

FROM ANTIFOULING COATINGS TO BIOCHIP TECHNOLOGY

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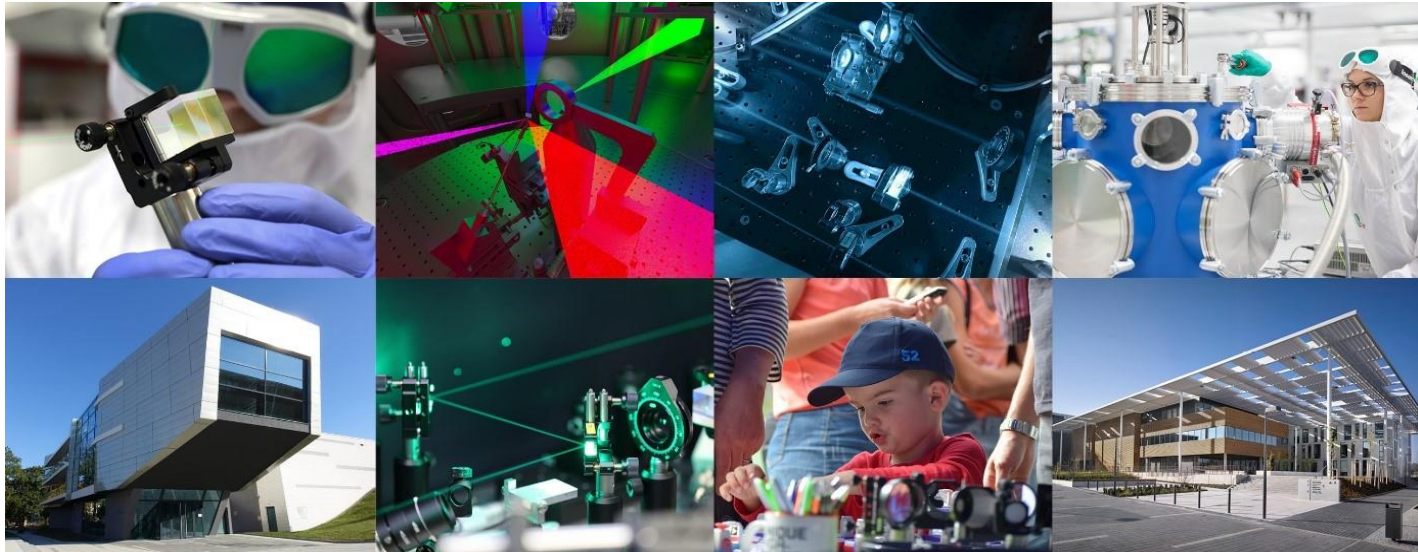


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Fundamental and applied research in physics

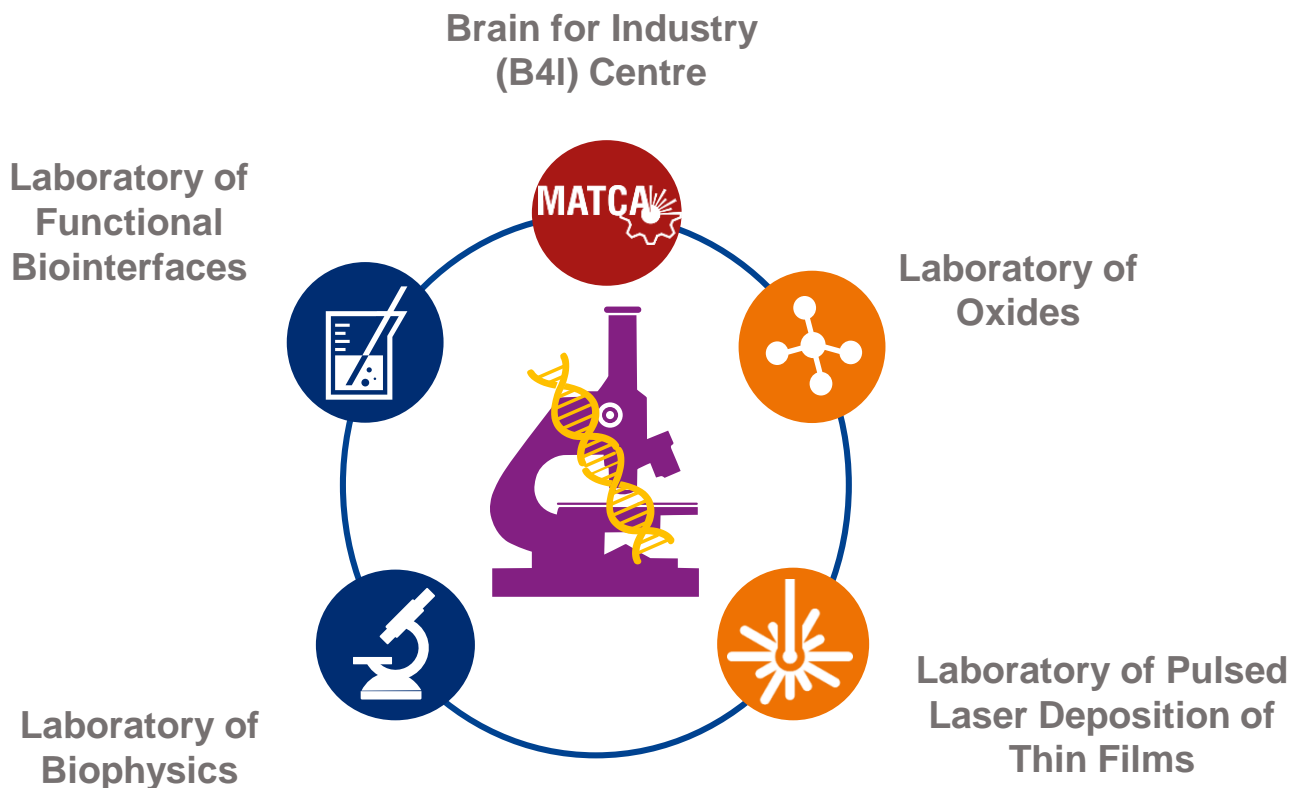
*(astrophysics, particle physics, condensed matter physics, solid state physics, plasma physics, optics and **biophysics**)*

