Dual-function *de novo* peptides for bacteraemia diagnostic and treatment

Lucie BASTIEN [1, 2, 3], Didier BOTURYN [2], Sandrine BOISSET [3] and Yoann ROUPIOZ [1]

[1] *Univ. Grenoble Alpes, CEA, CNRS, Grenoble INP, IRIG, UMR 5819, SyMMES, 38000 Grenoble, France;*

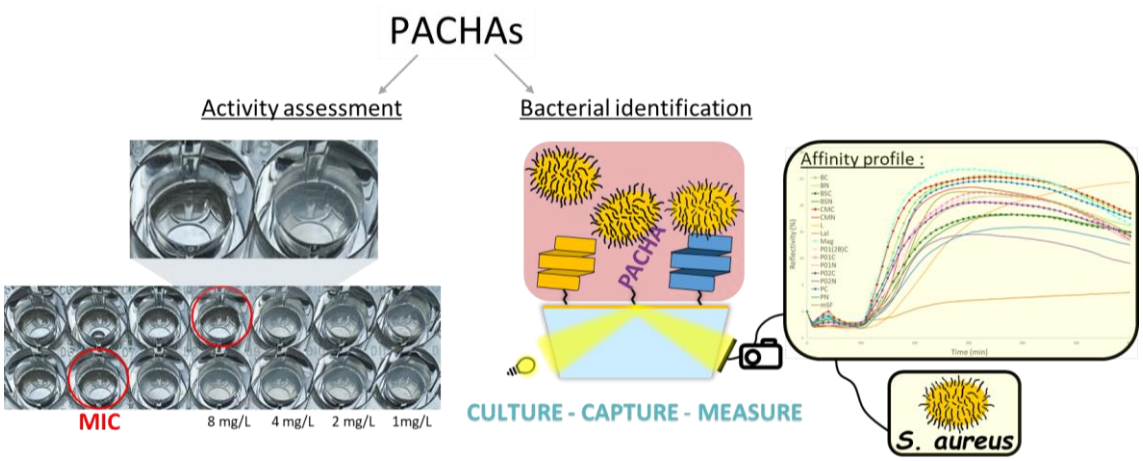
[2] *Univ. Grenoble Alpes, CNRS, UMR 5250, DCM, 38000 Grenoble, France;*

[3] *Univ. Grenoble Alpes, CHU Grenoble Alpes, CNRS, CEA, UMR5075, IBS, 38000 Grenoble, France*

Antimicrobial resistance (AMR) drives the urgent need for rapid diagnostic tools and new therapeutic options. Antimicrobial peptides (AMPs) are promising candidates to combat AMR thanks to their broad-spectrum activity, unique mechanisms of action, and relatively low toxicity.

We designed *de novo* AMP sequences, PACHA01 and PACHA02, with identical amino acid composition but distinct primary sequences and secondary structures. Both peptides displayed poor solubility in Mueller-Hinton Broth (MHB, the standard medium for microdilution antibiogram assays), hampering accurate assessment of their antimicrobial activity. Suspecting peptide aggregation with MHB components, a refined medium (rMHB) was employed and allowed a 4- to 8-fold increase in solubility of PACHA02. It enabled to determine the minimal inhibitory concentration (MIC) of PACH02 against *S. aureus* at 8 mg/L.

Despite their lack of solubility in complex media, the capacity of AMPs to interact with bacterial membrane give them strong potential for bacterial detection and identification when immobilized. Using surface plasmon resonance imaging (SPRi), PACHA01 and PACHA02 forms (N- or C-terminal anchoring with or without N-acetylation) were investigated to optimize their performance for bacterial detection. The development of a multi-AMP SPRi platform integrating the PACHAs allowed real-time bacterial identification, highlighting its potential for rapid diagnostic applications.[1]



Références :

[1]. Pardoux, É.; Roux, A.; Mathey, R.; Boturyn, D.; Roupioz, Y. Talanta 2019, 203, 322–327.

Correspondance :** ***lucie.bastien@univ-grenoble-alpes.fr

Static surfactant foams for biofilm removal

Nour-Ouda Benzaamia[1], Wiebke Drenckhan[1], Lydie Ploux[2*], Fouzia Boulmedais[1*]

[1] University of Strasbourg, CNRS, Charles Sadron Institute, France
[2] INSERM UMR_S 1121, Biomaterials and Bioengineering, University of Strasbourg, France
* Corresponding author: fouzia.boulmedais@ics-cnrs.unistra.fr and ploux@unistra.fr

The development of bacterial biofilms on medical devices contributes to nosocomial infections, leading to increased morbidity, mortality and costs[1]. Biofilms are structured communities of bacterial cells embedded in a self-produced extracellular polymeric matrix composed of proteins, polysaccharides, and nucleic acids. This matrix offers strong protection against environmental stresses and antimicrobial agents, making biofilm-associated bacteria up to 1000 times less sensitive to antibiotics than their planktonic states[2]. In addition, the World Health Organization continues to warn of the rise of antibiotic-resistance in bacteria. **In this context, innovative non-antibiotic solutions to treat bacterial biofilms are crucial.** Foam flow cleaning has demonstrated partial efficacy in the removal of bacterial biofilms[3]. More recently, surfactant foams have shown promise under static conditions for the removal of dust particles, leveraging the mechanical forces exerted at the air-liquid interface[4].

The poster will present novel results regarding the degradation of *P. aeruginosa* and *S. auerus* biofilms, the most common pathogens in hospital-acquired infections. We show that surfactant foams are significantly more efficient than surfactant solutions in reducing 24 h mature biofilms. The influence of the surfactant type is also studied.

References

[1] https://www.inserm.fr/Wp-Content/Uploads/2020-01/Inserm-Pprantibioresistance.Pdf

[2] Sharma, D et al. Antibiotics versus biofilm: An emerging battleground in microbial communities. *Antimicrobial Resistance & Infection Control*, **2019**, *8*(1), 76.

[3] Heni Dallagi, et al. Foam flow cleaning, an effective and environmentally friendly method for controlling the hygiene of closed surfaces contaminated with biofilms. *Food and Bioproducts Processing*, **2022**, 136, 236-248.

[4] Schad, Tamara, Preisig, Natalie, Piening, Heinrich and Stubenrauch, Cosima. "Innovative foam-based cleaning concepts for historical objects" *Tenside Surfactants Detergents.* **2022**, 59, 451-459.

Using cold atmospheric plasma to protect surface from bacterial contamination

Florian Bitterolf[1], Guillaume Nonglaton[1], Christelle Dublanche-Tixier[2], Cédric Ducros[3]

[1] Université Grenoble Alpes, CEA, LETI, DTIS, PRISM, F-38000 Grenoble
[2] Université de Limoges, UMR 7315, IRCER, F-87000 Limoges
[3] Université Grenoble Alpes, CEA, LITEN, DTNM, SCEF, LEFC, F-38000 Grenoble

Nowadays, biological contamination especially bacterial are a major concern regarding healthcare but many other including food industry and defense. While it takes up to 10 years to put a new antibiotic on the market, bacteria could acquire resistance to an antibiotic in just a week (1). In France in 2015, more than 120 000 cases of multidrug-resistant bacteria leading to more than 5 500 deaths (2). According to forecast, by 2050 death caused by superbugs could reach 238 000 persons (3). Urging the need to finds new ways to fight against bacterial contamination. Although bacteria on their planktonic form tends to be sensitive to environmental stresses and therapeutics agents, they have a tendency to form biofilm. Surface attached communities protected by a polymeric matrix exacerbating the development of resistance(4).

Therefore, effective ways to fight against bacterial contamination would be to prevent adhesion and biofilm formation in the first place. To do so, research focus on two main strategies, preventing bacteria's adhesion through super hydrophilic, super hydrophobic or micro/nanopatterned surface (5). The second strategies consist on a biocidal approach, either by surface releasing antibacterial compound or by grafting those antibacterial compounds on the surface for a contact killing approach (6).

Among all deposition techniques in surface chemistry, cold atmospheric plasma turns out to be great versatile techniques to achieve this goal. Allowing a greener chemistry by making solvent free plasma polymer coating and having a lesser energy consumption than low pressure deposition. Moreover, those plasma are non-thermal making them suitable for a wide range of substrate materials (plastic, metals, glass, textile) (7,8).

