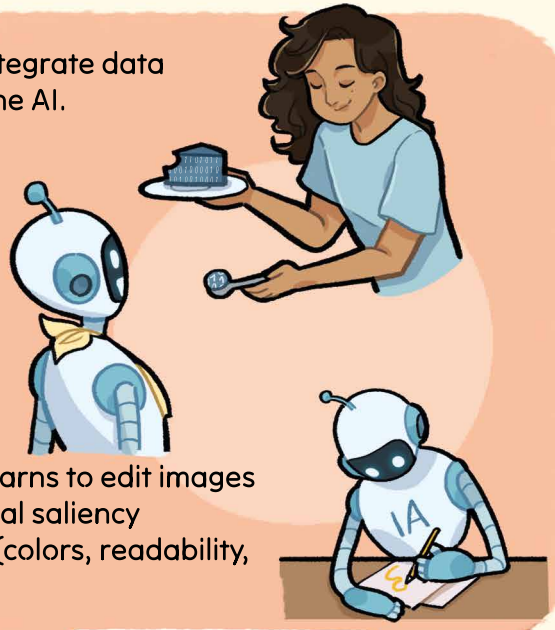
We capture the reaction of the human eye.

Generation of saliency maps



Saliency is the ability to attract attention

We integrate data into the AI.



The AI then learns to edit images by taking visual saliency into account (colors, readability, impact...).

Human behavior analysis → Visual saliency study → Integrating saliency into image editing

Thibault LELONG

COUNTRY OF ORIGIN	FRANCE
COUNTRY AT TIME OF SUBMISSION	FRANCE
DURATION	24 MONTHS
PROMOTORS	
ITTENTION (OLIVIER ROLLUS) | **WWW.ITTENTION.COM**	
UNIVERSITÉ DE MONS (THIERRY DUTOIT) | **WWW.UMONS.BE**	

AUTOMATED GENERATION AND EVALUATION OF VISUALS OPTIMIZED FOR HUMAN ATTENTION

After earning a bachelor's degree in engineering sciences from the University of Poitiers and a second master's degree from Pierre and Marie Curie University in Paris, Thibaut Lelong began a doctoral thesis, which he defended at the Institut Polytechnique de Paris – Paris Sud Télécom (IPP) in June 2023.

This thesis was carried out under an Industrial Agreement for Training through Research (the so-called *Convention industrielle de formation par la recherche*). This program, fully aligned with the BEWARE initiative, aims to foster collaboration between public research and socio-economic stakeholders, encourage the integration of PhDs into companies, and support innovation development within businesses established in France.

In Dr. Lelong's case, the thesis was conducted in partnership with the SAVOMAR laboratory at IPP and the company *Argo*, which specializes in augmented reality. This doctoral work led to the development of an image identification/recognition engine (server-side) as well as a real-time image tracking engine optimized for low-power devices and Web environments.

Thanks to this experience in applied research and industry collaboration, Dr. Lelong joined the Gensaliency project to design a tool that combines saliency modeling with generative AI. This collaborative project brings together the ISIA laboratory and the Walloon company *Ittention*, which specializes in optimizing visual impact for marketing and industry. Its goal is to develop an industrial solution capable of automatically analyzing, explaining, and optimizing the visibility of key elements in images.

THE GENSALIENCY PROJECT

As part of this collaboration with two Walloon partners, the GenSaliency project aims to merge two complementary technologies to assess the effectiveness of visuals and make them more impactful:

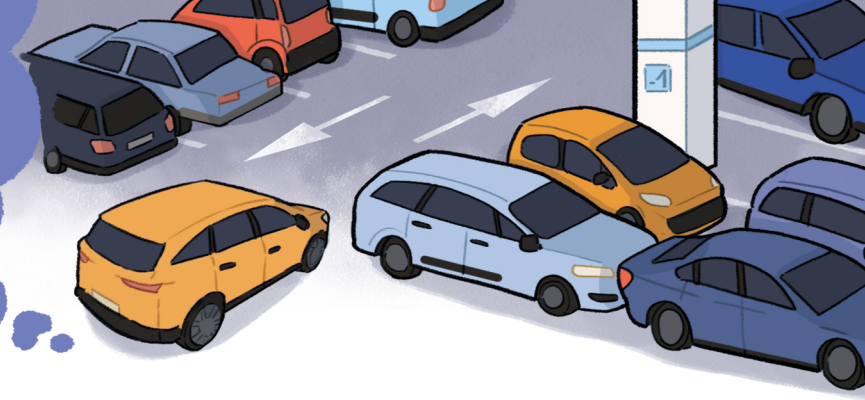
- **Visual Saliency Estimation:** The first component focuses on developing a system capable of identifying salient areas within an image or video – those whose complexity or semantic load is likely to attract human attention. This tool predicts whether the key elements of a visual will actually be perceived.

- **Image Generation and Editing via Diffusion Models:** The second component relies on using image generation models such as Stable Diffusion to create or modify visuals. The goal is to design an editing pipeline based on these models to produce optimized alternatives. The tool seeks to enhance the saliency of selected areas to increase the attention they draw.

By combining these two approaches, the result is a system that can not only evaluate the effectiveness of a visual but also automatically improve it to make it more striking and engaging. This innovative approach has the potential to transform how images are designed in advertising, marketing, and visual design.