The Department of Optical and Biophysical Systems



Dr. Alexander Dejneka

Head of the Department
of Optical and
Biophysical Systems,
Head of the Division of
Optics



Multidisciplinarity

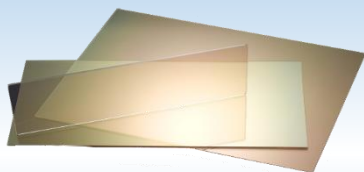
From fundamental research towards industry

LABORATORY OF FUNCTIONAL BIOINTERFACES

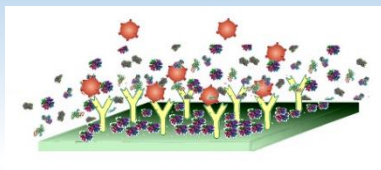


FIELD AND AIMS OF THE WORK

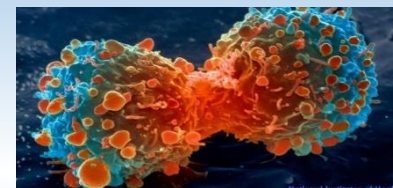
MULTIDISCIPLINARY FIELD



Material science



Biointerface research

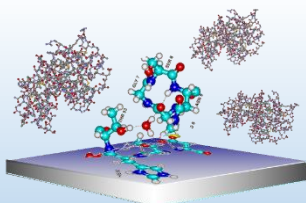


Biology

THE AIMS OF THE WORK

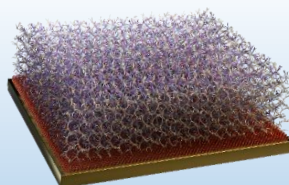
1.

Study on molecular interactions near surfaces



2.

Design of new antifouling platforms with tailored properties



3.