During my PhD, my goal will be to use a DBD-CAP (Dielectric barrier discharge Cold Atmospheric Plasma) deposition to obtain a plasma polymeric thin layer that will act as an anchoring point that I'll use to integrate NPs (TiO2, ZnO) to generate ROS but also Ag NPs for a contact killing strategies. Other ways to use the plasma polymeric layer will be to use it to graft antimicrobial peptide. The possibility and effectiveness of combining NPs and AMPs for a synergistic effect will be investigated. Coating will be characterized with common physical and chemical techniques (Water contact angle, Profilometry, Ellipsometry, FTIR, XPS, QCM-d) and effectiveness toward bacterial contamination will be assessed through microbiological test of viability and adherence using model bacteria (*E. coli*, *S. Epidermidis*).

References

1. Harms A, Maisonneuve E, Gerdes K. Mechanisms of bacterial persistence during stress and antibiotic exposure. Science. 2016;354(6318).
2. Cassini A, Högberg LD, Plachouras D, Quattrocchi A, Hoxha A, Simonsen GS, et al. Attributable deaths and disability-adjusted life-years caused by infections with antibiotic-resistant bacteria in the EU and the European Economic Area in 2015: a population-level modelling analysis. Lancet Infect Dis. 1 janv 2019;19(1):56-66.
3. OECD (2023), Embracing a One Health Framework to Fight Antimicrobial Resistance, OECD Health Policy Studies, OECD Publishing, Paris, https://doi.org/10.1787/ce44c755-en.
4. Davies D. Understanding biofilm resistance to antibacterial agents. Nat Rev Drug Discov. 2003;2(2):114-22.
5. Durand H, Whiteley A, Mailley P, Nonglaton G. Combining Topography and Chemistry to Produce Antibiofouling Surfaces: A Review. ACS Appl Bio Mater. 2022;5(10):4718-40.

6. Ahmadabadi HY, Yu K, Kizhakkedathu JN. Surface modification approaches for prevention of implant associated infections. Colloids Surf B Biointerfaces. 2020;193.
7. Bárdos L, Baránková H. Cold atmospheric plasma: Sources, processes, and applications. Thin Solid Films. 2010;518(23):6705-13.
8. Merche D, Vandencasteele N, Reniers F. Atmospheric plasmas for thin film deposition: A critical review. Thin Solid Films. 2012;520(13):4219-36.

Plasmonic nanohybrids for the vectorization and delivery of antisense oligonucleotides in metastatic melanoma models

Lola Blayac[1], Anne Vallée[1], Michèle Salmain[3], Ioanna Christodoulou[1], Valentin Saliba[1], Bruno Palpant[4], Guilhem Bousquet[2], Souhir Boujday[1]

[1]*Sorbonne Université, CNRS, Laboratoire de Réactivité de Surface (LRS)*
[2]***Université Sorbonne Paris nord, Inserm, MArkers in Stressed COndiTions*** *(MASCOT)*
[3]*Sorbonne Université, CNRS, Institut Parisien de Chimie Moléculaire (IPCM)*
[4]*Université Paris-Saclay, CNRS, Lumière, Matière et Interfaces (LuMIn)*

Despite progress in targeted therapies, nearly half of metastatic melanoma patients remain unresponsive or develop resistance. Prominin-2 (PROM2), recently identified as an early metastasis biomarker, can be specifically inhibited using its antisense oligonucleotide (ASO), anti-PROM2.[1]

We aim to develop reliable bioconjugates of hybrid anisotropic plasmonic nanoparticles with a silica-coated gold core, loaded with anti-PROM2 and functionalized with anti-PRAME antibodies for active targeting (Figure 1a).

Gold nanoparticles (AuNP) are efficient for photothermal therapy thanks to their localized surface plasmon resonance in the near-infrared (NIR) range tuned to biological windows, particularly in anisotropic shapes (nanorods (AuNR), bipyramids (AuBP)). The temperature elevation under NIR irradiation enables a selective tumor cell ablation while sparing surrounding tissues.

Different morphologies are compared, allowing the evaluation of the impact of tip sharpness on cellular internalization. AuBP were synthesized via a seed-mediated method using polycrystalline seeds[2] (Figure 1c), while AuNR used monocrystalline ones[3]. We successfully reproduced both synthesis and obtained stable particles. By varying the seed volume, we tuned the AuBP aspect ratio, yielding a wide range of plasmon resonance including the biological window (Figure 1b). Silica coating was achieved using a protocol adapted from AuNR[3], with shell thickness controlled by adjusting the TEOS amount (Figure 2d).

Later on, we aim to perform surface functionalization with ASO. Laser irradiation experiments will assess thermal elevation, comparing AuBP and AuNR. Photothermal ASO release tests will follow, with in vitro evaluations to determine system effectiveness. The best results will be tested in vivo.

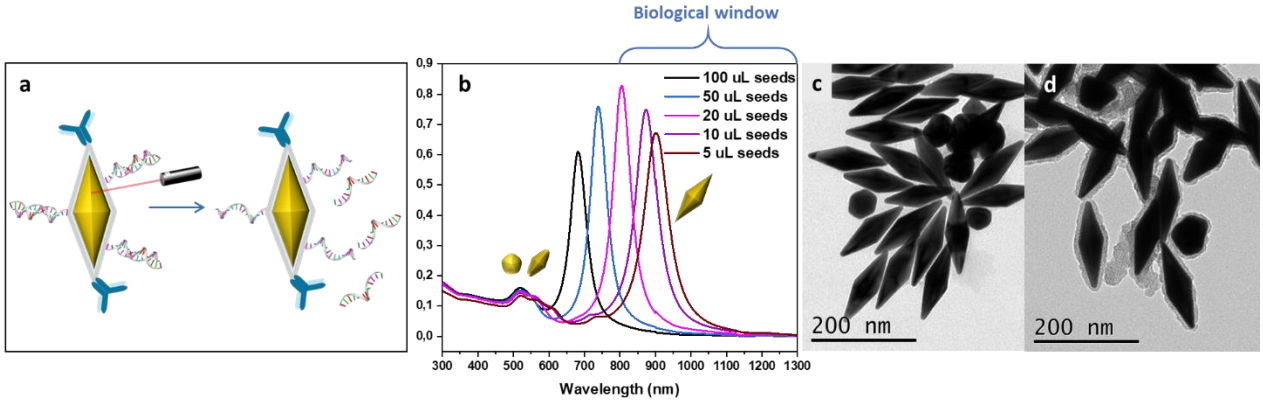


Figure 1: a) Schematic representation of ASO release on plasmonic nanohybrids under laser irradiation; b) UV-Visible study of the plasmonic bands of AuBP as a function of the seed volume added; c) TEM image of AuBP with a plasmonic band at 900 nm d) TEM image of AuBP with a silica layer of 8.5 ± 1.4 nm.

References:

(1) Paris, J.; Wilhelm, C.; Lebbé, C.; Elmallah, M.; Pamoukdjian, F.; Héraud, A.; Gapihan, G.; Walle, A. V. D.; Tran, V. N.; Hamdan, D.; Allayous, C.; Battistella, M.; Van Glabeke, E.; Lim, K. W.; Leboeuf, C.; Roger, S.; Falgarone, G.; Phan, A. T.; Bousquet, G. PROM2 Overexpression Induces Metastatic Potential through Epithelial-to-mesenchymal Transition and Ferroptosis Resistance in Human Cancers. *Clin. Transl. Med.* **2024**, *14* (3), e1632. https://doi.org/10.1002/ctm2.1632.

(2) Sánchez-Iglesias, A.; Winckelmans, N.; Altantzis, T.; Bals, S.; Grzelczak, M.; Liz-Marzán, L. M. High-Yield Seeded Growth of Monodisperse Pentatwinned Gold Nanoparticles through Thermally Induced Seed Twinning. *J. Am. Chem. Soc.* **2017**, *139* (1), 107–110. https://doi.org/10.1021/jacs.6b12143.

(3) Pellas, V.; Sallem, F.; Blanchard, J.; Miche, A.; Concheso, S. M.; Méthivier, C.; Salmain, M.; Boujday, S. Silica-Coated Gold Nanorods Biofunctionalization for Localized Surface Plasmon Resonance (LSPR) Biosensing. *Talanta* **2023**, *255*, 124245. https://doi.org/10.1016/j.talanta.2022.124245.