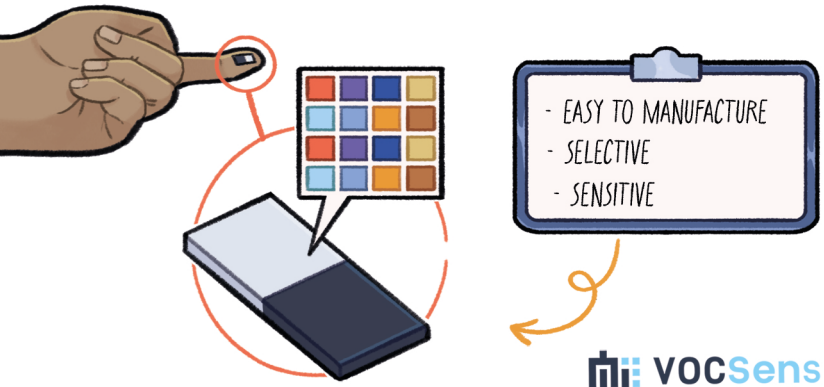
ISSUE

Measuring air quality is increasingly important, especially due to gas emissions and pollutants that can be harmful to health and the environment.



TECHNOLOGY USED

CHEMORESISTIVE GAS SENSORS → They allow varying amounts of electrical current to flow when exposed to a specific gas.



VOCSens
Smart sensing solutions

The VOCSens company has created the "ENVICam" device, which is composed of several sensors that are able to detect and quantify various types of gases.

The data collected by this device enables the monitoring of certain gas concentrations.

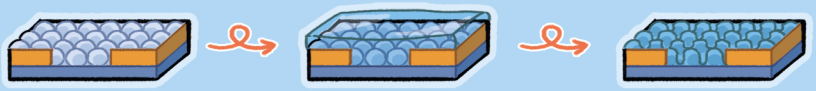
Illustration : CPiG.be

OBJECTIVE

Develop a new CO sensor using two innovative technologies:

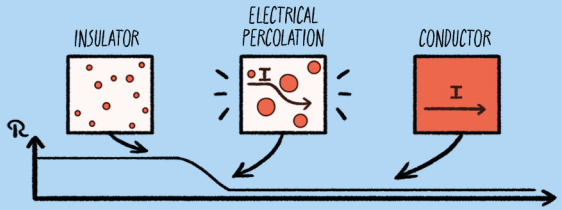
1) NANOSTRUCTURES

We use nanospheres as mold to form a nanostructured network that improves contact surface and conductivity.



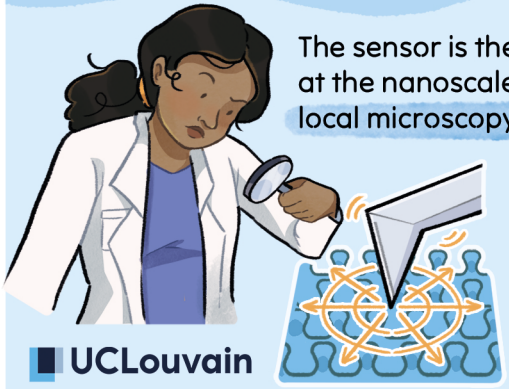
- ✓ Larger surfaces in contact with gas
- ✓ Better conductivity

2) ELECTRONIC PERCOLATION TRANSITION



In this intermediate regime, a small gas concentration is enough to cause large variations in the electrical current passing through the sensor.

- ✓ More sensitive sensor



The sensor is then studied at the nanoscale thanks to advanced local microscopy techniques.

Microwaves are sent through the sensor to better understand current variations through the sensor.

Less current is passing through areas that interact with gas.

UCLouvain

Arya MOHAN

COUNTRY OF ORIGIN	INDIA
COUNTRY AT TIME OF SUBMISSION	INDIA
DURATION	36 MONTHS
PROMOTORS ▾	
VOCSENS (YANN DANLÉE) | **VOCSENS.COM**	
UNIVERSITÉ CATHOLIQUE DE LOUVAIN (BENOÎT HACKENS) | **WWW.UCLOUVAIN.BE**	

USING PERCOLATION TRANSITION TO DEVELOP BETTER SENSORS

What is your background ? *I have a background in fundamental physics of condensed matter (Indian Institute of Science, Bangalore) with a solid foundation in low-temperature measurements and instrumentation. For this project funded by the BEWARE program, training in handling the local probe microscope built at the* Université catholique de Louvain *was necessary. For sample fabrication and characterization, training in XPS for composition and oxidation state analysis will be useful, as well as training on the* Raman *spectrometer.*

Remind us of the importance of conductive polymers. *Conductive polymers are stable materials that conduct electric current and can be used to detect various gases or pollutants. During my PhD, I studied these polymers and their blends, especially when they are close to the point where they start conducting well (known as the percolation threshold). I also analyzed in detail how certain polymers transition from a conductive state to an insulating state (the so-called metal-insulator transition). In blends of PEDOT:PSS with non-conductive polymers, electrical transport changes depending on the structure of the mixture, particularly when conductive regions become scarce. To better understand this phenomenon, I designed a device capable of measuring the electrical properties of five samples simultaneously, even at very low temperatures. This device is lightweight and can be used in a special container filled with liquid helium.*

What do you like about working here ? *You know, Belgium is one of the main contributors to the global market for conductive polymers. Moreover, the country offers a research environment that promotes both fundamental and applied research, which I believe must go hand in hand for sustainable growth of human knowledge.*

(1) PEDOT:PSS refers to a mixture of two polymers, poly(3,4-ethylenedioxythiophene) (PEDOT) and sodium poly(styrene sulfonate) (PSS).

THE COPERNICAN PROJECT

Today, air quality is a major concern for our health and the environment. To better monitor pollutant gases, industrial processes, and safety-related risks, increasingly efficient sensors are needed. These sensors allow precise detection of gases present in the air.