Applications in biosensing and cell research



MOTIVATION: Fouling As Global Issue

Fouling is nonspecific adhesion of molecules from biological media to surfaces



Medical implants

Nosocomial infections

Bio-imaging technologies

Separation techniques

Drug delivery systems

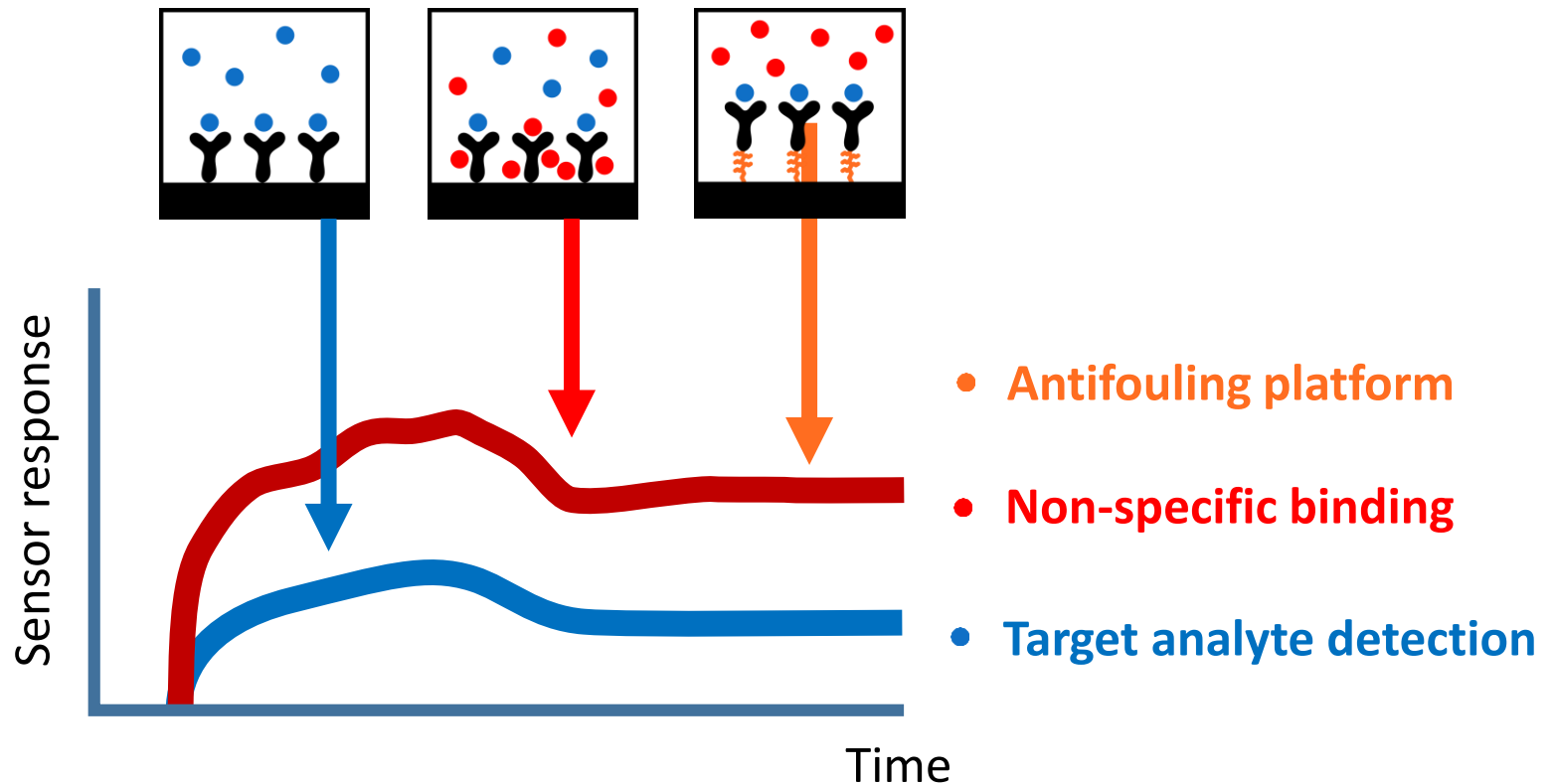
Bioanalytical techniques

Food packaging

Ship hulls

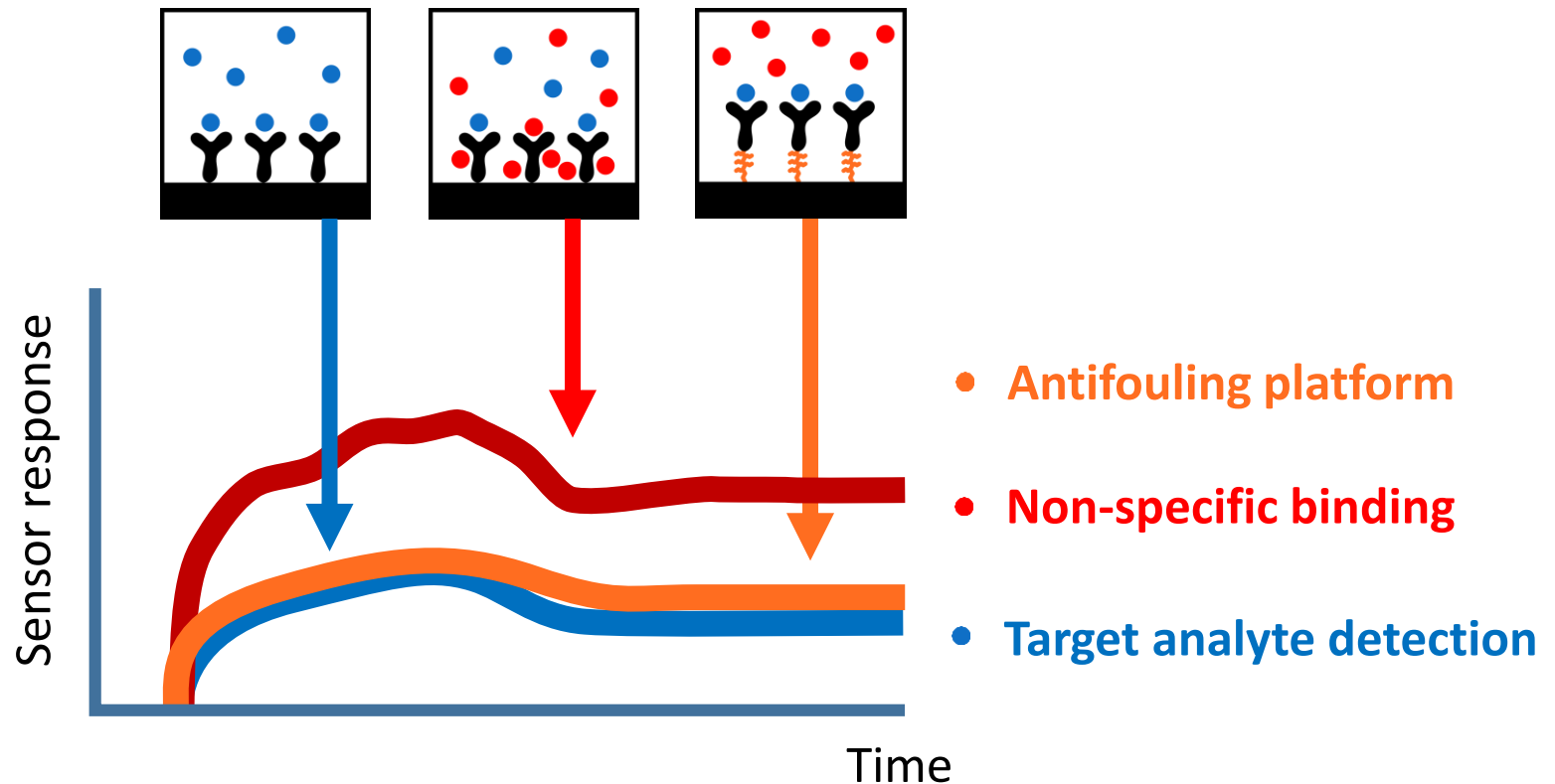
Fouling is a global problem in technologies aimed to be used with a direct contact with a complex biological sample

