Department of Biomaterials & Biomedical Technology

2025
Annual Report

Contents

UMCG
Department of Biomaterials & Biomedical Technology

2025
Annual Report

Foreword by the Head of Department

Dear BBT Members,

It is with great pride that I present the Annual Report 2025 of the Department of Biomaterials and Biomedical Technology (BBT) at the University Medical Center Groningen. BBT is driven by a clear mission: To translate biomedical engineering innovations into tangible medical impact. By integrating biomaterials and materials science, nanomedicine, biofabrication, nanotechnology, microbiology, and targeted drug delivery, we strive to ensure that technological advances reach patients more rapidly, safely, and effectively.

Translating biomedical engineering innovations into tangible medical impact.

The year 2025 brought strong international recognition of our scientific excellence. For example, Prof. Hélder A. Santos and Prof. Henny C. van der Mei were named among the World's Best Scientists 2025 in Materials Science by Research.com, affirming BBT's global standing at the interface of materials science, engineering, and medicine. In total, BBT researchers contributed to more than 100 peer-reviewed publications, many in leading journals in biomaterials, biomedical engineering, and translational medicine. BBT's work was presented at over 60 international conferences, further strengthening BBT's visibility and global collaborations. For example, at the 34th Annual Conference of the European Society for Biomaterials (ESB 2025) in Turin, BBT senior and early-stage researchers delivered keynote lectures, four oral presentations, and three posters. BBT was honored with both Best Oral Presentation and Best Poster awards, clear evidence of the breadth, quality, and impact of our research in nanomedicine, regenerative medicine, and biomedical engineering.

BBT's research pipeline also made decisive progress toward clinical translation. For example, in a Health~Holland–funded collaboration led by Prof. Santos, the INNO4GBM project was launched to develop a local, injectable hydrogel therapy for post-surgical glioblastoma treatment. This initiative brings together UMCG, the University of Groningen, and InnoCore Technologies, combining advanced biofabrication with controlled drug release strategies to reduce tumor recurrence and accelerate clinical implementation. Moreover, Dr. Adéla Melcrová, a BBT postdoctoral researcher, was awarded an NWO Off Road grant to support her work on a novel, multi-pronged approach to combating antibiotic-resistant bacteria. Furthermore, three new postdoctoral fellows were awarded prestigious EU MSCA grants to join Prof. Santos's research group, further strengthening BBT's translational research capacity.

In parallel, BBT's entrepreneurial ecosystem continued to mature. BBT spin-out QT Sense secured €6 million in investment to scale Quantum Nuova, a nanodiamond-based quantum sensing platform for real-time, single-cell diagnostics. In 2025, the UMCG Emergency Department began using this technology to explore early sepsis detection from blood samples, marking an important step toward real-world clinical adoption. Momentum in oncology was further strengthened as the ONCO Q consortium, led by QT Sense and involving partners across UMCG and the University of Groningen, secured approximately €2 million (SNN) to investigate diamond-based quantum sensing for colon cancer diagnosis and drug response prediction.

A cornerstone achievement of 2025 was the award of an ERC Consolidator Grant (€2 million) to Prof. Romana Schirhagl for the FORESEE project. This ambitious research program aims to pioneer in vivo quantum sensing for early sepsis detection by quantifying free-radical dynamics using nanodiamond magnetometry. The ultimate goal is to develop a fiber-based platform capable of monitoring sepsis at the single-cell level directly in the bloodstream, an advance with the potential to fundamentally transform the diagnosis and management of critical illness in the ICU. This project exemplifies BBT's strategy to design high-impact technologies and accelerate translation through close clinical and industrial partnerships.

Education and talent development continued to be defining pillars of BBT. In 2025, we celebrated a total of 15 PhD thesis defenses, underscoring both the strength of our training environment and our commitment to excellence in research. Notably, recent BBT PhD graduates received national and international recognition, including Best PhD Thesis awards from the Netherlands Society for Biomaterials and Tissue Engineering (Dr. Lisa Tromp) and São Paulo State University (Dr. Gabriela Corrêa Carvalho) – we are very proud of all of you!

None of successes in 2025 would be possible without the dedication of all BBT's researchers, students, technical staff, support teams, and collaborators, past, present, and future.

The achievements of 2025 underscore the transformative power of interdisciplinary collaboration across laboratories and clinics, and between academia and industry. These successes were made possible through strong partnerships with our existing collaborators and the integration of new partnerships that brought fresh perspectives and expertise. Looking ahead, BBT will continue to push the frontiers of materials-enabled medicine, precision therapeutics, and biofabrication, while strengthening our culture of excellence, inclusion, and societal engagement.

Our commitment to collaboration remains unwavering. We will deepen ties with our long-standing partners, both from academia and industry, and actively seek new strategic alliances across disciplines, ensuring that innovation thrives in a truly global ecosystem. These partnerships will accelerate the translation of discovery into clinical solutions, leveraging shared infrastructure, joint research programs, and also co-development initiatives with industry partners.

None of successes in 2025 would be possible without the dedication of all BBT's researchers, students, technical staff, support teams, and collaborators, past, present, and future. Their commitment is the foundation of everything BBT achieved in 2025 and will continue to drive our success in 2026 and beyond.

As we look ahead to 2026, we do so with confidence and momentum. The achievements of the past year make us proud of what BBT has accomplished and give us strong confidence in what lies ahead. Together, within BBT and with our trusted partners and new collaborators, we will continue to translate discovery and innovation into care, faster and further, shaping the future of health through science and technology.

I wish everyone a successful 2026!

Sincerely,

Hélder Almeida Santos
Head of Department
Department of
Biomaterials &
Biomedical Technology

University Medical Center Groningen

Research at Department of Biomaterials & Biomedical Technology

Enhance medical therapies through the design and application of nextgeneration biomaterials

The Department of Biomaterials and Biomedical Technology (BBT) at UMCG is at the forefront of innovative research aimed at revolutionizing healthcare. Operating at the crossroads of materials science, engineering, biology, and medicine, BBT focuses on creating advanced biomaterials and biomedical technologies that elevate patient care and improve clinical outcomes.

BBT's research is driven by the ambition to enhance medical therapies through the design and application of nextgeneration biomaterials. This includes developing biocompatible and bioactive materials for tissue engineering, regenerative medicine, medical devices, and innovative drug delivery systems. By integrating breakthroughs in nanotechnology, nanomedicine, 3D printing, and biomaterial design, BBT works toward solutions capable of healing, replacing, or regenerating damaged tissues and organs.

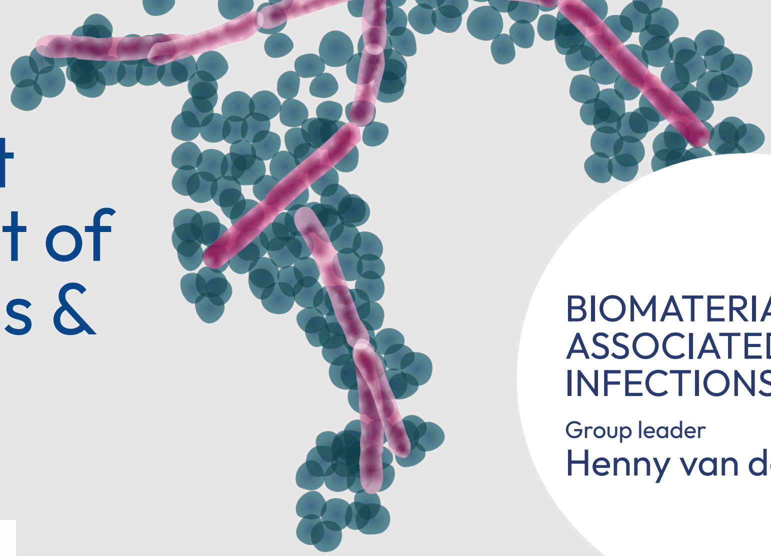
A defining strength of BBT is its strong inter and multidisciplinary foundation. The department brings together specialists in fields such as biomedical engineering, pharmaceutical nanotechnology, regenerative medicine, and biofabrication to tackle complex medical challenges collaboratively. This environment encourages innovative approaches to personalized treatments, particularly for difficult-to-treat conditions. BBT's research portfolio covers a broad spectrum—from bone and cartilage regeneration and wound healing to smart nanobased systems for targeted delivery of drugs and genes, as well as 3Dprinted, highly organized structures for regenerative medicine.

Recent research highlights at BBT include advancements in 3D-printed constructs for regenerative applications, a field with the potential to reshape the future of transplantation and tissue repair. Promising progress has also been made in biomaterial coatings for implants, which may significantly reduce rejection rates and improve long-term patient outcomes. Another major focus is personalized healthcare, exemplified by the development of tailor-made biomaterials and targeted nanomedicines designed for individual patient needs.

Overall, BBT at UMCG continues to push the boundaries of biomedical innovation. The department is committed to developing smarter, safer, and more effective medical technologies across a wide range of cuttingedge fields, including regenerative medicine and tissue engineering, smart biomaterials, drug delivery systems, wearable and implantable medical devices, biocompatible polymers and hydrogels, nanotechnology for medical applications, artificial organs and biohybrid systems, biomedical robotics and prosthetics, gene therapy and CRISPR-based approaches, as well as biomechanics and advanced implant materials.

BBT at UMCG continues to push the boundaries of biomedical innovation

Research at Department of Biomaterials & Biomedical Technology

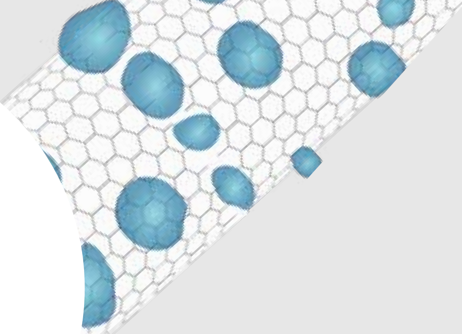


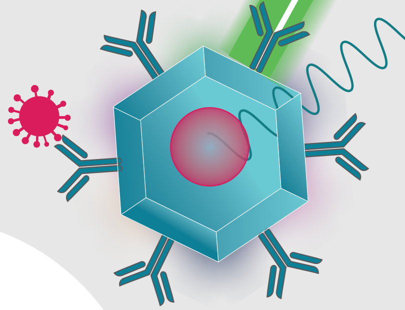
BIOMATERIALS-ASSOCIATED INFECTIONS

Group leader
Henny van der Mei

BIOINSPIRED MATERIALS AND BIOENGINEERING (BioMatBio)

Group leader
Mohammad-Ali Shahbazi





BIOIMAGING AND BIOANALYSIS

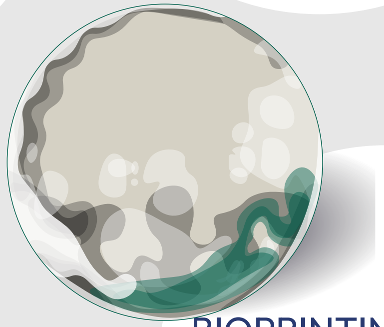
Group leader
Romana Schirhagl

BACTERIAL ADAPTIVITY

Group leader
Brandon Peterson

TARGETED DRUG DELIVERY WITH NANOMEDICINE

Group leader
Inge Zuhorn



BIOPRINTING AND BIOFABRICATION

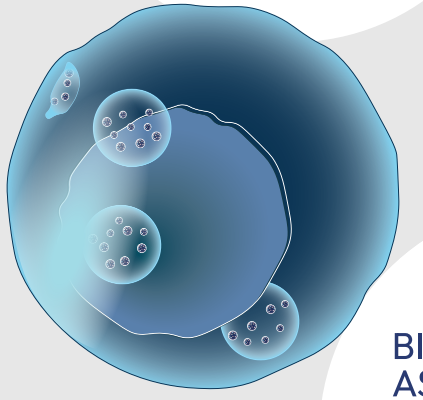
Group leader
Monize Decarli

BIOTRIBOLOGY AND REGENERATION

Group leader
Prashant Sharma

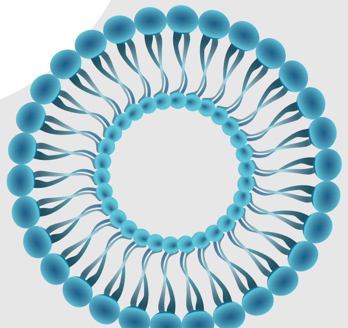
SURGICAL ROBOTICS

Group leader
Sarthak Misra



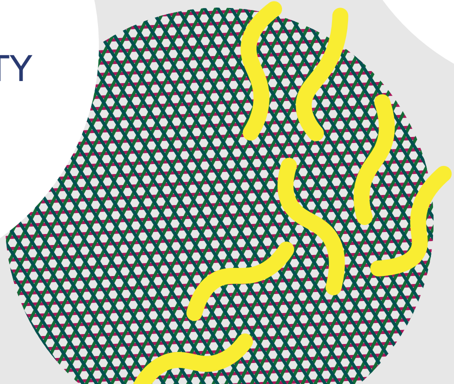
TRANSLATIONAL BIONANOMICRO THERAGENERATIVE MEDICINE

Group leader
Hélder Santos



BIOMATERIAL ASSOCIATED INFECTIONS AND BIOCOMPATIBILITY

Group leader
Jelmer Sjollema

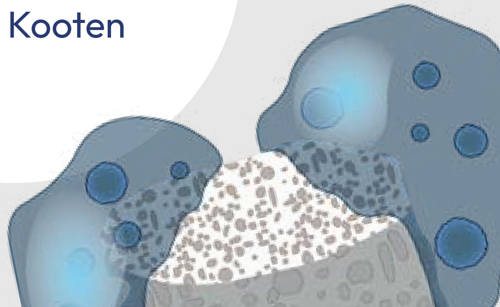


TRANSLATIONAL & REGENERATIVE BIOMATERIALS

Group leader
Patrick van Rijn

CELL-BIOMATERIAL INTERACTIONS

Group leader
Theo van Kooten



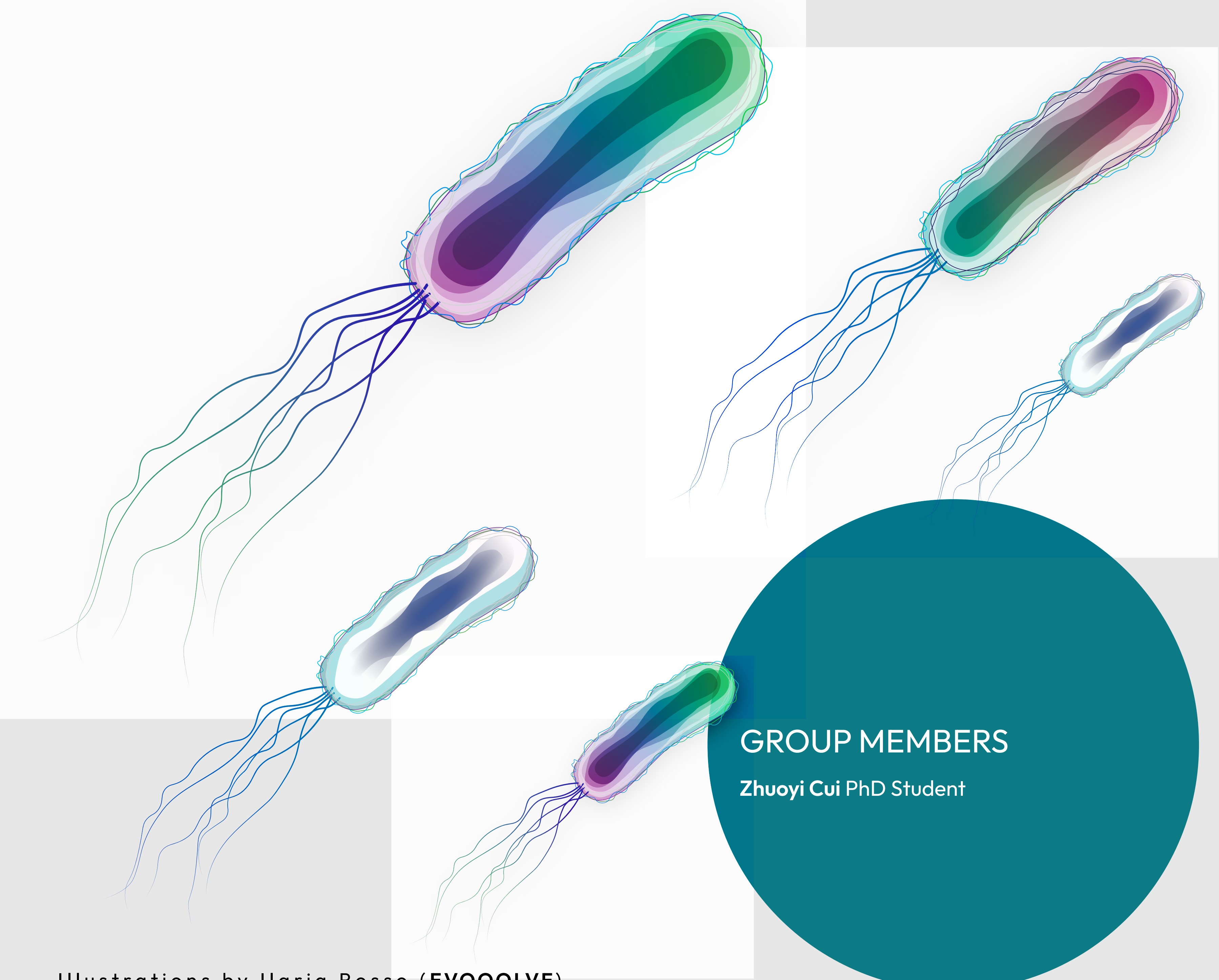
Research at Department of Biomaterials & Biomedical Technology

BACTERIAL ADAPTIVITY

Group leader

Brandon Peterson

Learning how bacteria adapt to the their environments provides new methods of control.



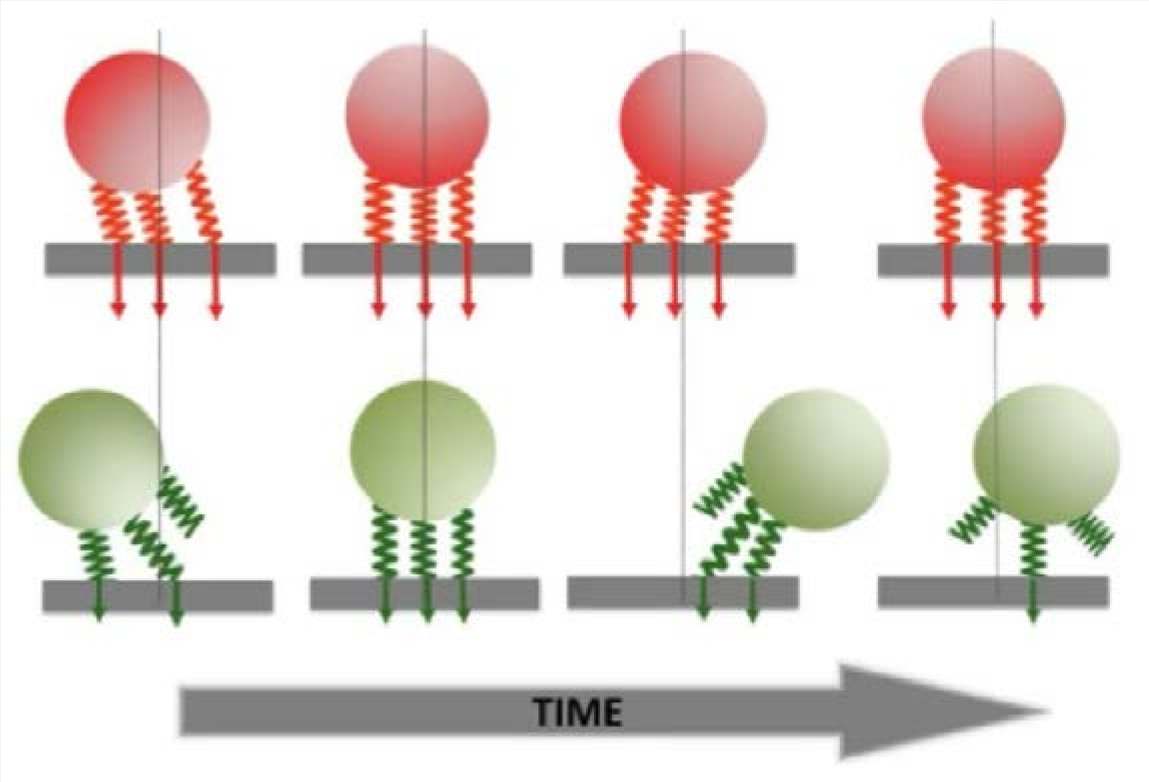
GROUP MEMBERS

Zhuoyi Cui PhD Student

Illustrations by Ilaria Rosso (**EVOOOLVE**)
Free interpretation of bacteria, and their ever-changing nature.

INTRODUCTION

Bacteria have many survival mechanisms helping them survive changing environments. Mutations are a common form of evolution to long term changes, however, bacteria can change expression by adapting to short term fluctuations in the environment. Learning how bacteria adapt to the their environments provides new methods of control. Newly developed biomaterials are typically tested against initial bacterial adhesion, but do not consider adaptation to the bacteria-biomaterial interface with time. How bacteria adapt to the interface will determine the success of the biomaterial. Antimicrobial resistance is an advanced form of adaptation. Preventing short term adaptation will reduce instances of resistance formation.



Proposed mechanism of the irreversibility of bacterial adhesion due to multiple, reversibly binding tethers as derived from the influence of adhesion forces on the vibration amplitude and confined Brownian motion of adhering bacteria and supported by in silico simulations: Strong adhesion forces (red panel) of individual tethers impede Brownian-motion induced detachment of tethers resulting in small vibration amplitudes, while small adhesion forces (green panel) allow detachment of tethers resulting in larger vibration amplitudes and nanoscopic displacement parallel to the surface when re-attaching at a different position.

RESEARCH FOCUS

Discover mechanisms bacteria use to adapt to their environments

Innovate biomaterials and test for antifouling and antibacterial properties

Develop and validate new microbiological models for testing biomaterials

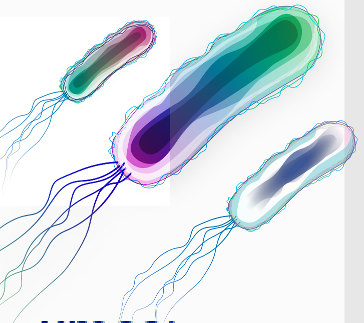
Combat increasing antimicrobial resistance

Develop innovative drug delivery systems to eradicate biofilms

Sjollema, J., van der Mei, H.C., Hall, C.L. et al. Detachment and successive re-attachment of multiple, reversibly-binding tethers result in irreversible bacterial adhesion to surfaces. Sci Rep 7, 4369 (2017). doi.org/10.1038/s41598-017-04703-8

Bacterial Adaptivity

Group leader
Brandon Peterson



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THE FUTURE

Growth of this research team is the primary goal for the future. Collaborations with companies for microbiological testing is a good way to demonstrate the strength of my team. Fundamental research regarding adaptivity and antimicrobial resistance can be maintained through bachelor and master theses until enough supporting data provides opportunities for funding. Clinical collaborations developing innovative biomaterials are being pursued for growth opportunities. Once established, the group will maintain a balance of fundamental research, microbiological testing, and developing innovative biomaterials all utilizing knowledge of bacterial adaptivity to our advantage.

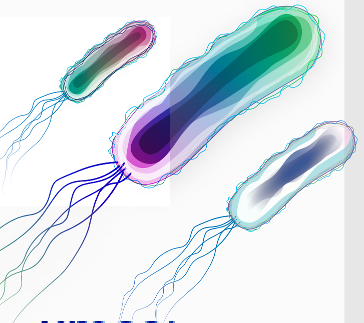
SELECTED PUBLICATION

Qiaolan Shi, Lu Yuan, Joop de Vries, Brandon Peterson, Jian Liu, Yijin Ren, Henny C. van der Mei.
Pt nanoparticles grown on Bi_3O_4Br nanosheets enhance the efficacy of ampicillin against infectious biofilms.
Chemical Engineering Journal, Volume 525, 2025, 170597,
DOI: 10.1016/j.cej.2025.170597

Due to the high resistance and complexity of biofilms, alternatives to traditional antibiotic treatments are urgently needed. Here, we investigated whether Pt nanoparticles grown on Bi3O4Br nanosheets (PtNP/Bi3O4Br) can enhance the efficacy of the antibiotic ampicillin against biofilm-associated infections. X-ray photoelectron spectroscopy revealed abundant oxygen vacancies in the Bi3O4Br nanosheet creating an ideal surface for Pt nanoparticles growth. The obtained PtNP/Bi3O4Br nanozyme had a uniform Pt nanoparticle distribution confirmed by X-ray powder diffraction and transmission electron microscopy with high-angle annular dark-field scanning. Compared to Bi3O4Br nanosheets alone, the nanozyme demonstrated significantly higher catalytic activity for reactive oxygen species generation facilitated by efficient electron transfer from Pt nanoparticles. When combined with ampicillin, PtNP/Bi3O4Br nanozyme significantly enhanced bactericidal efficacy against both Gram-positive Staphylococcus aureus and Gram-negative Escherichia coli biofilms in vitro as shown by reduction in biofilm thickness and colony-forming units. In a murine skin infection model, the combination accelerated wound healing following S. aureus infection. Additionally, the combined treatment selectively reduced the pathogen Streptococcus mutans in human ex vivo oral biofilms while preserving the healthy human microbiome indicating potential applications in dental care. In conclusion, this work demonstrates that nanozyme-enhanced antibiotic therapy offers a promising strategy to combat biofilm-associated infections and antibiotic resistance.

Bacterial Adaptivity

Group leader
Brandon Peterson



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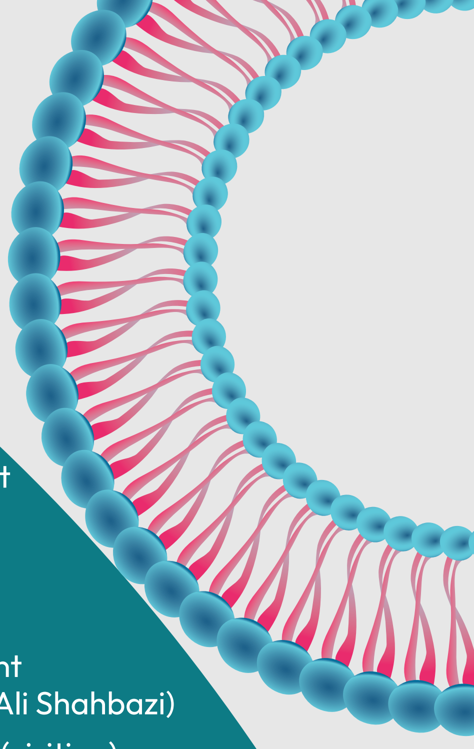
TRANSLATIONAL BIONANOMICRO THERAGENERATIVE MEDICINE

Group leader

Hélder Santos

Precise drug delivery, improved diagnostics, tissue engineering, and enhanced therapeutic efficacy while minimizing side effects



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Zehua Liu Postdoc

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Clara Maas PhD Student

Daniela Orefice PhD Student

Duarte Salgado de Almeida PhD Student

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Mariana Salomão PhD Student

Mariane Carraro PhD Student

Meng Qiao PhD Student
(in collaboration Inge Zuhorn)

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(in collaboration Mohammad-Ali Shahbazi)

Muhammad Noh PhD Student (visiting)

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Raquel Bártolo PhD Student

Raquel Bolconte PhD Student

Renata Maia PhD Student

Saret Galindo PhD Student

Sebastian Lopez PhD Student

Shuai Hu PhD Student
(in collaboration Mohammad-Ali Shahbazi)

Xueqing Li PhD Student
(in collaboration Monize Decarli)

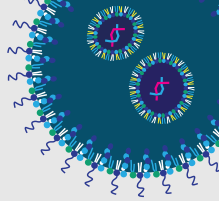
Yu He PhD Student

Yuewen Zhu, PhD Student
(in collaboration Mohammad-Ali Shahbazi)

Zhuoyi Cui, PhD Student
(in collaboration Brandon Peterson)

Gésinda Geertsema-Doornbusch
Research Technician

Joop de Vries, Research Technician



INTRODUCTION

Prof. Hélder A. Santos research focuses on the development of advanced nanomedicines and biomedical engineering solutions aimed at addressing unmet clinical needs in complex diseases, particularly in regenerative medicine, and cancer and cardiovascular diseases.
The central aim is to design multifunctional nanobiomaterials that enable precise drug delivery, improved diagnostics, tissue engineering, and enhanced therapeutic efficacy while minimizing side effects. By integrating principles from biomedical engineering, materials science, pharmaceutical nanotechnology, and regenerative medicine, our research seeks to bridge the gap between fundamental medical problems and real clinical applications. A strong emphasis is placed on translational research, scalability, and clinical translation of the biomedical technologies developed in the lab to ensure that laboratory innovations can progress toward patient-ready solutions. Ultimately, the goal is to contribute to personalized and precision medicine by creating smart, responsive, and clinically relevant biomedical platforms.

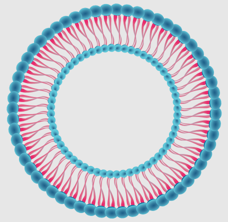
RESEARCH FOCUS

Professor Hélder Santos' research focus is driven by the vision of transforming nanomedicine from laboratory concepts into clinically relevant solutions. The group focuses on the rational design and translation of advanced nanomedicines and biomaterials that enable precise, adaptive, and personalized therapeutic interventions.
Central to this work is the development of polymeric, inorganic, lipid-based, and hybrid and biomimetic nanosystems, including porous materials, lipid and biomimetic micro/nano-particles, engineered for controlled, targeted, and stimuli-responsive drug delivery. These biomaterials are designed to sense and respond to disease-specific biological cues, enabling site-specific therapeutic release. By tailoring material properties to physiological needs, the research aims to maximize therapeutic efficacy while minimizing side effects. Applications span major global health challenges, including cancer, cardiovascular diseases, inflammatory conditions, etc. The research work further advances theranostic nanomedicine by integrating diagnostic and therapeutic functionalities within single platforms. These systems enable real-time monitoring of biodistribution, disease progression, and treatment response, supporting data-driven and adaptive therapeutic strategies aligned with precision medicine.

A defining pillar of the group's research focus is also the integration of advanced microfluidic approaches and microneedle technologies for the fabrication and delivery of micro- and nanomaterials. Microfluidic platforms enable unprecedented control over particle size, composition, and architecture while ensuring high reproducibility and scalability, critical prerequisites for regulatory approval and clinical translation. In parallel, microneedle systems provide minimally invasive, localized, and patient-friendly interfaces for transdermal and interstitial delivery, sensing, and combined theranostic applications. Complementary efforts in biomaterials and regenerative medicine explore bioengineered systems, including 3D-bioprinted constructs, for example, for bone and cardiovascular tissue regeneration.

Through strong interdisciplinary integration and close collaboration with clinical and industrial partners, Professor Santos' research bridges fundamental materials science and clinical implementation. The long-term goal is to deliver safe, scalable, and clinically impactful biomedical technologies that redefine how complex diseases are diagnosed and treated.