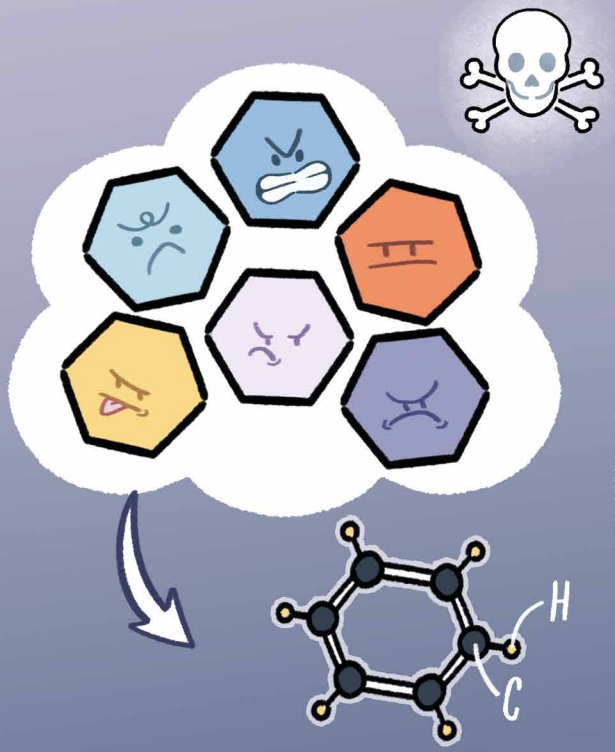
Among the technologies used, so-called chemiresistive sensors are particularly interesting. Their principle is simple: they react to the presence of a gas by changing their electrical resistance. They are easy to manufacture, capable of detecting specific gases, and highly sensitive – even at low concentrations. Several can even be grouped on a single chip to create a kind of «air camera», capable of providing an overall image of the gases present in an atmosphere. This is the case with *ENVICam®*, developed by the company *VOCSens*.

The COPERNICAN project aims to go even further by developing a sensor based on a physical phenomenon called percolation transition. This means that a very small amount of gas can cause a significant change in the sensor's electrical behavior. To achieve this, a special material will be used: a conductive polymer called PEDOT:PSS. This material will be modified to better detect carbon monoxide (CO) and structured at the nanometric scale to increase its sensitivity.

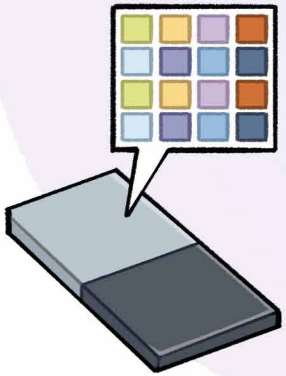
To fully understand how this sensor works, an advanced imaging technique combining microscopy and high-frequency electrical measurements will be used. This research project will add CO detection to the *ENVICam®* camera by developing a new, innovative sensitive material, whose operation will be studied in detail through original experiments

CONTEXT

Volatile Organic Compounds (VOCs) are a family of very diverse gases. Among them, some come from products or industrial processes and are often toxic.



It is therefore important to monitor the presence of these gases in the air.



TECHNOLOGY USED

To identify these gases in the air, one can use...

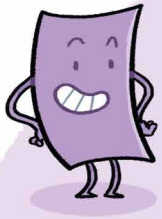
GAS SENSORS

In the "ENVICam" device developed by VOCSens, each sensitive area contains sensors that can detect a specific gas.

When a small quantity of gas is present in the air, the sensor is activated.

VOCSens
Smart sensing solutions

PROJECT

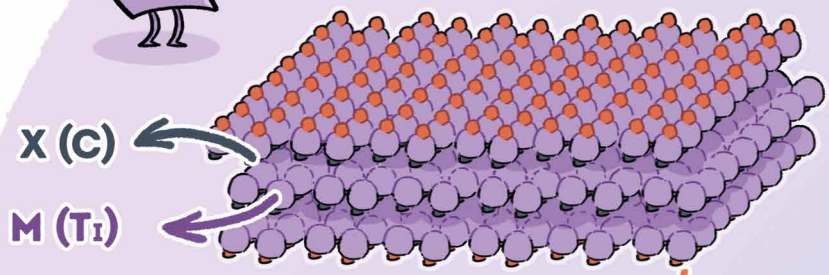


MXenes are special 2D materials with a structure that is only a few atomic layers thick. They are studied as VOC detectors.

1. SYNTHESIS AND FUNCTIONALIZATION OF MXENES

On the surface of MXenes, functional groups (–OH, –O, or –F) can be modified to enhance the material's properties for sensing applications.

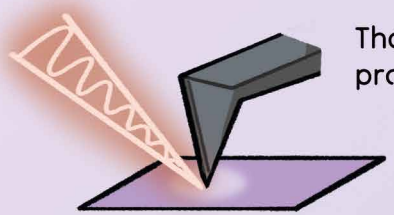
UCLouvain



Layers of metal atoms (M) are sandwiched between layers of carbon atoms (C).

2. ANALYSIS OF CHEMICAL AND OPTICAL PROPERTIES AT THE MICROSCOPIC LEVEL

Illustration : CPiG.be



Thanks to local probe microscopy...

...it is possible to obtain a "chemical portrait" of the MXene

Cristiane NASCIMENTO SANTOS

COUNTRY OF ORIGIN	BRAZIL
COUNTRY AT TIME OF SUBMISSION	FRANCE
DURATION	18 MONTHS
PROMOTORS ▾	
VOCSENS (YANN DANLÉE) | **VOCSENS.COM**	
UNIVERSITÉ CATHOLIQUE DE LOUVAIN (SOPHIE HERMANS) | **WWW.UCLOUVAIN.BE**	

TWO-DIMENSIONAL CRYSTALS FOR GAS DETECTION

Originally from Aracaju, a small capital in northeastern Brazil, and holding a master's degree in applied physics from the University of São Paulo (USP), Cristiane Nascimento Santos began her research in Europe during her Ph.D., specifically in Grenoble, France, as part of a joint program between USP and Joseph Fourier University (UJF, now *Université Grenoble Alpes*). She earned a dual doctorate in applied physics (USP) and in physics of materials and nanostructures (UJF) for her thesis work on luminescent materials in the near-infrared range.