MOTIVATION: Fouling Influences Specific Interactions



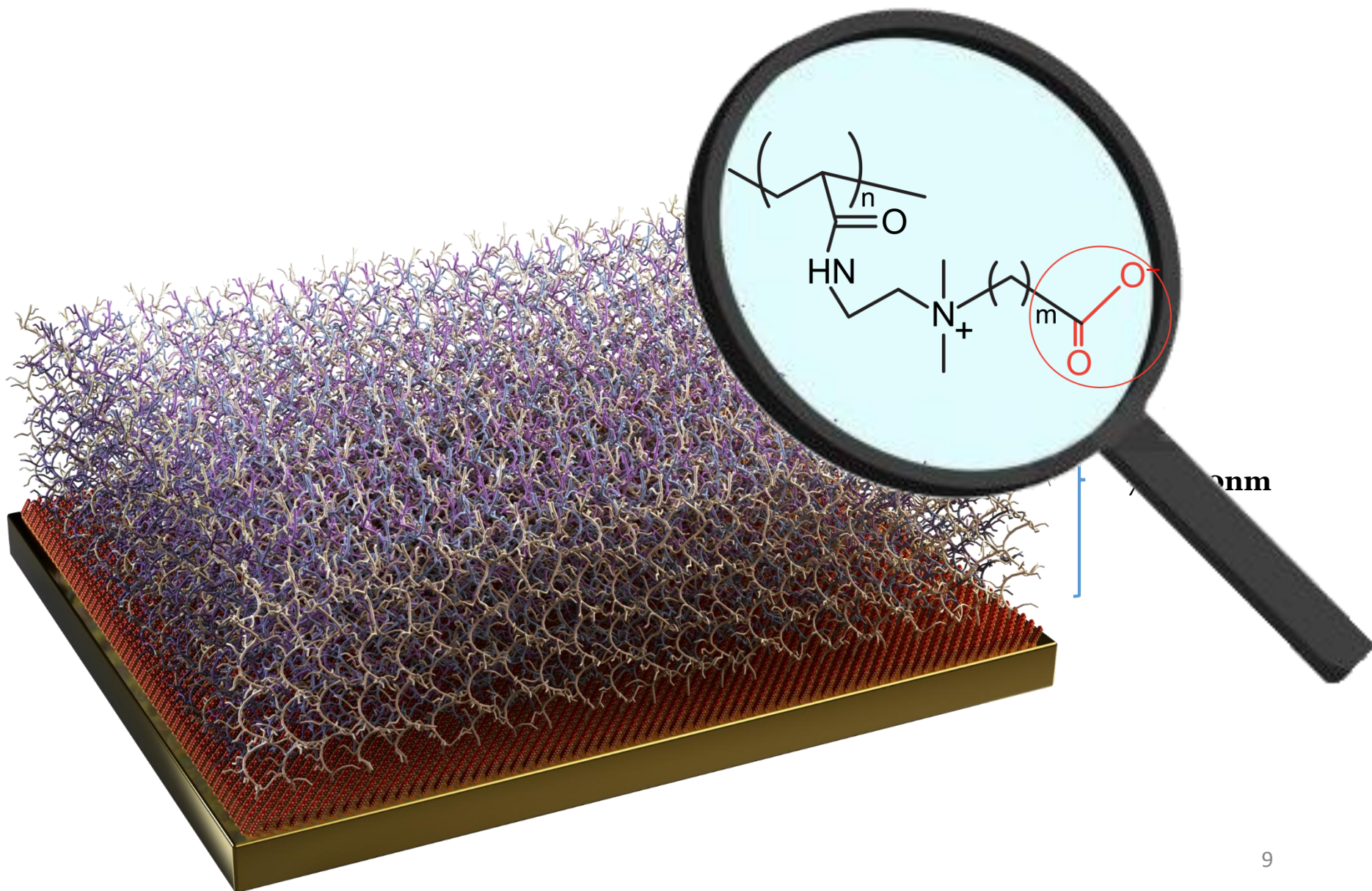
The influence of fouling level on the sensor response of surface-sensitive affinity biosensor.