TRANSLATIONAL BIONANOMICRO THERAGENERATIVE MEDICINE
Group leader
Hélder Santos



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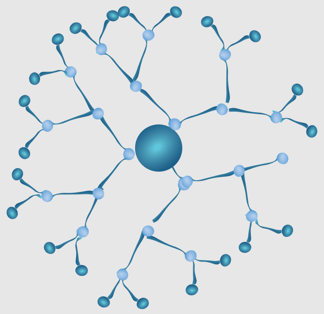
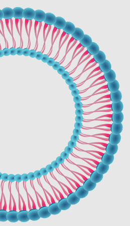




TRANSLATIONAL BIONANOMICRO THERAGENERATIVE MEDICINE

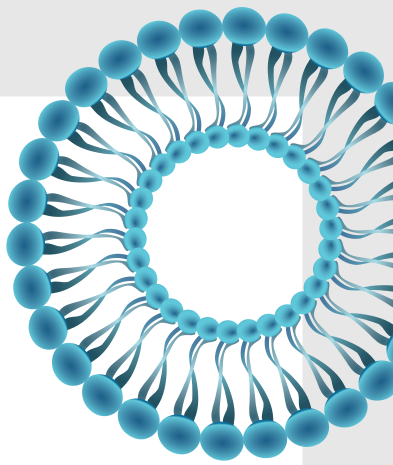
Group leader
Hélder Santos

THE FUTURE

Future research will focus on advancing next-generation medicines toward clinical translation and personalized healthcare, with a strong emphasis on micro/nano-systems adaptable to patient-specific needs. Artificial Intelligence (AI) will play a pivotal role in accelerating this progress by enabling predictive modeling, data-driven optimization, and virtual screening of nanomaterial properties. AI-powered algorithms will guide the rational design of smart and adaptive nanobiomaterials, including lipid nanoparticles for nucleic acid delivery, polymeric nanocarriers with stimuli-responsive release profiles, and cell-based or hybrid biomimetic nanosystems that exploit natural targeting mechanisms. These platforms will be engineered to respond dynamically to disease-specific cues, leveraging AI-driven insights to fine-tune composition, functionality, and performance. By integrating computational intelligence with experimental innovation, the future of nanobiomaterials will move toward highly personalized, efficient, and safe therapeutic solutions.

In parallel, scalable and robust manufacturing strategies will be further developed using advanced microneedle and microfluidic technologies, enabling precise control over particle size, composition, and batch-to-batch reproducibility while supporting regulatory-compliant production. Another key direction is the integration of AI and data-driven approaches to guide nanobiomaterial design, predict biological performance, and optimize therapeutic outcomes. Close collaboration with industrial and clinical partners will accelerate validation, regulatory translation, and commercialization. In addition, bioengineered and regenerative materials, for example, for bone and cardiac tissue regeneration using 3D bioprinting technologies, will be explored for chronic and degenerative diseases, with the long-term goal of delivering safe, effective, and clinically impactful nanomedical solutions.

Illustrations by Ilaria Rosso (**EVOOOLVE**)
Free interpretation of nanocarries.



SELECTED PUBLICATION

Sen Li, Han Gao*, Haoji Wang, Xiaolin Zhao, Da Pan, Idaira Pacheco-Fernández, Ming Ma, Jianjun Liu, Jouni Hirvonen, Zehua Liu*, Hélder A. Santos*

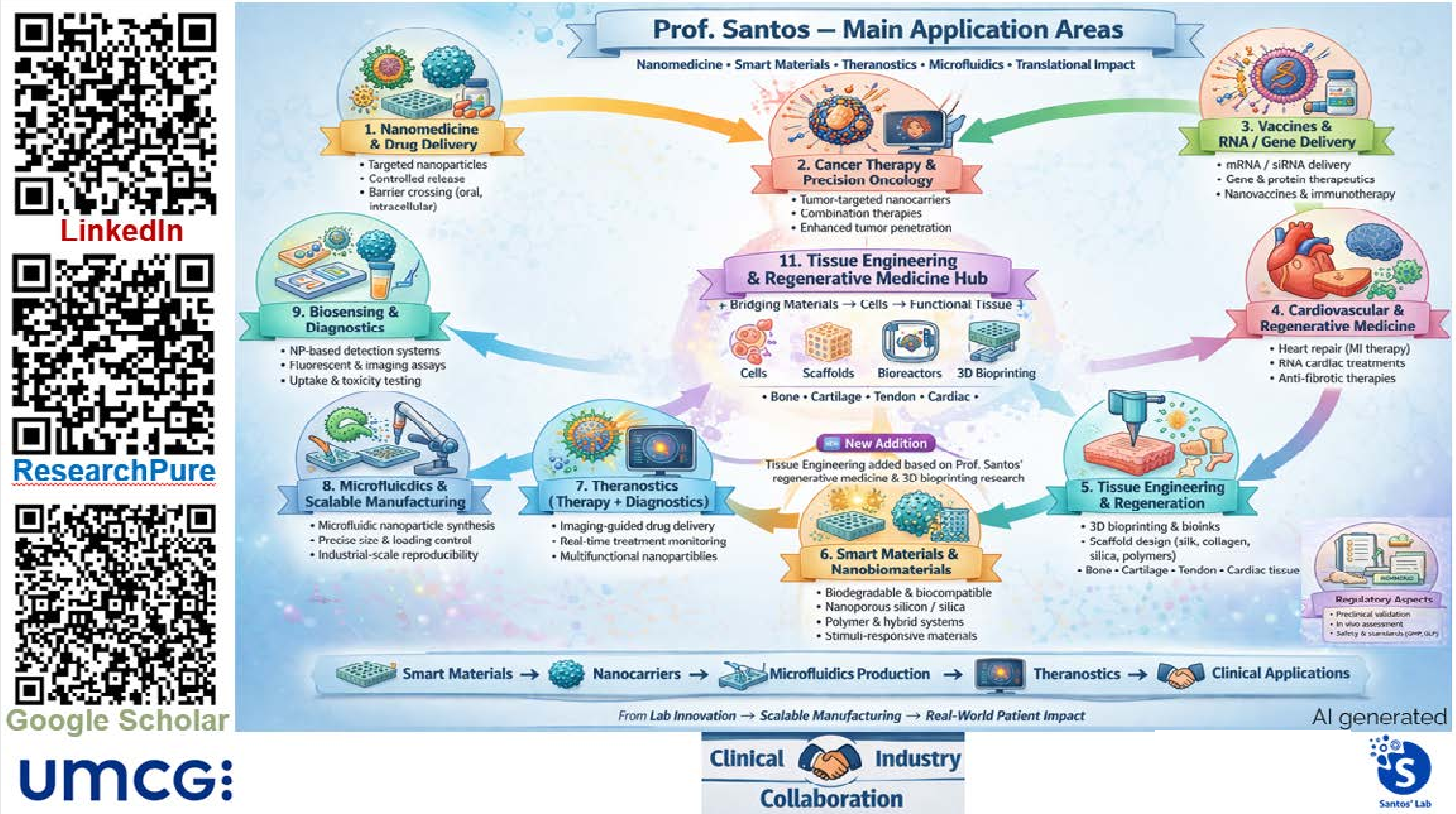
Tailored Polysaccharide Entrapping Metal-Organic Framework for RNAi Therapeutics and Diagnostics in Atherosclerosis

Bioact. Mater. 2025, 43, 376-391.
DOI: 10.1016/j.bioactmat.2024.08.041

Metal-organic frameworks (MOFs) hold promise as theranostic carriers for atherosclerosis. However, to further advance their therapeutic effects with higher complexity and functionality, integrating multiple components with complex synthesis procedures are usually involved. Here, we reported a facile and general strategy to prepare multifunctional anti-atherosclerosis theranostic platform in a single-step manner. A custom-designed multifunctional polymer, poly(butyl methacrylate-co-methacrylic acid) branched phosphorylated β-glucan (PBMMA-PG), can effectively entrap different MOFs via coordination, simultaneously endow the MOF with enhanced stability, lesional macrophages selectivity and enhanced endosome escape. Sequential ex situ characterization and computational studies elaborated the potential mechanism. This facile post-synthetic modification granted the administered nanoparticles atherosclerotic tropism by targeting Dectin-1+ macrophages, enhancing in situ MR signal intensity by 72 %. Delivery of siNLRP3 effectively mitigated NLRP3 inflammasomes activation, resulting a 43 % reduction of plaque area. Overall, the current study highlights a simple and general approach for fabricating a MOF-based theranostic platform towards atherosclerosis conditioning, which may also expand to other indications targeting the lesional macrophages.

TRANSLATIONAL
BIONANOMICRO
THERAGENERATIVE
MEDICINE

Group leader
Hélder Santos



Cartoon showing the innovations and technologies of Prof. Santos´ Lab research focus. (Source: ChatGPT generated by BBT)

Research at
Department of
Biomaterials &
Biomedical
Technology

BIOMATERIALS-ASSOCIATED INFECTIONS

Group leader

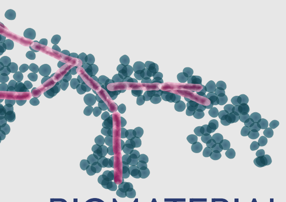
Henny van der Mei

Drug-resistance amongst pathogenic bacteria is a growing threat to human health and predicted to become the number one cause of death by the year 2050.

Illustrations by Ilaria Rosso (**EVOOOLVE**)
Free interpretation of bacteria growing colonies.

GROUP MEMBERS

Lu Yuan Postdoc
Veridianna Pattini PhD Student
Cong Li PhD Student
Yaran Wang PhD Student
Tianrong Yu PhD Student
Qiaolan Shi PhD Student
Fan Wu PhD Student
Siran Wang PhD Student
Yuanlong Cao PhD Student
Liliana Agresti PhD Student
Elles Boonstra PhD Student



BIOMATERIALS-ASSOCIATED INFECTIONS

Group leader
Henny van der Me

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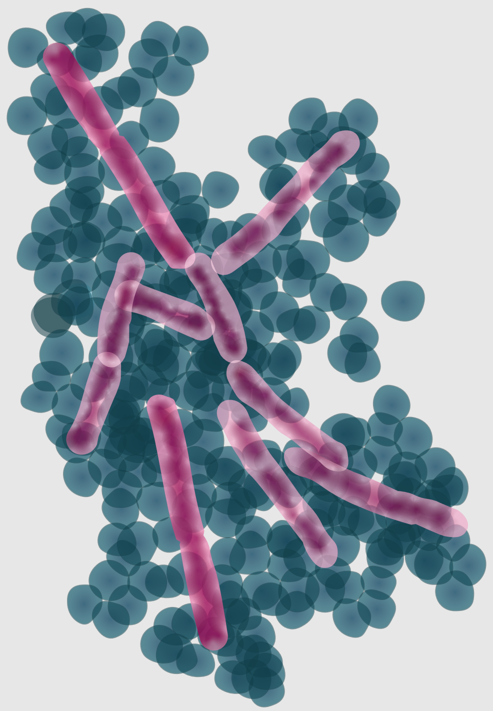
Department of Biomaterials & Biomedical Technology

INTRODUCTION

Drug-resistance amongst pathogenic bacteria is a growing threat to human health and predicted to become the number one cause of death by the year 2050, all as a consequence of the overuse of antibiotics. Therefore I aim to develop new strategies to combat infectious biofilms in the human body or on implants. When combating infectious diseases, care needs be taken for collateral damage on healthy tissue around the infection. Another problem with bacterial infections is the bacterial infected tumor. Bacteria can degrade chemotherapeutics, meaning the treatment is not successful. In this case a dual-treatment combating the bacteria and tumor cells is the strategy to be developed.

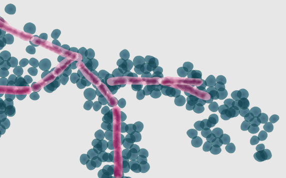


RESEARCH FOCUS

Antibiotics in nanocarriers for localized treatment can be used, but non-antibiotic based strategies are preferable. Nano-antimicrobials like nanozymes which catalytically generate reactive oxygen species to which bacterial pathogens have little or no defense. These nano-materials are non-specific and can kill Gram-positive, Gram-negative and antibiotic-resistance bacteria.

For the treatment of an infected tumor liposomes are used containing an antibiotic and a chemotherapeutic. The liposome is pH responsive and degraded in the neighborhood of the bacterium in the tumor.

Bacterial infectious related to implants will be combatted with a nano-carrier as described above or with a coating on the implant. At the moment I am working on several coatings on dental implants.



BIOMATERIALS-
ASSOCIATED
INFECTIONS

Group leader
Henny van der Me

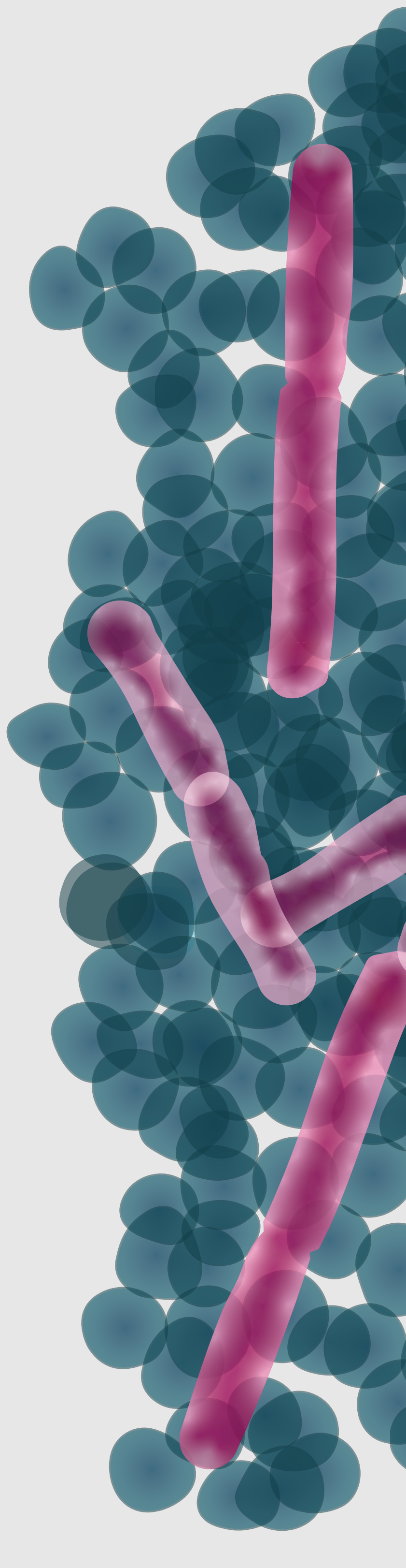
SELECTED PUBLICATION

Yaran Wang, Fan Wu, Lei Hua, Chang Gao, Siran Wang, Yong Liu, Yijin Ren,
Linqi Shi, Henny C. van der Mei, and Yuanfeng Li.

Bimetal-Phenolic Framework to Combat Bacterial Infections via Synergistic Biofilm Dispersal, Bacterial Killing and Immune Modulation.

Advanced Science 2025, 12, e13863.
DOI: 10.1002/advs.202513863

The presence of drug-resistance and extracellular matrix protection in biofilms, makes it increasingly difficult to control bacterial infections using antibiotics. Therefore, there is an urgent need to develop new non-antibiotic approaches to eradicate drug-resistant bacterial infections. Here, a bimetal-phenolic framework (Que-Fe-CeMPF) was constructed by direct self-assembly of coordinated Fe- and Ce-ions with the polyphenol quercetin (Que). Que-Fe-CeMPF enhanced hydroxyl-radical (•OH) generation particularly in an acidic environment and presence of H2O2 compared with single metal-phenolic frameworks (Que-FeMPF and Que-CeMPF). •OH damaged bacterial cell walls, resulting in intracellular protein loss and bacterial cell death. Additionally, Que-Fe-CeMPF effectively dispersed biofilms by degrading matrix eDNA, allowing easier •OH penetration, resulting in higher killing efficiency compared to Que-FeMPF and Que-CeMPF. Que-Fe-CeMPF stimulated macrophages to adopt a M2-like phenotype, suppressing excessive immune activation and promoting tissue repair at the infection site. As a combined effect of bacterial killing, biofilm degradation and immune-modulation, the infectious pneumonia caused by Pseudomonas aeruginosa in mice was more effectively eradicated by Que-Fe-CeMPF than by free quercetin or the antibiotic ciprofloxacin. Moreover, Que-Fe-CeMPF is less prone to resistance development in pathogens compared to ciprofloxacin. Thus, Que-Fe-CeMPF is a promising non-antibiotic antimicrobial agent with multimodal activity for controlling drug-resistant bacterial infections.



Research at
Department of
Biomaterials &
Biomedical
Technology

TARGETED DRUG DELIVERY WITH NANOMEDICINE

Group leader

Inge Zuhorn

Design precise, manufacturable, scalable, patient-friendly nanomedicine

Illustration by
Ilaria Rosso
(**EVOOOLVE**)
Free interpretation
of nanoparticles
interacting with cell

GROUP MEMBERS

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TARGETED DRUG DELIVERY WITH NANOMEDICINE

Group leader
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Technology

INTRODUCTION

The 'Targeted Drug Delivery with Nanomedicine' research group focuses on drug delivery across cellular barriers. Our research involves the design and synthesis of nanoparticles, and the study of nanoparticle-cell dynamics. By studying the mechanisms of drug delivery and elucidating structure-function relationships we aim for rational design of drug delivery systems. The overarching aim of the work is to exploit physiological transport routes for nanoparticle-mediated drug delivery.

Overarching research lines

1. Elucidation of the mechanisms of nanocarrier-mediated drug and gene delivery, including the cellular processing of nanoparticles and the mechanisms of endosomal escape of (therapeutic) cargo

2. Design of nanocarriers for drug delivery to the brain, bridging basic science with clinical applications.

We develop lipid-based, polymer-based and natural nanocarriers such as extracellular vesicles (EVs) for drug delivery. Translational and collaborative research projects include nanocarrier design for treatment of glioblastoma, Alzheimer's Disease (AD), Multiple Sclerosis (MS), Huntington's Disease (HD), and Spinocerebellar Ataxia Type 1
(SCA-1), and prevention of anastomotic leakage following esophageal surgery.

RESEARCH FOCUS

In our work we design nanoparticles for specific applications by exploiting the physicochemical characteristics of nanoparticles (size, shape, stiffness, surface charge, chemical composition,...) to i. enhance their circulation time and surmount biological barriers (such as the blood-brain barrier) in order to direct them to their target, and ii. trigger uptake and drug release in target cells in order to exert therapeutic effects.

In addition to engineering of the intrinsic physicochemical properties of nanoparticles, we perform surface functionalization with targeting peptides. E.g for drug delivery to the brain we use the G23 peptide, a peptide that mediates the transport of nanoparticles across the blood-brain barrier (BBB). In addition, we use stimuli-sensitive materials for controlled drug release. Our work encompasses the creation of cell culture models -including BBB models and 3D tumor spheroid models (Figure 1)- to quantitatively measure nanocarrier transport, and the development of cell assays to measure the endocytosis and endosomal escape of nanocarrier systems, using state of the art techniques, including CLEM and super resolution microscopy.

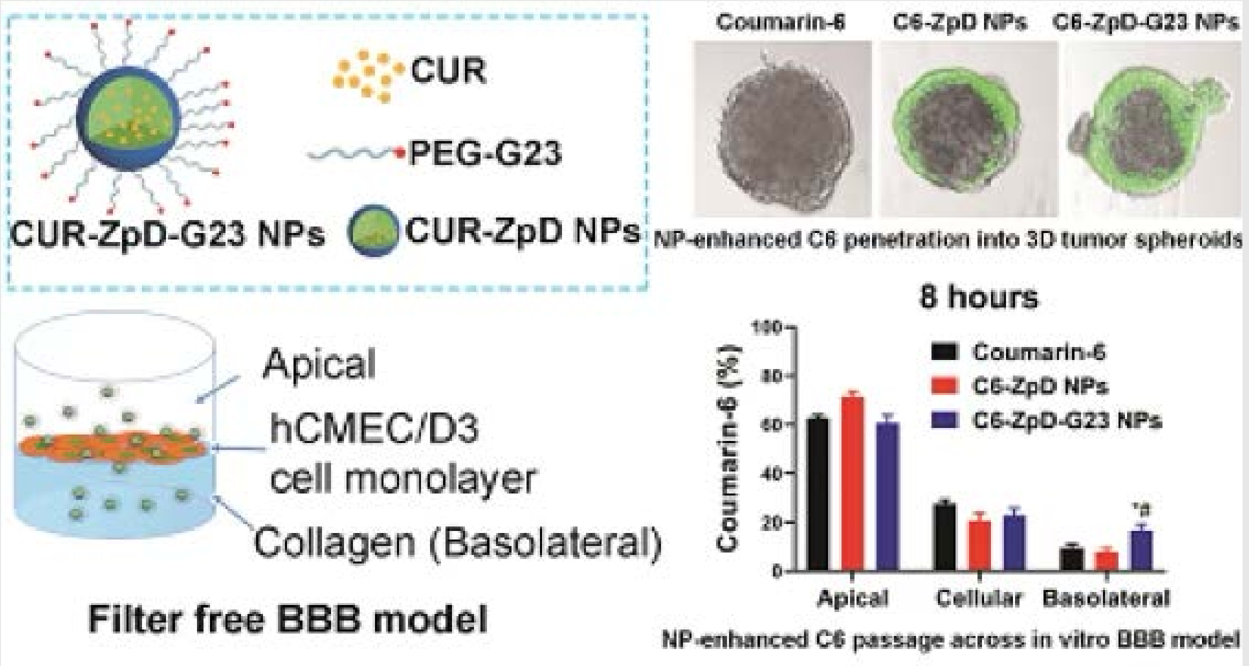


Figure 1
Filter-free BBB model and 3D tumor spheroids (generated with our in-house developed microwells) are used to measure the transport of zein-curcumin nanoparticles across the BBB and their penetration in glioblastoma spheroids.
DOI 10.1039/d0bm01536a

Ultimately, nanocarriers are tested in relevant in vivo models to study side effects and therapeutic outcome, taking into account the influence of pharmacokinetics and pharmacodynamics (Figure 2).

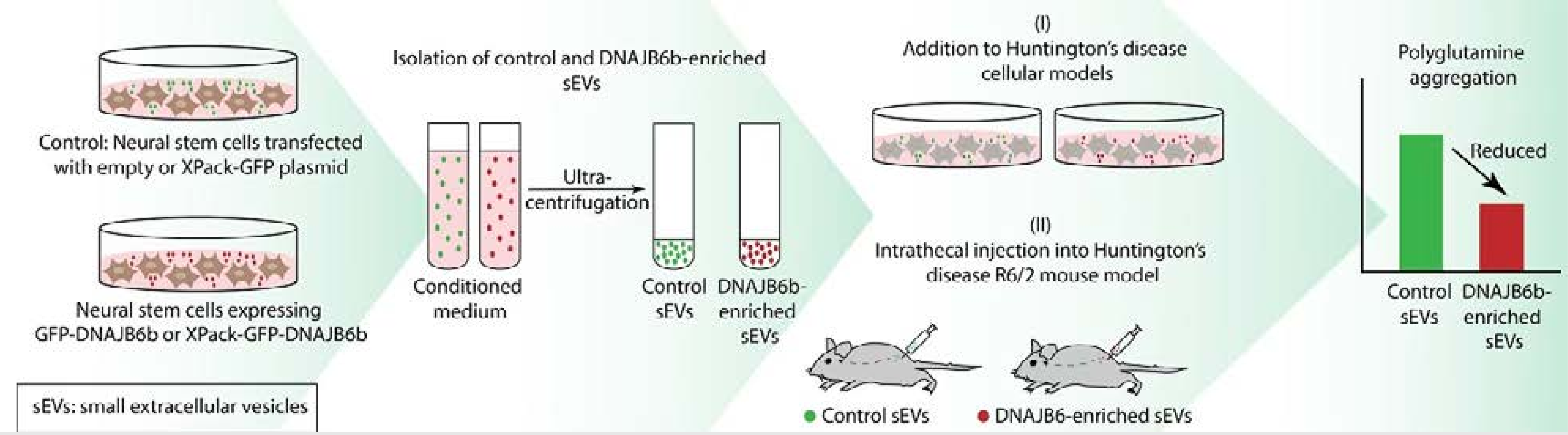


Figure 2
Production of DNAJB6-loaded extracellular vesicles (EVs) through genetic engineering of neural stem cells, and evaluation of therapeutic effects in in vitro and in vivo Huntington's Disease models.
DOI 10.1016/j.isci.2021.103282

Our work follows a multidisciplinary approach, bridging polymer chemistry/materials science to tailor nanocarrier properties, biology/medicine to understand disease/cell interactions/drug delivery, engineering for assay design/(large-scale) manufacturing, and in vivo validation to assess biocompatibility/safety/therapeutic outcome, for clinical translation.

THE FUTURE

We strongly believe that therapeutic efficacy critically depends on how and when drugs are delivered. Therefore, the understanding of the drug delivery process as mediated and controlled by nanomedicine formulations is key in the design of effective therapies, and continues to be a focus of our research.

In addition, we focus on the design of affordable nanomedicine, as simple as possible to prepare, and scalable. While nanomedicine is hyped because of its promise for precision medicine, offering targeted drug delivery to minimize side effects, we should not forget that the prevention of side effects can be simply due to the drug encapsulation per se, irrespective of drug targeting. For this reason, appropriate in vitro model systems to test for reduction of off-target effects are of interest. In addition, PKPD modeling of nanomedicine formulations will help to optimize formulations and reduce animal experimentation.

Overall, our focus is on the design of precise, manufacturable, scalable, patient-friendly nanomedicine.

SELECTED PUBLICATION

Roujia Chang, Bryn D. Monnery, Inge S Zuhorn

Solvent and temperature effects in the photoiniferter RAFT polymerisation of PEG methacrylate

Polym. Chem. 2025,16, 2952-2961;
DOI: 10.1039/D5PY00300H

Photoiniferter (PI)-RAFT polymerization is a promising approach to synthesise a broad range of (meth)acrylic and styrenic polymers because of its highly ‘living’ nature. The lack of an imbalance between initiating and chain-transfer fragments minimises the inherent bimolecular termination of conventional RAFT. Poly(poly(ethylene glycol) methyl ether methacrylate) (P(PEGMA)) is a potential biocompatible material for biomedical applications, but the highly reactive free radical of PEGMA makes control of its polymerisation challenging. In this study, we investigated the synthesis of P(PEGMA) through PI-RAFT. Current studies on the PI-RAFT mechanisms are limited and the effect of solvents on kinetics has not been reported. We varied several reaction conditions: excitation wavelengths, monomer concentrations, temperatures, and solvents. The propagation constant (kp) values were affected by the RAFT main equilibrium. We calculated the Arrhenius parameters, enthalpy of activation (ΔH‡), and entropy of activation (ΔS‡) for polymerization in various solvents. Regression analysis was conducted to fit the results with extinction coefficients of CTA in seven common solvents, solvent physical properties, and solvatochromic scales. The effective collision factor A had a good fitting with an exponential regression model of the extinction coefficients, indicating a strong relationship between the reaction rate and excitation of the CTA. Solvent polarity scales, such as Kalmet–Abraham–Taft (KAT) and Catalan parameters, failed to predict kp, Arrhenius parameters, ΔH‡, and ΔS‡. A chain transfer constant Ctr > 1 for all syntheses indicated relatively good control over the polymerization through degenerative chain transfer with CTA radicals. In general, Ctr decreased with increasing temperatures, a result of the rate of excitation by photon absorption being constant, but the kp being increased by the temperature. Anisole was the best solvent, able to keep Đ = 1.30 even at 40 °C.

Artwork drawn by
Roujia Chang

TARGETED DRUG DELIVERY WITH NANOMEDICINE

Group leader
Inge Zuhorn

umcg
Department of Biomaterials & Biomedical Technology

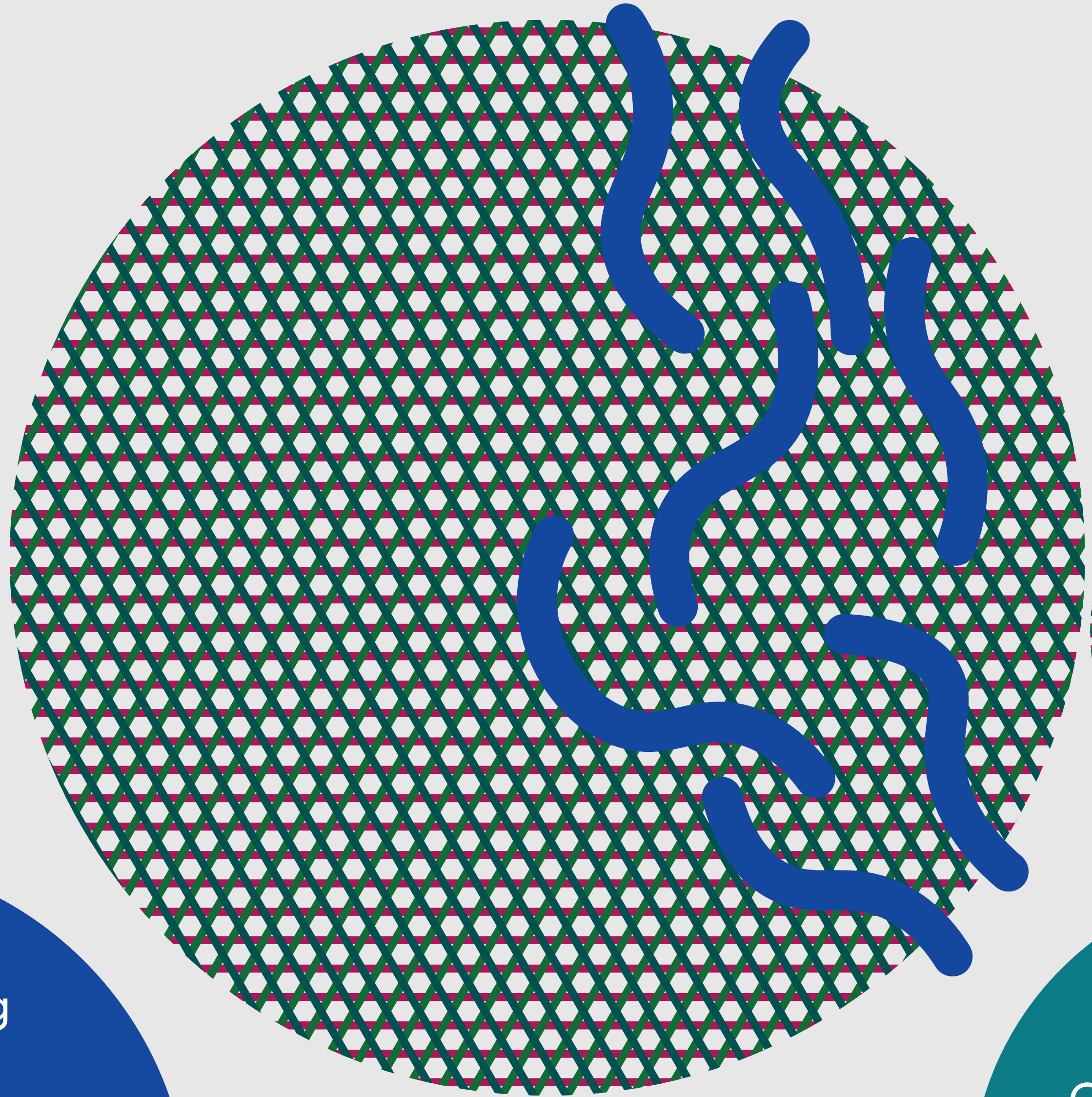
Research at Department of Biomaterials & Biomedical Technology

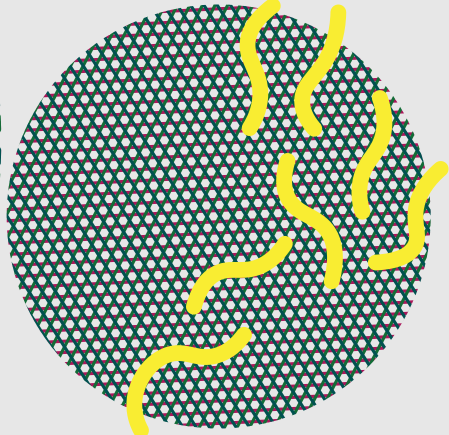
BIOMATERIAL ASSOCIATED INFECTIONS AND BIOCOMPATIBILITY

Group leader

Jelmer Sjollema

Better understanding of the interaction between implants and the local immune system enabling the design of more biocompatible and inherently infection resistant biomaterials.