Her career continued with various projects in Belgium, interrupted by a two-year postdoctoral position at the French National Centre for Scientific Research (CNRS) in Orléans, where she specialized in infrared spectroscopy. «*I returned to France in October 2020 to join IEMN/CNRS – University of Lille, in Villeneuve d'Ascq,* explains the researcher. *It was another postdoctoral position, focused on local-probe optical microscopy or s-SNOM, a technique that reveals extremely fine details on materials at the nanometric scale, far smaller than what can be observed with conventional optical microscopy. It's a fascinating research field, and s-SNOM can be applied across a wide range of the electromagnetic spectrum, from visible light to invisible waves such as infrared and terahertz, to explore the surface of different materials. At that time, this type of instrument was not yet available in Belgium.*»

This research helps to better understand the structural and optical characteristics of these materials, which can lead to new technologies such as more efficient sensors or components for future photonics and electronics.

Today, Dr. Nascimento Santos is back in Walloon Brabant to continue her research. «*This type of funding, combining academic research and its application in a private company, is extremely attractive*, she explains. *In principle, it offers the opportunity to apply fundamental research directly to a real-world problem, which can result in a market-ready product within a relatively short timeframe.*»

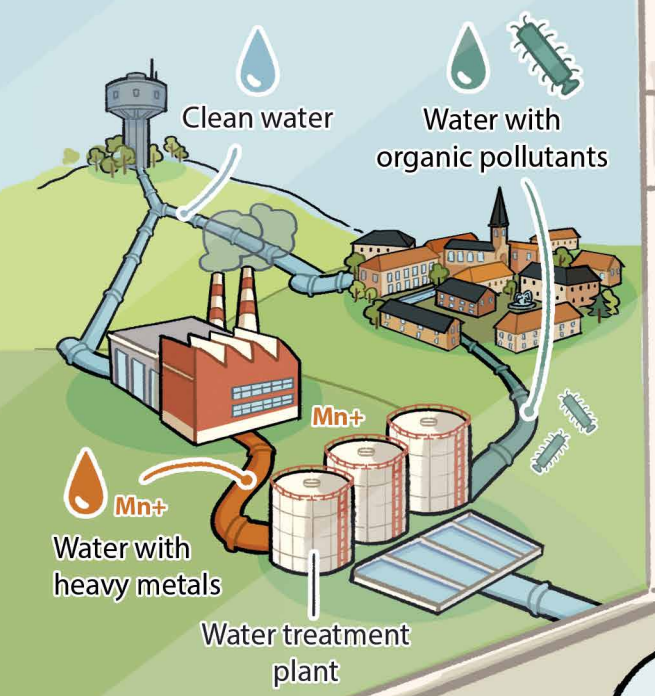
For the researcher, the Institute of Condensed Matter and Nanosciences (IMCN) at UCLouvain is the ideal place for this work, as it brings together chemists, physicists, and specialists in solid-state and materials science within the same institute, fostering interdisciplinary research.

THE SENXENES PROJECT

The SenXenes project aims to develop gas microsensors based on MXenes, a new family of ultra-thin metallic crystals known as two-dimensional (2D) materials. The project plans to combine different types of MXenes to extend the range of gases detected by the current «environmental camera» *EnviCam* developed by *VOCSens*, with a particular focus on volatile organic compounds (VOCs).

Specific objectives include identifying the gas detection mechanisms in MXenes using various local probe microscopy techniques, such as TERS (nano-Raman) and s-SNOM. Characterizations will be carried out on individual MXene sheets as well as on multiple layers deposited to fabricate the micro-sensors. In addition, the project aims to functionalize MXenes during or after their synthesis to study how this functionalization improves the material's selectivity, sensitivity, and stability as a gas detector. Finally, the best MXene candidates will be integrated into *EnviCam* for gas leak detection and industrial process monitoring related to VOCs.

CONTEXT



RAW MATERIALS

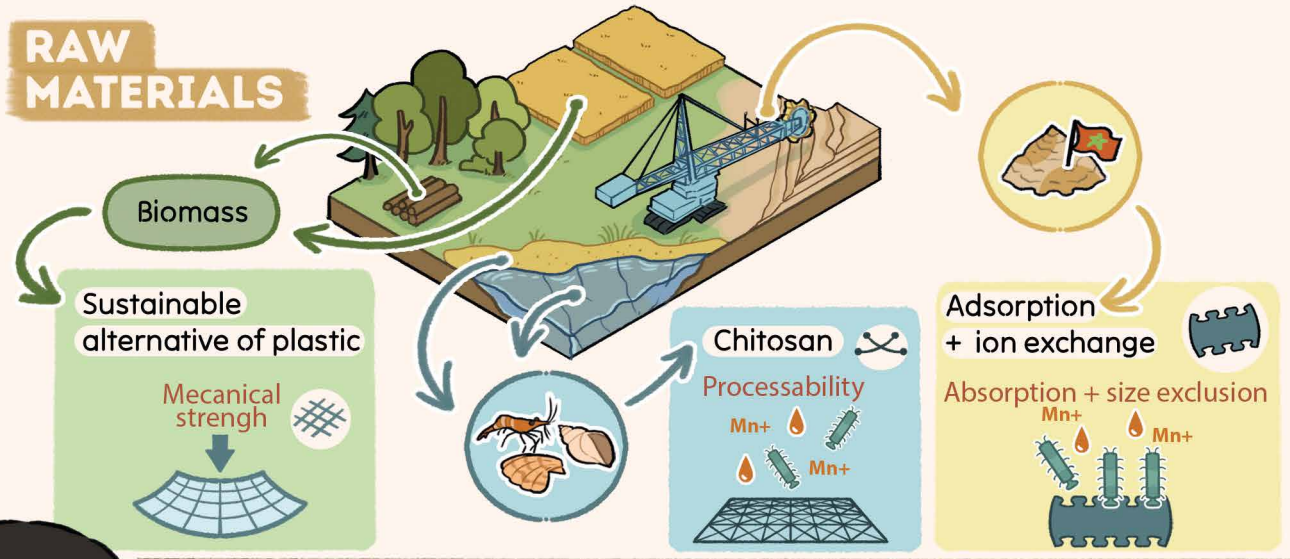
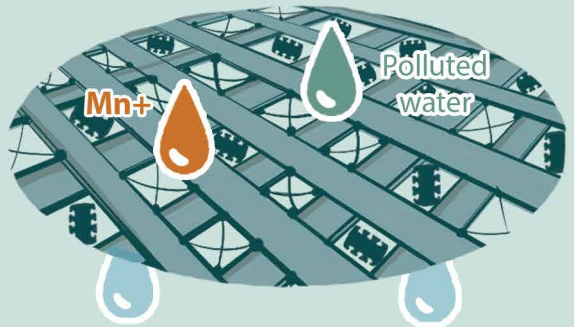