DEVELOPMENT OF A WEARABLE BIOCOMPATIBLE SENSOR FOR DIALYSIS MONITORING

Adélèyè CHOGOLOU1*, Véronique MOURIER1, Yohann THOMAS and Isabelle TEXIER1

Univ. Grenoble Alpes, CEA, Leti, F-38000 Grenoble, France

Keyword: Ion-Selective-Electrode, Biocompatible sensor, Potassium, Urea, Micro-needle

Improving patients' monitoring between dialysis treatment sessions is desirable to adjust the therapy and offer a better quality of life for patients suffering from kidney failure. For instance, urea concentration in blood is low post-dialysis, but it does not reflect its concentration in the interstitial fluid (ISF) bathing the tissues. After treatment, a significant rebound in urea concentration in blood is often observed, indicating the release of urea from non-purified tissues towards this compartment. A wearable, biocompatible, electrochemical sensor able to continuously monitor markers in the ISF could therefore present a high interest to enhance dialysis treatment quality by adjusting time between sessions. In particular, devices composed of microneedles able to uptake mini-invasively interstitial fluid and electrochemical sensors for performing in-situ its analysis are of high interest. An Ion-Selective-Electrode (ISE) measures a potential dependent on the selected ion activity according to the Nernst equation and offers high sensitivity and selectivity for the specific detection of ionic species in biological environments thanks to an Ion-Selective Membrane (ISM). Integrated into wearable sensors, ISEs open the way to numerous applications in monitoring, understanding biological processes and assisting in diagnosis. The use of biocompatible ISE sensing materials is however crucial for the development of wearable devices including these sensors in direct contact with biological fluids such as ISF.

We therefore herein explore the development of ISM formulations based on biocompatible materials to prevent undesired immune responses, comply with the regulation and enable mid- to long-term monitoring on the person. Different formulations of ISM were screened and characterized for potassium and urea sensing. In the presentation, we will detail their electrochemical performances and the perspectives for their integration in a wearable device.

Electroactive Biotin Monolayers on Chalcogenide Glasses for Charge-Controlled Biosensing

Chloé Courdurié, Antonio De La Torre, Thierry Buffeteau, Svitlana Shinkaruk, Mathilde Laird, Vincent Rodriguez, Marc Dussauze, Luc Vellutini

Institut des Sciences Moléculaires (ISM), UMR 5255 CNRS-Université de Bordeaux, 351 Cours de la Libération, 33400 Talence, France
chloe.courdurie@u-bordeaux.fr

Chalcogenide (ChG) glasses are transparent in the mid-infrared region, making them highly promising materials for the development of devices such as chemical and biosensors. The main challenge lies in surface functionalization of such surfaces with organic monolayers. To functionalize the ChG glasses, the thiol groups available on the surface were used to react with the maleimide groups of heterobifunctional linkers bearing a terminal biotin.[1] A lysine-based spacer not only bridges the maleimide and biotin groups but also introduces electroactivity through its positively charged ammonium group (NH_3^+). When combined with the intrinsic electro-patterning capabilities of ChG glasses, this strategy enables the spatial definition of bioactive domains with selective probe functionality. [3] This work provides fundamental insights into the chemical, electrical, and optical interactions at functionalized ChG glass surfaces, paving the way for advanced biosensor fabrication, including DNA microarrays and other multiplexed diagnostic platforms.

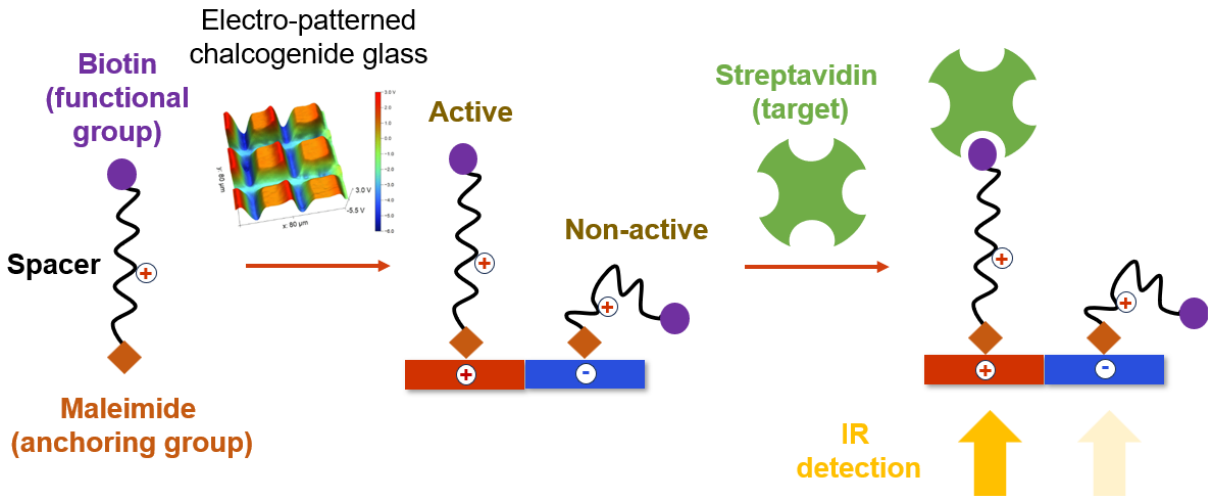


Figure: Formation of electroswitchable monolayers for biodetection.

[1] R. Alvarado, N. Al-Hajj, M. Chazot, T. Buffeteau, L. Vellutini, M. Dussauze, *Appl. Surf. Sci.* **2022**, *573*, 151589.
[2] R. Alvarado, L. Karam, R. Dahmani, A. Lepicard, F. Calzavara, A. Piarristeguy, A. Pradel, T. Cardinal, F. Adamietz, E. Fargin, M. Chazot, K. Richardson, L. Vellutini, M. Dussauze, *J. Phys. Chem. C* **2020**, *124*, 23150–23157.
[3] C. L. Yeung, P. Iqbal, M. Allan, M. Lashkor, J. A. Preece, P. M. Mendes, *Adv. Funct. Mater.* **2010**, *20*, 2657–2663.

Encapsulation of bacterial GMOs for a whole-cell-based optical and electrochemical sensor targeting environmental water pollutants

Luana Cuvillier[1], Nathan Haasbroek[2], Sonia Mecacci[2], Sana Muzaffar[3], Richard Murray[3], Alan O'Riordan[3], Enrique Asin-Garcia[2], and Guillaume Nonglaton[1]

[1] CEA-Leti, Université Grenoble Alpes, France.

[2] Wageningen University & Research, Netherlands.

[3]Tyndall National Institute, Ireland.

Environmental pollution poses a major threat to health and biodiversity. Aligned with the European Union's programme ZERO-POLLUTION, the BioSensei project addresses this challenge through a real-time, multiplexed, end-to-end, on-site optical and electrochemical monitoring system. Using cellular responses, this hybrid biosensor targets biotic and abiotic pollutants in water (i.e., nitrates, phosphates, endocrine disruptive chemicals, PFAS, and toxins).

To this purpose, immobilisation of genetically engineered bacterial cells on the transducer surface is required. Moreover, this project follows a Safe-and-Sustainable-by-Design (SSbD) framework, necessitating rigorous risk assessments, thus preventing environmental release of modified bacteria. Additional constraints include maintaining a metabolic activity for ideally a month, avoiding optical or electrochemical interference, and ensuring rapid diffusion of analytes from the environment to the bacteria and then to the transducers.

In that regard, a layer-by-layer encapsulation of cells in alginate microbeads, coated with poly-L-lysine (PLL) is performed to confine a model whole-cell sensor (*P. putida* with a rhamnose-induced Green Fluorescent Protein production). This approach minimises capsule swelling and bacterial release while maintaining cell viability, as demonstrated by Laser Scanning Confocal Microscopy.
Cryo-Scanning Electron Microscopy images of encapsulated cells revealed a uniform bacterial distribution inside and on the capsule surface. The sensing activity of the model cells in single use, measured using fluorescent scanning spectroscopy, retained 84% one week after encapsulation and storage at room temperature, and 37% three weeks after, compared to the activity on the day of encapsulation. Experiments also confirmed that the PLL layer does not impede diffusion of analytes or pollutants. Strategies are evaluated to enhance performance of immobilised cells in a reusable fashion, including sample preparation, cell load or oxygen supplementation in the sensor chamber.