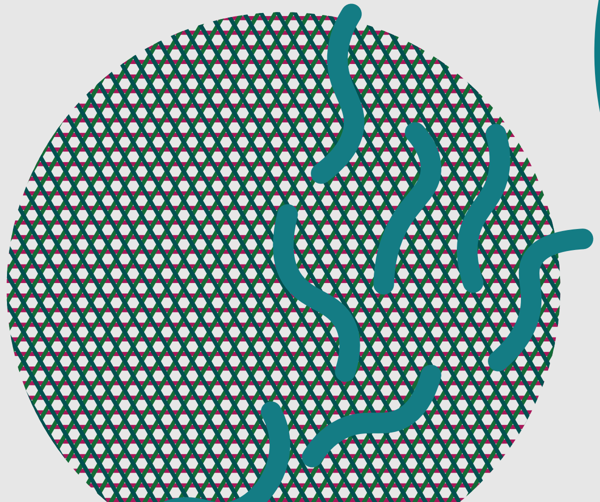


Illustration by Ilaria Rosso (**EVOOOLVE**)
Free interpretation of bacteria interacting with implant materials

GROUP MEMBERS

Liliana Agresti PhD candidate
Elles Boonstra PhD candidate
Florence Witzel PhD candidate

BIOMATERIAL ASSOCIATED INFECTIONS AND BIOCOMPATIBILITY

Group leader
Jelmer Sjollema

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INTRODUCTION

Currently most preclinical research on implant infection and biocompatibility is taking place using in vitro assays or in animal models. There is increasing ethical pressure to replace animal testing by in vitro models, but the current in vitro models are far from ideal. Moreover, the animal models that we have only provide us with a limited insight in the interaction of the implant with the local immune system on a cellular level. The aim of my research is to improve the current experimental models, both the in vitro and the animal models, with the ultimate goal to gain a better understanding of the interaction between implants and the local immune system enabling the design of more biocompatible and inherently infection resistant biomaterials.

RESEARCH FOCUS

My first research focus is on a further development of intravital imaging in experimental animals for infection and biocompatibility research. This technology, in combination with advanced light microscopy enables the spatio temporal distribution of immune cells that constitute the foreign body reaction, with or without the interaction with pathogens.

My second research focus is on the development of in vitro 3D tissue mimics to study the foreign body reaction and implant infections. These tissue mimics are 3D-printed scaffolds populated with relevant cells like macrophages and fibroblasts in a matrix mimicking the extracellular matrix in soft tissue. We aim, by adding small biomaterial particulates, to simulate as much as possible the foreign body reaction in this system and to quantitatively evaluate this process by quantitative image analysis.

The third research focus is on the evaluation of infection probes to be used in the clinic for early implant infection diagnosis. The aim is, by choosing, adapting and optimizing the research technologies as described above, to discriminate inflammation (e.g. as a result of the foreign body reaction) from infection. The result of the research will lead to a better understanding and optimization of the sensitivity and specificity of these probes.

BIOMATERIAL ASSOCIATED INFECTIONS AND BIOCOMPATIBILITY

Group leader
Jelmer Sjollema

THE FUTURE

The future will partly on finalizing the research in the DARTBac consortium for the development of antimicrobial resistance technology. In this consortium we aim for both a further refinement of the intravital imaging technology and a further optimization of the 3D-printed tissue mimic to study biomaterial associated infections. The other part will concern two new projects, the first being a project granted by the Ubo Emmius fund on the development of infection probes, the second is a project granted by Health Holland on the development of 3D-printed scaffolds for bone repair with ceramic, antimicrobial fillers.

SELECTED PUBLICATION

Agresti L, Boonstra EC, Jutte PC,
van der Mei HC, Sjollema J.
The applicability of fluorescent optotracers for in vitro and in vivo Staphylococcus aureus detection and quantification.
Sci Rep. 2025 Oct 3;15(1):34503.
DOI: 10.1038/s41598-025-17029-7.
PMID: 41044209; PMCID: PMC12494981.

A sensitive and specific method for assessing microbial contamination is crucial in many sectors of our society like the medical field. Optotracers that trigger fluorescence upon binding to bacterial cell surfaces offer a novel approach. Several studies have highlighted limitations in the specificity of these optotracers with respect to their molecular targets, but, to the best of our knowledge, none did in vivo studies with the same bacterial strain as the in vitro studies. In this study, we compared the activatable optotracer EbbaBiolight 680 for bacterial detection, both in vitro and in vivo with the same Staphylococcus aureus bacterial strain, while analyzing the sensitivity and specificity of the probe against this strain. In vitro the probe's fluorescence correlated strongly with the number of bacterial colony-forming units, both in planktonic suspension and biofilms. However, in vivo results from a mouse model demonstrated limited specificity for S. aureus, as the probe also binds to repetitive component motifs in the extracellular matrix of the tissue. This resulted in a substantial background signal that obscured bacterial detection. In conclusion, while EbbaBiolight 680 effectively detects S. aureus in planktonic suspension and biofilms in vitro, the probe has unfortunately limited specificity in vivo, which can hinder accurate bacterial detection.

Research at
Department of
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Technology

BIOINSPIRED MATERIALS AND BIOENGINEERING (BioMatBio)

Group leader

Mohammad-Ali Shahbazi

GROUP MEMBERS

Kiyan Musaie PhD candidate

Yuewen Zhu PhD candidate

Shuai Hu PhD candidate

Miguelina Beatriz Martínez Aguilera PhD candidate

Advance scalable, modular biomaterial-cell interfaces that can be readily adapted for therapeutic translation, including regenerative medicine, immune engineering, and targeted cancer therapies.

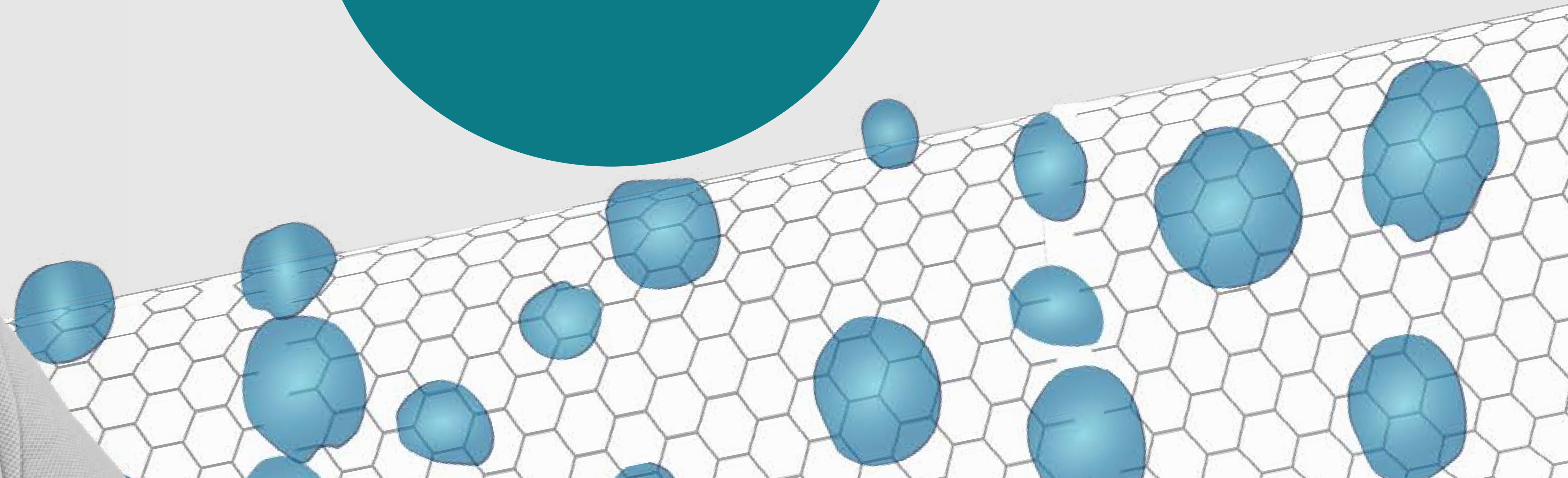


Illustration by Ilaria Rosso (**EVOOOLVE**)
Free interpretation of smart biomaterials

BIOINSPIRED MATERIALS AND BIOENGINEERING (BioMatBio)

Group leader
Mohammad-Ali Shahbazi

INTRODUCTION

My research aim for developing new therapeutic strategies and technologies that can make transformative benefits for society by addressing major challenges in healthcare. Our hybrid nano-biomaterials enable more effective tissue regeneration strategies that could accelerate healing after injury and reduce the need for long hospitalization. Through synthetic immunology, we create immune-instructive materials that can train immune cells to fight cancer more precisely, which ultimately can have an impact on prolonged healthier life for patients. Our work on nano-programmed bio-communication opens new possibilities to control how cells communicate during disease or repair, offering innovative strategies to treat chronic inflammation, cancer, fibrosis, and impaired healing. By drawing inspiration from nature, our biomimetic and bioinspired materials offer cheaper, safer, more adaptive, and more sustainable therapeutic solutions. Finally, our material-mediated synthetic biology platforms provide the foundation for next-generation "living therapeutics," smart biomaterials, and controllable cell-based therapies, creating opportunities for personalized medicine, early disease intervention, and treatments that adapt to the patient's biological environment. Together, these research directions aim to improve patient outcomes, reduce healthcare burdens, and build a new generation of biomedical technologies capable of addressing some of the most pressing medical needs of our time.

RESEARCH FOCUS

My research focus centers on integrating biological design principles with multi-scale engineering to create cell-mimicking and tissue-like systems capable of replicating, modulating, or reprogramming biological functions at the cellular and tissue levels. By developing hybrid platforms that bridge the boundary between living and synthetic matter, our work advances the frontiers of bioengineering using biomaterials and nanotechnology. Key efforts include the design of hybrid nano-biomaterials for programmable tissue regeneration, where responsive nanomaterials combined with biopolymers create dynamic 3D microenvironments that actively direct cell behavior through external stimuli such as light, ultrasound, or electrical signals. The research also explores synthetic immunology, engineering immune-instructive materials that guide immune cell fate for cancer therapy and regenerative medicine. Another major focus is nano-programmed bio-communication, using nanomaterials as active mediators to regulate biochemical, mechanical, and electrical signaling between cells and synthetic systems. Complementing this, we develop biomimetic and bioinspired materials to recreate adaptive, extracellular-matrix-like environments and smart therapeutic platforms. These systems enable remote control of cellular functions, gene expression, and biochemical pathways, opening new avenues for programmable cell therapies and life-like engineered biological systems.

THE FUTURE

The future direction of my research focuses on translating biomaterial-driven synthetic biology technologies into clinically and technologically relevant solutions. By integrating programmable biomaterials with synthetic and living systems, I aim to develop hybrid platforms that enable precise control over cellular behavior, gene expression, and intercellular communication in complex biological environments. These material-encoded systems will function as active regulators rather than passive supports, allowing remote and spatiotemporal modulation of biological functions through physical stimuli such as light, ultrasound, and magnetic fields.

A key goal is to advance scalable, modular biomaterial-cell interfaces that can be readily adapted for therapeutic translation, including regenerative medicine, immune engineering, and targeted cancer therapies. By embedding synthetic biological circuits within responsive biomaterial frameworks, this work will enable safe, tunable, and controllable living therapeutics.

SELECTED PUBLICATION

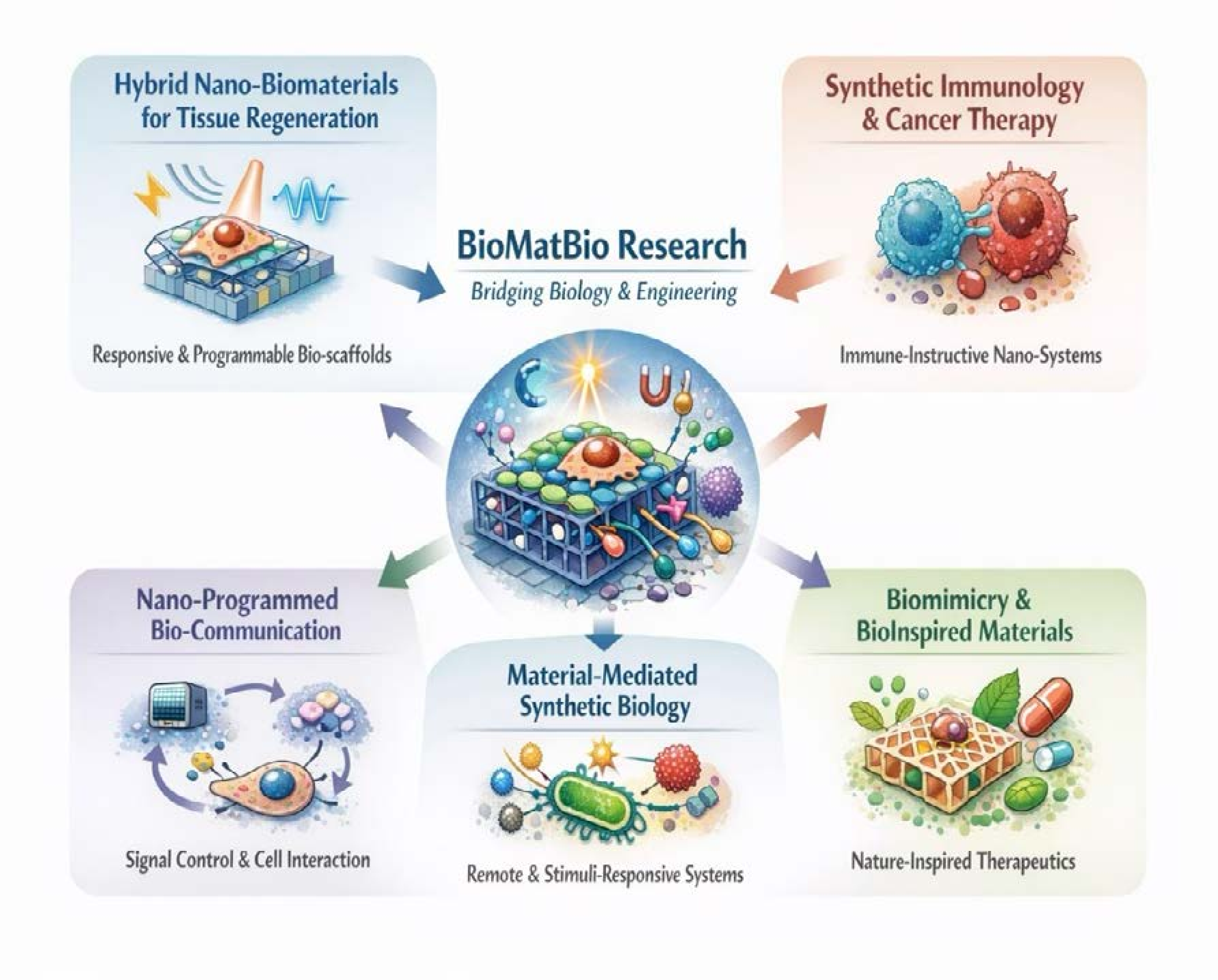
Combined M1 macrophage inhibition and thermotherapy for controlled fibroplasia and accelerated wound repair via an oxygenating ROS-responsive hydrogel

DOI: 10.1016/j.jconrel.2025.114554

Abstract: Wound healing remains a major clinical challenge, as hypoxia, oxidative stress, and immune dysregulation collectively impede tissue regeneration. To overcome these multifactorial barriers, we developed an injectable hydrogel (FH-PMC-T) by integrating multifunctional PDA@ MnO2@CuO (PMC) nanoparticles and taurine into a Fe3+ crosslinked Farsi gum–hyaluronic acid (FH) network. The hydrogel exhibits excellent photothermal conversion efficiency, catalase-like activity, and antioxidant capacity, enabling synergistic redox modulation and immune microenvironment regulation. Taurine is responsively released under high reactive oxygen species (ROS) conditions, contributing to the attenuation of inflammation and the suppression of macrophages M1 phenotype polarization. Moreover, the near-infrared (NIR)-responsive property allows mild photothermal therapy (PTT) to further stimulate fibroblast migration and tissue remodeling. In vivo, FH-PMC-T combined with NIR irradiation accelerates wound closure and enhances both structural and functional skin regeneration. This study proposes a hybrid photothermal–immunoregulatory hydrogel that orchestrates oxygenation, redox balance, and immune modulation for accelerated and restorative wound repair.

BIOINSPIRED MATERIALS AND BIOENGINEERING (BioMatBio)

Group leader
Mohammad-Ali Shahbazi



Cartoon showing the innovations and technologies of Prof. Mohammad-Ali Shahbazi Lab research focus. (Source: ChatGPT generated by BBT)

BIOINSPIRED MATERIALS AND BIOENGINEERING (BioMatBio)

Group leader
Mohammad-Ali Shahbazi

Research at Department of Biomaterials & Biomedical Technology

BIOPRINTING AND BIOFABRICATION

Group leader

Monize Decarli

We investigate, develop, and manufacture hydrogels that encapsulate human cells and bioactive molecules to produce reliable human tissues and 3D models.

GROUP MEMBERS

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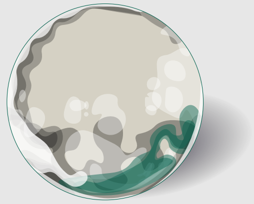
Xueqing Li PhD candidate, PhD candidate
Rodolpho Fagundes Correa PhD candidate
Amanda Domingues PhD candidate
Kantert Severens PhD candidate
Ana Marcial Cardoso Masters student
Lotte Baars Masters student

Illustration by Ilaria Rosso (**EVOOOLVE**)
Free interpretation of hydrogels.



BIOPRINTING AND BIOFABRICATION

Group leader
Monize Decarli

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INTRODUCTION

Bioprinting our future: from development to regeneration! In the Bioprinting and Biofabrication group at BBT, led by Dr. Decarli, we investigate, develop, and manufacture hydrogels that encapsulate human cells and bioactive molecules to produce reliable human tissues and 3D models. Our primary focus is manufacture tissue-like constructs for tissue engineering applications that will ultimately serve as implants. Our target tissues are focused on cardiac, vascular, lungs, and musculoskeletal systems. Likewise, we also manufacture reliable 3D models for drug screening, investigation of tissue formation, and development of pathologies. All projects developed in the Bioprinting and Biofabrication group are closely connected to clinical applications at UMCG, and focus on proposing solutions to unmet clinical needs. By combining advances in bioactive hydrogels and cutting-edge bioprinting technologies within an ML-II facility, we are at the forefront of the tissue engineering field.

RESEARCH FOCUS

To manufacture tissue-like constructs for tissue engineering purposes, which will ultimately act as implants, and reliable 3D models for drug screening, investigation of tissue formation, and development of pathologies, our research group focuses on four main pillars:

- Materials sciences: development of biocompatible materials, mostly hydrogels, that are produced, extracted or reused from plants and animals. Furthermore, we focus on humanized hydrogels developed purely using human sources e.g. blood, fluids, tissues, extracellular matrix, extracellular vesicles, and secreted bioactive molecules. We also focus on efficient and innovative crosslinking strategies to enhance hydrogel stability for up to several months.

- Design: We study the anatomy, physiology, and mechanical forces of the target tissue or organ to design its 3D structure with high accuracy and precision.

- Manufacturing processes: Using a combination of cutting-edge bioprinting technologies located within an ML-II facility, we manufacture the intended 3D structure by employing biomaterials encapsulating human single cells or human 3D models (spheroids or organoids).

- Biological responses: We investigate our tissues and 3D models regarding many biological responses and pathways related to cell function, fate, and the interaction with their micro- and macro-environment from development to regeneration. We navigate throughout biological responses caused by injuries, damage, aging, diseases, and in healthy conditions.

THE FUTURE

The Bioprinting and Biofabrication Group aims to make a difference in the global landscape that faces a critical shortage of tissues and organs for transplantation. Transplantation is currently the primary procedure for repairing or replacing human tissues and organs that fail, are damaged, or malfunction. However, the gap between the number of people on the transplant waiting list and the number of available donors continues to expand dramatically. In the Bioprinting and Biofabrication Lab, we aim to develop alternative strategies for manufacturing reliable tissue-like structures using highly bioactive or humanized hydrogels to enhance implant-host interactions when used as implants. Although there is a long way to go before we can manufacture solid, complete organs in the laboratory, we have seen significant advances in the tissues we are producing and validating. Hence, we believe we are on the correct path to address this challenging global situation.

SELECTED PUBLICATION

Decarli et al., 2025

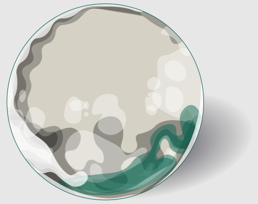
DOI: 10.1021/acsami.5c08442

Journal: ACS Applied Materials & Interfaces

Xanthan Gum–Iron System: Natural, Mechanically Tunable, Bioactive, and Magnetic-Responsive Hydrogels for Biomedical Engineering Applications

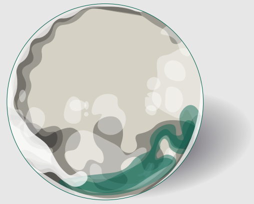
Xanthan gum (XG) has performed far better than other polysaccharides for industrial purposes, e.g., food, pharmaceutical, and cosmetic applications, due to its outstanding thickening effect, pseudoplastic rheological properties, and non-toxicity. However, there is no crosslinking strategy available for non-modified XG that allows its sole use within cells for biomedical engineering applications. Here, we established this crosslinking strategy while processing it via additive manufacturing techniques. The suitability of divalent (Ca^{2+}, Mg^{2+}, and Fe^{2+}) and trivalent (Al^{3+} and Fe^{3+}) ions was evaluated by an in situ rheological assessment. Fe^{3+} demonstrated a high affinity to XG by forming a stable crosslinking effect, and the baseline XG−Fe^{3+} hydrogel exhibited outstanding printability and high culture stability (60 days). Although XG−Fe^{3+} demonstrated high biocompatibility for hMSCs with sustained cytocompatible iron release, these cell-laden constructs are inert. Envisioning biological functionality, we blended human methacryloyl platelet lysates (hPLMA) with XG−Fe^{3+} and either used inert XG−Fe^{3+} or bioactive cell-adhesive XG−Fe^{3+}−PLMA, resulting in a 10-fold increase in strength compared to non-crosslinked XG. Remarkably, whether inert or bioactive, hydrogels proved to be mechanically tunable (from ~3 to 203 kPa), ideal for tissue engineering applications. Later, we expanded the XG−Fe^{3+} role to a delivery system using magnetic nanoparticles (MNPs), and magnetically responsive scaffolds were obtained (XG−Fe^{3+}−MNP). Finally, to explore the convergence of 3D printing and melt electrowriting (MEW), polycaprolactone (PCL) was included to obtain hybrid scaffolds (XG−PLMA−PCL). Our findings present a novel XG−Fe^{3+} hydrogel with remarkable versatility as a natural, mechanically tunable, bioactive, and magnetic- responsive system for sole or hybrid use. This unusual set of capabilities meets the current demand for developing tailored hydrogels for complex biomedical engineering applications.

KEYWORDS: xanthan gum, 3D printing, hydrogel, ionic crosslinking, tissue engineering.



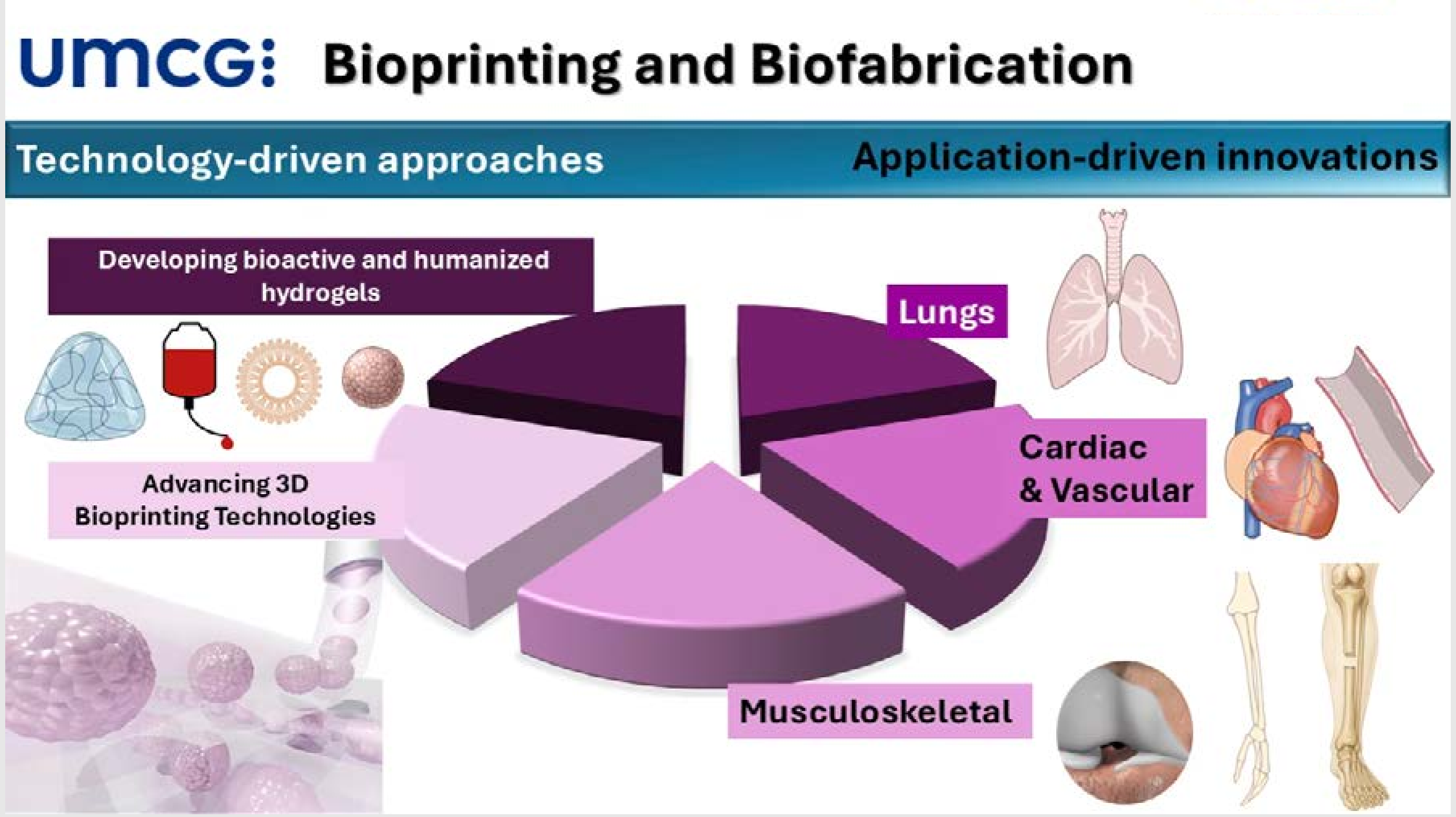
BIOPRINTING AND BIOFABRICATION

Group leader
Monize Decarli



BIOPRINTING AND
BIOFABRICATION

Group leader
Monize Decarli



Research areas of the Bioprinting and Biofabrication group (BBT/UMCG), led by Dr. Decarli.

Research at
Department of
Biomaterials &
Biomedical
Technology

TRANSLATIONAL & REGENERATIVE BIOMATERIALS

Group leader

Patrick van Rijn

Engineer material-based approaches towards regenerative medicine by utilizing physicochemical properties of materials and stimuli responsive polymers in order to match the required properties needed for the best biological interaction and clinical outcome

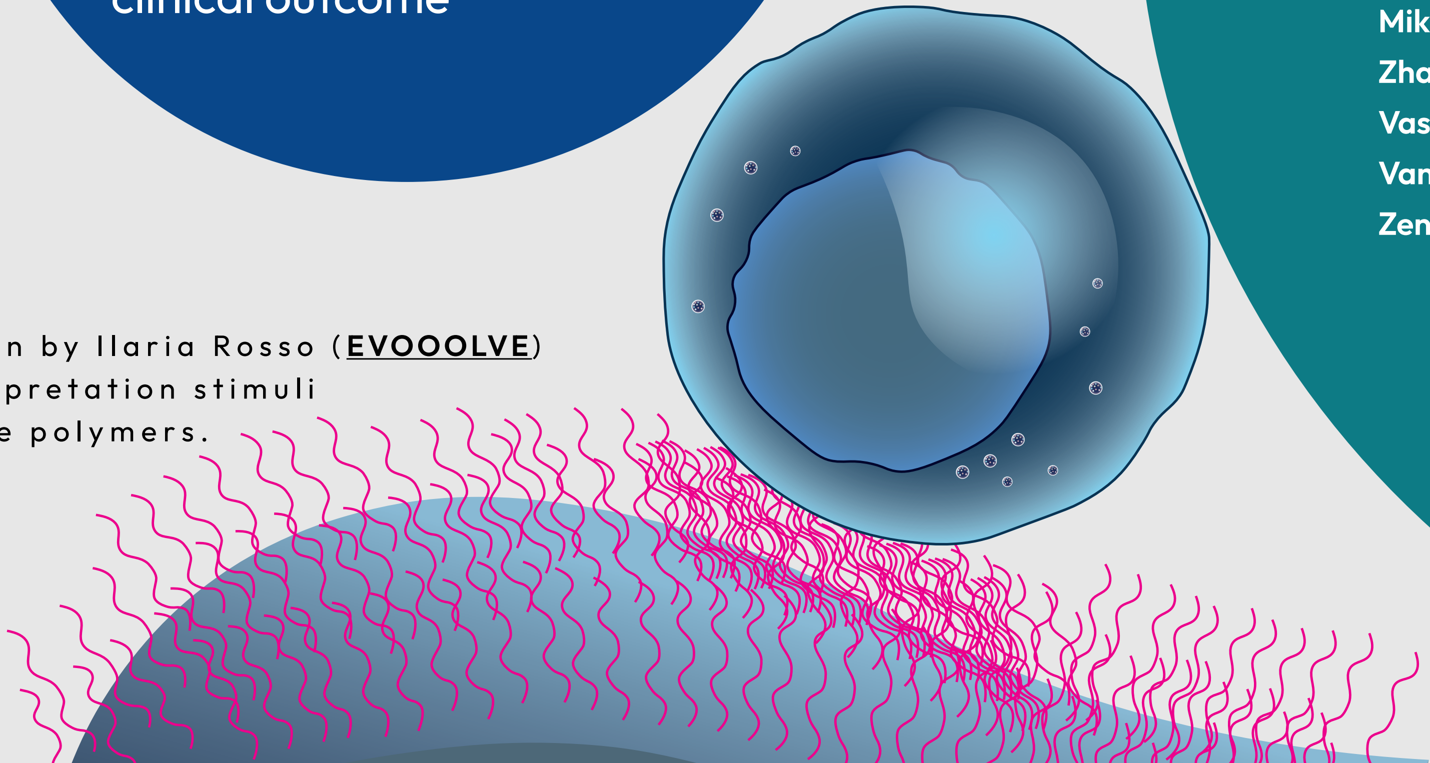


Illustration by Ilaria Rosso (EVOOOLVE)
Free interpretation stimuli responsive polymers.

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Zhang, R PhD candidate
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Zengin, A Postdoc

TRANSLATIONAL & REGENERATIVE BIOMATERIALS

Group leader
Patrick van Rijn

INTRODUCTION

The aim is to engineer material-based approaches towards regenerative medicine by utilizing physicochemical properties of materials and stimuli responsive polymers in order to match the required properties needed for the best biological interaction and clinical outcome. The materials used are mainly polymeric and encompass the tuning of the material-tissue interface or more specifically the material-cell interface to direct the cellular response and the biological events. Implants materials, cell culture models, drug delivery strategies are part of this focus and in many cases, it is in collaboration with clinical and industrial partners.