MOTIVATION: Fouling Influences Specific Interactions

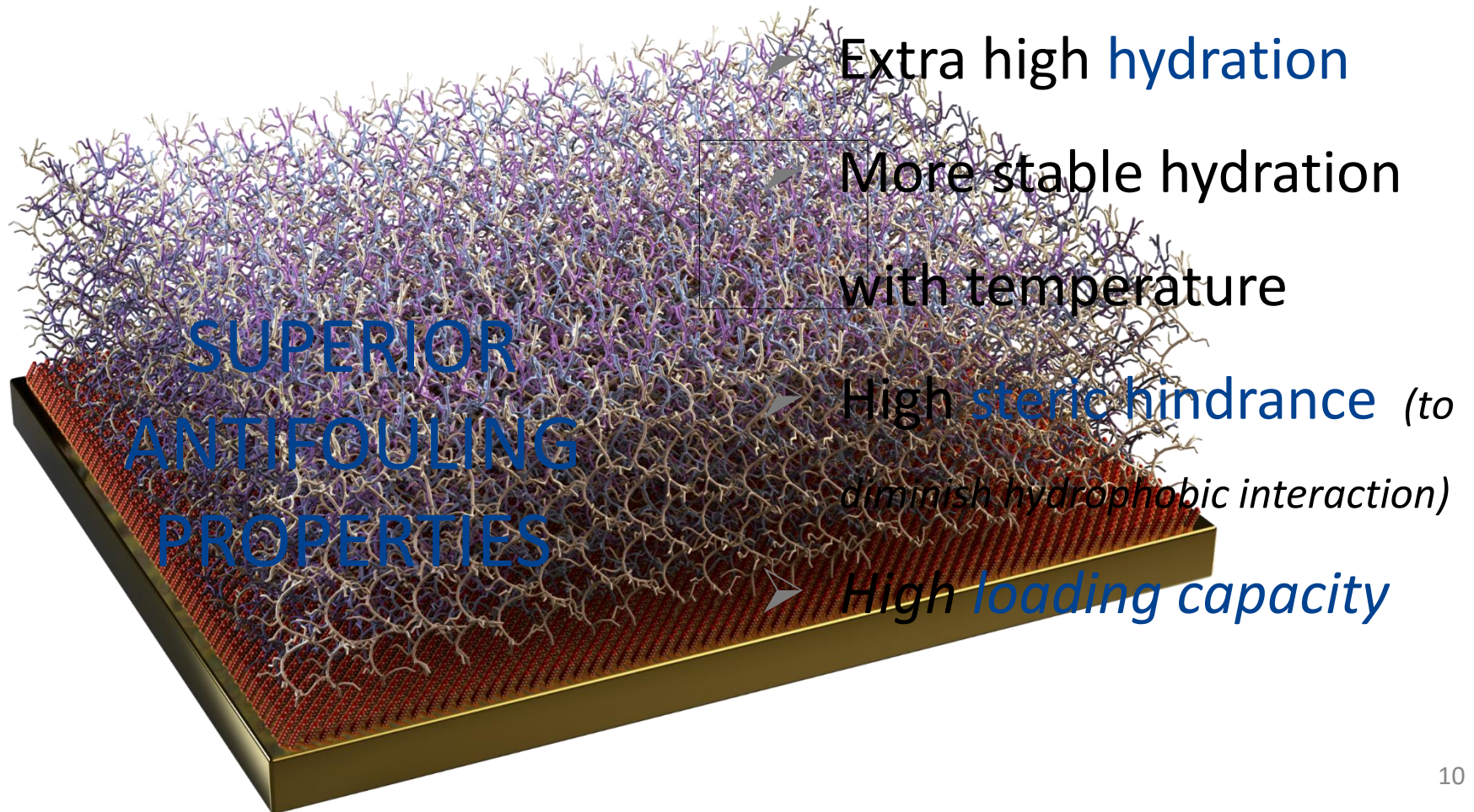


The influence of fouling level on the sensor response of surface-sensitive affinity biosensor.