Finally, integration of cell-loaded capsules onto electrochemical sensor interface is underway, with strategies being explored to enhance compatibility at the transducer surface while covalently grafting capsules onto the surface.

Design of innovative pre-cellularized microparticles with enzyme-activated degradation to enhance cell proliferation for 3D-bioprinting

C. Dupré[1]*, A. Specht[2], F. Bolze[2], Q. Muller[3], E. Mathieu[1], B. Vincent[4], M. Matsusaki[5], Y. Arntz[1], D. Vautier[1].

[1]*Inserm UMR_S 1121, CNRS EMR 7003, Biomaterials & Bioengineering, Strasbourg University, France.*
[2]*CNRS UMR 7199 CBST, Strasbourg University, France.*
[3]*Consortium for Future Innovation by Cultured Meat, Osaka University, Osaka, Japan.*
[4]*CNRS UAR 2042, Fédération de Chimie LeBel, Strasbourg University, France.*
[5]*Joint Research Laboratory for Advanced Cell Regulatory Chemistry, Graduate School of Engineering, Osaka University, Osaka, Japan.*
charlene.dupre@etu.unistra.fr

3D bioprinting is a tissue engineering technique that uses bioinks - living cells embedded in a matrix - to mimic cells environment and create complex biological models. However, the shear stress from extrusion can reduce cellular adhesion and viability. To counter this, a bioink incorporating porous poly(D, L-lactic-co-glycolic acid) (PLGA) microparticles (mPs) as cellular scaffolds was developed[1]. Post-printing, cells remodel the bioink by degrading the mPs, a process that can take months, exceeding the required tissue growth period. This work aims to design new mPs with active degradation by chemically coupling PLGA with a peptide containing a domain cleavable by cellular metalloproteinases (MMPs), enzymes secreted by cells[2]. After printing, MMPs will cleave the peptide to induce rapid and time-controlled degradation. The synthesis of the PLGA-peptide conjugate was verified by FT-IR, ^{1}H NMR, and DOSY NMR, with the latter indicating a diffusion coefficient equivalent to that of PLGA. From this conjugate labeled with rhodamine B, the mPs were successfully elaborated. Scanning electron microscopy (SEM) and confocal microscopy (CM) enable the characterization of mPs size and porosity. Peptide coating strategies were explored to enhance cell adhesion and proliferation[3], as an indirect means of accelerating mPs degradation. Fluorescence spectroscopy was used to compare the degradation of the mPs by collagenase B (MMP) for preliminary tests. Cleavage of the coupled peptide was monitored by measuring the fluorescence of the released sequence.

1. Rousselle, A. et al. Bioprinting. **2022**, 28, e00247.
2. Lutolf, M. P. et al. PNAS. **2003**, 100(9), 5413-5418.
3. Zeng, J. et al. Small. **2020**, 1907434.

Mechanical induction of colon stem cells by tumor growth pressure in cancer progression

Laurie Exposito[1,4*], ME Fernández-Sánchez[1], THN Ho-Bouldoires[1], K Sollier[1], L Zamfirov[1,2], F Broders-Bondon[1], G Champenois[3], R Leclère[3], N André[3], D Meseure[3], A Michel[4], C Ménager[4], C Demené[2], M Tanter[5], E Farge[1]

[1] Mechanics and Genetics of Embryonic Development group, Institut Curie, Centre OCAV PSL Research University, Sorbonne University, CNRS UMR168 Physics of Cells and Cancer, Inserm, 11 rue Pierre et Marie Curie, 75005, Paris, France.

[2] Physics for Medicine Paris, ESPCI ParisTech, PSL Research University, Inserm U1273, F-75005 Paris, France.

[3] Platform of Investigative Pathology, Institut Curie, 75248 Paris, France.

[4] Physico-chimie des Électrolytes et Nanosystèmes Interfaciaux, PHENIX, Sorbonne Université, CNRS, Paris, France.

[5] Sorbonne Université, INSERM, CNRS, Institut de la vision, Paris, France.

* Corresponding author: lexposit@curie.fr

Abstract

Mechanical forces play a key role in colon tissue homeostasis and tumour progression. In mice, we show that physiological high-frequency pulsatile myogenic stresses maintain homeostatic stem cell levels through Ret-dependent mechanosensitive signalling, while pathological tumour growth pressure abnormally over-activates Ret upstream of β-catenin, driving hyperproliferation and tumour initiation in an APC+/– context representative of 85% of human colorectal cancers. Such physiological pulsatile and pathological constant stresses were mimicked by magnetic manipulation of ultramagnetic liposomes (UMLs) stabilized in the connective tissue of the colon in vivo. UMLs are small lipid vesicles densely loaded with magnetic nanoparticles, which makes them highly sensitive to external magnetic fields while keeping them biocompatible.

Constant-pressure–induced nuclear translocation of β-catenin overstimulates the production of Lgr5+ stem cells, leading to early tumour formation. Pharmacological inhibition of Ret reverses these effects. Our results identify mechanical pressure as a driver of Ret- and β-catenin-dependent tumorigenesis and highlight mechanotransduction as a key contributor to tumour heterogeneity and progression

Influence of composition and physical properties of the surrounding medium on cell-to-cell communication in *Streptococcus salivarius*

Julie Geortay [1], Mathilde Aubry [2], Julien Damoczi [2], Pascal Hols [2], Alain M. Jonas [1], Karine Glinel [1]

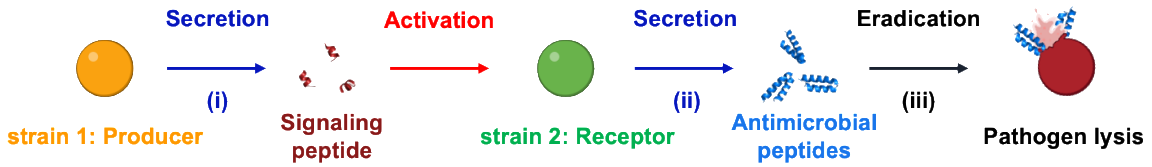
[1] Institute of Condensed Matter and Nanosciences (Bio- and Soft Matter division), UCLouvain, Belgium

[2] Louvain Institute of Biomolecular Science and Technology (Biochemistry and Genetics of Microorganisms division), UCLouvain, Belgium

Abstract

The rise of antimicrobial resistance calls for innovative strategies to control pathogenic bacteria. One promising avenue is to exploit commensal bacteria secreting antibacterial peptides that kill target pathogens. However, such an approach requires to activate the production of molecules of interest at desired times. This might be attained by triggering molecular production *via* signaling molecules involved in controlled cell-to-cell communication cascades.

In this study, we thus focus on an intercellular interaction cascade composed of three steps: (i) a producer strain secretes a signaling peptide; (ii) a receptor strain detects this signal and activates specific pathways leading to the secretion of antimicrobial molecules, (iii) which act against a target pathogen.



More specifically, we have investigated the influence of the composition and the physical properties of the medium surrounding the cells on the propagation of the signaling molecules between producer (1) and receptor (2) strains. To this aim, we used a bacterial system composed of a producer strain secreting the signaling peptide and a receptor strain equipped with a luminescent reporter system. Physically-separated co-culture of both strains was performed in a compartmentalized device in which the two strains are separated by a 0.2 µm-pore size membrane. Emission of luminescence is triggered only when the signaling peptide successfully diffuses across the membrane, providing a direct and quantifiable readout of communication efficiency.