RESEARCH FOCUS

Providing tangible solutions for current biomedical problems that are centered around materials for clinical use, preferably in collaboration with clinical and industrial partners, is our aim. Not focusing on development of new drugs or new cell-based therapies, but making use of the intrinsic power that is hidden within every material and that can be altered in such a way that it is able to stimulate biology in the broadest sense, all it requires is to find the best combinations of properties to stimulate cells. There are three main drivers within our research:

1. (Bio)Materials
   (physicochemical properties of materials)
2. Regenerative medicine
   (stimulate biology and interface with cells)
3. Translational motivation towards use
   (key partnerships)

That means that the modification of a material focuses on a particular medical problem or condition where the body requires assistance in combating the illness or pathology and it is engineered in a way that product translation is being facilitated striving for the highest chance to making the solution clinically-relevant.
The use of materials encompasses implant materials (stents, biodegradable implants, valves) currently focusing, but not limiting to, vascular, pulmonary, bone, muscle as well as novel micro- and nano-devices for drug delivery, imaging and theragnostic purposes in the form of degradable nanoparticles, nanogels and bubble-based technologies. Particularly of interest are systems that can be controlled in a dynamic fashion where materials (nano, micro, macro) can be controlled via internal (environmental) stimuli such as pH, temperature, ions and external stimuli including light, magnetic fields and ultrasound. All these approaches make our research extremely versatile and powerful to fully control the entire range of material properties required to optimally interface with biological systems.

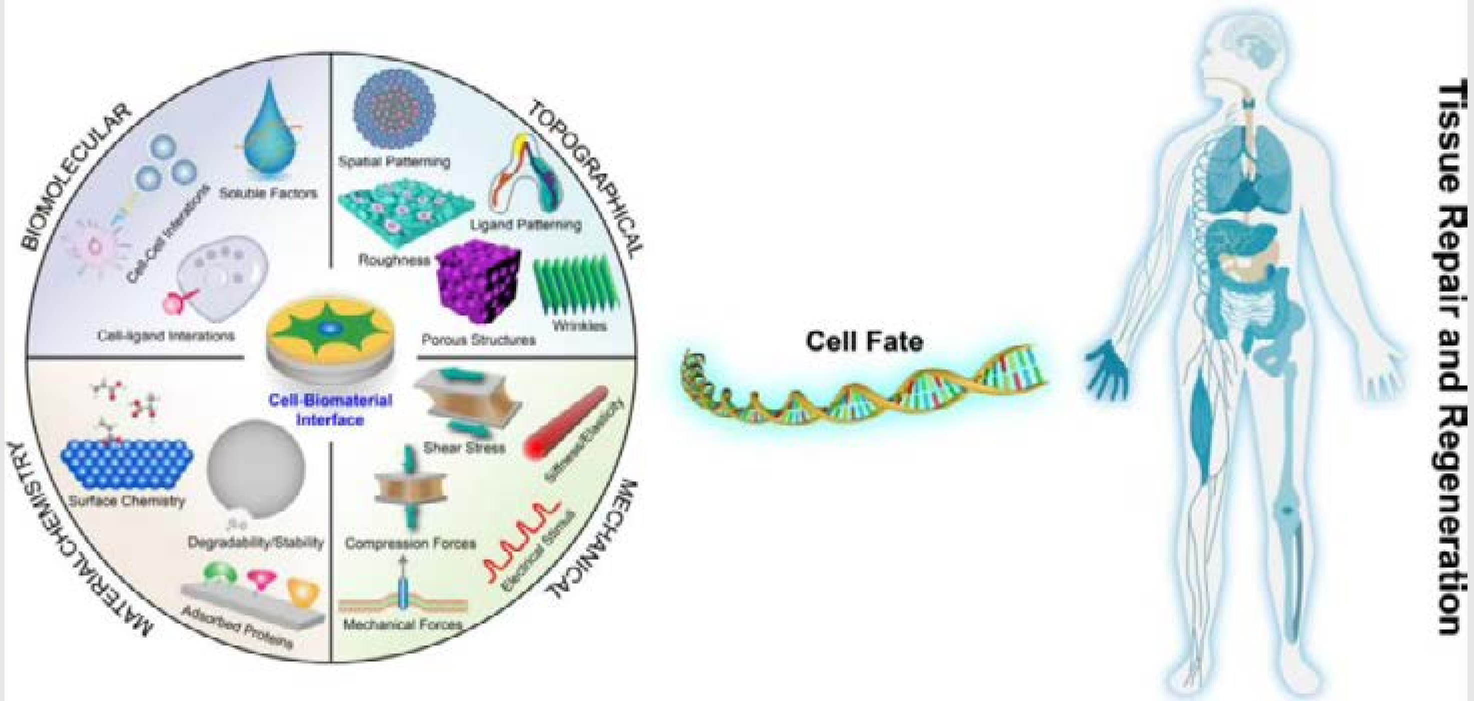
THE FUTURE

Many of the developed system such as the nanogels, antibubbles, formulations and the novel biointerfaces have many potential applications and the future direction is to capitalize these applications and transform these systems and approaches in tangible products. It is great to tackle innovative design questions and scientific break-throughs, which also is still a main focus, actually making an impact on medical technology and patient well-being is a main driver. That means that a more intensive collaboration with clinicians and industry is required and even setting-up own industry to push scientific innovations to the market.

SELECTED PUBLICATION

L. E. Tromp, T. A. van der Boon, R. H. de Hilster, R. Bank, P. van Rijn
Modulation of Biomaterial-Associated Fibrosis by Means of Combined Physicochemical Material Properties.
Adv. Sci. 2025, 12, 2407531.
DOI: 10.1002/advs.202407531

Biomaterial-associated fibrosis remains a significant challenge in medical implants. To optimize implant design, understanding the interplay between biomaterials and host cells during the foreign body response (FBR) is crucial. Material properties are known to influence cellular behavior and can be used to manipulate cell responses, but predicting the right combination for the desired outcomes is challenging. This study explores how combined physicochemical material properties impact early myofibroblast differentiation using the Biomaterial Advanced Cell Screening (BiomACS) technology, which assesses hundreds of combinations of surface topography, stiffness, and wettability in a single experiment. Normal human dermal fibroblasts (NHDFs) are screened for cell density, area, and myofibroblast markers α-smooth muscle actin (α-SMA) and Collagen type I (COL1) after 24 h and 7 days of culture, with or without transforming growth factor-beta (TGF-β). Results demonstrated that material properties influence fibroblast behavior after 7 days with TGF-β stimulation, with wettability emerging as the predominant factor, followed by stiffness. The study identified regions with increased cell adhesion while minimizing myofibroblast differentiation, offering the potential for implant surface optimization to prevent fibrosis. This research provides a powerful tool for cell-material studies and represents a critical step toward enhancing implant properties and reducing complications, ultimately improving patient outcomes.



Variables within the cell-microenvironment interface can invoke a biological response and decide cell fate in the process of tissue repair and regeneration. Properties that can be implemented into biomedical applications where materials themselves become therapeutic. Obtained from: Chem. Rev. 2021, 121, 8, 4561-4677

TRANSLATIONAL & REGENERATIVE BIOMATERIALS

Group leader
Patrick van Rijn

Research at Department of Biomaterials & Biomedical Technology

BIOTRIBOLOGY AND REGENERATION

Group leader

Prashant Sharma

Understanding the biomechanical and biotribological aspects of friction related diseases and find biomaterial based therapies for these chronic, quality of life degrading diseases and understanding and modulating biomechanical cues in tissue engineering.

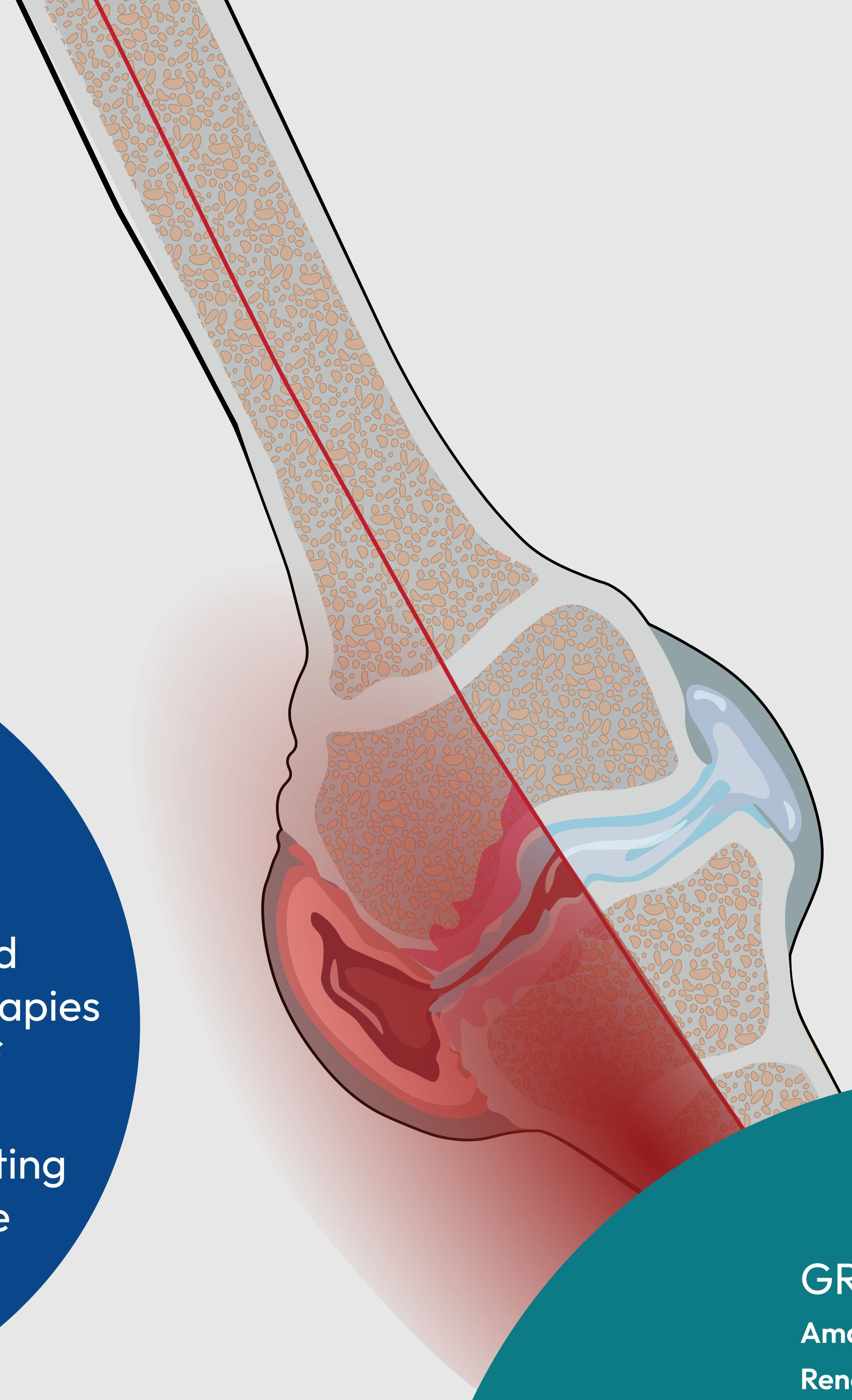


Illustration by Ilaria Rosso (**EVOOOLVE**) Free interpretation easing of articular cartilage pain.

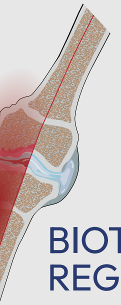
GROUP MEMBERS

Amanda Domingues PhD student

Rene J.B. Dijkstra PhD candidate

Yong Chen PhD candidate

Jhon Alexander Ramirez Researcher



BIOTRIBOLOGY AND REGENERATION

Group leader
Prashant Sharma

INTRODUCTION

The aims are two folds

1. Understand the biomechanical and biotribological aspects of friction related diseases and find biomaterial based therapies for these chronic, quality of life degrading diseases.

2. Understanding and modulating biomechanical cues in tissue engineering.

RESEARCH FOCUS

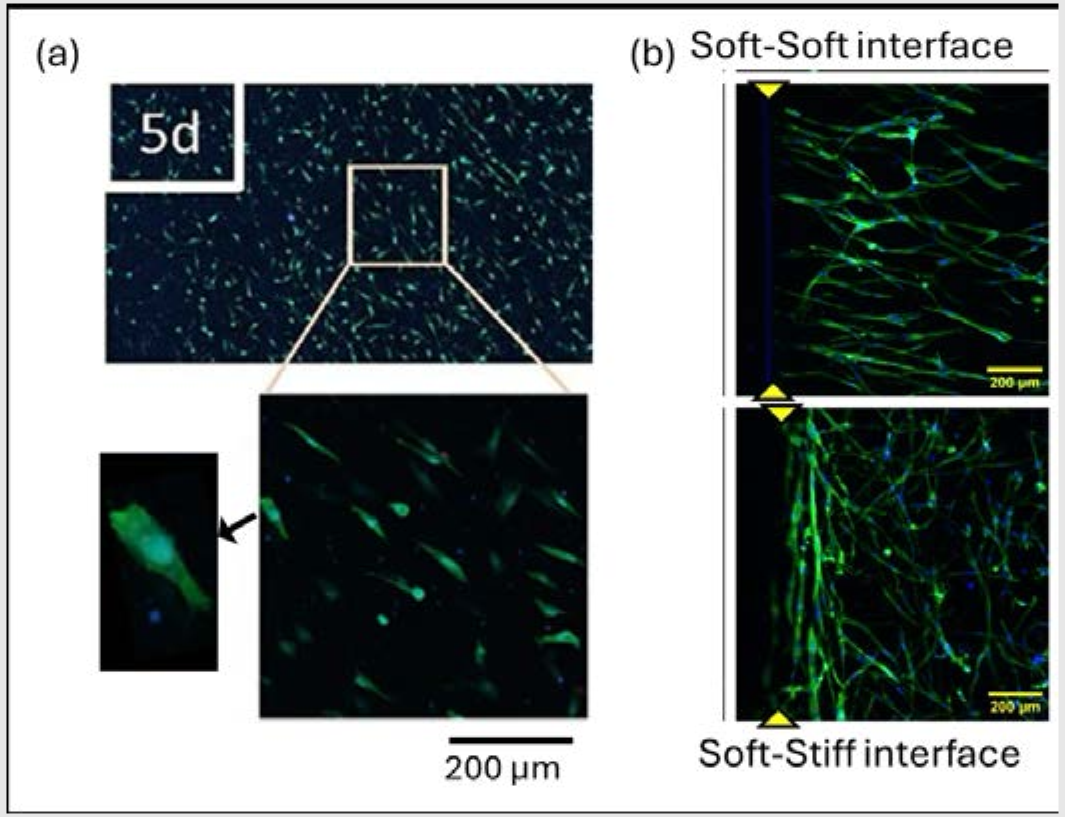
1. The focus of biotribology research is focused on chronic and quality of life degrading diseases like osteoarthritis, dry eye disease and dry mouth disease. Natural and healthy lubrication mechanisms degrades due to ageing, auto immune syndromes or multipharmacy leading chronic pain, irritation and dryness. Respectively making activities like walking, running, bicycling, blinking, talking, swallowing of food very difficult. This lead to degradation of quality of life of the patient and lower work efficiency even leading to unemployment in some cases.

Osteoarthritis (OA)

Slow degradation of articular cartilage leads to break down of the natural lubrication of articular joints leading to pain and lack of mobility. My focus here is two folds 1. to understand the reasons for reduction in cartilage thickness and the overlap between enzymatic degradation and mechanical failure and wear of cartilage. In 2025 we published a nice paper showing that GAG depletion caused by enzymatic degradation reduced the crack resistance of articular cartilage (DOI: 10.1016/j.jmbbm.2025.107122). Cartilage cracking and crack growth leads to mechanical destruction of cartilage. At present we are working on a crack growth model, which will be used to test biomolecules which help in cartilage consolidation and slowing down of crack growth. 2. Finding novel biolubricating molecules for cartilage in vivo (DOI: 10.1016/j.jcis.2022.03.119).

BIOTRIBOLOGY AND REGENERATION

Group leader
Prashant Sharma



(a) Human fibroblasts responding to a stiffness gradient by aligning 45O to the gradient and
(b) fibroblasts responding to abrupt stiffness change at an interface.

Dry Eye Disease (DED)

Lack of tear fluid or changes on the corneal surface leads to breakdown of the natural lubrication mechanism between the eyelid and the corneal surface. In this area we use porcine eye and eyelid to setup a friction system to measure the friction coefficient and the speed of drying of the eyelid-eye interface. We have developed a swing device to be setup on universal tribometers to exact motion to mimic blinking. At the moment we have submitted two manuscript to elucidate the importance of a. using biological surface in order to study ocular tribology (DOI: 10.64898/2026.01.23.701244) and b. The importance of sliding type and direction in studying ocular tribology (under review in IOVS).

Dry mouth disease

In the past we have expensive work in this area where a tongue-enamel friction system has been established to help understand xerostomia (DOI: 10.1007/s00784-020-03758-8) and develop new molecules (DOI: 10.1021/acsami.0c06159) to synergistically work with the impaired lubrication system to alleviate the dry mouth feel.

2. The focus on Tissue Engineering research is mainly on 1. understanding the role of passive mechanostimulation e.g. stiffness and stress relaxation on cell response in 3D hydrogel systems (DOI: 10.1016/j.actbio.2024.05.018) and 2. Role of active mechanostimulation e.g. cell response to stretch (DOI: 10.1016/j.mbplus.2025.100169).

THE FUTURE

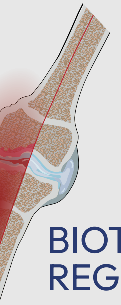
In future, my group will continue to focus on the two research lines. Focus will be development of cartilage consolidation as a treatment of early OA, where the cartilage crack growth model will be established, also attention will be laid on early detection of cartilage fibrillation in vivo using ultrasound. In the ocular tribology area the focus will be on establishing that shedding of corneal glycocalyx due to Sjögren's syndrome leads to increase in corneal surface friction, furthermore to find a lubricating molecules which can potentially relieve the pain and irritation of DED patients.

In tissue engineering area the goal is to prove that we can enlarge a basement membrane containing scaffold with the cell of stretching, caused by extracellular matrix remodelling by epithelial cell.

SELECTED PUBLICATION

Ren, K., Zhao, F., Tzaneti, N. K., Kaper, H. J. & Sharma, P. K., Oct-2025
Glycosaminoglycan depletion lowers the crack resistance of articular cartilage under impact loading, Journal of the mechanical behavior of biomedical materials. 170, 10 p., 107122.
DOI: 10.1016/j.jmbbm.2025.107122

Osteoarthritis is a degenerative and debilitating disorder affecting diarthrodial joints, where articular cartilage degeneration occurs due to simultaneous, enzymatic degradation and mechanical damage through crack initiation and propagation. Healthy cartilage is effective in absorbing impact loads and resists cracking but physical impact beyond a certain high energy is considered as the critical reason for initiation and propagation of cracks. Enzymatic degradation destroys the molecular structure of cartilage affecting its biomechanical properties and is bound to affect its crack resistance. This research aims to explore the conditions associated with crack initiation in healthy bovine cartilage through indirect assessment of absorbed impact energy, and to determine the influence of enzymatic degradation on cartilage cracking. Cartilage cracks are characterized by length, number of branches and endpoints. Bovine cartilage enzymatic degradation was achieved through treatment with chondroitinase ABC, which reduces the cartilage glucosamine glycan (GAG) content. A drop tower impact test (stainless steel ball-bovine cartilage plug) was applied to evaluate the absolute energy absorption capacity of the cartilage. In contrast, the pendulum test was designed to better replicate a physiological scenario—specifically, cartilage-on-cartilage contact from a massive collision. The absorbed impacting energy by both sides together was obtained in this case. Due to the depletion of GAGs by chondroitinase ABC, the digested cartilage showed more severe cracks under the same impact energy as healthy cartilage. Also single cracks formed from parallel to 45° to perpendicular to the collagen fibers orientation on both cartilage groups.



Group leader
Prashant Sharma

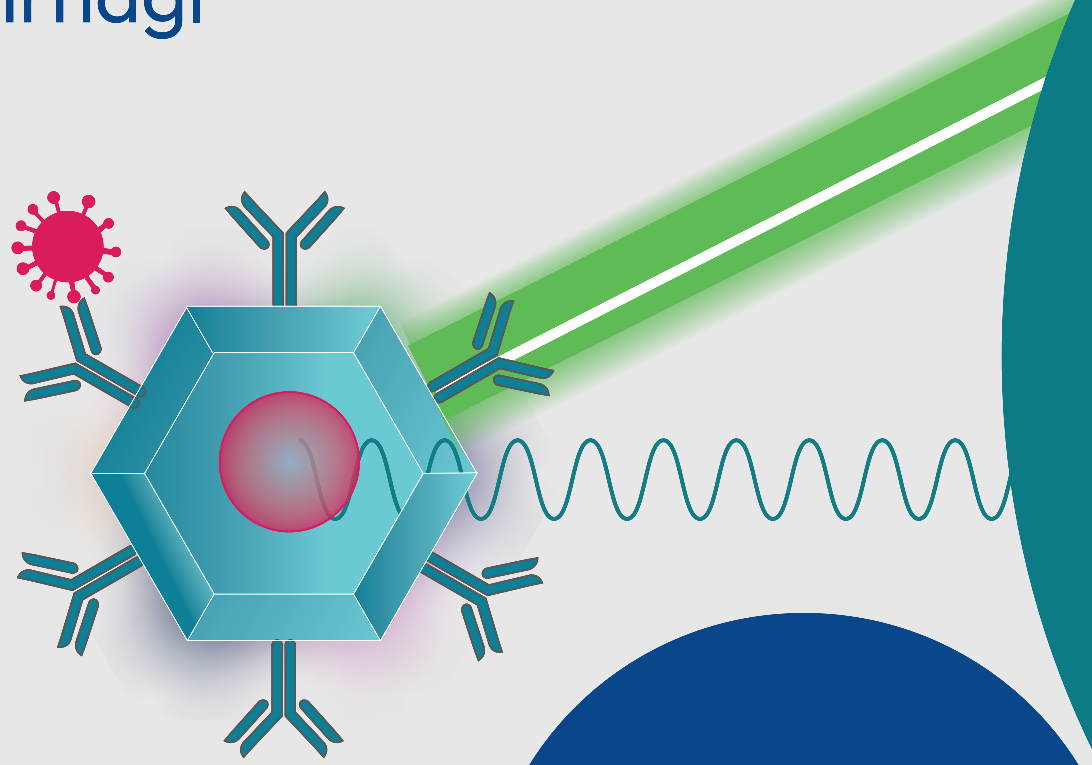
Research at
Department of
Biomaterials &
Biomedical
Technology

BIOIMAGING AND BIOANALYSIS

Group leader

Romana Schirhagl

Illustration by Ilaria Rosso (**EVOOOLVE**)
Diamond Based Quantum Sensing, a free interpretation inspired by the illustration **"Microwaves brighten the light emitted by nanodiamonds attached to a virus"** by Rosanna Wan, published in Nature (2021).



We have pioneered the use of DIAMOND BASED QUANTUM SENSING, a powerful technology for answering fundamental questions

GROUP MEMBERS

Willem Woudstra Technician
Adela Melcrova Postdoc
Felipe Perona Martinez Postdoc
Marina Volkova Postdoc
Abhay Sachdev Postdoc
Nuan Lin Postdoc
Jiazhe Lin Postdoc
Samin Abbaszadeh Postdoc
Andrea Boscovic PhD student
Harsh Jain PhD student
Huiting Li MDPhD student
Daniela Rassler PhD student
Nastaran Ashoori PhD student
Britt Coenen PhD student
Yuanyuan Chai PhD student
Minle Zhan PhD student
David Hernan Aquierre Padilla PhD student
Kazuki Kinjo Guest
Virun Malalasena Master student
Tijmen van Hoef Master student
Lucija Buric Master student
Isra Noor Master student
Nhyira Quashie-Asiedu Master student
Wesley Nieuwhof Master student

BIOIMAGING AND BIOANALYSIS

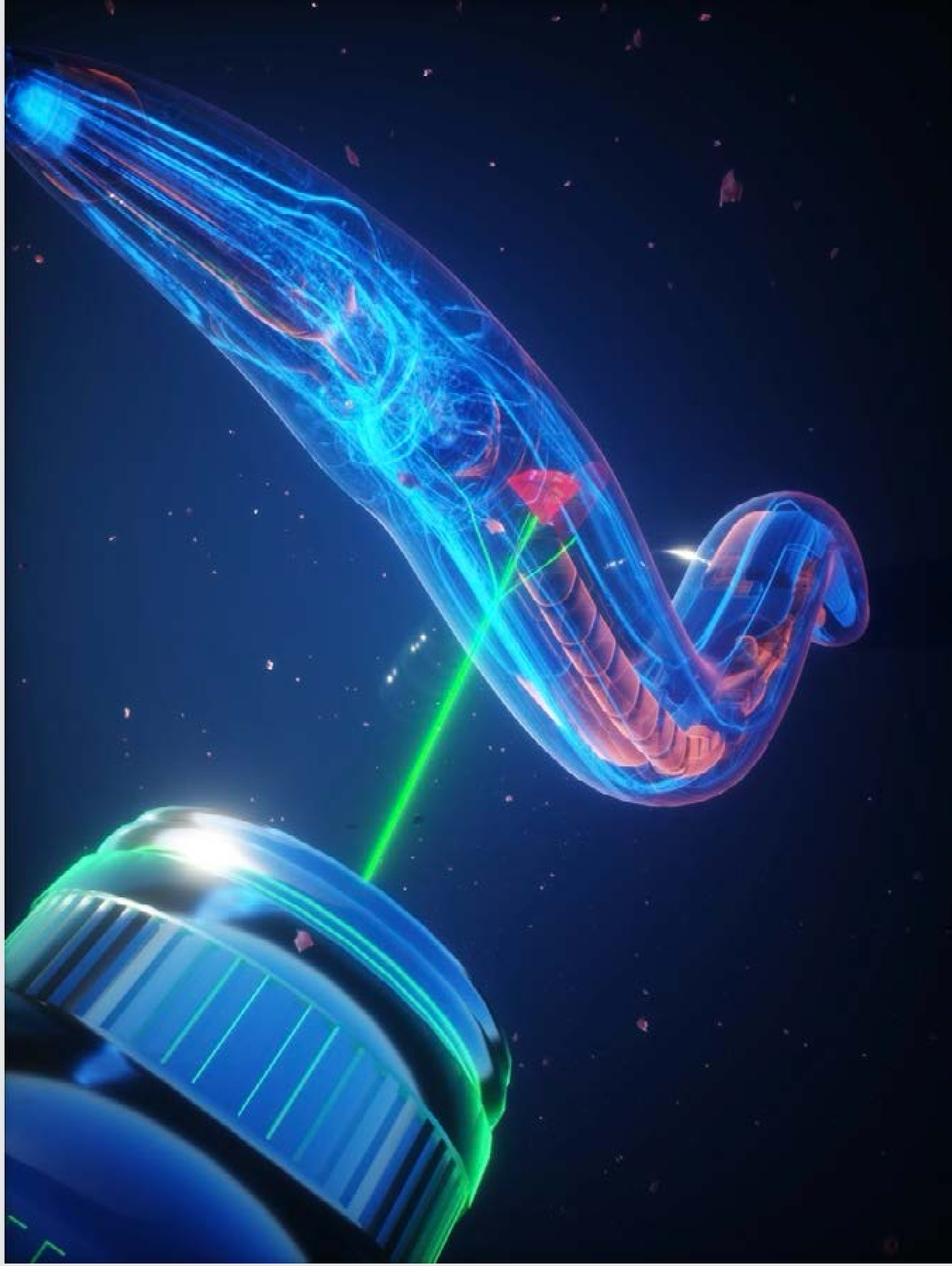
Group leader
Romana Schirhagl

INTRODUCTION

Diamond based quantum sensing is a new technique which allows measuring magnetic resonance signals in the nanoscale. The aim of my group is to bring the technology to the biomedical field. There it allows measurements of free radical generation with subcellular resolution at a single cell level. In my research group we have pioneered the use of this powerful technology for answering fundamental questions (for example where exactly on a sperm cell free radicals are generated during capacitation), testing drug candidates (like for instance anti-cancer drugs) or for clinical diagnostics (for instance in early sepsis diagnosis). In our spin off company QTsense, we are bringing this technology to the market.

RESEARCH FOCUS

Currently, we are focusing on expanding the applications of diamond based quantum sensing. More specifically, we are aiming at collaborating with clinical groups to determine the potential of diamond based quantum sensing for diagnostics. These applications include early sepsis diagnostics, predicting the resistance of cancer or assessing bioreactor health. Apart from applications, we are also thriving to forward the technical capabilities of diamond based quantum sensing. More specifically, we are developing a probe which will allow in vivo monitoring or obtain additional information from our measurements including for instance spectroscopic data.



Artistic image of our paper on quantum sensing in a c elegans model for Huntingtons disease. The first measurements that were conducted with this technique in-vivo

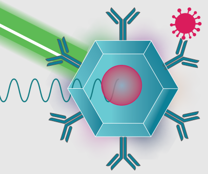
THE FUTURE

In the future, we will further the technical development of diamond based quantum sensing to obtain more information from the cells of interest. We will aim to combine diamond based quantum sensing with state of the art single cell tools. Further, we will extend the usefulness of the technology by broadening the applications.

SELECTED PUBLICATION

Fan, S., Zhang, Y., Ainslie, A.P., Seinstra, R., Zhang, T., Nollen, E. and Schirhagl, R., 2025.
In vivo nanodiamond quantum sensing of free radicals in caenorhabditis elegans models.
Advanced Science, 12(14), p.2412300.
DOI: 10.1002/advs.202412300

Free radicals are believed to play a secondary role in the cell death cascade associated with various diseases. In Huntington's disease (HD), the aggregation of polyglutamine (PolyQ) not only contributes to the disease but also elevates free radical levels. However, measuring free radicals is difficult due to their short lifespan and limited diffusion range. Here, a quantum sensing technique (T1 relaxometry) is used that involves fluorescent nanodiamonds (FND). Nitrogen vacancy (NV) centers within these nanodiamonds change their optical properties in response to magnetic noise, which allows detecting the unpaired electron from free radicals. This method is used to monitor the production of free radicals inside Caenorhabditis elegans models of Huntington's disease in vivo and in real-time. To investigate if radical generation occurs near polyglutamine expansions, a strain expressing Q40 yellow fluorescent protein (Q40::YFP, polyglutamine expansion overexpressed in the muscle) is used. By applying T1 relaxometry on FNDs in the body wall muscle, it is found that the production of free radicals significantly increase when PolyQ is expressed there (compared to the FNDs in intestine). The technique demonstrates the submicrometer localization of free radical information in living animals and direct measurement of their level, which may reveal the relation between oxidative stress and Huntington's disease.