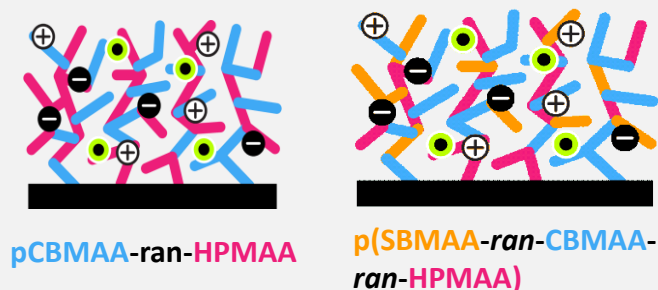
ZWITTERIONIC ANTIFOULING POLYMER BRUSHES



WHY ZWITTERIONIC BRUSHES?

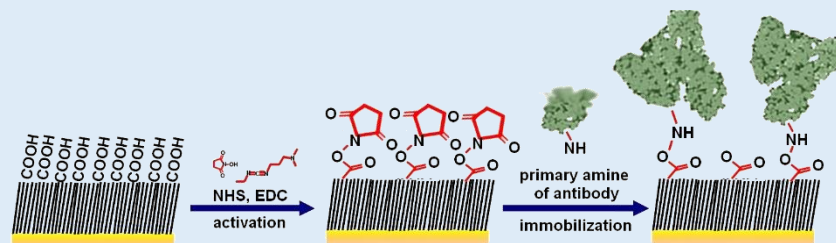


NEW COPOLYMER STRUCTURES ENGINEERING



- Vaisocherová-Lísalová, Surman, Víšová, et al., *Anal. Chem.*, 2016, 88 (21), 10533.
- Forinová, Pilipenco, Víšová, et. all, *ACS Appl. Mater. Interfaces*, 2021,13(50), 60612.
- Víšová, Vrabcová, Forinová, at al., *Langmuir*, 2020, 36(29), 8485


FUNCTIONALIZATION OF ANTIFOULING PLATFORMS

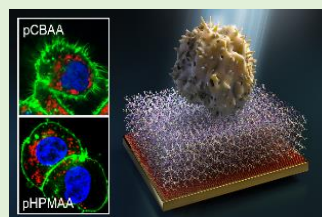


- Lísalová, Brynda, Houska, Víšová et al., *Anal. Chem.*, 2017, 89 (6), 3524.
- Víšová, Forinová, Pilipenco et al., 2022, submitted to *Adv. Mater. Interfaces*
- Víšová, Houska, Lísalová, 2022, *Analyst*, DOI: 10.1039/D2AN00436D

APPLICATIONS

BIOANALYTICAL APPLICATIONS (food safety, medical care)

- 
- Vaisocherová-Lísalová, Víšová, Ermini, at all., *Biosens. Bioelectron.*, 2016, pp. 84
 - Vaisocherová-Lísalová, Surman, Víšová, et al., *Anal. Chem.*, 2016, 88 (21), pp 10533.



COATINGS FOR CELL RESEARCH

- Víšová, Smolková, Uzhytchak, at all., *Macromol Biosci*, 2020, pp.1900351.
- Víšová, Smolková, Uzhytchak, at all., *Biomolecules*, 2020, pp.1146