By comparing liquid and gel-based environments, we show that the physicochemical properties of the medium affect peptide diffusion, signal perception, and activation dynamics. The source of carbon used in the medium also impacts the cellular response. These findings demonstrate the potential of biomaterial-assisted control of bacterial signaling as a foundation for designing smart probiotic systems capable of inhibiting pathogens over controlled time span

Inhibiting Pseudomonas aeruginosa with Staphylococcus epidermidis encapsulated in a honey-based prebiotic-probiotic hydrogel

HELLE Sophie [1*], IGBOKWE Victor C.[1], BALL Vincent [1], FESSELIER Chelsea [1], GREE Simon [2], MATHIEU Eric [1], NARDIN Corinne [3], PLOUX Lydie [1]

[1] Inserm UMR_S 1121, CNRS EMR 7003, Université de Strasbourg, Biomaterials and Bioengineering, Centre de Recherche en Biomédecine de Strasbourg, 1 rue Eugène Boeckel, 67000 Strasbourg, France

[2] CNRS UMR 7361 IS2M, Université de Haute-Alsace, 68200 Mulhouse, France

[3] Universite de Pau et des Pays de l'Adour, E2S UPPA, CNRS, IPREM, Pau, France, 2 avenue P. Angot, 64000 Pau, France

Bacteriotherapy has emerged as an effective strategy to combat bacterial infections prevalent in skin wounds, particularly those associated with diabetic ulcers and burns. In this contest, we found that the supplementation of hydrogels with honey enhanced the potential of *Staphylococcus epidermidis*, a skin commensal bacterium, to inhibit the growth of *Pseudomonas aeruginosa*. In this study, we varied the concentration of *S. epidermidis* encapsulated in the hydrogels with and without honey. After gelation, we inoculated *P. aeruginosa* on the surface on the hydrogel and 24h later, we observed a remarkable difference in morphology and size of the colony of *P. aeruginosa* in presence of either honey or *S. epidermidis*. Importantly, a distinct absence of *P. aeruginosa* colony was noted in the agarose + honey hydrogel at the two highest concentrations of *S. epidermidis*. These observations suggest that *S. epidermidis* and honey, alone or together, create an unfavorable environment for *P. aeruginosa* growth. Also, combining honey with *S. epidermidis* inhibits the growth of *P. aeruginosa*, in a concentration-dependent manner. The results of our experiment on the hydrogels excluded a direct effect of the viscoelastic or hydration properties of the hydrogels on *P. aeruginosa* growth whereas the ATR-FTIR fingerprint of the solution extracted from this hydrogel suggests a crucial role of the sugar catabolism by *S. epidermidis* in honey-containing hydrogels, probably triggered by *P. aeruginosa*. These anti-pathogen effect of encapsulated *S. epidermidis* enhanced by honey could advance the use of bacteriotherapy in developing therapeutic dressings to prevent bacterial infections associated with skin wounds.

Fonctionnalisation de surface pour pallier l'adsorption des bactériophages

Eve LE DAUPHIN

CEA-Leti

Bacterial resistance to antibiotics, also called antibioresistance, is increasing and "could cause 10 billion deaths each year by 2050" according to the World Health Organization [1]. An alternative to antibiotics is phagotherapy, which involves bacteriophages. These bacterial viruses are extremely specific to their bacterial hosts. In order to be able to treat a maximum of bacterial infections, a large phage library is needed. However, some studies [2,3] have recently highlighted difficulties associated with bacteriophages storage, notably due to vials material composition. Phages suspension stability is impacted, leading to the infectious titer decrease by several decades over time, which impedes its use for bacterial infection mediation.

The aim of the study is to develop an antibiofouling coating that prevents bacteriophages, and more widely proteins, from being adsorbed. An atmospheric pressure plasma assisted deposition equipment is used to compare conventional dip-coating to plasma polymers.

PEG-like and zwitterionic compounds are generally cited as having a good antibiofouling aptitude [4,5], which explain the decision to explore their potential to overcome bacteriophages adsorption. After substrates functionalization the coating is characterized by ellipsometry, FTIR, XPS and QCM-D. The Quartz Cristal Microbalance with Dissipation monitoring (QCM-D) is used to determine the coating antibiofouling strength. This technique can quantitatively evaluate the adsorption and desorption phenomenon at the surface of quartz sensors. PEG-like and zwitterionic coatings have been studied in that way and appears to be promising candidates to overcome bacteriophages adsorption.

The presentation will detail the chosen monomers and compare the conventional dip-coating method to atmospheric pressure plasma deposition. Interactions between coatings and bacteriophages will be discussed using results obtained by QCM-D.

References:

[1] No Time to Wait: Securing the Future from Drug-Resistant Infections. https://www.who.int/publications/i/item/no-time-to-wait-securing-the-future-from-drug-resistant-infections (29/04/20219).

[2] Richter, Ł. et al. Adsorption of bacteriophages on polypropylene labware affects the reproducibility of phage research. Sci Rep 11, 7387 (2021).

[3] O'Connell, L., Roupioz, Y. & Marcoux, P. R. Container material dictates stability of bacteriophage suspensions: Light scattering and infectivity measurements reveal mechanisms of infectious titre decay. Journal of Applied Microbiology (2022) doi:10.1111/jam.15581.

[4] Hartig, T. *et al.* iCVD Polymer Thin Film Bio-Interface-Performance for Fibroblasts, Cancer-Cells, and Viruses Connected to Their Functional Groups and In Silico Studies. *Advanced Materials Interfaces* **11**, 2300587 (2024).

[5] Yang, R. & Gleason, K. K. Ultrathin Antifouling Coatings with Stable Surface Zwitterionic Functionality by Initiated Chemical Vapor Deposition (iCVD). *Langmuir* **28**, 12266–12274 (2012).

Surface Functionalization as a Key Step for Engineering Nanodiamonds with NV Centers for Bioimaging and Sensing

Bénédicte Malemo[1], Anne Vallée[1], Alexis Loiseau[1], Jean-Charles Arnault[2], Hugues Girard[2], Souhir Boujday[1]

[1]Laboratoire de Réactivité de Surface (LRS) – Sorbonne Université – France
[2]Nanosciences et Innovation pour les Matériaux, la Biomédecine et l'Energie (NIMBE) – CEA, CNRS, Université Paris-Saclay – France

Nanodiamonds (NDs) with nitrogen-vacancy (NV) centers are promising probes for bioimaging and quantum sensing (1), but their practical use relies critically on surface functionalization. Only through controlled surface chemistry can NDs be integrated into hybrid architectures and tailored to exhibit new properties (2).

We investigate two complementary surface chemistry strategies to endow these NDs with additional functionalities. In the first, NDs are modified with cysteamine via EDC/NHS coupling, introducing thiol groups that act as versatile reactive anchors for subsequent chemical modifications or nanoparticle attachment. In the second approach, NDs are encapsulated within a tunable silica spacer layer (3) using a sol-gel method (Figure 1). This shell provides a chemically versatile interface while enabling precise control over ND-environment spacing, a parameter essential for distance-sensitive applications.

These strategies establish robust routes for tailoring ND surfaces and highlight surface engineering as the key enabler for exploiting the unique properties of NV centers in advanced bioimaging and sensing applications.

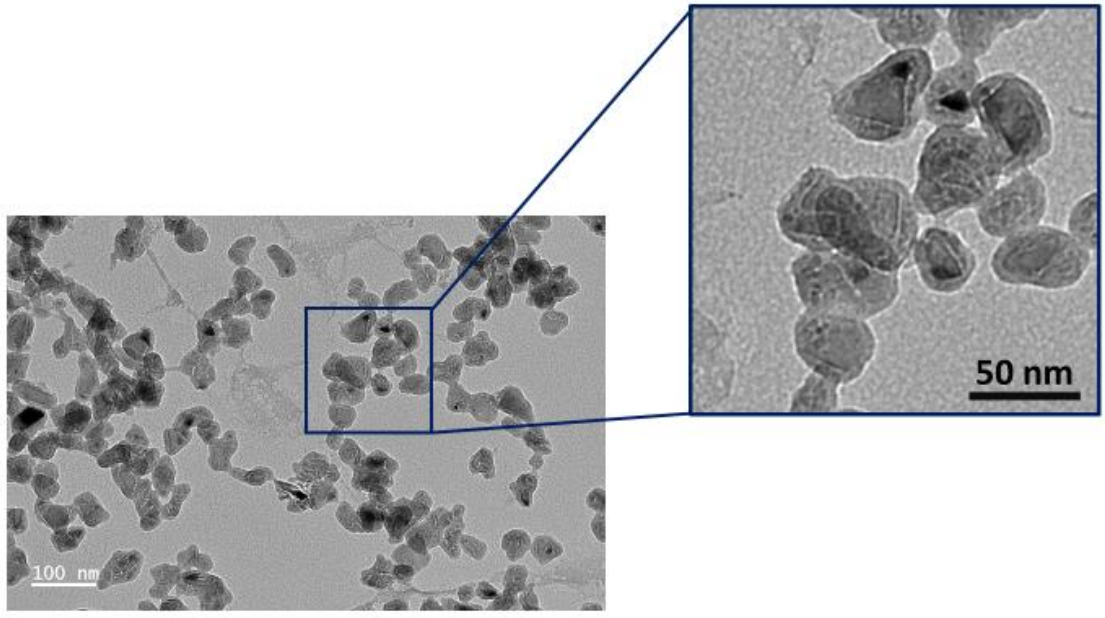


Figure 1. *TEM image of oxidized NDs coated with a layer of silica, with a thickness of 5.0 ± 0.9 nm*