BIOIMAGING AND BIOANALYSIS

Group leader
Romana Schirhagl

umcg
Department of Biomaterials & Biomedical Technology

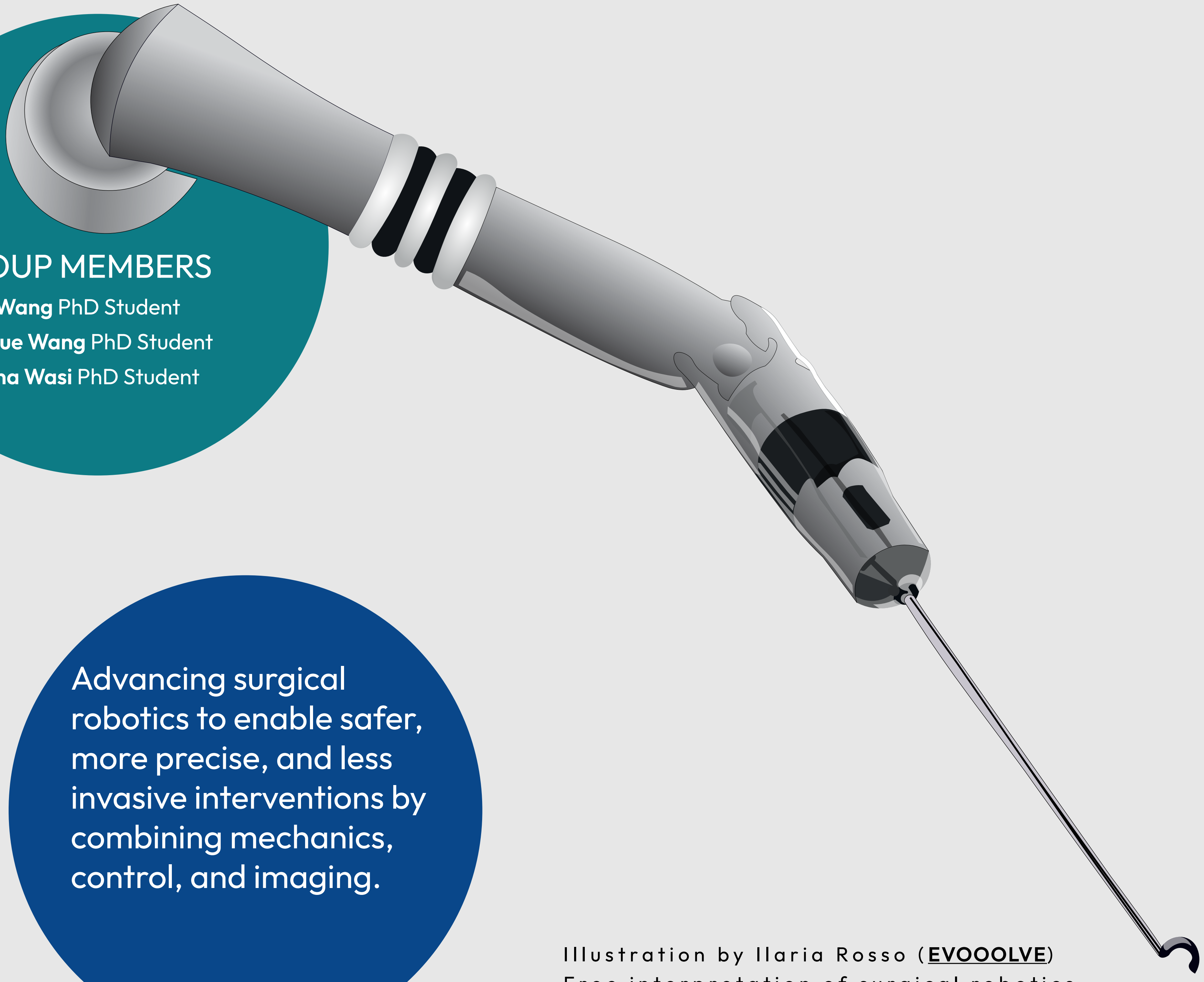
Research at Department of Biomaterials & Biomedical Technology

SURGICAL ROBOTICS

Group leader
Sarthak Misra

GROUP MEMBERS

Chen Wang PhD Student
Zhuoyue Wang PhD Student
Adriana Wasi PhD Student



Advancing surgical robotics to enable safer, more precise, and less invasive interventions by combining mechanics, control, and imaging.

Illustration by Ilaria Rosso (**EVOOOLVE**)
Free interpretation of surgical robotics.

SURGICAL ROBOTICS
Group leader
Sarthak Misra

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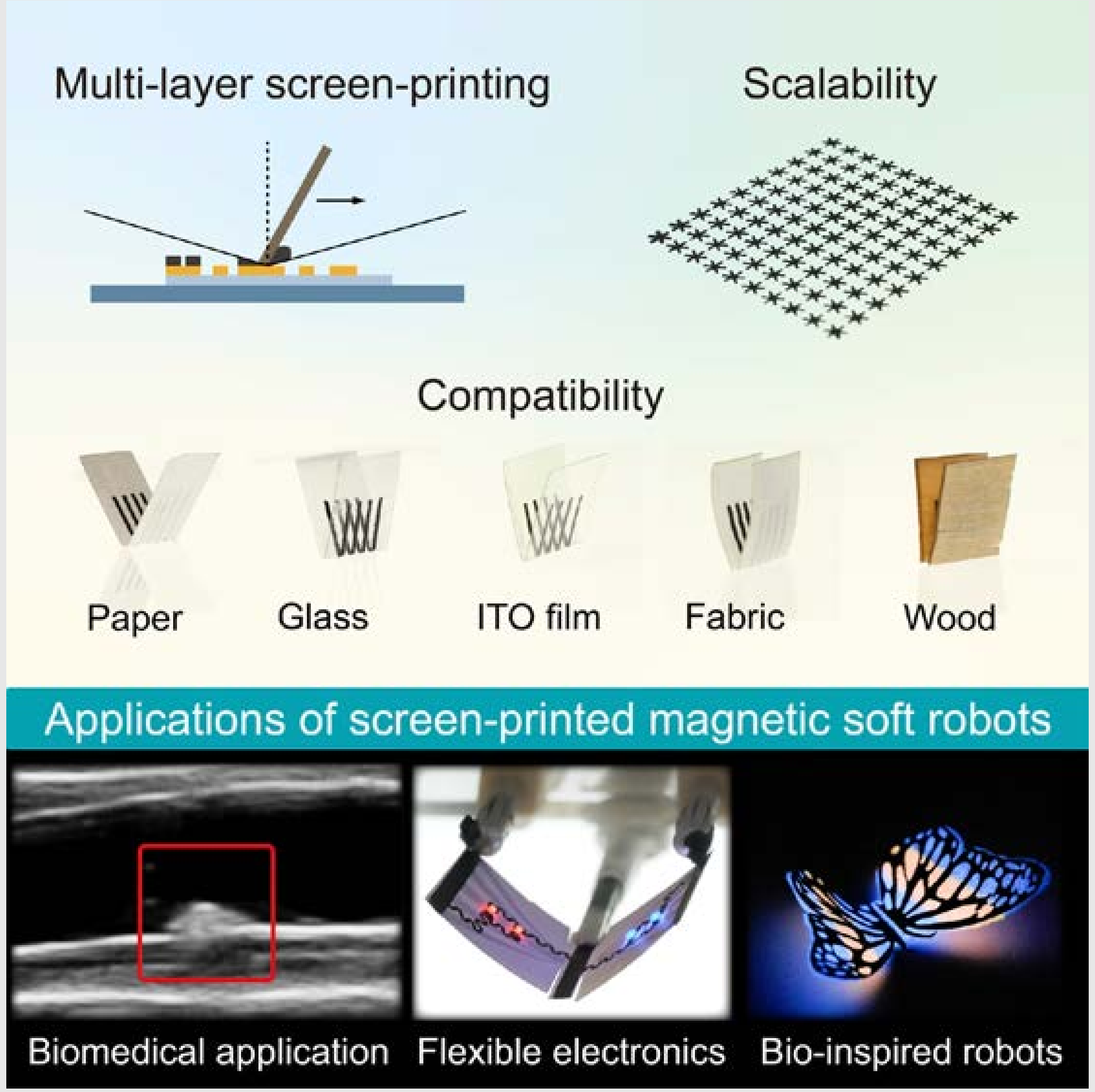
Department of
Biomaterials &
Biomedical
Technology

INTRODUCTION

Prof. Sarthak Misra leads the Surgical Robotics Laboratory (SRL) at the University of Twente, with affiliations at the University of Groningen and University Medical Center Groningen. SRL's research focuses on advancing surgical robotics to enable safer, more precise, and less invasive interventions by combining mechanics, control, and imaging. The laboratory addresses key challenges in flexible instrument navigation, continuum robotic manipulation, and medical microrobotics, with an emphasis on systems that can reach hard-to-access anatomical sites. By integrating modeling, control, and clinical imaging modalities such as ultrasound, CT, and MRI, the research aims to overcome the limitations of conventional instruments and improve procedural outcomes. The overarching objective is to translate robotic innovation into clinically relevant solutions that enhance surgical dexterity and patient care while minimizing trauma and recovery time.

RESEARCH FOCUS

Research at SRL encompasses three synergistic domains: needle steering, continuum robotics, and medical microrobotics. Needle steering research develops robotic approaches and control strategies to guide flexible needles in soft tissue for procedures like biopsies and targeted injections, accounting for tissue motion and obstacles. SRL has created ultrasound-guided, MR-compatible steering systems and advanced control algorithms that support accurate instrument navigation. Continuum robotics explores highly flexible, snake-like robotic devices that can navigate tortuous paths within the body. This includes the design and control of magnetically actuated and shape-sensing structures that enable precise maneuvering and integration with imaging feedback to maintain situational awareness during intervention. Medical microrobotics aims to fabricate and control miniaturized robotic agents capable of interacting at microscopic scales for tasks such as targeted manipulation, delivery, and sensing. This work combines magnetic actuation strategies with modeling and real-time control to explore new capabilities for minimally invasive therapy.



Magnetic soft robots offer programmable shape-morphing capabilities through magnetic field actuation. To overcome current limitations on manufacturing scalability and material compatibility, Here we introduce a screen-printing strategy for fabricating robots with customized magnetic profiles and materials, enabling the efficient production of multifunctional robots for drug delivery, flexible electronics, and biomimicry.

THE FUTURE

SRL's future direction will further strengthen the integration of autonomous decision-making and advanced perception into surgical robotic systems. A key objective is to incorporate learning-based models and real-time imaging feedback to improve adaptability and robustness in dynamic clinical environments. Additional work will focus on enhancing multi-modal imaging integration, enabling systems to use combined data from ultrasound, MRI, and CT for more accurate scene understanding and instrument localization. In the microrobotics domain, efforts will expand toward cooperative robotic agents and swarm-inspired behaviors that can collaboratively perform complex tasks at micro-scales, potentially extending applications into targeted therapy, precision diagnostics, and minimally invasive interventions. Furthermore, translational pathways to pre-clinical and clinical evaluations will be emphasized through collaborations with clinicians and industrial partners, ensuring that innovations progress toward practical adoption in healthcare settings.

SELECTED PUBLICATION

Franco N. Piñan Basualdo, Vasileios D. Trikalitis, Sabrina Visconti, Fanny Ficuciello, Constantinos Goulas, Jeroen Rouwkema, and Sarthak Misra

Magnetic Nozzle-Free Embedded 3D (MagNoFE3D) Printing

Advanced Materials Technologies, 10(5):2401097, 2025.

DOI: 10.1002/admt.202401097

The functional principle behind extrusion-based printing is the capability of flowing material through a nozzle on demand, which must solidify upon deposition, a behavior exhibited only by some materials. Embedded printing offers a solution to maintain shape fidelity during the deposition of a wider range of materials. However, the use of a moving nozzle in a support bath can lead to bath disturbance and the spreading of the ink. In this study, a novel embedded printing technique that eliminates the need for a nozzle by employing a magnetic sphere as the plotting moiety is introduced. The externally steered sphere creates a path by locally fluidizing the bath, allowing the simultaneously injected ink to flow into the space behind it. The method is benchmarked using water as an ink, achieving free-form printing without additional stabilization methods. The creation of solid structures is also demonstrated by printing a photocurable ink that is crosslinked and removed from the bath. Moreover, the plotting magnet can be incorporated into the printed part during the crosslinking, thus giving place to a magnetically responsive structure. This advancement paves the way for innovations in fields such as tissue engineering and microrobotics by enabling the fabrication of intricate and functional designs.

SURGICAL ROBOTICS

Group leader
Sarthak Misra

Research at Department of Biomaterials & Biomedical Technology

CELL-BIOMATERIAL INTERACTIONS

Group leader

Theo van Kooten

The focus on foreign body response aspects concerns both the development of biomaterials, possible modifications to these materials, and models that can be used to observe and explain this response in more detail.

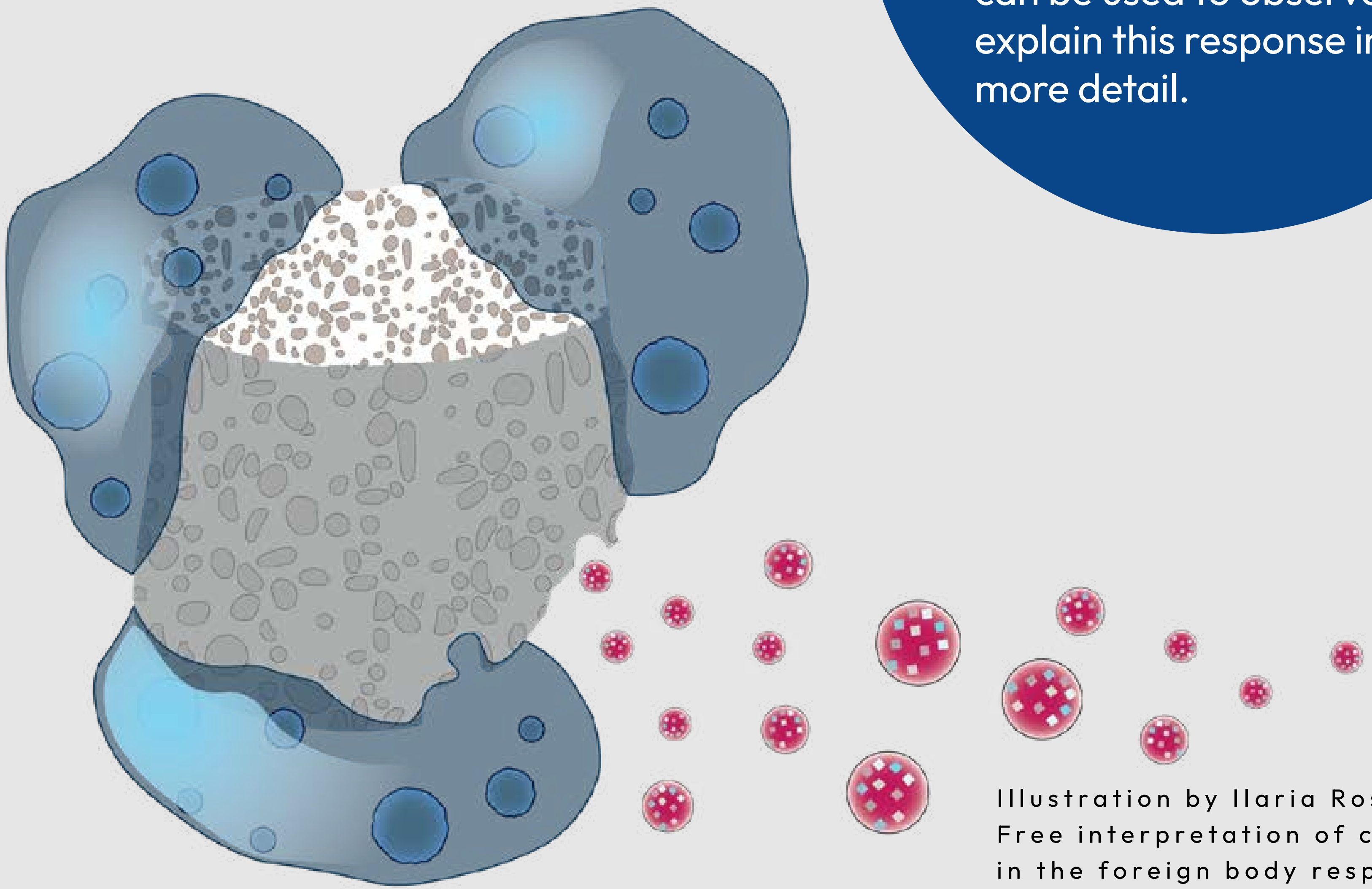
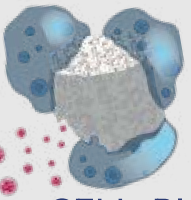


Illustration by Ilaria Rosso (**EVOOOLVE**)
Free interpretation of cells involved in the foreign body response.



CELL-BIOMATERIAL INTERACTIONS

Group leader
Theo van Kooten

INTRODUCTION

I am involved in co-supervising five PhD students, using my expertise in cell culture and the interactions between cells and materials, with a focus on cells involved in the foreign body response. This concerns both in vitro and in vivo models, such as the window-on-a-mouse model. Aspects of cell interactions with biomaterials are also studied in bachelor and master projects of students.

RESEARCH FOCUS

The focus on foreign body response aspects concerns both the development of biomaterials, possible modifications to these materials, and models that can be used to observe and explain this response in more detail. In the past I developed a model to study polymer degradation using mouse J774 macrophages, and I showed that these cells are perfectly capable to degrade poly-trimethylenecarbonate. This model has been used in a number of bachelor and master projects. Currently I am attempting to have human macrophages, in specific THP-1 cells, doing the same, but this proves to be much more difficult and complex because of their different nature, being monocytes to start with.

THE FUTURE

My future work is very limited as I am approaching my retirement. Therefore the focus is on education within Biomedical Engineering and in Medicine.

FACTS & FIGURES
Awards

Veronique Botrugno
PhD student
Monize Decarli group
European Society for Biomaterials (ESB 2025)

Best Poster Presentation Award

Torino | Italy

Zhuoyi Cui
PhD student
Brandon Peterson group
54th World Congress on Microbiology
Outstanding Oral Presentation Award

Rome | Italy

Gabriela Corrêa Carvalho PhD student
Helder Santos Group
The Unesp Thesis Award

Biological Sciences Area 2025

São Paulo | Brazil

Lisa Tromp
student
Patrick van Rijn group
Dutch Society for Biomaterials & Tissue Engineering

Best Thesis award NBTE

Lunteren | The Netherlands

Yuewen Zhu
PhD student
Ali Shahbazi group
European Society of Biomaterials, 2025

Best Oral Presentation Award

Torino | Italy

FACTS & FIGURES
Promotions

Last year
16 students
graduated from

umcg

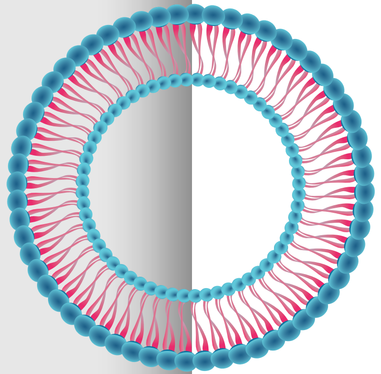
Department of Biomaterials & Biomedical Technology

DATE	STUDENT	TITLE	PROMOTER(S)
1/6/2025	**Xixi Wu**	Melt Electrowriting with Nanodiamond Integration for Biomedical Advancements	Romana Schirhagl
1/13/2025	**Han Gao**	β-glucan-based nanosystems for targeted delivery of RNAi therapeutics for cardiac therapy	Hélder Santos
3/12/2025	**Veridianna Camilo Pattini**	Evaluation of curcumin derivatives: antifungal activity and possible applications	Henny van der Mei
3/12/2025	**Victor Feliz Pedrinha**	Innovative Insights in Decontamination and Healing During Endodontic Treatment	Prashant Sharma / Shahbazi, Ali
3/12/2025	**Zihan Wang**	Fabrication, modeling, and actuation of soft bioinspired microrobots	Sarthak Misra
3/19/2025	**Klaudia Małgorzata Jurczak**	Advanced Bioactive Stent Grafts Based on Physicochemical Surface Properties: A Journey Through Biocompatibility and Manufacturability in Cardiovascular Product Development	Patrick van Rijn
4/14/2025	**Daniel Doeller**	Tuning the Properties of Molecular Switches & Motors	Patrick van Rijn / Ben Feringa
5/21/2025	**Devlina Ghosh**	One size fits all: Navigating the Landscape of Universal Nanogel Coating Strategies from Bench towards Bedside Translation	Patrick van Rijn
7/9/2025	**Kaixuan Zhang**	Dynamics of Paired Bovine Spermatozoa	Sarthak Misra
7/11/2025	**Elkin Escobar Chaves**	Polymeric nanoparticles and nanodiamond-based quantum sensing: applications in managing metabolic-associated diseases with a natural extract as a therapeutic agent	Romana Schirhagl
9/8/2025	**Fenghua Zhao**	Mechanics dictate stromal cell – ECM dynamic interactions: studies using organ-derived ECM hydrogels	Prashant Sharma
9/8/2025	**Siyu Fan**	Fluorescent Nanodiamond Quantum Sensing: From Cell to Organism	Romana Schirhagl
11/12/2025	**Cong Li**	Antimicrobial carbon quantum dots: a Phoenix out of the ashes	Henny van der Mei / Henk Busscher
11/21/2025	**Lisa Tromp**	Designing cell-instructive biomaterials to improve implant outcomes: High-throughput screening to modulate cell-material interactions	Patrick van Rijn
12/18/2025	**Yanjing Ji**	Stimuli-responsive nanogels for drug delivery and dental applications	Patrick van Rijn / Inge Zuhorn
12/18/2025	**Tianqi Feng**	Topography-mediated control of myoblasts behavior for skeletal muscle engineering	Patrick van Rijn / Theo van Kooten

FACTS & FIGURES
Scientific Publications

83

82 publications + 1 pre print



TRANSLATIONAL BIONANOMICRO THERAGENERATIVE MEDICINE

Group leader

Hélder Santos

1. **Amniotic Epithelial Cell Microvesicles Uptake Inhibits PBMCs and Jurkat Cells Activation by Inducing Mitochondria-Dependent Apoptosis**
Cerveró-Varona, A., Prencipe, G., Peserico, A., Canciello, A., House, A. H., Santos, H. A., Perugini, M., Sulcanese, L., Takano, C., Miki, T., Iannetta, A., Russo, V., Mattioli, M. & Barboni, B., 21-Feb-2025, In: Iscience. 28, 2, 25 p., 111830.
DOI: 10.1016/j.isci.2025.111830

2. **A Near-Infrared Light Absorbable Hydrogel with Antibacterial Effect for Mild Photothermal Regeneration of Infected Wounds**
Musaie, K., Qahremani, M., Ebadi, S., Haghighi, H., Nosrati-Siahmazgi, V., Abbaszadeh, S., Eskandari, M. R., Slomp, M., Atema-Smit, J., Santos, H. A. & Shahbazi, M.-A., 20-Aug-2025, In: J. Mater. Chem. B. 36 p.
DOI: 10.1039/d5tb01346a

3 **A ratiometric theranostic nanoplatform with acid-triggered drug release and glutathione-activated fluorescence turn-on**
Flores-Cruz, R. D., Figueroa-DePaz, Y., Lobita, M. C., Hernández-Ayala, L. F., López-Pacheco, A. P., Dijkstra, E., Ruiz-Azuara, L. & Santos, H. A., 10-Oct-2025, (E-pub ahead of print) In: Journal of Controlled Release. 40 p., 114309.
DOI: 10.1016/j.jconrel.2025.114309

4. **Artificial Cells and Biomimicry cells: A Rising Star in the Fight Against Cancer**
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11. **Engineered Shape-Tunable Copper-Coordinated Nanoparticles for Macrophage Reprogramming**
Gao, H., Cheng, R., Cardoso, I., Lobita, M., Pacheco-Fernández, I., Bártolo, R., Rodrigues, L. R., Hirvonen, J. & A. Santos, H., 19-Feb-2025, In: Nano Letters. 25, 7, p. 10 10 p.
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14. **Granular Hydrogels as Modular Biomaterials: From Structural Design to Biological Responses**
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17. **Hybrid lipid nanoparticles derived from human mesenchymal stem cell extracellular vesicles by microfluidic-sonication for collagen I mRNA delivery to human tendon progenitor stem cells**
Pareja Tello, R., Lamparelli, E. P., Ciardulli, M. C., Hirvonen, J., Barreto, G., Maffulli, N., Della Porta, G. & Santos, H. A., 2025, In: Biomaterials Science. 13, p. 2066-2081 16 p.
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18. **Hybrid Nanoparticles Dual-Loaded With Curcumin and Benzydamine Hydrochloride for the Treatment of Vulvovaginal Candidiasis: From Development to Biological Application In Vitro and In Vivo**
(Adv. Therap. 1/2025)
Carvalho, G. C., Domingues, M. N. V., Marena, G. D., Mäkilä, E., Li, J., Geertsema-Doornbusch, G., de Andrade, C. R., Stuart, M. C. A., Shahbazi, M.-A., Corrêa, I., Peterson, B. W., Salonen, J., Florindo, H. F., Bauab, T. M., Chorilli, M. & Santos, H. A., Jan-2025
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19. **Hybrid Nanoparticles Dual-Loaded With Curcumin and Benzydamine Hydrochloride for the Treatment of Vulvovaginal Candidiasis: From Development to Biological Application In Vitro and In Vivo**
Carvalho, G. C., Domingues, M. N. V., Marena, G. D., Mäkilä, E., Li, J., Geertsema-Doornbusch, G., de Andrade, C. R., Stuart, M. C. A., Shahbazi, M.-A., Corrêa, I., Peterson, B. W., Salonen, J., Florindo, H. F., Bauab, T. M., Chorilli, M. & Santos, H. A., Jan-2025, In: Advanced Therapeutics. 8, 1, 19 p., 240034
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22. **Local glycolysis-modulating hydrogel microspheres for a combined anti-tumor and anti-metastasis strategy through metabolic trapping strategy**
Han, H., Wang, S., Shahbazi, M. A., Du, Y., Zuhorn, I. S., Li, J., Chen, J., Chen, Y., Bártolo, R., Cui, W. & Santos, H. A., 10-Feb-2025, In: Journal of Controlled Release. 378, p. 320-333 14 p.
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23. **Metal-organic frameworks in sample preparation for clinical applications** –
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Bettahar, H., Tapeinos, C., Işıtman, O., D'Amico, C., Correia, A., Santos, H. A. & Zhou, Q., 28-May-2025, (E-pub ahead of print) In: Advanced Functional Materials. 17 p., 2507301.
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Feng, G., Tang, H., Xie, S., Wang, Y., Wu, T., Cai, X., Zhou, Y., Lu, Y., Bai, Y., Zhao, M., Hu, S., Zhang, Y., Shahbazi, M.-A., Santos, H. A., Fan, J. & Liu, D., Aug-2025, (E-pub ahead of print) In: Acs Nano 19 p
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29. **Quantum Sensing of Free Radicals in Macrophages Reveals Early Autophagy-lysosome regulation in an Atherosclerosis cell model**
Fan, S., Gao, H., Nieuwhof, W., Mulder, T., Fumelli, B., Li, R., Sharmin, R., Niora, M., Sorensen, K. B., Haan, W. D., Santos, H. A. & Schirhagl, R., Aug-2025, (E-pub ahead of print) In: Redox Biology. 103825.
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Han, H., Wang, S., Shahbazi, M.-A., Zuhorn, I. S., Cai, Z., Chen, J., Li, J., Chen, Y., Du, Y., Bártolo, R., Chen, L., Santos, H. A. & Cui, W., 10-Feb-2025, In: Journal of Controlled Release 378, p350-364 15 p
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31. **Selenium Nanoparticles Synergize with a KRAS Nanovaccine against Breast Cancer**
Ferro, C., Matos, A. I., Serpico, L., Fontana, F., Chiaro, J., D'Amico, C., Correia, A., Koivula, R., Kemell, M., Gaspar, M. M., Acúrcio, R. C., Cerullo, V., Santos, H. A. & Florindo, H. F., 18-Feb-2025, In: Advanced healthcare materials. 14, 5, 22 p., 2401523.
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34. **Wisdom of Crowds for Supporting the Safety Evaluation of Nanomaterials: Environmental Science & Technology**
Saarimäki, L. A., Fratello, M., Del Giudice, G., Di Lieto, E., Afantitis, A., Alenius, H., Chiavazzo, E., Gulumian, M., Karisola, P., Lynch, I., Mancardi, G., Melagraki, G., Netti, P., Papadiamantis, A. G., Peijnenburg, W., A Santos, H., Serchi, T., Shahbazi, M.-A., Stoeger, T. & Valsami-Jones, E. & 7 others, , 17-Jul-2025, (E-pub ahead of print) In: Environmental science & technology. 12 p.
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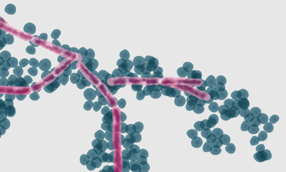

BIOMATERIALS-
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INFECTIONS
Group leader
Henny van der Mei

BIOMATERIALS-ASSOCIATED INFECTIONS

Group leader

Henny van der Mei

1. **Volumetric Engineered 3D Drug Reservoir Against Diabetic Implant Infection via Cuproptosis-Like Bacterial Death and Hunger-Triggered Maintenance of Mitochondrial Integrity**
Li D, Qin H, Jiang M, Wei H, Zhao H, Tang P, Jian G, van der Mei HC, Chen T.
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Pattini VC, de Assis LR, de Almeida MTG, Regasini LO, van der Mei HC.
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Wang Y, Wu F, Hua L, Gao C, Wang S, Liu Y, Ren Y, Shi L, van der Mei HC, Li Y.
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Sójka O, van der Mei HC, van Veelen HPJ, van Rijn P, Gagliano MC.
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5 **Chemical and functional inheritance of carbon quantum dots hydrothermally-derived from chitosan**
Li, C., Ren, Y., Busscher, H. J., Zhang, Z. & van der Mei, H. C., 15-Mar-2025, In: Journal of Colloid and Interface Science. 682, p. 680-689
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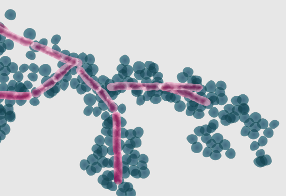

BIOMATERIALS-ASSOCIATED INFECTIONS

Group leader
Henny van der Mei

6. **Core-Shell ZnO2@Cerium-Based Metal-Organic Framework with Low Turnover, Dual-Catalytic Activity for Biosafe Biofilm Dispersal and Immune Modulation**
Wu, R., Ge, T., Yu, T., Shi, Q., Shi, R., Ren, Y., Busscher, H. J., Liu, J. & van der Mei, H. C., 4-Jun-2025, In: ACS Applied Materials and Interfaces. 17, 22, p. 32111-32126 16 p.
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7. **Phagocytosis by macrophages decreases the radiance of bioluminescent Staphylococcus aureus**
Boonstra, E. C., Agresti, L., van der Mei, H. C., Jutte, P. C. & Sjollema, J., 11-Jan-2025, In: BMC Microbiology. 25, 1, 10 p., 12.
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8. **Single-Atom Cu Anchored on Carbon Nitride as a Bifunctional Glucose Oxidase and Peroxidase Nanozyme for Antibacterial Therapy**
Wu, F., Wang, Y., Li, Y., Shi, L., Yuan, L., Ren, Y., van der Mei, H. C. & Liu, Y., 25-Mar-2025, In: Acs Nano. 19, 11, p. 10816-10828 13 p.
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9. **The applicability of fluorescent optotracers for in vitro and in vivo Staphylococcus aureus detection and quantification**
Agresti, L., Boonstra, E. C., Jutte, P. C., vander Mei, H. C. & Sjollema, J., 3-Oct-2025, In: Scientific Reports. 15, 12 p., 34503.