Illustration : CPiG.be

Green membrane synthesised using sustainable alternative of plastic in combination with Chitosan and Calcium phosphate



Clean water

OBJECTIVES

- Fabrication of sustainable membrane
- ~~Plastic~~ → Sustainable alternative
- Accessibility → €

CHALLENGES

- Green membrane must withstand water stress
- Sustainable alternative materials are more expensive than convenitonal plastics
- Development and commercialization of the developed green membrane

CEBEDEAU
APPLY SCIENCE. PROTECT WATER

PRAYON

Sherin PETER

COUNTRY OF ORIGIN	INDIA
COUNTRY AT TIME OF SUBMISSION	FRANCE
DURATION	36 MONTHS
PROMOTORS ▾	
CEBEDEAU (STÉPHANE NONET) | **WWW.CEBEDEAU.BE**	
PRAYON S.A. (ALAIN GERMEAU) | **WWW.PRAYON.COM**	

A FILTRATION MEMBRANE FOR WASTEWATER

The company *Prayon* is no stranger to Dr. Sherin Peter. During his PhD, which he began in 2019 at the *Institut Mines-Télécom* in Albi, in the southwest of France, he had the opportunity to collaborate with the Walloon company on the development of a filtration membrane made from inorganic materials.

This is not the researcher's only international collaboration. Throughout his doctoral and postdoctoral projects, he worked with several partners from universities and companies in different countries, such as Mahatma Gandhi University (India) and *Philos Membrane* (South Korea).

Thanks to the BEWARE mandate, Dr. Peter is undertaking major development projects for the future of Wallonia. He already has strong credentials in the environmental field and now aims to become a key player in Belgium's sustainable transition.

The collaboration between CEBEDEAU, an accredited research center, and *Prayon* could have a significant impact on the water sector in Wallonia, given their respective ties to research and industry.

«*For me*, explains Sherin Peter, *this project allows me to explore new techniques, optimize membrane performance, and contribute to advancing scientific knowledge in this field*.» It also offers him the opportunity to work closely with professionals in the wastewater treatment sector: «*this could generate valuable connections for future collaborations or career opportunities*.»

Another important point: CELLPHOS aims to develop solutions that reduce carbon footprints and ensure resilience and sustainability in wastewater treatment processes. Developing a sustainable nanocomposite membrane can also indirectly contribute to the reliability of petroleum products. Indeed, removing pollutants from wastewater helps protect water resources and reduce contamination, thereby ensuring the quality and availability of clean water resources.

THE CELLPHOS PROJECT

Current wastewater treatment approaches in membrane filtration require a fundamental shift to achieve true sustainability. One promising strategy is the integration of multiple filtration mechanisms within a single system. The CELLPHOS project addresses this challenge by developing a green nano-composite membrane composed of nanocellulose from biomass, chitosan, and calcium phosphate. These natural materials offer complementary properties: nanocellulose provides strength, reactivity, and fiber-forming capability; chitosan delivers antibacterial and adsorption functions; and calcium phosphate adds stability, biodegradability, and excellent adsorption capacity. Together, they present an alternative to petroleum-based chemicals traditionally used in membrane fabrication.

The membrane is designed to combine adsorption and size-exclusion mechanisms, enabling the removal of dissolved pollutants such as heavy metals and dyes, as well as suspended particles. A key focus of the development process is sustainability – avoiding toxic chemicals and complex modifications during manufacturing. This approach ensures that the production remains environmentally responsible while maintaining high performance in pollutant removal.

By utilizing renewable and eco-friendly materials, the CELLPHOS membrane demonstrates strong potential for advanced water treatment applications. Its combination of safety, efficiency, and sustainability sets a clear direction for future innovations in wastewater treatment, paving the way for greener technologies that align with global environmental goals.