ANTIFOULING COATINGS IN BIOSENSORS

Development of novel antifouling biochip technologies

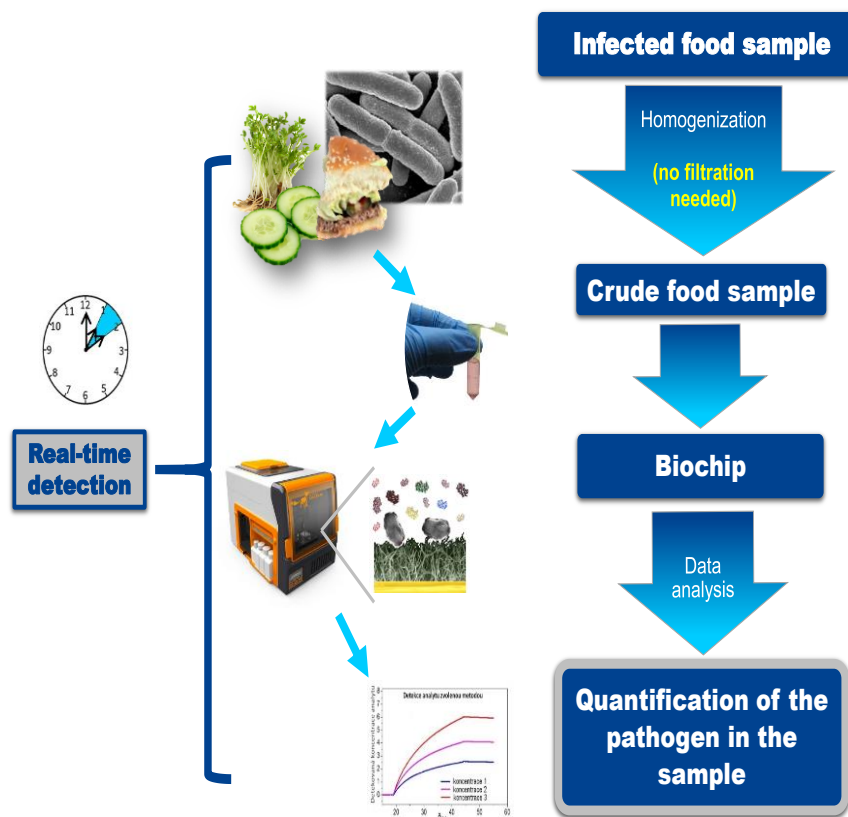
No sample pre-treatment

Fast analysis (~10 min)

Versatile platform

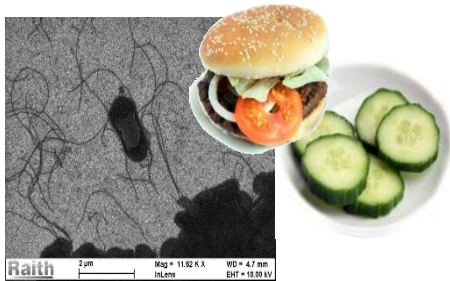
Point-of-care analysis

Easy-to-perform



Scheme of biochip-based analysis of real-world complex sample.

BACTERIA IN FOODS
(food safety)



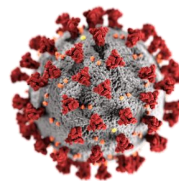
E.coli O157:H7: ~ **27 CFU/mL**
Salmonella sp.: ~ **4.5x10³ CFU/mL**

microRNA IN BLOOD LYSATE
(myelodysplastic syndrom early diagnosis)



miR 16, 181, 34a, 125b:
~ **0.35 – 0.95 pM**

SARS-Cov-2 in bodily fluids and surface swabs



~ **e3-e4 PFU/mL**

BIOSENSOR FOR SARS-COV-2 DETECTION (A-QCM)