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Yuan L, Mellema T, Geertsema-Doornbusch GI, van der Mei HC. .Front Cell Infect Microbiol. 2025 Dec 12;15:1706664.
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TARGETED DRUG DELIVERY WITH NANOMEDICINE

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1. **Local glycolysis-modulating hydrogel microspheres for a combined anti-tumor and anti-metastasis strategy through metabolic trapping strategy**
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2. **Reactive oxygen species switcher via MnO 2-coated Prussian blue loaded hyaluronic acid methacrylate hydrogel microspheres for local anti-tumor treatment**
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3. **Solvent and temperature effects in the photoiniferter RAFT polymerisationof PEG methacrylate**
Chang, R., Monnery, B. D. & Zuhorn, I. S., 7-Jul-2025, In: Polymer Chemistry. 16, 25, p. 2952-2961 10 p.
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4. **Development of a Microwell System for Reproducible Formation of Homogeneous Cell Spheroids.**
Reina Mahecha MA, Mariani G, van Schaik PEM, Schaafsma P, van Kooten TG, Sharma PK, Zuhorn IS.
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BIOMATERIAL ASSOCIATED INFECTIONS AND BIOCOMPATIBILITY

Group leader

Jelmer Sjollema

1. **The applicability of fluorescent optotracers for in vitro and in vivo Staphylococcus aureus detection and quantification.**
Agresti L., Boonstra E.C., Jutte P.C., van der Mei H.C., Sjollema J. (2025).
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2. **3D bio-printed GelMA hydrogels as an in vitro model for the foreign body reaction**
Agresti L., Van Der Mei H., Sjollema J., Jutte P. (2025)
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3. **Recent regulatory developments in EU Medical Device Regulation and their impact on biomaterials translation**
Jurczak K.M., van der Boon T.A.B., Devia-Rodriguez R., Schuurmann R.C.L., Sjollema J., van Huizen L., De Vries J.-P.P.M., van Rijn P. (2025).
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4. **Granular Hydrogels as Modular Biomaterials: From Structural Design to Biological Responses**
Vaziri A., Maia R., Zhang P., Agresti L., Sjollema J., Shahbazi M.-A., Santos H.A. (2025).
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5. **Phagocytosis by macrophages decreases the radiance of bioluminescent Staphylococcus aureus**
Boonstra EC, Agresti L, van der Mei HC, Jutte PC, Sjollema J.
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BIOINSPIRED MATERIALS AND BIOENGINEERING (BioMatBio)

Group leader
Mohammad Ali Shahbazi

1. **A near-infrared light absorbable hydrogel with antibacterial effect for mild photothermal regeneration of infected wounds**
Musaie K, Qahremani M, Ebadi S, Haghighi H, Nosrati Siahmazgi V, Abbaszadeh S, Eskandari MR, Slomp M, Atema-Smit J, Santos HA, Shahbazi MA
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2. **Programmable Nanostructure Assembly of a Paclitaxel Derivative Enables Tunable Anticancer Therapy via Hydrogen Bond Engineering.**
Feng G, Tang H, Xie S, Wang Y, Wu T, Cai X, Zhou Y, Lu Y, Bai Y, Zhao M, Hu S, Zhang Y, Shahbazi MA, Santos HA, Fan J, Liu D.
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3. **Ferroptosis induction by engineered liposomes for enhanced tumor therapy**
Ghasempour A, Tokallou MA, Naderi Allaf MR, Moradi M, Dehghan H, Sedighi M, Shahbazi MA, Lavi Arab F.
Beilstein J Nanotechnol. 2025 Aug 14;16:1325-1349.
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4. **Wisdom of Crowds for Supporting the Safety Evaluation of Nanomaterials**
Saarimäki LA, Fratello M, Del Giudice G, Di Lieto E, Afantitis A, Alenius H, Chiavazzo E, Gulumian M, Karisola P, Lynch I, Mancardi G, Melagraki G, Netti P, Papadiamantis AG, Peijnenburg W, A Santos H, Serchi T, Shahbazi MA, Stoeger T, Valsami-Jones E, Vivo P, Vinković Vrček I, Vogel U, Wick P, Winkler DA, Serra A, Greco D.
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5. **Immune-Vascular Synergy: A Photodynamic Hydrogel Activating ALDH2 to Combat Inflammation and Enhance Angiogenesis in Diabetic Wound Healing**
Xiong Y, Wu Q, Zhang P, Liao J, Hu H, Shahbazi MA, Zhao Y, Mi B.
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6. **Artificial cells and biomimicry cells: A rising star in the fight against cancer**
Maia RF, Vaziri AS, Shahbazi MA, Santos HA.
Mater Today Bio. 2025 Apr 3;32:101723.
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7. **Thermo-responsive and biodegradable MoS2-based nanoplatform for tumor therapy and postoperative wound management**
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Epub 2025 Jan 31. PMID: 39914308.

8. **Antimicrobial efficacy of alternative root canal disinfection strategies: An evaluation on multiple working models.**
Pedrinha VF, Barros MC, Portes JD, Slomp AM, Woudstra W, Lameira OA, Queiroga CL, Marcucci MC, Shahbazi MA, Sharma PK, Andrade FB.
Biomed Pharmacother. 2025 Feb;183:117833.
DOI: 10.1016/j.biopha.2025.117833
Epub 2025 Jan 18. PMID: 39827810.

9. **Nano-Armed Limosilactobacillus reuteri for Enhanced Photo-Immunotherapy and Microbiota Tryptophan Metabolism against Colorectal Cancer**
Xu H, Wang Y, Liu G, Zhu Z, Shahbazi MA, Reis RL, Kundu SC, Shi X, Zu M, Xiao B.
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DOI: 10.1002/advs.202410011
Epub 2024 Dec 30. PMID: 39739630; PMCID: PMC11831460.

10. **Reactive oxygen species switcher via MnO2-coated Prussian blue loaded hyaluronic acid methacrylate hydrogel microspheres for local anti-tumor treatment**
Han H, Wang S, Shahbazi MA, Zuhorn IS, Cai Z, Chen J, Li J, Chen Y, Du Y, Bártolo R, Chen L, Santos HA, Cui W.
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DOI: 10.1016/j.jconrel.2024.12.036
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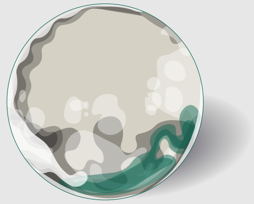
11. **Local glycolysis-modulating hydrogel microspheres for a combined anti-tumor and anti-metastasis strategy through metabolic trapping strategy.**
Han H, Wang S, Shahbazi MA, Du Y, Zuhorn IS, Li J, Chen J, Chen Y, Bártolo R, Cui W, Santos HA.
J Control Release. 2025 Feb 10;378:320-333
DOI: 10.1016/j.jconrel.2024.12.025
Epub 2024 Dec 18. PMID: 39689815.



BIOPRINTING AND BIOFABRICATION

Group leader
Monize Decarli

1. **Mechanical Reinforced and Self-healing Hydrogels: Bioprinted Biomimetic Methacrylated Collagen Peptide-Xanthan Gum Constructs for Ligament Regeneration**
Weng H, Decarli MC, He L, Chen W, van Rijt S, Bernaerts KV, Moroni L.
Regeneration. Adv Healthc Mater. 2025 Sep;14(25):e2502341. doi: 10.1002/adhm.202502341. Epub 2025 Jul 16.
PMID: 40665850; PMCID: PMC12477574.
DOI: 10.1002/adhm.202502341.

2. **Xanthan Gum–Iron System: Natural, Mechanically Tunable, Bioactive, and Magnetic-Responsive Hydrogels for Biomedical Engineering Applications**
Decarli MC, Babilotte J, Chen W, Kappesz J, Ten Brink T, Dechant L, Kalogeropoulou M, Tomasina C, Custódio CA, Mano JF, Moroni L
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2025 Sep 17;17(37):51588-51604. doi: 10.1021/acsami.5c08442. Epub 2025 Sep 3.
DOI: 10.1021/acsami.5c08442.

3. **The Route to Artery Mimetics: Hybrid Bioinks for Embedded Bioprinting of Multimaterial Cylindrical Models.**
Aizarna-Lopetegui, U., Herrero-Ruiz, A., Decarli, M., Urigoitia-Asua, A., Chavarri-Urraca, K., Moroni, L., Henriksen-Lacey, M., & Jimenez de Aberasturi, D. (2025).)
Advanced Functional Materials, 35(49),
Article e19072
DOI: 10.1002/adfm.202419072

4. **Embedded 3D Printing of Graphene Oxide-Containing, Chemically Crosslinkable Poly(Ethylene Glycol) Inks**
Ferreira Helena P., Decarli Monize C., Moura Duarte, Pereira Rúben F., Pereira Andreia T., Moroni Lorenzo, Gonçalves Inês C.
Small Sci.. 2025; 5:e202500278.
DOI: 10.1002/smsc.202500278.

5. **Blood-Based Bioinks in a Crystal Self-Healing Transparent Supporting Bath.**
M.Caiado Decarli, H. P.Ferreira, R.Sobreiro-Almeida, F. C.Teixeira, T. R.Correia, J.Babilotte, J.Olijve, C. A.Custódio, I. C.Gonçalves, C.Mota, J. F.Mano, L.Moroni, Embedding Bioprinting of Low Viscous, Photopolymerizable
Small Methods2025, 9, 2400857.
DOI: 10.1002/smtd.202400857.

6. **Engineering bioactive fibrous constructs: Bioprinting stem cell-laden collagen-derived hydrogels with short collagen microfibers**
Weng, H., Decarli, M. C., Chen, W., Bernaerts, K. V., & Moroni, L. (2025).
Biomaterials. Advance online publication.
DOI: 10.1016/j.biomaterials.2025.123965

umcg
Department of
Biomaterials &
Biomedical
Technology

TRANSLATIONAL & REGENERATIVE BIOMATERIALS

Group leader
Patrick van Rijn

1. **Enhance cell-material interaction for ingrowth of eptfe-sleeved cardiovascular stent based on physicochemical surface properties**
Hamstra, R. (Inventor), van Rijn, P. (Inventor), Jurczak, K. (Inventor), Schuurmann, R. (Inventor) & de Vries, J.-P. P. M. (Inventor), 24-Jul-2025, Patent No. WO2025153322, 20-Jan-2025, Priority date 19-Jan-2024.

2. **Functionalized Multi-Walled Carbon Nanotube Enhanced Myogenic Differentiation for Aligned Topography-Induced Skeletal Muscle Engineering**
Feng, T., Ceroni, L., Tromp, L. E., Siebenmorgen, C., Casalini, S., Menna, E. & van Rijn, P., 24-Jul-2025, (E-pub ahead of print) In: Small. 11 p., e2504992.
DOI: 10.1002/smll.202504992

3. **Harnessing the power of physicochemical material property screening to direct breast epithelial and breast cancer cells**
Tromp, L. E., de Jong, R., van der Boon, T. A. B., Mahecha, A. R., Bank, R., de Boer, J. & van Rijn, P., Aug-2025,In:Bioactive Materials. 50, p.494-509 16 p.
DOI: 10.1016/j.bioactmat.2025.04.003

4. **Modulation of Biomaterial-Associated Fibrosis by Means of Combined Physicochemical Material Properties**
Tromp, L. E., van der Boon, T. A. B., de Hilster, R. H. J., Bank, R. & van Rijn, P., Jan-2025, In: Advanced science. 12, 4, 14 p., e2407531
DOI: 10.1002/advs.202407531

5. **Porous polytrimethylenecarbonate scaffolds: Design considerations and porosity modulation techniques**
Jurczak, K. M., Zhang, R., Hinrichs, W. L. J., Grijpma, D. W., Schuurmann, R. C. L., de Vries, J. P. P. M. & van Rijn, P., Feb-2025, In: Materials and Design. 250, 14 p., 113588
DOI: 10.1016/j.matdes.2025.113588

6. **Quaternary ammonium-functionalized carbon nanotubes/alginate nanocomposite hydrogels support myoblast growth and differentiation**
Ceroni, L., Feng, T., Calvillo, L., Casalini, S., Van Rijn, P. & Menna, E., 21-Jul-2025, In: Journal of materials chemistry b. 13, 27, p. 8105-8120 16 p
DOI: 10.26434/chemrxiv-2025-j87l1-v2

7. **Recent regulatory developments in EU Medical Device Regulation and their impact on biomaterials translation**
Jurczak, K. M., van der Boon, T. A. B., Devia-Rodriguez, R., Schuurmann, R. C. L., Sjollema, J., van Huizen, L., De Vries, J. P. P. M. & van Rijn, P., Mar-2025, In: Bioengineering and Translational Medicine. 10, 2, 18 p., e10721
DOI: 10.1002/btm2.10721

MATERIOBIOLOGY AND NANOBIOMATERIALS

Group leader
Patrick van Rijn

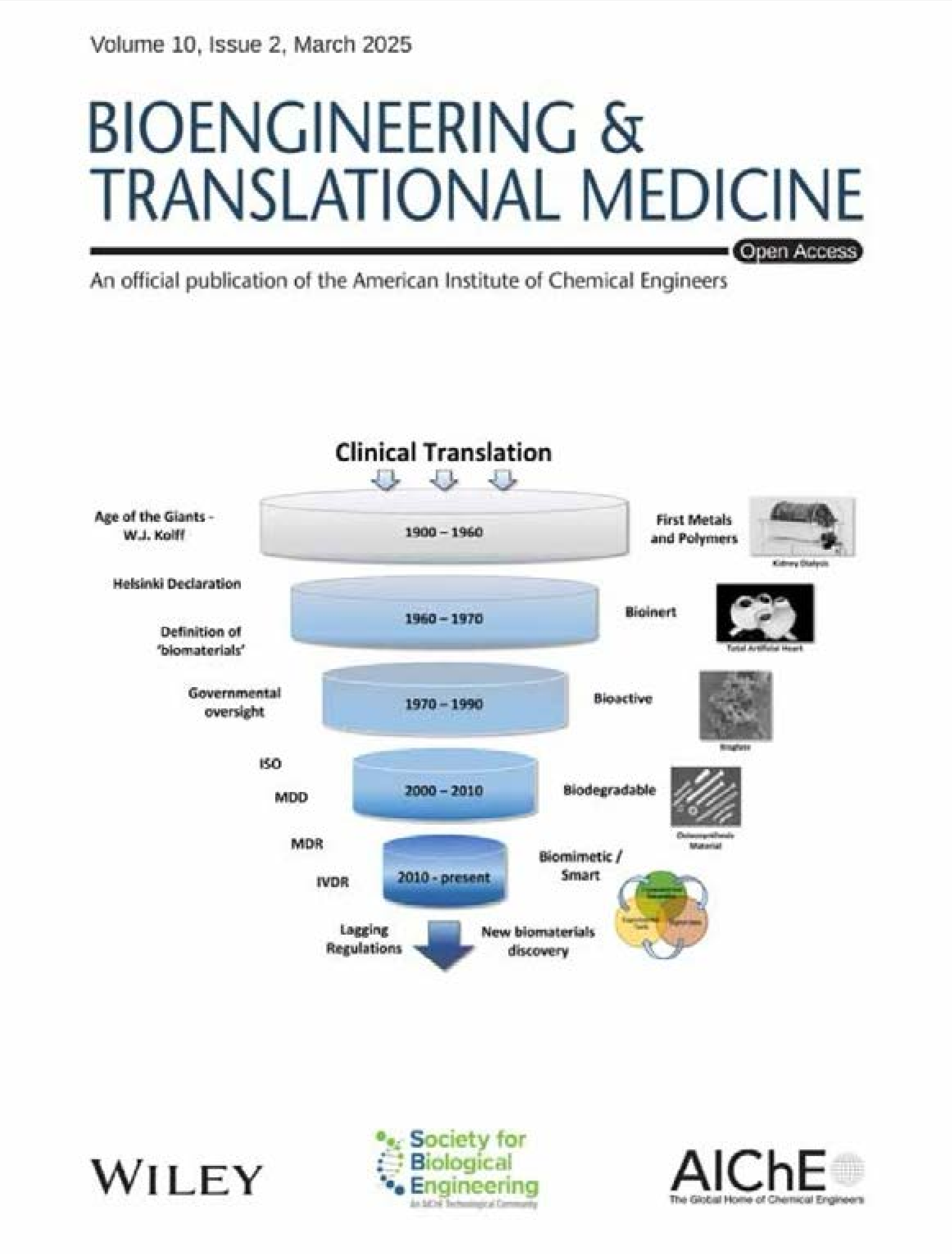
8. **Smart Microgel and Nanogel Platforms for Biomedical Applications**
Ghosh, D., Zhang, R., Ji, Y. & van Rijn, P., 13-Jun-2025, Advanced Polymer Life Science. Friedrichs, J., Freudenberg, U. & Werner, C. (eds.). World Scientific Publishing, p. 381-456 (World Scientific Series On Emerging Technologies: Avram Bar-cohen Memorial Series; vol. 7).
DOI: 10.1142/9789819806782_0011

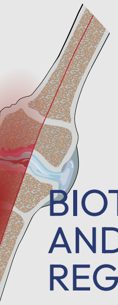
9. **Tailoring antifouling performance of zwitterionic nanogels through an advanced universal coating approach**
Ghosh, D., Ji, Y., Kaper, H., de Vries, J., Witjes, M. J. H. & van Rijn, P., 1-Sept-2025, In: Surfaces and Interfaces. 72, 12 p., 107084.
DOI: 10.1016/j.surfin.2025.107084

Patent

Hamstra, R., van Rijn, P., Jurczak, K., Schuurmann, R., & de Vries, J.-P. P. M. (2025).
Enhance cell-material interaction for ingrowth of eptfe-sleeved cardiovascular stent based on physicochemical surface properties.

Patent No. WO2025153322





BIOTRIBOLOGY AND REGENERATION

Group leader
Prashant Sharma

1. **Advancements in exosome-based cancer diagnosis: from chipsets to nano vaccine**
Mukerjee N, Sarkar S, Uti DE, Sharma PK. Cancer Biol Ther. 2025 Dec;26(1):2541991. doi: 10.1080/15384047.2025.2541991. Epub 2025 Aug 3. PMID: 40754671; PMCID: PMC12323433.
DOI: 10.1080/15384047.2025.2541991

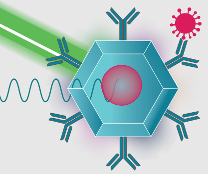
2. **Antimicrobial efficacy of alternative root canal disinfection strategies: An evaluation on multiple working models**
Pedrinha, V. F., Barros, M. C., Portes, J. D., Slomp, A. M., Woudstra, W., Lameira, O. A., Queiroga, C. L., Marcucci, M. C., Shahbazi, M.-A., Sharma, P. K. & de Andrade, F. B., Feb-2025, In: Biomedicine & Pharmacotherapy. 183, 21 p., 117833
DOI: 10.1016/j.biopha.2025.117833

3. **Development of an in vitro platform for epithelial-stromal interactions: A basement membrane-containing scaffold from decellularized porcine bladders**
Ramirez Idarraga, J., Estrada, S., Harmsen, M. & Sharma, P. K., Jun-2025, In: Matrix biology plus. 26, 12 p., 100169.
DOI: 10.1016/j.mbplus.2025.100169

4. **Influence of Neutral and Cationic Phytoglycogen Nanoparticles on Cartilage and Ocular Lubrication**
Mazarevica, N. R., Chen, Y., Ren, K., Kaper, H. J., Monnery, B. D. & Sharma, P. K., Jan-2025, In: Biosurface and Biotribology. 11, 1, 12 p., e70002
DOI: 10.1049/bsb2.70002

5. **Development of a Microwell System for Reproducible Formation of Homogeneous Cell Spheroids**
Reina Mahecha MA, Mariani G, van Schaik PEM, Schaafsma P, van Kooten TG, Sharma PK, Zuhorn IS.
Pharmaceutics. 2025 Dec 31;18(1):56.
doi: 10.3390/pharmaceutics18010056.
PMID: 41599163; PMCID: PMC12844868.

6. **Glycosaminoglycan depletion lowers the crack resistance of articular cartilage under impact loading.** Ren, K., Zhao, F., Tzaneti, N. K., Kaper, H. J., & Sharma, P. K. (2025)
Journal of the mechanical behavior of biomedical materials, 170, Article 107122.
DOI: 10.1016/j.jmbbm.2025.107122



BIOIMAGING AND BIOANALYSIS

Group leader
Romana Schirhagl

1. **Amphiphilic Janus nanoparticles for image-guided cancer treatment: cell internalization mechanism, molecular action, challenges, and outlook.**
Madni A, Iqbal MZ, Schirhagl R, Khan WS, Bajwa SZ. J Mater Chem B. 2025 Nov 12;13(44):14239-14259.
DOI: 10.1039/d5tb01548k
PMID: 41090604.

2. **Follicle-stimulating hormone stimulates free radical generation without inducing substantial oxidative stress in human granulosa cells**
Lin, N., van Zomeren, K. C., Plosch, T., Hofsink, N., van Veen, T., Li, H. T., Lin, J., Zhou, X., Groen, H., Tietge, U. J. F., Cantineau, A., Schirhagl, R. & Hoek, A., 2025, In: Human reproduction open. 2025, 2, 17 p., hoaf007.
DOI: 10.1093/hropen/hoaf007

3. **In Vivo Nanodiamond Quantum Sensing of Free Radicals in Caenorhabditis elegans Models**
Fan, S., Zhang, Y., Ainslie, A. P., Seinstra, R., Zhang, T., Nollen, E. & Schirhagl, R., 10-Apr-2025, In: Advanced science. 12, 14, 9 p., 24123
DOI: 10.1002/advs.202412300

4. **Integrating melt electrowriting (MEW) PCL scaffolds with fibroblast-laden hydrogel toward vascularized skin tissue engineering**
Wu, X., Zhao, F., Wang, H., Schirhagl, R. & Włodarczyk-Biegun, M. K., Apr-2025, In: Materials Today Bio. 31, 17 p., 101593
DOI: 10.1016/j.mtbio.2025.101593

5. **Quantum Sensing of Free Radicals in Macrophages Reveals Early Autophagy-lysosome regulation in an Atherosclerosis cell model**
Fan, S., Gao, H., Nieuwhof, W., Mulder, T., Fumelli, B., Li, R., Sharmin, R., Niora, M., Sorensen, K. B., Haan, W. D., Santos, H. A. & Schirhagl, R., Aug-2025, (E-pub ahead of print) In: Redox Biology. 103825
DOI: 10.1016/j.redox.2025.103825

6. **Quantum sensing to monitor changes in free radical generation by intracellular vesicles of polarized macrophages**
Mzyk, A., Reyes-San-Martin, C., Doğan, Y., Woudstra, W., Zhang, Y., Yilmaz, E., Bron, R., de Haan-Visser, W., Berg-Sorensen, K. & Schirhagl, R., 1-Jun-2025, In: Acta Biomaterialia. 199, p. 315-323 9 p.
DOI: 10.1016/j.actbio.2025.04.024

7. **Treating the untreatable: Reversing β-lactam resistance in MRSA by membrane-domain-dissolving antibiotics**
Adéla Melcrová, Willem Woudstra, Michaela Wenzel, Mariella Gabler, Wenche Stensen, John S. M. Svendsen, Wouter H. Roos, Romana Schirhag
DOI: 10.1101/2025.10.27.684379

SURGICAL ROBOTICS

Group leader
Sarthak Misra

1. **Magnetic localization and manipulation of locking synchronous motors**
Richter, M., Masjosthusmann, L., Makushko, P., Venkiteswaran, V. K., Makarov, D. & Misra, S., Dec-2025, In: Communications Engineering. 4, 16 p., 91.
DOI: 10.1038/s44172-025-00424-3

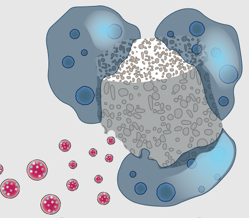
2. **Magnetic Nozzle-Free Embedded 3D (MagNoFE3D) Printing**
Piñan Basualdo, F. N., Trikalitis, V. D., Visconti, S., Ficuciello, F., Goulas, C., Rouwkema, J. & Misra, S., 4-Mar-2025, In: Advanced Materials Technologies. 10, 5, 9 p., 2401097.
DOI: 10.1002/admt.202401097

3. **Multi-layer screen-printing of magnetic soft robots with integrated materials and functions**
Wang, Z., Misra, S. & Kalpathy Venkiteswaran, V., 18-Jun-2025, In: Cell Reports Physical Science. 6, 6, 12 p., 102614
DOI: 10.1016/j.xcrp.2025.102614

4. **Design and control of a permanent magnet-based robotic system for navigating tetherless magnetic devices in viscous environments**
Zhang Z, Klingner A, Misra S, Khalil ISM. Sci Rep. 2025 Aug 23;15(1):31041.
doi: 10.1038/s41598-025-15247-7.
PMID: 40849574; PMCID: PMC12375033.

5. **Technology Roadmap of Micro/Nanorobots**
Ju X, Chen C, Oral CM, Sevim S, Golestanian R, Sun M, Bouzari N, Lin X, Urso M, Nam JS, Cho Y, Peng X, Landers FC, Yang S, Adibi A, Taz N, Wittkowski R, Ahmed D, Wang W, Magdanz V, Medina-Sánchez M, Guix M, Bari N, Behkam B, Kapral R, Huang Y, Tang J, Wang B, Morozov K, Leshansky A, Abbasi SA, Choi H, Ghosh S, Borges Fernandes B, Battaglia G, Fischer P, Ghosh A, Jurado Sánchez B, Escarpa A, Martinet Q, Palacci J, Lauga E, Moran J, Ramos-Docampo MA, Städler B, Herrera Restrepo RS, Yossifon G, Nicholas JD, Ignés-Mullol J, Puigmartí-Luis J, Liu Y, Zarzar LD, Shields CW 4th, Li L, Li S, Ma X, Gracias DH, Velev O, Sánchez S, Esplandiu MJ, Simmchen J, Lobosco A, Misra S, Wu Z, Li J, Kuhn A, Nourhani A, Maric T, Xiong Z, Aghakhani A, Mei Y, Tu Y, Peng F, Diller E, Sakar MS, Sen A, Law J, Sun Y, Pena-Francesch A, Villa K, Li H, Fan DE, Liang K, Huang TJ, Chen XZ, Tang S, Zhang X, Cui J, Wang H, Gao W, Kumar Bandari V, Schmidt OG, Wu X, Guan J, Sitti M, Nelson BJ, Pané S, Zhang L, Shahsavan H, He Q, Kim ID, Wang J, Pumera M
ACS Nano. 2025 Jul 15;19(27):24174-24334.
doi: 10.1021/acsnano.5c03911.
Epub 2025 Jun 27. PMID: 40577644; PMCID: PMC12269370.

6. **Magnetic localization and manipulation of locking synchronous motors**
Richter M, Masjosthusmann L, Makushko P, Venkiteswaran VK, Makarov D, Misra S.
Commun Eng. 2025 May 22;4(1):91.
doi: 10.1038/s44172-025-00424-3.
PMID: 40404797; PMCID: PMC12098917.



CELL-BIOMATERIAL INTERACTIONS

Group leader
Theo van Kooten

1. **Development of a Microwell System for Reproducible Formation of Homogeneous Cell Spheroids**
Reina Mahecha MA, Mariani G, van Schaik PEM, Schaafsma P, van Kooten TG, Sharma PK, Zuhorn IS.
Pharmaceutics. 2025 Dec 31;18(1):56.
doi: 10.3390/pharmaceutics18010056.
PMID: 41599163; PMCID: PMC12844868.

Facts & Figures

Funding & Grants

Research within the Department of Biomedical Engineering (BBT) is driven by a commitment to advancing human health and transforming the future of healthcare. Our scientists lead innovative, multidisciplinary efforts that push the boundaries of biomedical discovery and technology. Each year, they successfully secure competitive funding from major national and international agencies, enabling groundbreaking work across our research portfolio.

The following list details the funded projects currently contributing to our research mission.

€4,032,387.69

Total funding for projects started during 2025

RESEARCHER	CALL	TITLE OF THE PROJECT	AMOUNT
Hélder Santos	Health~Holland PPP	INNO4GBM: Enhancing Glioblastoma Treatment Using Local Injectable Hydrogels Containing Drug-Loaded Polymeric Particles	€159,000.00
Hélder Santos	Stichting AVS Proefdiervrij	MyHeart: Miniaturized your Heart 's Environment for Advanced Research and Testing	€5,000.00
Hélder Santos	HORIZON-MSCA-2024-PF-01-01	Nannochloropsis loaded lipid nanoparticles for atherosclerosis: Development of a biocompatible lipid system for inflammation-responsive and image-guided cardiovascular therapy	€187,624.08
Hélder Santos	HORIZON-MSCA-2024-PF-01-01 (HORIZON-TMA-MSCA-PF-EF)	Innovative Flavonoid-based Nanoparticles (Flav-NPs) to Fight Against Colorectal Cancer (FLAVCAN)	€232,916.17
Hélder Santos	HORIZON-MSCA-2024-PF-01-01 (HORIZON-TMA-MSCA-PF-EF)	SKINNOVATE Synergistic Nano-Therapeutic Approach for Psoriasis: Targeting TNF-α and IL-17 Pathways via Transdermal Delivery	€232,916.17
Monize Decarli	Stichting Astma Bestrijding (Foundation for Asthma Prevention)	M.Decarli Treatment of air-trapping in COPD using airway stents: an in vitroassessment of 3D-printed biomimetic tubular scaffolds	€35,000.00
Monize Decarli	HTRIC/ UMCG Innovatieruimte funding (Internal)	Treatment of air-trapping in COPD using airway stents: an in vitro assessment of 3Dprinted biomimetic tubular scaffolds	€35,587.50
Monize Decarli	Triade - ProofIT fund (Triade - HanzePoort B.V.,)	ProofIT - Feasibility Credit Agreement for The Spheroid Fusion Device project	€25,000.00
Patrick van Rijn	NWO-TTW OTP (Open Technology Programme (OTP))	Longer air with hydrogel-coated lung implantable devices	€381,450.00
Huiting Li (Romana Schirhagl's group)	De Cock-Hadders Foundation funding for scientific research	Exploring the Interplay Between Seminal Microbiota and Oxidative stress in Male Fertility	€3,500.00
Siyu Fan (Romana Schirhagl's group)	De Cock-Hadders Foundation funding for scientific research	Quantum sensing of Huntington's disease in C.elegans model.	€4,500.00
Romana Schirhagl	Interreg Deutschland - Nederland Euregio Maas-Rijn	(NanoDetect - Interreg) Revolutionary cancer diagnostics through nanodiamond relaxometry	€638,505.27

Facts & Figures

Funding & Grants

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RESEARCHER	CALL	TITLE OF THE PROJECT	AMOUNT
Romana Schirhagl	Ubbo Emmius Fonds T.a.v. D. Bosker	Het fundament van HTRIC: Investeren in NextGen Gezondsheidstechnologie	€249,100.00
Kiyan Musaie (Mohammad Ali Shahbazi's group)	De Cock-Hadders Foundation funding for scientific research	Role of Ionic Crosslinkers on Cellular Crosstalks Involved in Inflammation and Fibrosis Modulation	€4,500.00
Yuewen Zhu (Mohammad Ali Shahbazi's group)	De Cock-Hadders Foundation funding for scientific research	Role of Ionic Crosslinkers on Cellular Crosstalks Involved in Inflammation and Fibrosis Modulation	€4,500.00
Ramirez Idarraga (Prashant Sharma's Group)	De Cock-Hadders Foundation funding for scientific research	Tissue Engineered corneal epithelium	€3,894.00
Jelmer Sjollema	Ubbo Emmius Fonds T.a.v. D. Bosker	Het fundament van HTRIC: Investeren in NextGen Gezondsheidstechnologie	€230,000.00
Jelmer Sjollema	Ubbo Emmius Fonds T.a.v. D. Bosker	Het fundament van HTRIC: Investeren in NextGen Gezondsheidstechnologie	€368,000.00
Inge Zuhorn	Ubbo Emmius Fonds T.a.v. D. Bosker	Het fundament van HTRIC: Investeren in NextGen Gezondsheidstechnologie	€390,000.00
Inge Zuhorn	NL/HERSENSTICHTING NEDERLAND; Op Weg Naar Genezing	Development of an allele-specific RNA targeting therapy to treat SCA1	€223,168.00
Henny van der Mei	HORIZON-CL4-2021-RESILIENCE-01	Sustainable Development of a Safe and Biobased Antimicrobial, Antifungal and Antiviral Nanocoating Platform- TripleAcoat	€143,912.50
Monize Decarli	Ubbo Emmius Fonds	Het Fundament van HTRIC: Investeren in NextGen Gezondsheidstechnologie	€40,535.00
Patrick van Rijn	Chemistry NL	ChemistryNL van Rijn	€76,659.00
Romana Schirhagl	(ZonMw) Off Roads 2025	Treating the untreatable	€100,000.00
Romana Schirhagl	SNN- European Regional Development Fund (ERDF)	Oncology Assessment via Quantum Sensing Technologies (ONCO-Q)	€257,120.00

Facts & Figures

Funding & Grants

Research within the Department of Biomedical Engineering (BBT) is driven by a commitment to advancing human health and transforming the future of healthcare. Our scientists lead innovative, multidisciplinary efforts that push the boundaries of biomedical discovery and technology. Each year, they successfully secure competitive funding from major national and international agencies, enabling groundbreaking work across our research portfolio.