CONTEXT

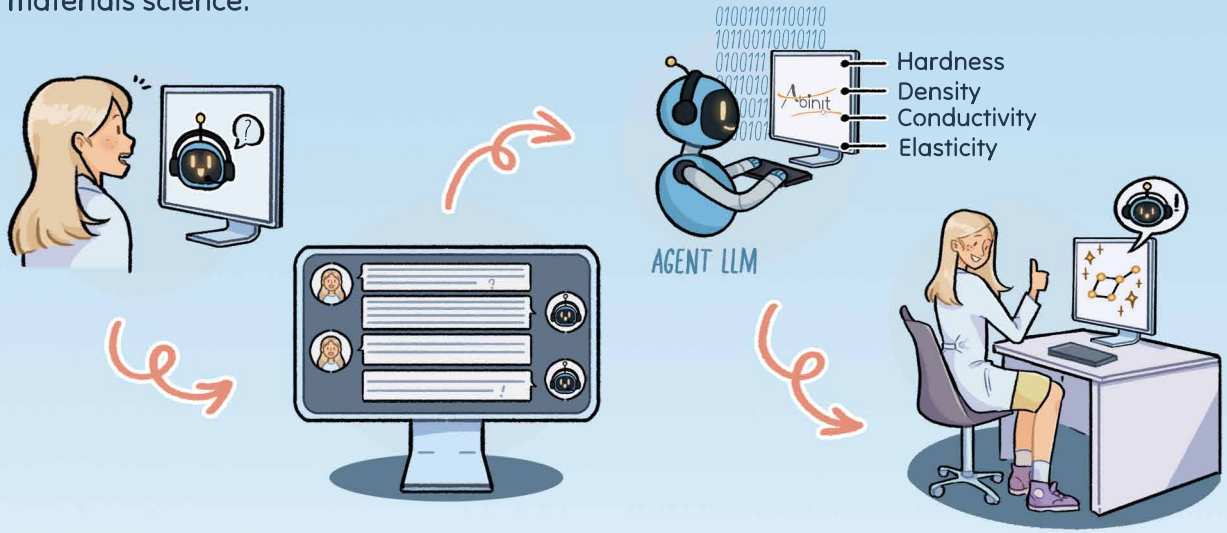
Searching for the ideal material for a specific application is a difficult task.
This requires a large amount of trial and error.

In addition, mastering the necessary software for this task demands advanced knowledge and strong scientific skills.

PROJECT

"Large Language Models" (LLMs) are artificial intelligence (AI) programs capable of understanding and generating human language.

They are also powerful tools for addressing specific scientific challenges in materials science.

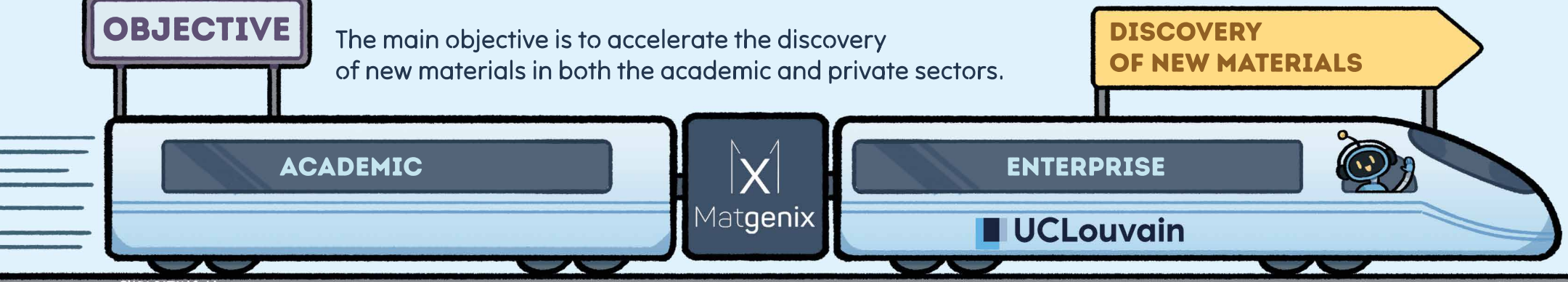


The main goal of the project is to use LLMs to automate calculations and reinforce the researchers' abilities by providing IT tools able to predict material performance.

This project aims to make these prediction tools accessible to companies with low knowledge in this domain.

OBJECTIVE

The main objective is to accelerate the discovery of new materials in both the academic and private sectors.



Francesco RICCI

COUNTRY OF ORIGIN	ITALY
COUNTRY AT TIME OF SUBMISSION	USA
DURATION	36 MONTHS
PROMOTORS ▾	
MATGENIX (DAVID WAROQUIERS) | **MATGENIX.COM**	
UNIVERSITÉ CATHOLIQUE DE LOUVAIN (GIAN-MARCO RIGNANESE) | **WWW.UCLOUVAIN.BE**	

TOWARDS A NEW ERA OF MATERIALS SCIENCE THROUGH LANGUAGE MODELS

Before moving to Belgium, Francesco Ricci held the position of Project Scientist at the Lawrence Berkeley National Laboratory in Berkeley, California (USA), where he conducted cutting-edge research on the discovery and modeling of new materials.

His work revolved around three main projects:

- The discovery of ferroelectric and multiferroic materials using automated calculations
- The use of machine learning techniques to predict vector properties of materials, in collaboration with experimental and computational teams
- The automation of electronic band structure calculations through Range-Separated Hybrid Functionals

Prior to his current position, and for five years, he completed a postdoctoral fellowship at the *Université catholique de Louvain*, where he applied high-throughput ab initio methods and data analysis techniques for materials design. Notably, he contributed to engineering electronic structures to improve thermoelectric material performance and to high-throughput screening of databases to identify new thermoelectric materials and «electrides».

As part of a research fellowship at Temple University (USA), he also worked on integrating structural motifs into machine learning models applied to inorganic systems.

He holds a Ph.D. from the University of Cagliari (Italy), where his thesis focused on the study of layered and low-symmetry oxides, with particular interest in multiferroic tunnel junctions, ferroelectric metals, and transparent conducting oxides.

His technical expertise includes Python programming, setting up automated workflows, and managing databases for *ab initio* calculations aimed at materials discovery.

THE LLM4AMD PROJECT

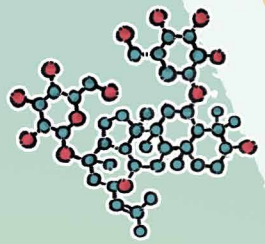
Artificial intelligence models capable of understanding and generating language, such as GPTs (Generative Pretrained Transformers), have evolved considerably in recent years. Although they are primarily designed to process language in general, they have also proven to be highly useful in complex fields such as materials physics and chemistry. These tools can help predict outcomes, automate certain tasks, and extract valuable information – even in highly technical domains.