References

(1) Balasubramanian, G.; Lazariev, A.; Arumugam, S. R.; Duan, D. Nitrogen-Vacancy Color Center in Diamond-Emerging Nanoscale Applications in Bioimaging and Biosensing. Current Opinion in Chemical Biology 2014, 20, 69–77.
(2) Orlanducci, S. Gold-Decorated Nanodiamonds: Powerful Multifunctional Materials for Sensing, Imaging, Diagnostics, Therapy. Eur J Inorg Chem 2018, 2018 (48), 5138-5145.
(3) Pellas, V.; Blanchard, J.; Guibert, C.; Krafft, J.-M.; Miche, A.; Salmain, M.; Boujday, S. Gold Nanorod Coating with Silica Shells Having Controlled Thickness and Oriented Porosity: Tailoring the Shells for Biosensing. ACS Appl. Nano Mater. 2021, 4 (9), 9842–9854.

Bactericidal and Bioinspired Chitin-Based Layer-by-Layer Brushed-Nanocoatings

Asma Riahi [a], Bernard Hezard [b], Laurent Heux [c], Fouzia Boulmedais [a]

[a] Université de Strasbourg, CNRS, Institut Charles Sadron, Strasbourg, France

[b] Aérial, Parc d'Innovation, Illkirch, France

[c] CERMAV, CNRS, Grenoble, France

Healthcare-associated infections, also known as nosocomial infections, remain a critical challenge, largely due to the ability of bacteria to form resilient biofilms on medical and other surfaces. Conventional antibiotics often fail to eradicate these communities, emphasizing the urgent need for innovative preventive materials [1]. Biopolymers such as cellulose and chitin are particularly attractive for surface functionalization owing to their abundance, renewability, biodegradability, and intrinsic antibacterial potential [2,3].

In this study, we report a simple brushing-based layer-by-layer (LbL) deposition method using chitin nanocrystals. This surface-functionalization strategy enables precise control over the number of deposited nanocoatings and promotes nanoscale structuration resulting in finely tuned surface roughness [4]. The resulting nanostructured films were systematically characterized by AFM under different deposition conditions. Subsequently, their antibacterial activity was assessed against *Staphylococcus aureus* and *Escherichia coli* to explore the relationship between layer number, nanoscale architecture, and antibacterial performance. This straightforward and scalable approach offers a promising avenue for the development of antimicrobial coatings for medical and hospital surfaces.

Keywords : Biofilms ; Layer-by-layer (LbL) deposition ; Multilayers; Bio-sourced; Nanotopography; Nanostructured surfaces ; Antibacterial

References

[1] :Mishra A, Aggarwal A, Khan F. Medical device-associated infections caused by biofilm-forming microbial pathogens and controlling strategies. Antibiotics (Basel). 2024 Jul 4;13(7):623. doi:10.3390/antibiotics13070623.

[2] :Kumar MNR. A review of chitin and chitosan applications. React Funct Polym. 2000;46(1):1-27. doi:10.1016/S1381-5148(00)00038-9

[3] : Xie S, Zhang X, Walcott MP, Lin H. Applications of cellulose nanocrystals: a review. *Eng Sci.* 2018;2(3):7-28. doi:10.30919/es.1803302.

[4] :Iqbal MH, Quilès F, Pradel E, Benmalek-Kehili S, Lancelon-Pin C, Heux L, Meyer F, Ploux L, Francius G, Boulmedais F. Bactericidal and bioinspired chitin-based anisotropic layer-by-layer brushed-nanocoating. Appl Mater Today. 2023;32:101816. doi:10.1016/j.apmt.2023.101816.

Milk pathogens trapping with nanoparticles and detection by QCM

Chloé RICHET[1,2*], Delphine LAROSE[2], Philippe TROSSAT[2], Thérèse LEBLOIS[1], Vincent HUMBLOT[1]

[1]*Université Marie et Louis Pasteur, CNRS UMR 6174, Institut FEMTO-ST, 15B Avenue des Montboucons, F-25000 Besançon, France.*

[2]*ACTALIA CECALAIT, rue de Versailles, F-39800 Poligny, France.*

**Correspondence: chloe.richet@femto-st.fr*

The dairy sector can be faced with contamination of raw materials and transformed products by pathogenic bacteria [1]. Existing methods take a long time to detect the absence of contamination by these bacteria, **ranging from one to several days depending on the method**. In addition, these methods must have very low detection thresholds, regarding the microbiological criterion for these micro-organisms of "**absence of pathogen in 25 g of product**".
Therefore, and in order to release safely the dairy production or in the contrary to stop production or distribution of contaminated products, it is essential to set-up a method that can quickly confirm the absence of ***Listeria monocytogenes***, a pathogenic germ, in the products.

In this context, the overall objective of the DEPLASP-BAAG project (*DEveloppement d'une PLateforme de détection rApide et SPécifique de BActéries sur matrices complexes AGroalimentaires*) is to **significantly reduce the time required to obtain the first negative result** by improving the two main stages of the analytical process: the enrichment phase and the detection stage using a quartz crystal microbalance (QCM).

The joint optimization of these two stages will, on the one hand, **significantly reduce the enrichment step** by artificially concentrate the sample using magnetic separation and, on the other hand, **lower the detection limit of the QCM** by weighting the bacteria through complex formation with heavy nanoparticles.

To achieve this, two types of nanoparticles were used for now (Figure 1): magnetic nanoparticles (MNPs) and gold nanoparticles (GNPs); both are functionalized with an anti-*Listeria monocytogenes* antibodies. The first (MNPs) are used to separate specific targeted bacteria from other bacteria, using a magnet whereas the second (GNPs) have a role of mass amplifier. Trapping these heavier complexes (4 to 10 times heavier than a bacterium alone) using a functionalized QCM surface will lead to the creation of a 'sandwich type' device.

With preliminary results, we validate the functionalization pathway, that allows bacteria captures on surfaces (flat or particles). We also tested different ligands, that shown relative specificity between species and *Listeria* strains. These first results are encouraging, but certain aspects still need to be improved. This raises several questions:

- What is the most suitable ligand (in terms of specificity, selectivity, cost, …)?
- What would be the ideal particles to use to optimize the capture stage (size, concentration, composition)?
- What parameters should be prioritized for the detection stage (resonance frequency value, sensitivity of the quartz, media, flow rate, concentration of MNP) ?

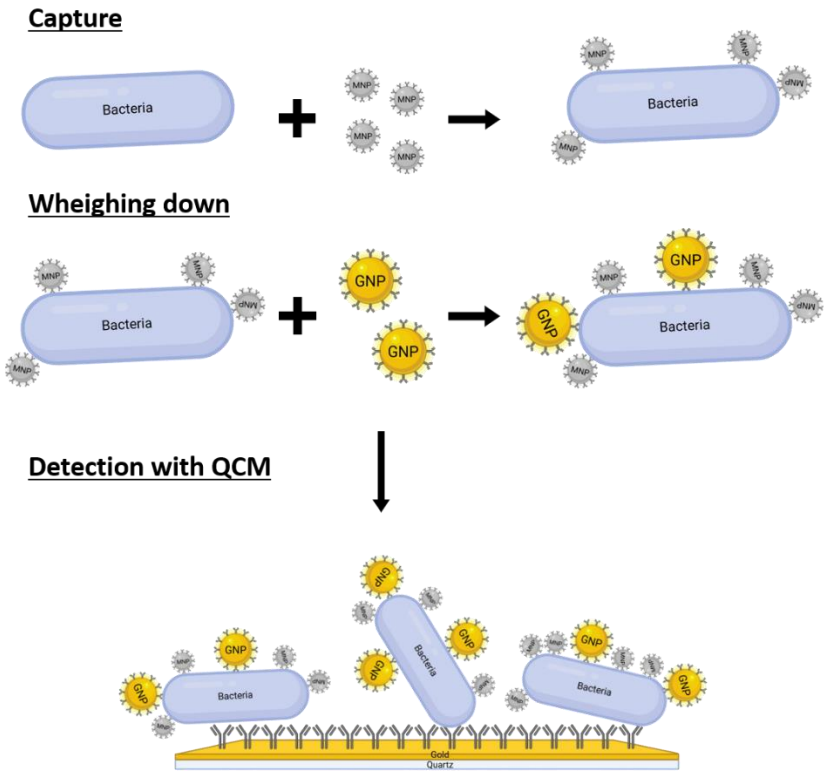


Figure 1: Sandwich type device for pathogens-particles complexes trapping on functionalized QCM quartz