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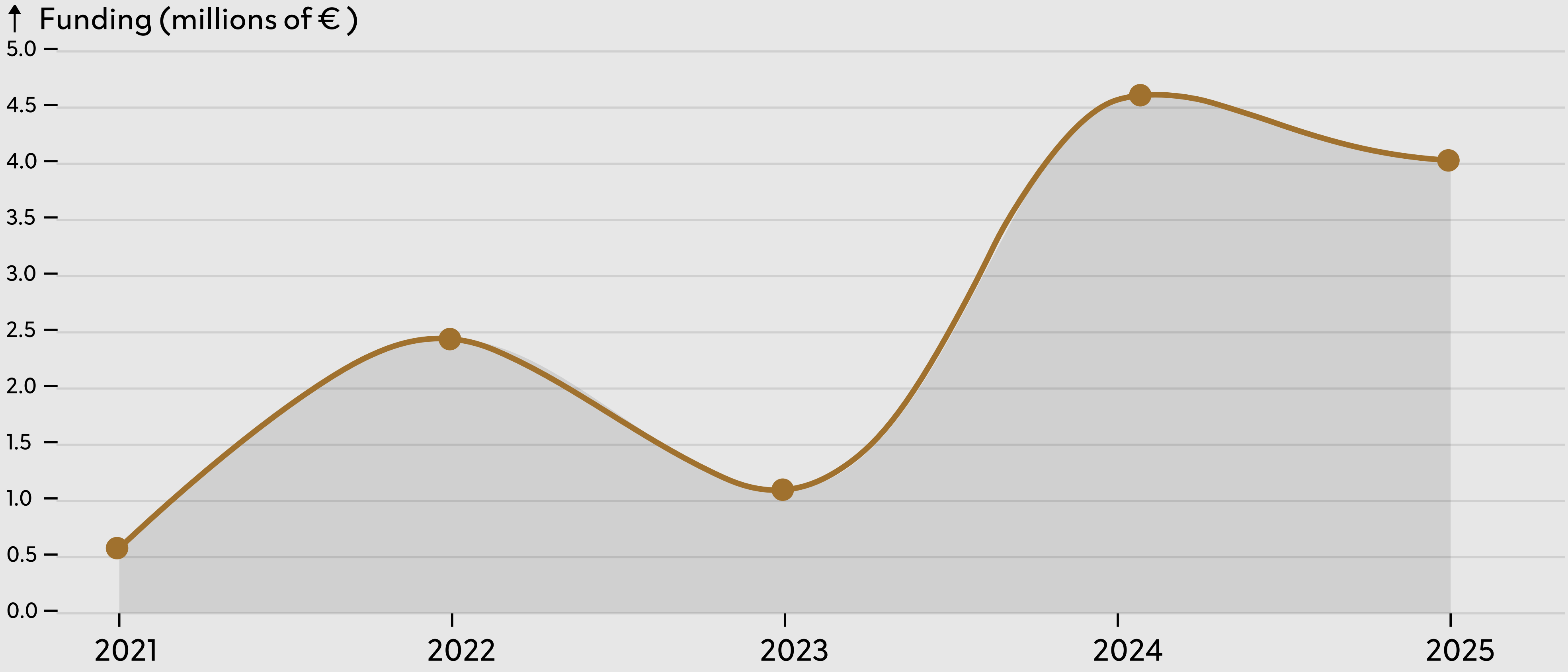


€4,032,387.69

Total funding for projects started during 2025

Facts & Figures

People

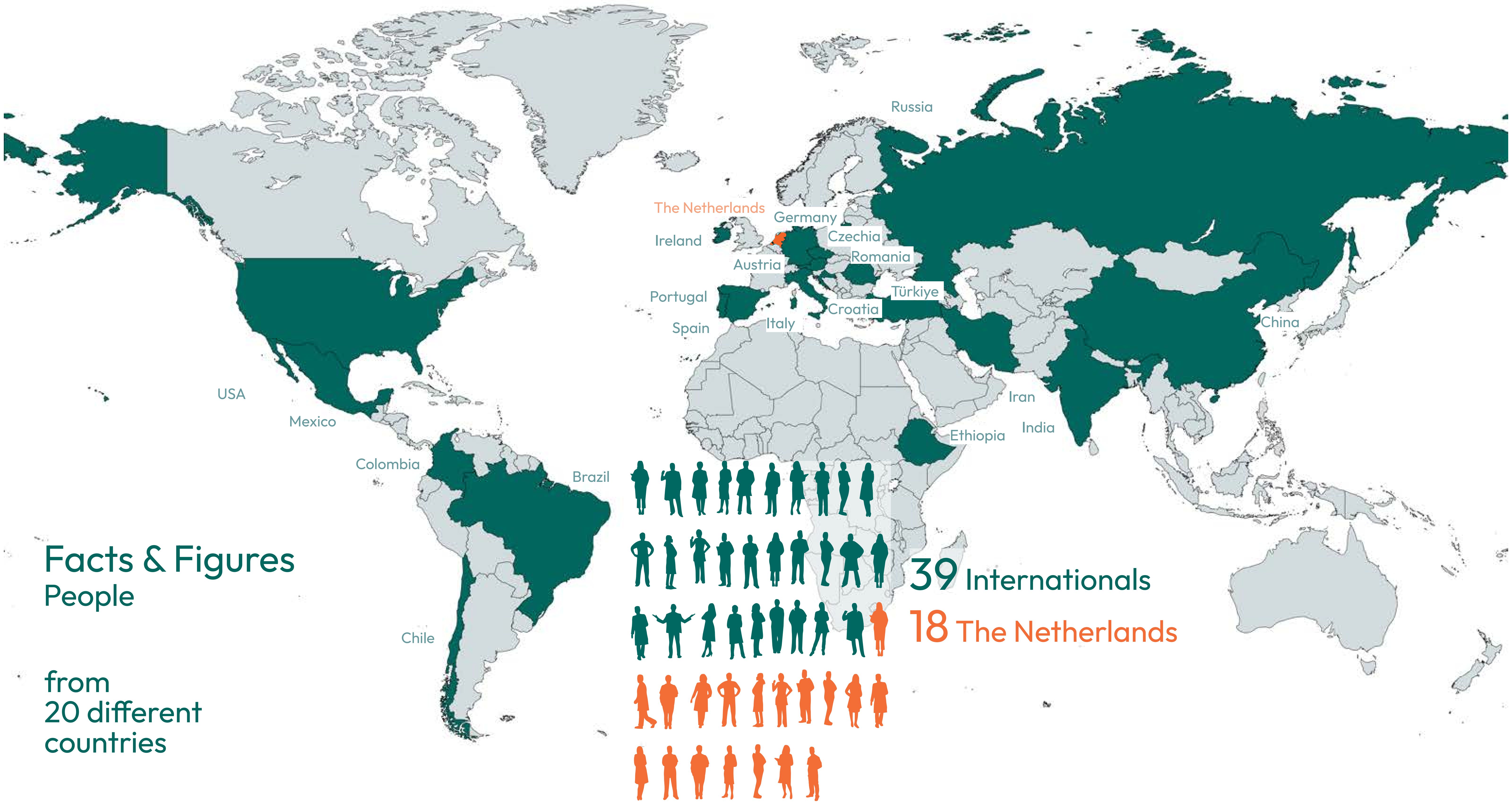
57 employees

20 Men
37 Women

20 PhD students
37 Staff Members

Facts & Figures
People

from
20 different
countries



MANAGEMENT TEAM

Hélder Santos
Head of Department

Marnix Labberte
Manager

Henk Heidekamp
Cluster Director
(retired)

Hayo Schultink
Cluster Director
(since 1 June 2025)

Jesse Medema
Finance Project Controller

Megha Upadhyay
Research Officer

Mallik Gurram
Research officer

Ria Ubels
Staff Advisor

Willy Koebrugge
Secretary

Education

Beyond standard lectures and undergraduate internships, BBT scientists spearhead a diverse array of high-impact educational initiatives.

The following selection highlights their most significant contributions to teaching and academic mentorship throughout 2025.

COURSE TITLE **Nanomedicines for Biomedical Applications**
NUMBER OF STUDENTS **20** ECTS **5**
DURATION **10 weeks**
COORDINATOR **prof. dr. H. Almeida Santos**

The aim of the course is to introduce to the students different nanomedicines biomedical applications, and to demonstrate their importance in, e.g., controlled drug release, precise and personalized drug therapy, and theranostics in cancer, cardiovascular diseases and diabetes, as well as to give an introductory overview of the production of different nanoparticles (e.g., using microfluidics technology) for biomedical and bio-imaging applications using different techniques. The course will introduce use of nanomedicines in therapy. In detail, the course will cover biomaterials, nanoparticles and drug encapsulation strategies. Methods and possibilities for drug delivery and nanoparticle fabrication and surface nanoparticle modifications, as well as the use and design of nanoparticles for drug delivery and drug targeting are presented. Physiological, cellular and toxicological aspects for medical use of nanomedicines are introduced. Theranostics, the combined use of in vivo imaging/diagnostics and therapy, as well as clinical aspects of nanomedicines are demonstrated.

The course will have lectures and all students will perform two experimental works (hands-on) on preparation of nanoparticles and testing.

Completion of the course requires full participation in the lectures, review the literature, describe current methods, consider and recommend use of emerging nanomedicines in a therapeutic setting, hands-on experimental works in group, including short scientific reports written in group and an oral group presentation of the experimental works, as well as solving problem-based learning exercises in group.
https://ocasys.rug.nl/2025-2026/catalog/course/WMBE030-05

COURSE TITLE **Writing and defending your own PhD Research Proposal**
NUMBER OF STUDENTS **37** ECTS **8**
DURATION **FMW Semester 1 (2025-09-01 - 2026-02-01)**
COORDINATORS
prof dr J.M. van Dijl, prof. dr. H. Almeida Santos, dr J. Moser

The acquisition of knowledge and skills during the MMIT programme culminates in the final phase of the programme where students will write their own PhD project proposal. The topic of the project and corresponding supervisor (PI) depends on the student's own preference but needs to be motivated by the student. The course starts with writing a tender, which is a short summary of the proposed project. The tender is sent to three or four independent UMCG/GRIP PIs for evaluation and feedback. The feedback will help the student in writing the full research proposal. Students are guided in writing the proposal by an expert supervisor but are explicitly instructed to write their own research proposal. The research proposal will be written and evaluated as a real grant proposal (NWO-Veni-like procedure). Three or four reviewers will evaluate the proposal and send their feedback after which students write a rebuttal. Finally, the students present and defend their proposal in front of a committee consisting of a minimum of four independent UMCG/GRIP PIs. This intense and challenging course ensures the quality of the proposals and also trains students to perform well in future grant applications and procedures.
https://ocasys.rug.nl/2025-2026/catalog/course/GKMMIT600

COURSE TITLE: **Drug and Devices**
NUMBER OF STUDENTS: **37** ECTS: **10**
DURATION **FMW Semester 1 (2025-09-01 - 2026-02-01)**
COORDINATOR **prof. dr. H. Almeida Santos**,

The first course 'Mechanisms of disease and innovative therapies' (10 ECTS) addresses contemporary topics in cell biology in (bio)medical and pharmaceutical sciences. Students acquire an in-depth and state-of-the-art understanding of the various research fields of the specializations. Every week another specialization is discussed. The specialization coordinators play an important role in the organization of their specialization-week and provide the students with an overview of the possibilities and opportunities within their specialization. Additionally, the students acquire general research skills such as critical reading and reviewing, summarizing and interpreting scientific articles, debating on and dealing with opposing views, scientific writing and presenting. The training of these skills is integrated in the weekly assignments. Also, the e-modules scientific reading and scientific writing are integrated in this course to further guide the students in their general academic skills. Since all assignments in this course find their origin in the day-to-day scientific practice, students are also challenged by the constraints of being a member of a scientific community through deadlines for reports and participating in debates with opposing views.

COURSE TITLE **Interface Biology**
NUMBER OF STUDENTS **36** ECTS **5**
DURATION **9 weeks**
COORDINATOR **Theo van Kooten**

This course is devoted to the very diverse relations that exist between the living elements on one hand and the materials world on the other. Living elements include eukaryotic cells and micro-organisms, tissues, proteins and blood. Many, if not all materials are sensed by the body as foreign. The body responds to the presence of the material. This can result in both desired and undesired effects. The course is fundamental in nature, but with clear references to the literature, clinical problems and trends within the use of materials for biomedical devices. The breadth of living elements necessitates a good knowledge of the essentials of cell biology, although care will be taken to explain the relevant concepts.

At the end of this course you will have knowledge of and insight in biological processes that occur at material surfaces, related to the biomedical applications of these materials.

By the end of the module, students will have knowledge and an understanding of biological processes that occur on material surfaces, related to the biomedical applications of these materials.

COURSE TITLE **Anatomy and Physiology**
NUMBER OF STUDENTS **105** ECTS **5**
DURATION **9 weeks**
COORDINATOR **Theo van Kooten**

At the end of the course, the student is able to:

1. Explain the anatomy in relation to the function of the treated tissues

2. Explain the mechanisms of homeostasis in the body (blood pressure regulation, blood pH regulation, other physiological systems)

3. Explain the medical terminology for positioning within the body

4. Integrate anatomy and physiology with biomechanics and material properties

COURSE TITLE C**ell Biology and Immunology**
NUMBER OF STUDENTS **60** ECTS **5**
DURATION **9 weeks**
COORDINATOR **Theo van Kooten**

Explain basic principles of cell communication, division, and death.

Understand tissue homeostasis and cancer, as well as the fundamentals of the immune system.

Distinguish between acute and chronic inflammation.

Recognize the cells involved in innate and adaptive immunity.

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COURSE TITLE
Ooorzaken van Ziekten" Education unit 1.3 Infection and Immunity
NUMBER OF STUDENTS **450**
DURATION **6 weeks**
COORDINATOR **Theo van Kooten**

Acting as Course Director and examinar

COURSE TITLE **Integrated Lab Course Biomaterials**
NUMBER OF STUDENTS **9** ECTS **5**
DURATION **140 hrs**
COORDINATOR **Monize Decarli**

Biomaterials have been largely employed to manufacture tissue-like constructs for tissue engineering applications, which will ultimately act as implants. Likewise, they have also been used for manufacturing drug delivery systems and 3D models for investigating tissue formation and pathological development. In combination with the bulk properties of a biomaterial to be used as an implant, the biomaterial-biological interface is a key determinant of the success of an implant. The characteristics of this interface determine key features such as protein adsorption, bacterial adhesion, host interactions, cell attachment, and tissue integration. Hence, this course focuses on preparing and manufacturing different types of biomaterials in several forms, e.g. scaffolds, hydrogels, microparticles, coatings and films.

COURSE TITLE **Integrated Lab Course Biomaterials**
NUMBER OF STUDENT **10** ECTS **5**
DURATION **Period 1a 2024-2025 academic year**
COORDINATOR **Monize Decarli**

At the end of the course, the student is able to:

1. Discuss the strengths and weaknesses for scientific literature.
2. Perform lab techniques used in interface studies
3. Evaluate own data and data provided in a manner consistent with scientific reports and publications
4. Integrate literature critiques into practical report
5. Assemble the collected data and literature critiques into a report in the manner of a scientific publication

COURSE TITLE **Intuitive Biostatistics**
NUMBER OF STUDENTS **50** ECTS **0.5**
DURATION **2 days between periods 1a and 1b 2024-2025 academic year**
COORDINATOR **GSMS, Brandon Peterson**

A statistical refresher for PhD students and/or staff
At the end of the course, the student is able to:

1. use statistical and data-analysis and presentation program
2. select appropriate statistical techniques to analyze data
3. describe statistical tests, critically analyse literature
4. assess significance of claimed trends in datasets

COURSE TITLE **Biofilms**
NUMBER OF STUDENTS **10** ECTS **5**
DURATION **Period 1b 2024-2025 academic year**
COORDINATOR **Brandon Peterson**

At the end of this course, the students are able to:
1. Identify and contrast different types of bacterial biofilms.
2. Describe different imaging techniques used to observe and measure bacterial biofilms.
3. Illustrate how bacterial biofilms form and interact with surfaces.
4. Distinguish between bacterial biofilm experimental models for their positive and negative attributes.
5. Propose how to influence bacterial biofilms to prevent infection.
6. Design experiments to solve problems surrounding bacterial biofilms.
7. Compare and contrast different treatment methodologies against bacterial biofilms.

COURSE TITLE **Statistics 1 for BME**
NUMBER OF STUDENTS **89** ECTS **5**
DURATIO **Period 2a 2024-2025 academic year**
COORDINATOR **Brandon Peterson**

At the end of the course, the student is able to:
1. Able to summarize the mathematical aspects of statistics
2. Able to demonstrate appropriate application of mathematical aspects of statistics
3. Able to select appropriate statistical techniques to analyze data
4. Able to describe statistical tests, analyse literature
5. Able to assess significance of claimed trends in datasets

COURSE TITLE: **Statistical Methods for BME**
NUMBER OF STUDENTS: **44** ECTS: **5**
DURATION: **Period 1b 2024-2025 academic year**
COORDINATOR **Brandon Peterson**

At the end of the course, the student is able to:
1. use statistical and data-analysis and presentation program
2. select appropriate statistical techniques to analyze data
3. describe statistical tests, critically analyse literature
4. assess significance of claimed trends in datasets

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COURSE TITLE **Microbiology for BME**
NUMBER OF STUDENTS **83** ECT **4**
DURATION **Period 2b 2024-2025 academic year**
COORDINATOR **Brandon Peterson**

At the end of the course, the student is able to:

1. able to describe the structure and life / reproductive cycle of micro-organisms, and the diversity herein nominated for the treatment of microorganisms. The student is able to illustrate for example micro-organisms the manner in which antibiotics or anti-viral agents have an effect on their life cycle.

2. able to state the interaction between microbes with each other and that of humans with the microbes. The student is able to summarize the pathogenesis of infection with micro-organisms in general and explain how this affects the treatment of micro-organisms.

3. able to identify of some pathogenic microorganisms, identify the associated syndromes and cause of the disease, method of transmission, method of diagnosis, method of prevention and the applied therapy.

4. able to explain the medical microbiological background of a number of social public health problems such as: antibiotic resistance, pandemics, vaccination, treatment and prevention.

5. able to reproduce and apply the rules for working according to VMT (Safe Microbiological Technique) & the student can apply different techniques to identify bacteria, characterize, determine antibiotic resistance and diagnose viruses.

6) able to present a laboratory notebook to keep track of in which experiment, analysis results and conclusion according to standard described are carried out. The experiment and the appended claims, are summarized in a scientific abstract and report.

COURSE TITLE **Safe Microbial Techniques (SMT)**
NUMBER OF STUDENTS **93** ECTS **1**
DURATION **Period 2b 2024-2025 academic year**
COORDINATOR **Brandon Peterson**

After completing this course students should be able to:

1. Demonstrate knowledge of good microbiology safe practices.

2. Apply good microbiology safe practices in simple experiments and interpret results.

3. Accurately record experimental details in a laboratory notebook.

COURSE TITLE **MSc Molecular Medicine and Innovative Treatment**
Program Director: **Inge Zuhorn** FTE: **0.2 fte**

RESPONSIBILITIES: Translate important developments in science, education and in the society into the MSc programme. Safeguard quality of the programme.

The two-year Molecular Medicine and Innovative Treatment (MMIT) master is an international, selective, multidisciplinary, and research-oriented programme of 120 ECTS that is embedded within the University Medical Center Groningen (UMCG). MMIT is organized by the Graduate School of Medical Sciences (GSMS), which is part of the UMCG. The aim of the programme is to prepare talented students for a career in scientific research in the field of (bio)medical and pharmaceutical sciences in academic and private sector environments.

COURSE TITLE **Introduction to research project I**
NUMBER OF STUDENTS **~30** ECTS: **2**
DURATION **1 Month**
COORDINATOR **Inge Zuhorn**

Prior to the start of Research Project I, students need to write an introduction paper essay concerning the proposed research project.

COURSE TITLE **Research project I**
NUMBER OF STUDENTS **~30** ECTS **30**
DURATION **5 Months**
COORDINATOR **Inge Zuhorn**

First year students need to select a topic of research of their choice within the UMCG.

The research project during the MMIT programme should be hypothesis driven. During the research project, students have to perform experiments, evaluate the data obtained, adjust their questions and methods, think of additional experiments, collect and analyse new data, interpret the results and draw scientific conclusions. During this phase, the students should experience being a junior scientist through active participation in a research group. For example, the students should participate in group meetings about ongoing research, visit seminars provided by experts, and participate in journal clubs. At the end of the project, students present their work to their research group, write a report about the results of their project and present their results in a concluding symposium by means of a poster presentation

COURSE TITLE **Research project II**
NUMBER OF STUDENTS **~30** ECTS **35**
DURATION **5 months**
COORDINATOR **Inge Zuhorn**

Second year students can perform their research project both in and outside the UMCG.

The research project during the MMIT programme should be hypothesis driven. During the

research project, students have to perform experiments, evaluate the data obtained, adjust their

questions and methods, think of additional experiments, collect and analyse new data, interpret the results and draw scientific conclusions. During this phase, the students should experience being a junior scientist through active participation in a research group. For example, the students should participate in group meetings about ongoing research, visit seminars provided by experts, and participate in journal clubs. At the end of the project, students present their work to their research group (30 minutes presentation, 15 minutes questions) and write a report about the results of their project.

COURSE TITLE **Fit for practice**
NUMBER OF STUDENTS **~30** ECTS **3**
DURATION **140 hrs**
COORDINATOR **Inge Zuhorn**

The course Fit for practice focuses on the student's personal and professional development. The course is set up to support MMIT students with increasing insight in themselves and their context.

COURSE TITLE **Capita selecta**
NUMBER OF STUDENTS **~30** ECTS **5**
DURATION **3 weeks**
COORDINATOR **Inge Zuhorn**

To provide students with in-depth knowledge on a research topic within the field of (bio)medical and/or pharmaceutical research and to train scientific writing and reading skills. Students perform a literature study and write an essay on a topic of their choice in consultation with and supervised by the scientific staff of UMCG.

COURSE TITLE **Material Science (WBBE005-05), BSc course**
NUMBER OF STUDENTS **100** ECTS **5**
DURATION **3 months**
COORDINATOR **Prashant Sharma**

At the end of the course, the student is able to:

1. The student is able to explain 3D arrangement of atoms and bonding which makes the three classes of materials i.e. metals, polymers and ceramics different from each other and relate the presence of flaws to the mechanical properties and failure of these materials.

2. The student is able to calculate the mechanical properties of materials and relate them to the inherent flaw orientation, size and shape

3. The student is able to differentiate the three classes of material on the basis of their characteristics, applications and processing.

4. Analyze a clinical problem by integrating, applying and transferring knowledge of anatomy, physiology, material science and biomechanics.

COURSE TITLE **Engineering and Biotribology (WMBE014-05), MSc course**
NUMBER OF STUDENTS **50** ECTS: **5**
DURATION **3 months**
COORDINATOR **Prashant Sharma**

At the end of the course, the student is able to:

1. Relate the surface and mechanical properties to the contact pressures and can explain its influence on the mechanisms of friction and wear of metals, polymers and ceramic materials.

2. Solve problems related to the friction coefficient and wear rate under different lubricating conditions

3. Explain various aspects of orthopaedic, oral, ocular, skin and tactile tribology and relate them to diseases like arthritis, xerostomia, dry eyes and Sjögren’s syndrome.

4 Assemble and present information on a tribological or biotribological topic.

COURSE TITLE **Biofabrication (WBBE052-05), BSc course**
NUMBER OF STUDENTS **50** ECTS **5**
DURATION **3 months**

At the end of the course, the student is able to:

1. Able to describe and differentiate between different 3D bioprinting techniques

2. Able to describe the polymeric and hydrogel biomaterials used for bioprinting

3. Understand the steps involved in converting medical imaging data into printable CAD models.

4. Able to collect information on the biofabrication method used for a particular tissue repair in a group and present this information to fellow students. The presentation is prepared in a group.

COURSE TITLE **Biomaterials 1**
NUMBER OF STUDENTS **100** ECTS: **5**
DURATION **8 weeks**
COORDINATOR **Patrick van Rijn**

Introduction to the world of biomaterials, and details of the materials that are relevant in this context. This centres around various types of materials, such as metals, polymers, and ceramics. The primary focus is on polymers, however, since the properties of this class of materials can vary greatly, depending on their composition/method of preparation. As a result, they have a wide range of applications. These include macroscopic “hard” materials (implants: artificial hips, hard contact lenses), “flexible” materials (blood bags and catheters), “soft” hydrogel (sponge-like) materials (intraocular lenses, soft contact lenses), as well as surface coatings (antibacterial coatings) and even nanocontainers for drug delivery. The course covers the polymer structures that are responsible for the properties of these materials, and the general methods of synthesis. The aim is twofold, to understand the relationships between molecular structures and material properties (hardness, biodegradability, biocompatibility) and to relate these to general applications. In addition to a number of important polymers, such as polyurethane, polysilicones, polyesters, and polyacrylates, the course covers various polymers with special additional functions,

such as antibacterial properties or coordinating/binding mineral salts and converting them into inorganic bodily materials. Various other structures that play an important part in biomaterials and in medical applications are also discussed, especially phospholipids, polypeptides, and collagen.

COURSE TITLE **Practical Course Biomaterials**
NUMBER OF STUDENTS **30** ECTS **5**
DURATION **8 weeks**
COORDINATOR **Patrick van Rijn**

Six different chemical and biomaterial-related experiments are covered, involving an examination of the biomaterial itself and its use. One important goal is gaining experience of laboratory work, in particular.

Biodegradable polymers, antimicrobial nanoparticles, and hydrogels for controlled release are some of the systems studied. The theoretical aspects of most of the projects carried out are dealt with in Biomaterials 1

COURSE TITLE **Biomaterials 2**
NUMBER OF STUDENTS **20** ECTS **5**
DURATION **8 weeks**
COORDINATOR **Patrick van Rijn**

Biomaterials 2 elaborates on Biomaterials 1 (Bachelor BME) in which the basic knowledge was obtained regarding Biomaterials. Biomaterials 2 presents more elaborate applications of polymers, molecular species, inorganic materials and incorporates relevant cell biological structures in biomedical areas and biomedical applications. The focus is more on current strategies and critical approaching literature on validity and clinical relevance. Topics include nanomaterials/nanomedicine, tissue engineering, implant technology & coatings, biodegradable polymers, all with a strong clinical character. The basic lectures are given by the lecturer and additionally the students teach each other by providing presentations on review papers together with a self-chosen research paper on the specific topic that was discussed during the basic lecture.

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COMMITTEE **Member of the Board of Examiners, Engineering, FSE, RUG**
HOURS **100**
DURATION **Year around**

BoE is responsible for the quality of examinations and final assessments, and thus that of degree certificates. The Board of Examiners is also the party that monitors compliance with the Teaching and Examination Regulations (OER). The Board of Examiners must independently and expertly determine whether each student meets the requirements set by the degree programme for obtaining the degree.

COURSE TITLE **Biomedical Instrumentation II**
NUMBER OF STUDENTS **72** ECTS **5**
DURATION **3 months**
COORDINATOR **Romana Schirhagl**

OBJECTIVE

1. Select an adequate measuring system to analyse body functions or physiological properties to determine medical problems or pathology;

2. Evaluate the strengths and weaknesses of measurement systems used in different medical areas (neurology, ophthalmology, cardiology, ENT, and rehabilitation);

3. Analyze data generated by measurement systems used in different medical areas;

4. Identify artefacts recorded during the use of several measurement systems and resolve analysis problems related to these artifacts;

5. Apply measurement systems to analyze and assess a patient case.

COURSE TITLE **Surface characterisation** ECTS **5**
NUMBER OF STUDENTS **50**
DURATION **3 months**
COORDINATOR **Romana Schirhagl**

OBJECTIVE

1. able to apply general and specific physico-chemical theories to interpret results of several techniques for the characterization of surfaces.

2. able to interpret the results of most commonly used techniques for surface characterization

3. able to explain the basics of the most commonly used techniques for surface characterization in a presentation.

4. able to clearly evaluate research from scientific literature and explain why specific characterization techniques are used.

5. identify the right methods for a certain surface characterisation task and know the pros and cons of different methods

6. be familiar with the most common artifacts and how to avoid them

COURSE TITLE **Research course BME**
NUMBER OF STUDENTS **70** ECTS **8**
DURATION **Semester 1b (2025-11-10 - 2026-02-01)**
COORDINATOR **Mohammad-Ali Shahbazi**

1. Understand Research Fundamentals:

2. Conduct Effective Literature Searches and Reading:

3. Summarize Research Outputs:

4. Understand Study Design Principles.

5. Manage Research Literature and Critically Evaluate Research Papers:

6. Document and Manage Research Data:

7. Know FAIR Principles and Open Science Practices:

COURSE TITLE **Recent Developments in Biomaterials**
NUMBER OF STUDENTS **2** ECTS **5**
DURATION **Semester 1a (2025-09-01 - 2025-11-09)**
COORDINATOR **Mohammad-Ali Shahbazi**

1. Present objectives, results and conclusions of recent papers about biomaterial development in a correct scientific way.

2. Identify common stages of biomaterial development and product validation.

3. Interpret and review papers with regard to what is needed in new biomaterial development in a multidisciplinary way.

4. To assess scientific papers and argue whether the paper is relevant, new or innovative.

5. Evaluate scientific papers on their shortcomings, the student needs to mention shortcomings in the appraisal.

6. Integrate components offered in the course lectures, the components offered in the course need to become back in the appraisal.

7. Propose a research project to develop new biomaterials or biomaterial coatings, this is the final report and presentation. You need to defend the new coating, biomaterial, or design, your colleague students will ask the questions as the course leader.

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COURSE TITLE **Thermodynamics**
NUMBER OF STUDENTS **130** ECTS **5**
DURATION **10 weeks**
COORDINATOR **Jelmer Sjollema**

The course involves:

- Knowledge and understanding of the principles of thermodynamics.
  First and second law of thermodynamics
  Chemical potential and osmotic pressure
  Relationship between state variables
- Application of thermodynamics on characteristics of water.
  Water as a solvent, Hydrophobic effect
- Electrochemistry.
  Charges on surfaces, Diffuse double layer, Surface potential
- Stability of suspensions.
  DLVO Theory, Double layer and dispersion interactions
- Surface free energy.
  Surface tension / surface free energy, Laplace equation,
  Kelvins equation, Nucleation and condensation, Selfassembly
- Biomolecules, cells and Protein conformation.
  Adhesion of cells and microbes

COURSE TITLE **Biophysical Concepts in Bionanotechnology**
NUMBER OF STUDENTS: **35** ECTS: **5**
DURATION **10 weeks**
COORDINATOR **Jelmer Sjollema**

The influence of modern nanotechnology on the biomedical field cannot be underestimated. For instance, drugs can be encapsulated by polymers to be delivered on exactly the right spot in the body, hydrogels can be tailored to be responsive to body temperature to allow easy application, biomaterial coatings can be designed to improve the biocompatibility or release drugs to eradicate bacterial biofilms. All these applications rely on physico-chemical properties of the interface of these (nano)materials with body fluids. The course focuses on the properties of interfaces (= phase boundaries) in an aqueous environment and the related physicochemical concepts that constitute modern nanotechnology. The following topics will be examined: water as a solvent and dispersion medium, interfacial tension and surface energy, electrostatic and electrokinetic properties, polymer- and protein folding and conformation and the mechanism of adsorption.