Despite their impressive performance, challenges remain to make them even more effective. Their application in materials research could profoundly change the way scientists work. This project will develop two key ideas: a virtual assistant to help researchers perform materials-related calculations, and an automated tool capable of independently computing certain material properties. Both solutions aim to make advanced technologies more accessible to companies, enabling them to save time and innovate faster.

The project will also emphasize integration with specialized software, rigorous result verification, and continuous improvement of AI models so they can assist researchers with complex tasks. The goal is to accelerate the discovery of new materials, whether in laboratories or in industry.

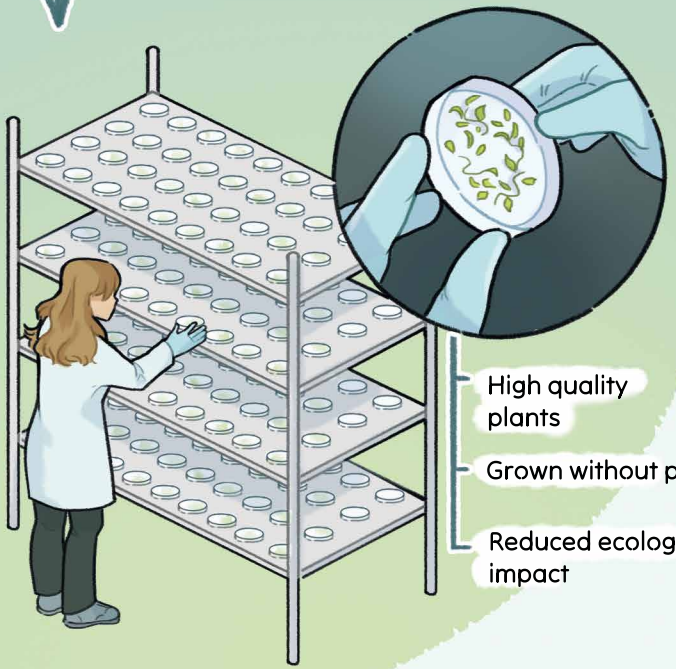
BOTALYS

Young company dedicated
to the cultivation of medicinal plants



Industrial-scale
production

VERTICAL FARMING



- High quality plants
- Grown without pesticides
- Reduced ecological impact

Shared interest
in plant cultivation

PROJECT OBJECTIVE

Development of plant cultures enriched with specific biologically active compounds.

Develop the cultivation
of rare and endemic plants
for the cosmetics market.

Province de Hainaut | HAUTE ÉCOLE CONDORCET

PMFF LAB IS FOCUSED ON:

- Sustainable crop protection
- Microbial services in agriculture
- "Molecular farming"

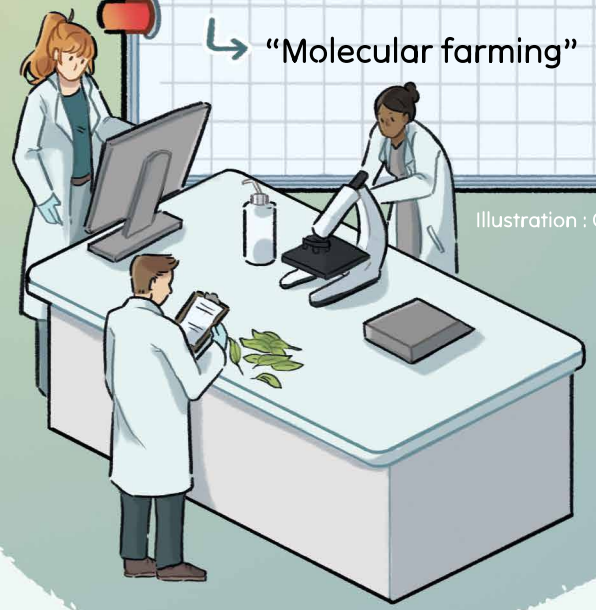


Illustration : CPiG.be

Oksana SYTAR

COUNTRY OF ORIGIN	UKRAINE
COUNTRY AT TIME OF SUBMISSION	SLOVAKIA
DURATION	36 MONTHS
PROMOTORS ▾	
BOTALYS (SYLVIE DEFRÈRE) | **BOTALYS.COM**	
HAUTE ÉCOLE PROVINCIALE DU HAINAUT - CONDORCET (NICOLAS DESOIGNIES) | **WWW.CONDORCET.BE**	

FROM PLANT BIODIVERSITY TO BIOTECHNOLOGICAL INNOVATION

Dr. Oksana Sytar, who obtained her Ph.D. in Plant Physiology from the Taras Shevchenko National University of Kyiv, Ukraine, specializes in developing advanced methods for producing innovative, high-value food ingredients using both whole plants and in vitro plant culture systems.

From 2014 to 2023, Dr. Sytar worked as an international scientific expert at the Slovak University of Agriculture in Nitra, while also being a visiting researcher at Taras Shevchenko National University of Kyiv.

In 2021, she conducted part of her research on phenolic secondary metabolites in the formation of plant stress tolerance and biofortification. These studies focused on the crucial role of secondary metabolites in plant resilience and improving their nutritional value.

In recent years, her research has shown a strong interest in discovering the biodiversity of rare or underutilized plants and specifying their biochemical composition for potential health applications. Over time, she has developed specialized expertise in plant biotechnology, particularly in areas such as hairy root cultures and the identification of specific secondary metabolites, demonstrating advanced competence in plant research methodologies.

During the COVID-19 pandemic, the need for developing plant-based medicines with immunomodulatory and antioxidant properties became increasingly evident. Dr. Sytar is actively involved in establishing a scientific database of rare medicinal plants with immunomodulatory potential, focusing on their specific bioactive metabolites. Her research aims to characterize the biochemical profiles and evaluate the potential nutritional benefits of various experimental species, including *Rosa canina*, *Rosa rubiginosa*, *Hypericum scabrum*, among others.