References :
[1] World Health Organization https://www.who.int/news/item/05-06-2019-23-million-people-falling-ill-from-unsafe-food-each-year-in-europe-is-just-the-tip-of-the-iceberg
[2] Li *et al.*, Using Positively Charged Magnetic Nanoparticles to Capture Bacteria at Ultralow Concentration, Nanoscale Research Letters (2019) 14:195

[3] Jiang *et al.*, Evaluation of different micro/nanobeads used as amplifiers in QCM immunosensor for more sensitive detection of E. coli O157:H7, Biosensors and Bioelectronics, Volume 29, Issue 1, 15 November 2011, Pages 23-28

[4] Liu *et al.*, QCM immunosensor with nanoparticle amplification for detection of Escherichia coli O157:H7, Sens. & Instrumen. Food Qual. (2007) 1:161–168

Development of multiplexed biosensors on interferometric optical fibers for *in vivo* molecular diagnosis.

C. Salameh[1], O. Bratash[1], T. Hassan[1], T. Livache[1], A. Buhot[1], L. Leroy[1], E. Engel[1]
1) Univ. Grenoble Alpes, CNRS, CEA, IRIG, SyMMES, Grenoble 38000, France
elodie.engel@univ-grenoble-alpes.fr; chalimar.salameh@univ-grenoble-alpes.fr

Lab-on-Fiber technology is emerging as a promising platform to overcome the limitations of conventional analytical methods [1]. The objective of this project is to develop a biosensor based on a 12-core interferometric optical fiber, functionalized through appropriate surface chemistry modifications, in order to contribute to the advancement of next-generation biosensors capable of performing remote and multiplex *in vivo* molecular analyses in real-time. Preceding work has enabled the identification of the compositions and thicknesses of the interferometric layers deposited at the fiber tips, improving their sensitivity to refractive index (RI) variations in the surrounding medium. A proof of concept for bio-detection was demonstrated using 3025-core image conduits (ICs), where two distinct DNA probes were grafted onto the tip using a polymeric 3D-printed microcantilever, allowing the detection of a complementary DNA strand, while using a secondary strand as negative control [2].
However, ICs are relatively rigid and bulky (1.6 mm in diameter), making them unsuitable for *in vivo* applications. To address this limitation, interferometric layers were instead deposited on more flexible 12-core optical fibers with a diameter of 187 µm (Fig.1.a.b). The characterization of 12-core fibers demonstrated an experimental sensitivity closely aligned with the numerical model (Fig.1.c), supporting their use as a proof of concept in the device's biological validation. In parallel, a UV laser-based setup was developed to achieve localized illumination of non-planar substrates with micrometer-scale precision, covering areas of just a few hundred µm². To complement this, a photo-grafting protocol utilizing a photosensitive crosslinker was established (Fig.1.d.e). Upon localized UV activation, this crosslinker enabled the precise immobilization of two distinct DNA probes on glass slides (Fig.1.f), as well as the successful grafting of Cyanine3-NH_2 (Cy3-NH_2), a model fluorophore probe, onto ICs (Fig.1.g). The following steps will be dedicated to the transition toward grafting and detecting proteins in media of increasing complexity, ultimately simulating real physiological conditions.

Keywords: *interferometric optical fibers, multiplexed detection, biosensors, surface functionalization.*

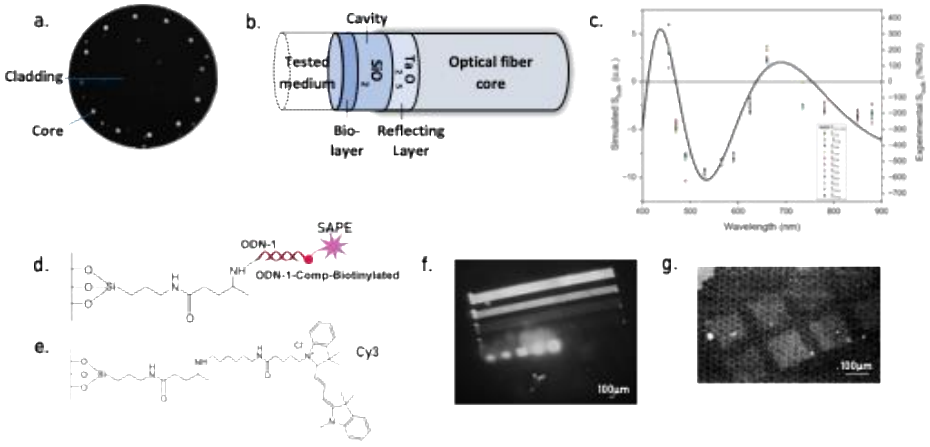


Figure 1: a. 12-core optical fiber cross-section; b. Schematic representation of the interferometric layers on top of the optical fiber core; c. Comparison between the simulated bulk sensitivity and the experimental sensitivity at discrete wavelengths. Schematic representation of the surface chemistry on: d. glass slide; e. IC. Results of the functionalization of: f. DNA on a glass slide revealed with streptavidin-phycoerythrin (SAPE) binding to the biotinylated complementary DNA strand; g. Cy3-NH_2 on IC.

[1] O. Bratash, A. Buhot, L. Leroy, E. Engel, Optical fiber biosensors toward in vivo detection, Biosens Bioelectron, Volume 251,

116088, ISSN 0956-5663. https://doi.org/10.1016/j.bios.2024.116088
[2] O. Bratash, R. Courson, L. Malaquin, T. Leichle, A. Buhot, L. Leroy, E. Engel, Multiplexed Bio-detection on an Interferometric
Optical Waveguide Assembly. Adv. Mater. Interfaces 2024, 2400941. https://doi.org/10.1002/admi.202400941

Nanobâtonnets d'or hybrides recouverts de silice pour la chimio et la photothérapie

V. Saliba [1,2,*], A. Vallée [1] , M. Salmain [3], J. Blanchard [1], B. Heddi [4], B. Palpant [2], S. Boujday [1]

[1] Laboratoire de Réactivité de Surface (LRS), Sorbonne Université, Paris, France

[2] Lumière Matière et Interfaces (LuMIn), Université Paris-Saclay, Gif-sur-Yvette, France

[3] Institut parisien de Chimie Moléculaire (IPCM), Sorbonne Université, Paris, France

[4] Laboratoire de Biologie et Pharmacologie Appliquée (LBPA), Université Paris-Saclay, Gif-sur-Yvette, France

Mon travail de recherche porte sur l'élaboration d'une nanoplateforme hybride à base de nanobâtonnets d'or (AuNR) pour le traitement innovant du cancer du sein triple négatif.

Les AuNR sont depuis plusieurs décennies, largement utilisés pour des applications biologiques incluant la délivrance de médicament, la thérapie photothermique ou l'élaboration de biocapteurs. Les AuNR présentent un intérêt majeur grâce à leur résonance plasmonique de surface localisée (LSPR), leur forme anisotrope et la possibilité d'adapter leur rapport d'aspect pour correspondre aux fenêtres biologiques d'absorption.

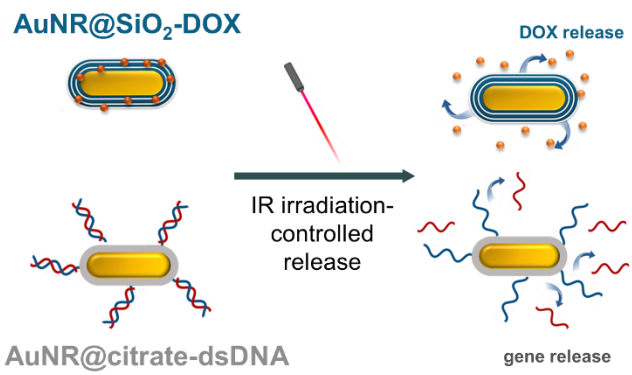
La synthèse des AuNR repose sur l'utilisation de CTAB, indispensable pour la stabilité colloïdale mais reconnu pour sa cytotoxicité. Plusieurs stratégies de chimie de surface ont été développé pour remédier à ce problème.