Based on these topics, interactions involving nano particles and interfaces will be discussed mainly in terms of thermodynamics. These include formation of supramolecular structures (including self-assembly), behaviour of (bio)polymers in solution and in hydrogels, stability of colloidal dispersions, adsorption, and adhesion of (bio)polymers, rheology, and the mechanisms involved in adhesion of microorganisms and biological cells. The module is meant for students taking a minor in (bio)materials science and engineering and others interested in (bio) technological and (bio)medical applications.

COURSE TITLE **Internship**
NUMBER OF STUDENTS **40** ECTS **15**
DURATION **10.5 weeks**
COORDINATOR **Jelmer Sjollema**

OBJECTIVE
The goal of the internship is to give students the opportunity to use acquired skills in an applied setting of either a company or hospital and clarify personal future career choices. By completing the internship a student learns to function at an academic level in a professional setting. An important goal of the internship is to practice various skills that are needed to finish a project successfully, including planning, data collection, analysis, writing and presentation.

COURSE TITLE **Master's project BME**
NUMBER OF STUDENTS: **40** ECTS: **30**
DURATION: **21 weeks**
COORDINATOR **Jelmer Sjollema**

OBJECTIVE
The Master's Project is an individual compulsory research project which is carried out under the supervision of two examiners from the Master's Programme Biomedical Engineering. The project can be conducted at departments affiliated with MSc programme Biomedical Engineering at UG/UMCG or at a company affiliated with biomedical engineering. It is possible to conduct (a part of) the Master's Project abroad.

The Master's Project preparation includes: finding a project, writing a project proposal with a (detailed) time planning, career related workshops, presentation of the project proposal (winter symposium) and presentation of the results (summer symposium).

MANAGERIAL ROLES IN EDUCATION

Director MSc MMIT
Inge Zuhorn

Member of the Board of Examiners BME
Theo van Kooten &
Prashant Kumar Sharma

Director MSc BME
Jelmer Sjollema

Admission Board MSc BME
Romana Schirhagl &
Brandon Peterson

Public Outreach & Dissemination

Beyond research and education, the scientific staff of BBT—including PhD candidates, postdoctoral researchers, and group leaders—actively contribute to scientific outreach and public engagement. Their efforts help broaden the impact of our work and strengthen connections with the wider scientific community and society.

The overview below highlights the most notable outreach and dissemination activities undertaken by BBT over the past year.

Researcher
Inge Zuhorn

For the Brain Foundation project **Development of an allele-specifc RNA targeting therapy to treat SCA1**, a collaboration between LUMC and UMCG, we frequently **interact with patient representatives**; maintain a website with regular updates https://www.sca1research.nl/onderzoek-2 and organize a.o. webinars to explain our research and progress.

Webinar on SCA1 research
https://www.youtube.com/watch?v=L0n-IsvXLkc

Screen-shot from prof. Inge Zuhorn's Webinar on SCA1 research

Researcher
Monize Decarli

Monize Decarli was nominated as country representative of the Netherlands for the management committee of the **COST Action Designae - Fostering Nature-Centred BioDESIGN** to Explore regenerative futures

Researcher
Romana Schirhagl

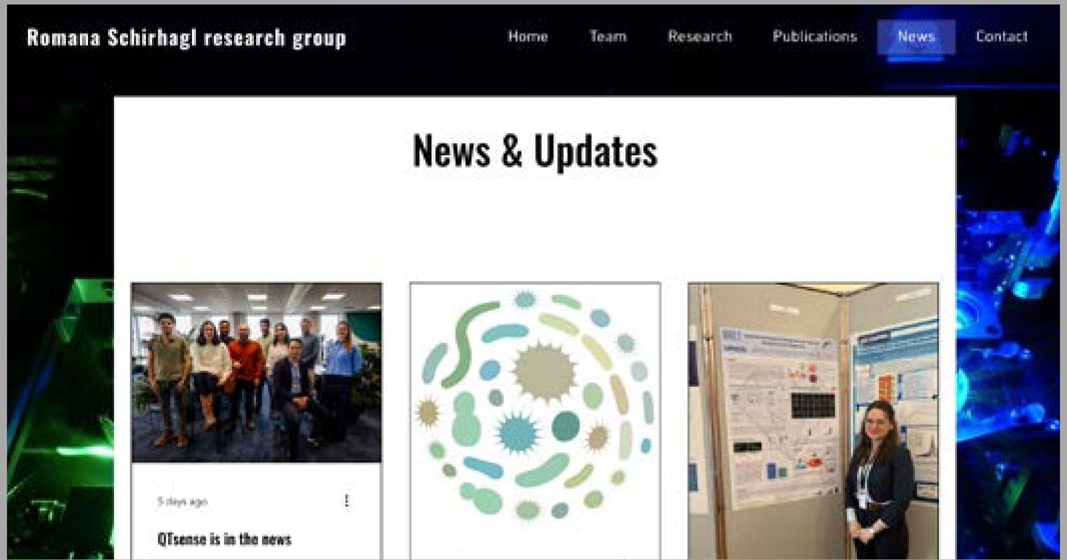
Contributed as opinion leader to the **Quantum guide to commercial acceleration** (Health and Life Science) https://www.infinityqd.nl/resources/quantum-guide-to-commercial-acceleration-health-and-life-sciences

Article Nanowerk covered our article
Wu, K., Fan, S., Zhang, Y., Woudstra, W., Mulder, T., Navarro, L., van Dijken, J., Loos, K., Schirhagl, R., **Fluorescent Nanodiamonds based Theranostic Platform for pH-Sensitive Drug Delivery and Quantum Sensing, in Advanced Functional Materials**: in their news: https://www.nanowerk.com/spotlight/spotid=67893.php

Press coverage by Daagblad van het Noorden
about our work on drug testing https://www.linkedin.com/posts/dagblad-van-het-noorden_het-is-nu-nog-een-vrij-fors-wit-apparaat-activity-7376284259717640192-gJ_4?utm_source=share&utm_medium=member_android&rcm=ACoAABV9V3kB0j22X-BGOZCq_8hb2gsGW95q3cg_

Press coverage Silicon Canals
writes about the Academic Startup Competition where QTsense is highlighted as one of the winners. https://siliconcanals.com/winners-of-the-academic-startup-competition-2025/

Screen-shot
from prof.Romana Schirhagl's
bioanalysisgroup.com/news



Winning teams on stage at TU/e
Image credit:
Jara van den Bosch
from **siliconcanals.com**

Researcher
Romana Schirhagl

Podcast interview the Superposition Guy's Podcast
with host Yuval Boger about quantum sensing in health tech
https://resonance-newsletters.beehiiv.com/p/the-daily-qubit-issue-05202025

The quantum insider
https://thequantuminsider.com/2025/02/25/qt-sense-raises-e6-million-to-use-quantum-sensing-to-understand-diseases/

QDNL Silicon Canals
https://siliconcanals.com/groningen-based-qt-sense-bags-6m/

Press coverage article on quantum sensing in sperm cells in in the Chilean news
https://www.elmostrador.cl/universoparalelo/2025/04/09/sexualidad-bajo-la-lupa-de-la-ciencia/

Press coverage QTsense's funding round from QDNLP as well as our Interreg project attract media coverage. Among others we were covered by Tech EU
https://tech.eu/2025/02/25/qt-sense-raises-6m-for-quantum-powered-disease-detection/

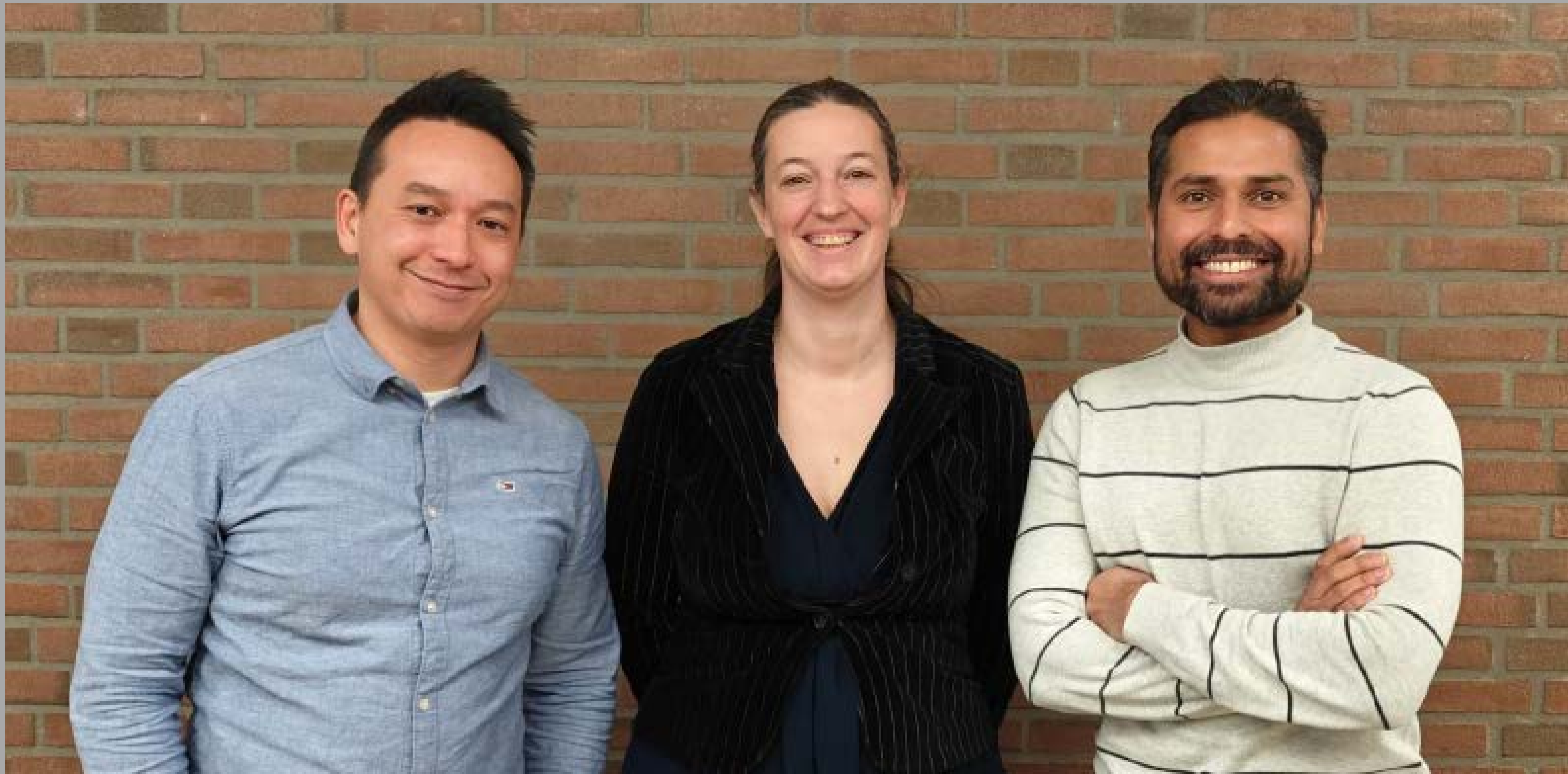


Image credits: QT Sense
from **siliconcanals.com**

Contact/interaction with patient group

The SIRIUS Study: Understanding Fertility

Researcher
Romana Schirhagl

We are currently partnering with Prof. Annemieke Hoek and Dr. Astrid Cantineau to investigate how “free radicals” (tiny reactive molecules) affect male fertility. This follows our successful GRANOX study, which looked at these same factors in women and is set to be published soon.

Status: We are actively inviting participants to join this study.

Early Sepsis Detection: The Power of Quantum Sensing

Researcher
Romana Schirhagl

In collaboration with Dr. Hjalmar Bouma and Prof. Geert van den Bogaart, we are testing a new “quantum sensing” technology to help doctors diagnose sepsis much faster than current methods. Rapid diagnosis is key to saving lives, and we are nearly finished with our first pilot study.

Status: The first phase of testing is nearing completion.

ONCO-q: A New Frontier in Cancer Care

Researcher
Romana Schirhagl

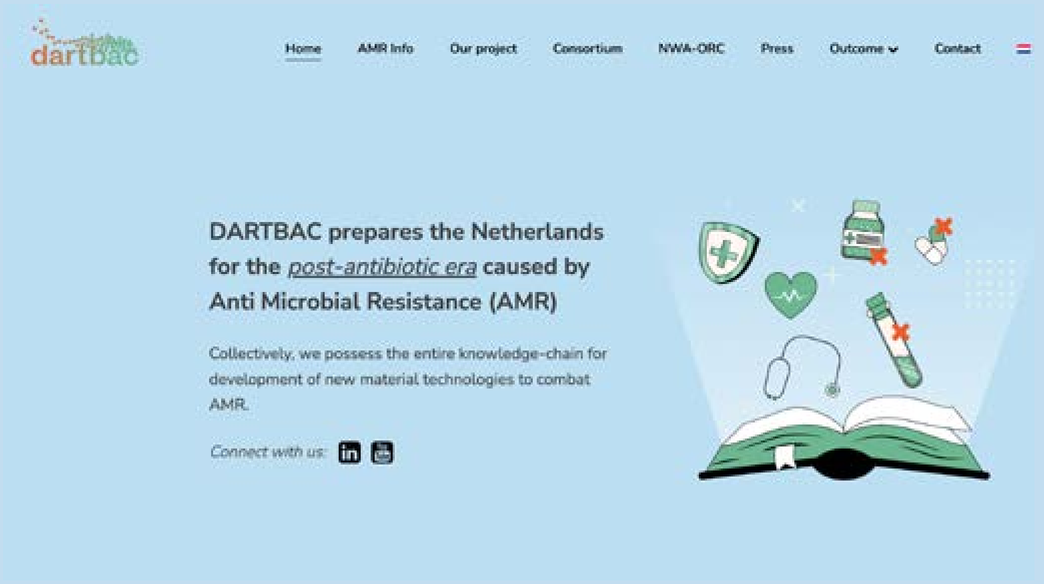
Working alongside Prof. Schelto Kruijff, our team is exploring how quantum technology can improve cancer treatment. We are looking at three main goals: identifying cancer cells more accurately, predicting how a specific cancer might respond to treatment, and testing new drugs more effectively.

Status: We are in the early stages of the project, establishing the best ways to handle and protect patient samples for the most accurate results

Researcher
Jelmer Sjollema

Within the context of the consortium **DartBac** we work on increasing awareness of antimicrobial resistance among medical staff and patients. Several strategies have been worked out, including setting up e-learning modules for (bio)medical students, medical staff, nurses and caregivers.

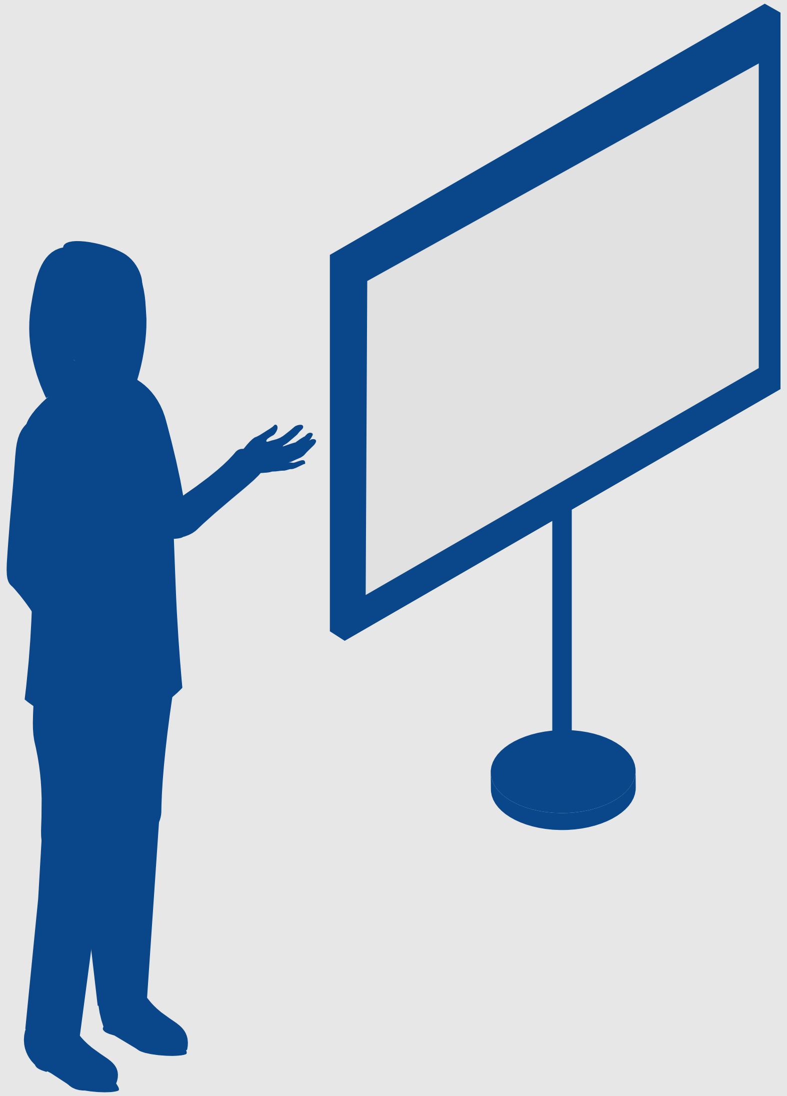
Consortium **DartBac** website



umcg
Department of Biomaterials & Biomedical Technology

Presentations &Talks

PRESENTATIONS at (inter)national meetings

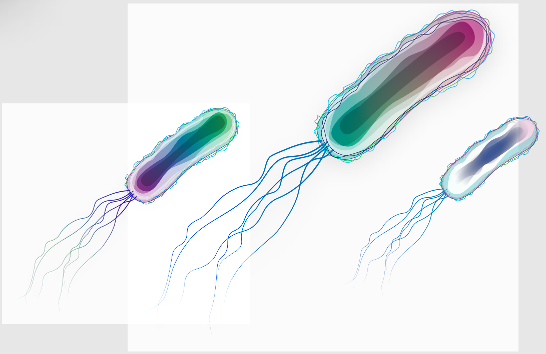


Brandon Peterson
Viscoelastic Failure Triggers Bacterial Adaptivity to Environmental Stresses
Stevens Institute of Technology, 7th Stevens Conference on Bacteria-Material Interactions
Hoboken, NJ, USA

Zhuoyi Cui (student **Group Brandon Peterson**)
Bacterial evolution: ESKAPE pathogens adapt to continuous shear stress
54th World Congress on Microbiology
Rome, Italy

Henny van der Mei
Man, Materials, Microbes and Infections
DARTBAC Consortium Meeting
Utrecht, Netherlands

Inge Zuhron
Cellular Processing of Delivery Vehicles
MOVE2025 Conference
Tartu, Estonia



Presentations &Talks

PRESENTATIONS at (inter)national meetings

Hélder A. Santos Invited Speaker
Biomaterials for heart tissue regeneration and myocardium infarction therapy
Institute for Technology-Inspired Regenerative Medicine (MERLN) – Maastricht University
Maastricht, The Netherlands

Hélder A. Santos Invited Speaker
Mending the Broken Hearts: RNA-Based Nanomedicines For Myocardial Infarction Repair
DTU Health Tech
Singapore

Hélder A. Santos Visiting Talk
Biomaterials and Biomedical Technologies for Medical Applications
Nanyang Technological University – NTU Singapore
Singapore

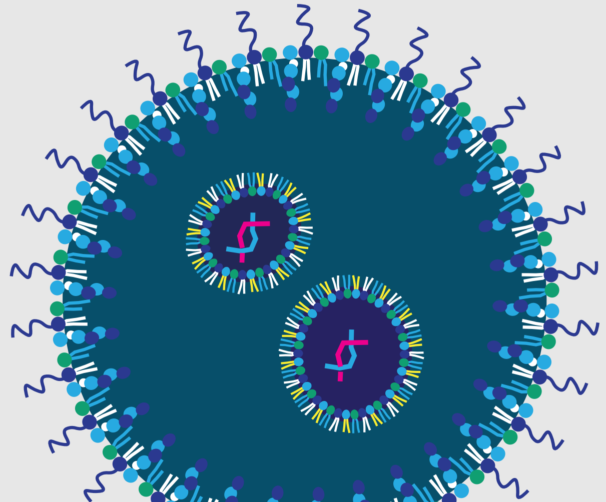
Hélder A. Santos Visiting Talk
Nanomedicines for Biomedical Applications: From Design to In Vivo Testing
NUS – National University of Singapore
Singapore

Hélder A. Santos Invited Speaker
Microfluidic-based methodologies for the development of micro- and nanoparticles for drug delivery applications
15th International Congress of Pharmaceutical Sciences (CIFARP 2025)
Ribeirão Preto, São Paulo, Brazil

Hélder A. Santos Keynote Speaker
RNA-Based Nanomedicines For Myocardial Infarction Repair: Mending the Broken Hearts
32th Annual Meeting of the European Society of Gene and Cell Therapy
Seville, Spain

Hélder A. Santos Keynote Speaker
RNA-Based Polysaccharide Nanoformulations for Myocardium Infarction Therapy
Next-Generation Nanomedicine (NET-NANO) Workshop – Institute for Bioengineering of Catalonia (IBEC)
Barcelona, Spain

Hélder A. Santos Keynote Speaker
Empowering porous silicon nanoparticles and metal-organic frameworks for solving medical problems: From cancer to heart diseases applications
NETPORE2025 Symposium
Tarragona, Spain



Presentations &Talks

PRESENTATIONS at (inter)national meetings

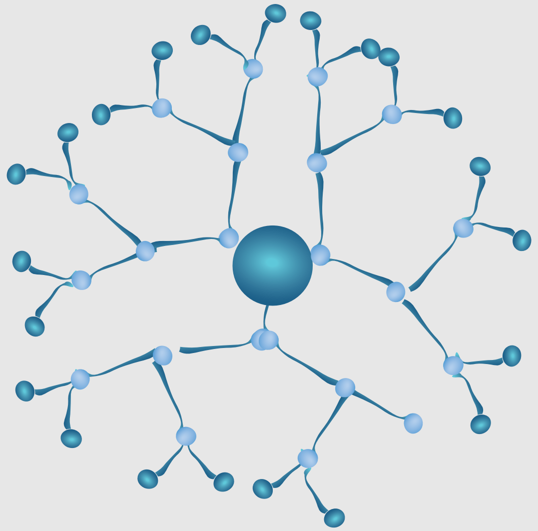
Hélder A. Santos Invited Speaker
Polysaccharide-based nanoformulations for myocardium infarction therapy: RNA-applications for mending the broken hearts
34th BioCity Symposium – Transforming Drug Development For Tomorrow
Turku, Finland

Hélder A. Santos Keynote Speaker
Polysaccharide-based nanoformulations for cardiac RNA-based therapies: From nano-design to in vivo applications
I-CAM2025 – The 2nd International Conference of Advanced Medical Engineering
Shanghai, China

Hélder A. Santos Invited Speaker
Mending the Broken heart: Empowering polysaccharide-based nanoformulations for cardiac RNA-based therapies
Universidade de Coimbra
Online

Hélder A. Santos Invited Speaker
Nano- and micro-delivery platforms for protein/RNA-based multimodal and synergetic cancer therapy
Nanjing Drum Tower Hospital – Nanjing University
Nanjing, China

Hélder A. Santos Invited Speaker
Smart nanoparticle-based platforms for cancer and heart diseases therapy
Beilstein Symposium – Smart materials for Advancing Healthcare
Limburg, Germany



Hélder A. Santos Invited Speaker
Tecnologias inovadoras na fabricação de medicamentos para terapias de precisão (nanomedicamentos)
Universidade Federal de Juiz de Fora
Online

Hélder A. Santos Invited Speaker
Mending the Broken heart: Empowering polysaccharide-based nanoformulations for cardiac RNA-based therapies
Instituto Nacional de Ciência e Tecnologia em Nano-Biofarmacêutica, Universidade Federal de Minas Gerais
Online

Presentations &Talks

PRESENTATIONS at (inter)national meetings

Hélder A. Santos Invited Speaker
Polysaccharide-based nanoformulations for cardiac RNA-based therapies
University of São Paulo Medical School, Heart Institute (InCor)
São Paulo, Brazil

Hélder A. Santos Invited Speaker
Polysaccharide-based nanoformulations for myocardium infarction therapy
TU Delft
Delft, The Netherlands

Hélder A. Santos Invited Speaker
Nanomedicines for gene and protein delivery: From tendon to heart therapy
Bernal Institute, University of Limerick
Limerick, Ireland

Hélder A. Santos Invited Speaker
Empowering polysaccharide-based nanoformulations for cardiac RNA-based therapies
Institute for Advanced Studies in Nanoscience (IMDEA Nanociencia) – Universidad Autónoma de Madrid
Madrid, Spain

Hélder A. Santos Invited Speaker
Nanomedicines for gene and protein delivery
Institut de Ciència de Materials de Barcelona (ICMAB-CSIC), Universitat Autònoma de Barcelona
Barcelona, Spain

Hélder A. Santos Keynote Speaker
Mending the broken heart: nanomedicines for targeting the myocardial infarction
Research Days of the Institute of Biomedicine and Translational Medicine, University of Tartu
Tartu, Estonia

Hélder A. Santos Invited Speaker
Nanomedicines for gene and protein delivery
Nanomedicine Course – University of Twente
Online

Presentations &Talks

PRESENTATIONS at (inter)national meetings

Monize Decarli Invited Speaker
Introducing the Bioprinting and Biofabrication Group (BBT/UMCG) for fostering potential collaborations with the Singapore Centre for 3D Printing
Singapore Centre for 3D Printing
Singapore

Monize Decarli Invited Speaker
Introducing the Bioprinting and Biofabrication Group (BBT/UMCG) for fostering potential collaborations with the University of São Paulo
University of São Paulo (USP)
São Paulo, Brazil

Monize Decarli Invited Speaker
Introducing the Bioprinting and Biofabrication Group (BBT/UMCG) for fostering potential collaborations with the Universitas Gadjah Made
Universitas Gadjah Mada
Yogyakarta, Indonesia

Monize Decarli
Symposium Organizer and Chair
Navigating new seas, life as a young PI in tissue engineering
Tissue Engineering and Regenerative Medicine International Society (TERMIS EU)
Freiburg, Germany

Monize Decarli Keynote Speaker
Building independence and expanding beyond the comfort zone: starting a research lab in Europe
International Conference on Biofabrication
Warsaw, Poland

Monize Decarli Invited speaker
Introducing the Bioprinting and Biofabrication Group (BBT/UMCG) for fostering potential collaborations with the Federal University of São Carlos
Federal University of São Carlos (UFSCar)
São Carlos, Brazil

Presentations &Talks

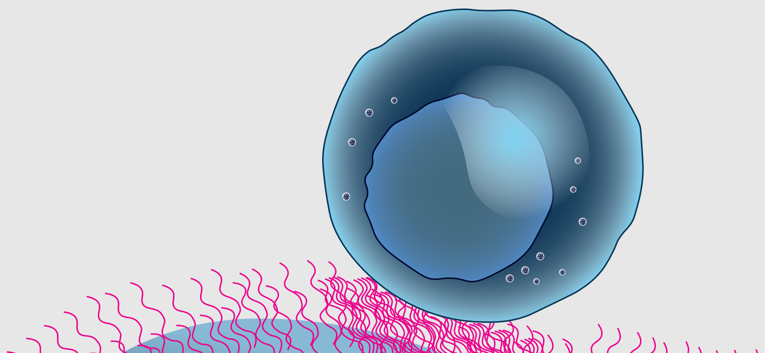
PRESENTATIONS at (inter)national meetings

Patrick van Rijn
Nanogels: a versatile approach towards nanomedicine
Beilstein Institut, Beilstein Nanotechnology
Germany

Patrick van Rijn
Nanogels: a versatile approach towards nanomedicine
Dutch Life Science Conference
Leiden, Netherlands

Patrick van Rijn
Nanogels: a versatile approach towards nanomedicine
European Biomaterials Society
Torino, Italy

Patrick van Rijn
Exploring the design space of biomaterials development
Johnson & Johnson Global
Online



Presentations &Talks

PRESENTATIONS at (inter)national meetings

Romana Schirhagl Keynote Speaker
—
Biofabrication 2025
Warsaw, Poland

Romana Schirhagl
IPIM – Industry Perspectives on Innovative Medicine
UMCG Summer School
Groningen, Netherlands

Romana Schirhagl Keynote Speaker
Emerging Technologies: Quantum in Life Science
IEEE Engineering in Medicine and Biology Society
Online

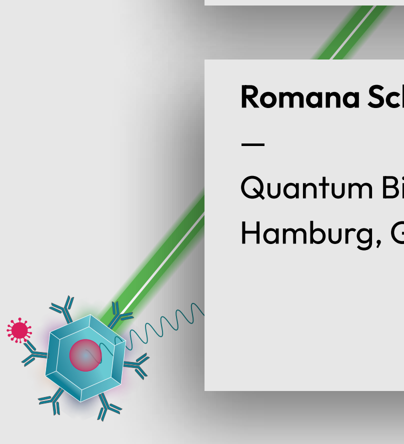
Romana Schirhagl Invited Speaker
—
Quantum Sensing Science Conference
Melbourne, Australia

Romana Schirhagl
Diamond based quantum sensing for biological applications
47th Annual International Conference of the IEEE Engineering in Medicine and Biolog
Copenhagen, Denmark

Romana Schirhagl Invited Speaker
—
Beilstein Online Workshop in Nanomedicine
Online

Romana Schirhagl
Diamond-based quantum sensing in diagnostics
International Conference on Quantum Technologies in the Life Sciences (qLife)
Wollongong, Australia

Romana Schirhagl
Quantum Sensing in Clinical Samples
Gordon Research Conference in Quantum Biology: Technology and Theory at the Intersection of Quantum Science and Biological Mechanisms
Lucca (Barga), Italy



Romana Schirhagl Invited Speaker
—
Quantum Biology Think Tank
Hamburg, Germany

Romana Schirhagl
Diamond-based quantum sensing in tissues and organisms
QUBIC Symposium
Wollongong, Australia

Romana Schirhagl
Diamond-based quantum sensing for detecting stress responses in living cells with subcellular resolution
SPIE Photonics West
San Francisco, USA

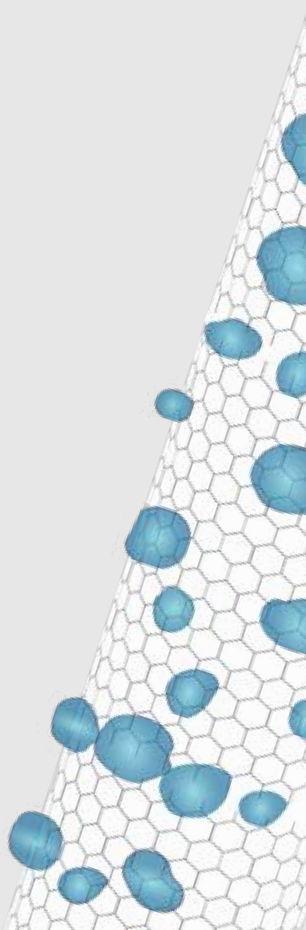
Presentations &Talks

PRESENTATIONS at (inter)national meetings

Mohammad-Ali Shahbazi Invited Speaker
Biomimetic Structures in Therapeutic and Regenerative Medicine
University "G.d'Annunzio" Chieti-Pescara, Workshop on Biomaterials and 3D Printing for Therapeutical Applications
Chieti, Italy

Mohammad-Ali Shahbazi Invited Speaker
Bridging Nanotechnology and Hydrogels: A Multitherapeutic Platform for Biomedical Applications
Bennet University, International Conference on Biotechnology
Noida, India

Mohammad-Ali Shahbazi
Photoactive and Biomimetic Materials for Tissue Regeneration and Cancer Therapy
School of Supramolecular and Bio-Nanomaterials, Politecnico di Milano
Milan, Italy



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