THE INVIRARE PROJECT

Botalys is an innovative Walloon company specializing in the cultivation of medicinal plants. Using advanced cultivation technologies, it produces natural, health-promoting bioactive ingredients on an industrial scale within vertical farming systems, while maintaining a minimal ecological footprint.

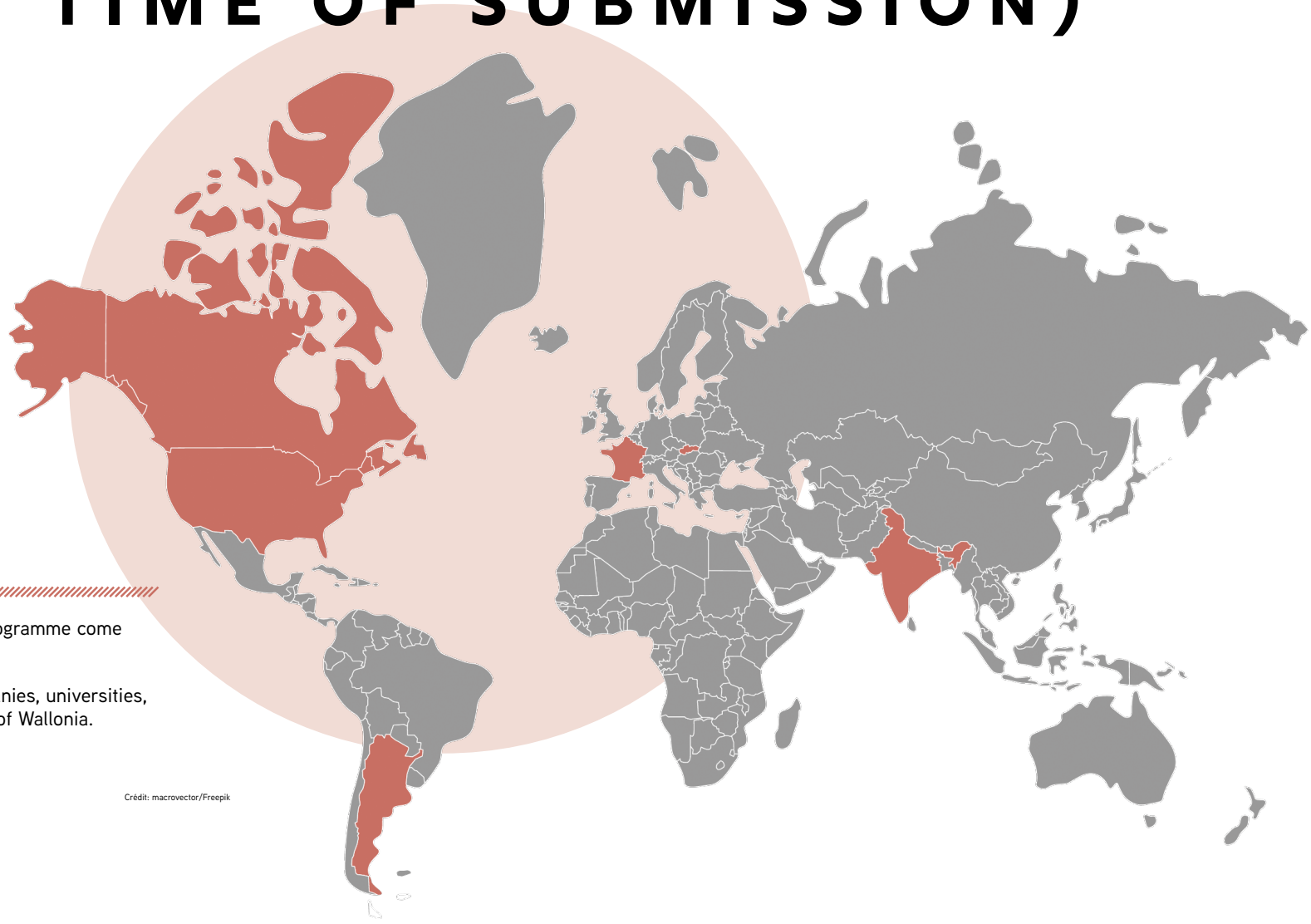
Meanwhile, the *Phytopathology, Microbial and Molecular Farming* (PMMF) laboratory at the *Haute École provinciale du Hainaut Condorcet* conducts research in several areas: sustainable crop protection, microbial services in agriculture (such as bioinoculation and preservation of soil microbial communities), and molecular farming—the production of valuable molecules through plant biotechnologies.

Botalys and PMMF share a common interest in plant cultivation, particularly in the production of secondary metabolites, and collaborate regularly.

This project aims to develop the cultivation of roots from rare and unique plant species for the cosmetic market. The goal is to achieve high-quality yields and produce specific secondary metabolites that meet human needs. This work contributes to strengthening expertise and expanding knowledge necessary to broaden the range of roots and secondary metabolites derived from rare medicinal plants adapted to *Botalys*' technology.

LIST OF RESEARCHERS

GEOGRAPHICAL VIEW (AT THE TIME OF SUBMISSION)



Researchers engaged by the BEWARE programme come from all continents.

They contribute to the influence of companies, universities, university colleges and research centers of Wallonia.

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GEOGRAPHICAL VIEW (NATIONALITIES OF RESEARCHERS)

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LEGAL NOTICE

The BEWARE programme is an initiative of Wallonia and benefits from a cofunding of the European Commission.

The objective of this programme is to attract high-level researchers within of our universities, university colleges, research centres and companies.

To do this, a large budget has been mobilized because the ambition of Wallonia is to recruit between sixty and seventy researchers from all over the world with their expertise for the benefit of Walloon R&D players.

Their research topics are varied, as will be read in this brochure: health, biotechnologies, space, environment… selected after a rigorous selection by a panel of foreign experts.

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