La première est de substituer le CTAB par des citrates, facilitant l'accès à la surface pour le greffage d'ADN double brin marqué par fluorophores. Ce système ouvre la voie au suivi du relargage de gènes thérapeutiques par fluorescence (FRET).

La seconde porte sur l'enrobage d'une silice poreuse épaisse et homogène en contrôlant les étapes d'hydrolyse et de condensation du TEOS, dérivé du procédé Stöber, permettant de créer des nanoparticules « cœur-coquilles » adaptées au chargement de la doxorubicine (DOX). L'étude montre que l'adsorption du médicament est efficace et que sa libération est accélérée en milieu acide (pH 5,5), condition proche de l'environnement tumoral, par rapport au pH physiologique (7,4).

Ces deux stratégies employées préservent la forme des AuNR ainsi que leurs propriétés optiques tout en augmentant leur biocompatibilité et stabilité.

L'ensemble constitue une stratégie combinant chimiothérapie et photothérapie contrôlée par irradiation infrarouge. Cette approche illustre le potentiel des nanomatériaux hybrides dans le développement de traitements innovants contre le cancer.



Mots clés : Nanobâtonnets d'or ; LSPR ; revêtement de silice ; biomatériaux ; nanoparticules à structure cœur-coquille ; matériel génétique ; greffe d'oligonucléotides ; irradiation laser NIR ; applications biomédicales.

Development of an immunomagnetic separation device to recover CD34 stem cells from cord blood.

Paul Sarpong, Agathe Figarol, Thérèse Leblois, Vincent Humblot

Université Marie et Louis Pasteur, CNRS UMR 6174, Institut FEMTO-ST, 15B Avenue des Montboucons, F-25000 Besançon, France.

This project involves the development of an immunomagnetic separation device for the isolation, quantification and recovery of CD34+ stem cells from complex media such as cord blood.

CD34 were discovered in 1984 as an antigen on haematopoietic stem cells [1]. These stem cells are early multipotent progenitor cells which can differentiate into several types of cells useful to the human body. The cord blood is a major source of CD34+ stem cells but rare (less than 2% in the cord blood)[2]. These stem cells are clinically used in applications such as regenerative medicine and cancer therapy [3, 4]. In this project, we propose to develop a reusable microfluidic device for the recovery of CD34+ stem cells which can be easily transferred to patients without the use of immobilizing drugs. This project will undergo four major steps: 1) Development of a specific biointerface for the capture of CD34+ stem cells on a solid substrate 2) Transposition of the specific biointerfaces onto magnetic nanoparticles 3) Reversible capture study of CD34+ cells using elution buffers for cell liberation 4) Generalization of previous steps and implementation in an immunomagnetic separation device for recovery of CD34+ stem cells from complex media such as cord blood. In this poster, we present the successful grafting of antibodies on a gold substrate using surface functionalization process with Thiol Self Assembled Monolayers (SAMs) and the characterization of the biointerface using Infrared Spectroscopy (IR) and X-ray Photoelectron Spectroscopy (XPS). Since pure CD34+ stem cells are costly (5000 €/ 1 million cells), we present a static and dynamic capture test using Human Umbilical Vein Endothelial Cells (HUVEC) which also express CD34 markers but at a lower level. The static capture test shows a specificity of 76 % despite lower level of CD34 expression on HUVEC cell surface and the dynamic capture test using Quartz Crystal Microbalance (QCM) with quantification analysis also shows the capture of 10,4k cells captured out of 50k cells.

References

1. Civin, C., *A hematopoietic progenitor cell surface antigen defined by a monoclonal antibody raised against KG-Ia cells.* J Immunol, 1984. **133**: p. 157-165.
2. Nimgaonkar, M.T., et al., *A unique population of CD34+ cells in cord blood.* Stem Cells, 1995. **13**(2): p. 158-166.
3. Mackie, A.R. and D.W. Losordo, *CD34-positive stem cells in the treatment of heart and vascular disease in human beings.* Texas Heart Institute Journal, 2011. **38**(5): p. 474.
4. Cieri, N., K. Maurer, and C.J. Wu, *60 years young: the evolving role of allogeneic hematopoietic stem cell transplantation in cancer immunotherapy.* Cancer research, 2021. **81**(17): p. 4373-4384.

Improving Electrochemical Aptasensor Sensitivity for Bacillus cereus Spore Detection in Food Safety Applications

M.Sentić[a]*, F. Rizzotto[b], Z. Novakovic[c], A. Karajić[d], B. Heddi[e], J. Vidic[b]

a University of Belgrade, Institute of Chemistry, Technology and Metallurgy, National Institute of the Republic of Serbia, Belgrade, Serbia

b Université Paris-Saclay, INRAE, AgroParisTech, Micalis Institute, Jouy en Josas, France.

c University of Novi Sad, BioSense Institute, 21000 Novi Sad, Serbia

d University of Cincinnati, Kilele Health Inc. 201E Dixon Avenure, USA

e ENS Paris-Saclay, Laboratoire de Biologie et Pharmacologie Appliquée (LBPA), UMR8113 CNRS, 91190 Gif-sur-Yvette, France

Corresponding author's e-mail address milica.sentic@ihtm.bg.ac.rs

Among food contaminating agents, *Bacillus cereus,* a Gram-positive spore-forming bacteria, poses serious problems for both consumers and food industry[1]. It is the primary microbe associated with baby food, third agent responsible for collective foodborne outbreaks in Europe and third leading foodborne pathogen in China[1]. The most dangerous species of the *B. cereus* group is *Bacillus anthracis*, the etiologic agent of anthrax, which causes a highly lethal disease in both humans and animals. Aptamers selected against *B. cereus* spores can be integrated into diagnostic aptasensors that function without the need for spore germination or lysis. Therefore, we speculate, here, that using a combination of aptamers that recognize *B. cereus* spores will allow targeting multiple epitopes at their surface, which will provide an enhance diagnostic sensitivity. For this, we tested three different aptamers already characterized for their binding to spores of various *B. cereus* strains, including. *B. anthracis*, named BAS6R in salade samples.

Keywords: Spores; health; aptamers; diagnostics; electrochemistry.

References

1. Authority, E. F. S. (2019). The European Union one health 2018 zoonoses report. EFSA Journal, 17(12), e05926
2. Cormontagne, D., Rigourd, V., Vidic, J., Rizzotto, F., Bille, E., & Ramarao, N. (2021). Bacillus cereus induces severe infections in preterm neonates: implication at the hospital and human milk bank level. Toxins, 13(2), 123.

Acknowledgment This research was financially supported by the Ministry of Science, Technological Development and Innovation of the Republic of Serbia (Contract No:451-03-136/2025-03/200026).

Title: **Magnetic hyperthermia coupled to siRNA deliverance to the cytosol for cancer treatment**

Lab: PHENIX (Physico-chimie des Électrolytes et Nanosystèmes Interfaciaux), Sorbonne Université, Inorganic colloids team (CIN)

Nanoparticles, positioned at the interface of nanotechnology and biomedicine, are typically smaller than 100 nm, enabling them to cross biological barriers, penetrate cells, and respond to external stimuli. In this project, we focus on the use of magnetic nanoparticles (MNPs) to induce cancer cell death through magnetic hyperthermia. When exposed to an alternating magnetic field, MNPs convert magnetic energy into heat, leading to thermal damage, enhancing chemotherapeutic activity, or triggering controlled drug release. Their efficacy, however, is limited by endosomal entrapment and aggregation, which reduce heating capacity. To overcome this, we designed core–shell nanoparticles (γ-Fe_2O_3–SiO_2) with an outer layer that can be functionalized. We then linked histidine-rich peptides to promote endosomal escape via a “proton sponge effect” and enable nanoparticles to diffuse in the cytosol through cleavable disulfide bonds.

To further improve therapeutic efficiency, the strategy also involves grafting siRNA targeting anti-apoptotic proteins (survivin, HSPs) or doxorubicin, thereby combining thermal and chemical effects. Both siRNA and drugs are designed for cytosolic release via intracellular disulfide cleavage, thus amplifying cancer cell death.