Department of Optical and Biophysical
Systems

Laboratory of Functional
Biointerfaces



National center of
competence

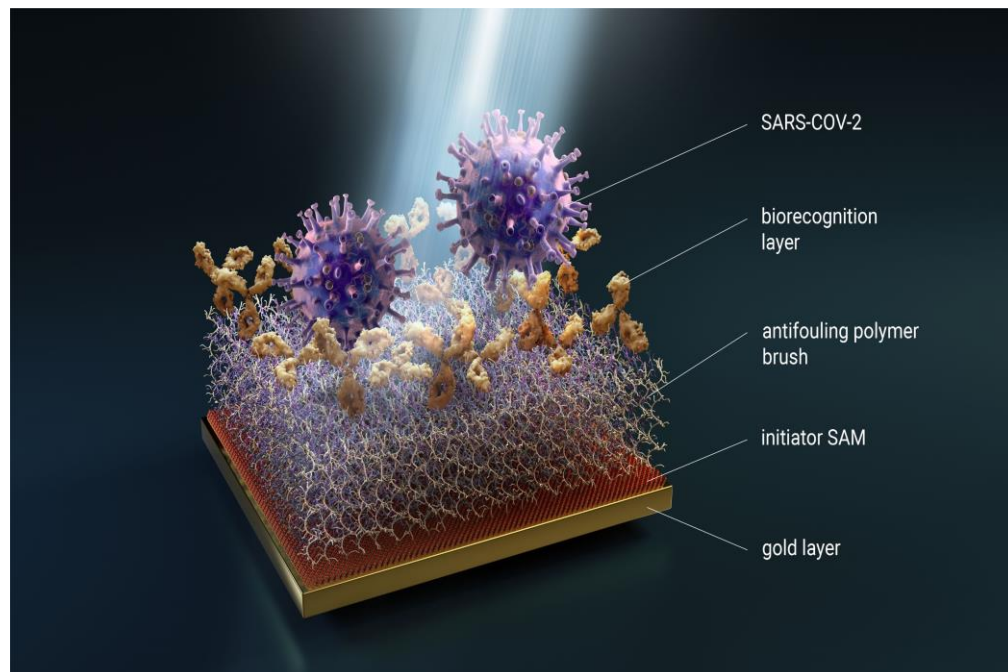


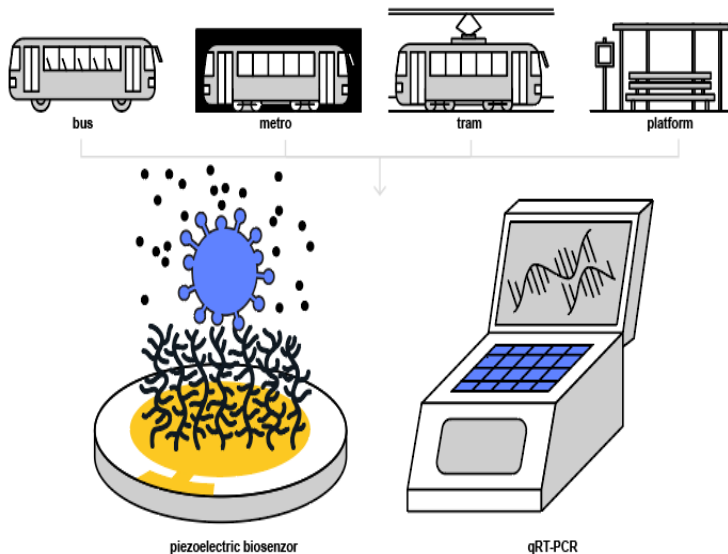
Illustration of antifouling biochip-based detection of SARS-COV-2.

- **Clinically relevant LOD**
- Detection time ~15 min
- No pre-treatment
- Universal (*for bodily fluids, surface swabs or environmental samples*)
- Quantitative analysis
- Repeated use
- Verified by qRT-PCR

SARS-COV-2 IN PUBLIC TRANSPORT: Large-scale study

558 samples

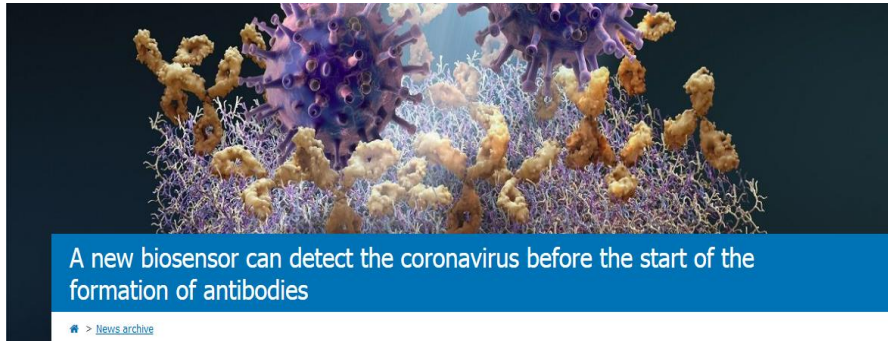
(surface swabs and air samples)



Blinded study regime: Each sample measured in duplicate by A-QCM, confirmed by qRT-PCR and cell culturing

No infectious sample confirmed

A-QCM SARS-COV-2 BIOSENSOR



Industrial partner CARDAM works on a robotic system construction for mass COVID19 testing based on presented biosensor technology



A-QCM for bioanalytical applications
has been transferred to industry

FUTURE PLANS



CURRENTLY

Institute of Physics, Joint Laboratory of Optics: Team of Quantum and Non-linear Optics

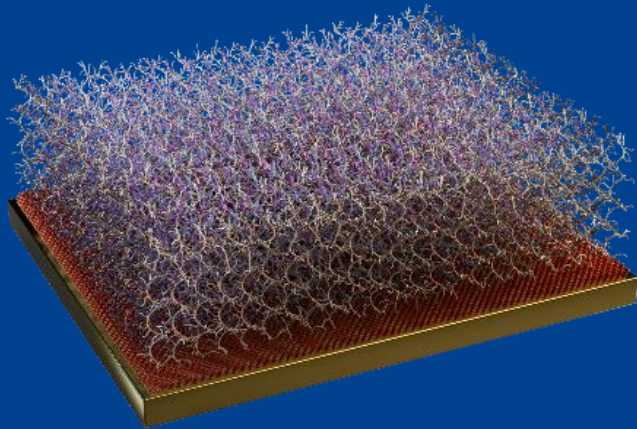
- Study on sub-shot-noise imaging using twin beams, focused on thin-layer absorption

NEAR FUTURE

Postdoc position abroad (MSCA and HFSP postdoctoral fellowship applications)

Summary

Antifouling functional polymer
brush platforms development



Applications: biosensors and cell
research platforms

