Research group A-PECS
Antwerp engineering, photoelectrochemistry and sensing

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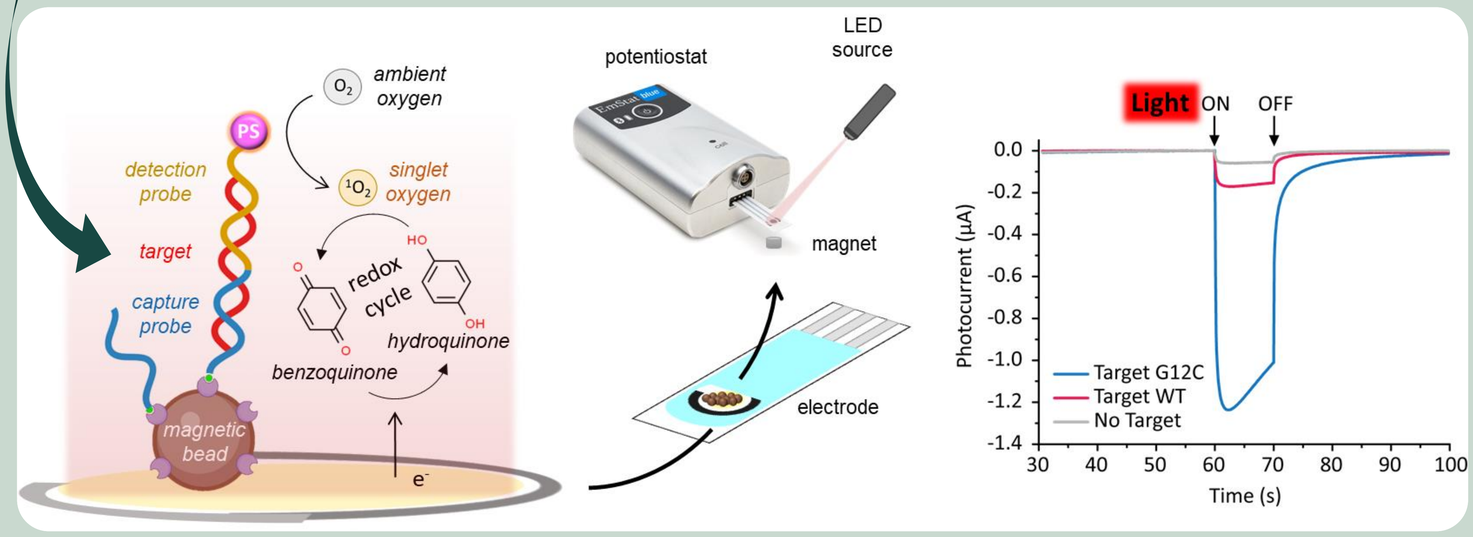
JOIN A-PECS!

DNA and RNA detection play a crucial role in cancer diagnosis, infectious disease detection, invasive species monitoring, and antimicrobial resistance surveillance. Despite the high specificity and sensitivity of current diagnostic methods such as polymerase chain reaction (PCR) and next-generation sequencing (NGS), these technologies are largely confined to laboratory settings due to their long time to result, cost and complexity. There is an urgency to develop accessible **diagnostics** that **anyone** can perform **anywhere** and **at any time**. Bioelectrochemistry offers a promising solution, and we invite you to join us in addressing these challenges!

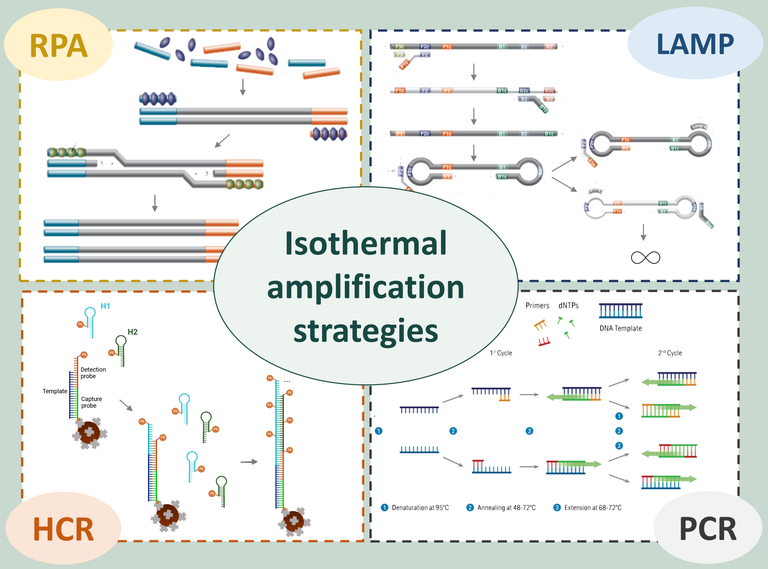
Our ambition: developing robust, low-cost biosensors for the detection of nucleic acid biomarkers



Singlet-oxygen ($^1O_2$)-based photoelectrochemical detection [1-3]

BOOSTING THE SENSITIVITY

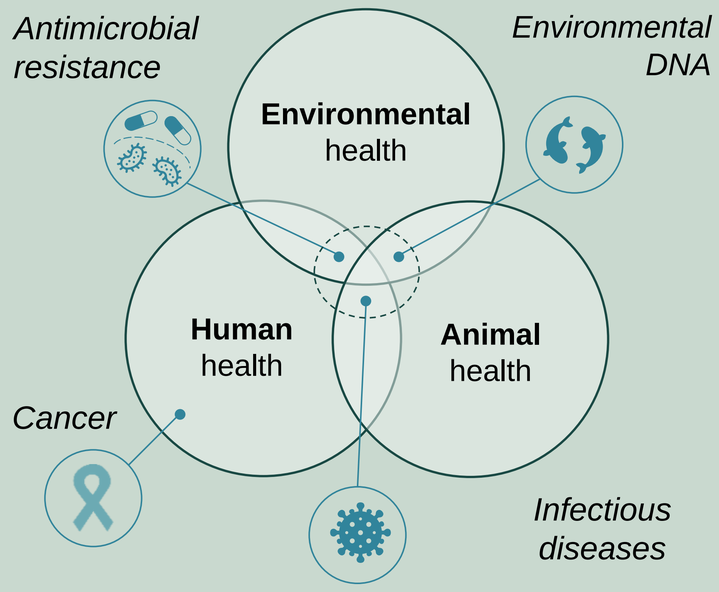
Isothermal amplifications such as recombinase polymerase amplification (RPA), loop-mediated isothermal amplification (LAMP) and hybridisation chain reaction (HCR) will be explored to boost the sensitivity of our detection platform. Initially, visualization techniques as **gel electrophoresis** will be used. Eventually, this knowledge will be integrated into novel platform using $^1O_2$-based **photoelectrochemical detection**, a cutting-edge technology from the research group.



VERSATILITY OF THE BIOSENSING PLATFORM

Current electrochemical methods focus on single-stranded DNA (ssDNA) for easy probe hybridization, but the natural **double-stranded DNA (dsDNA)** is more challenging. In this study, we tackle this issue by optimizing parameters like **denaturation efficiency, hybridization temperature and incorporating high-affinity building blocks** to ensure accurate and efficient probe hybridization.

REAL SAMPLE ANALYSIS



A crucial stage in sensor development is real sample analysis. We aim to deliver a versatile biosensing platform that fully aligns with the **One Health concept**, addressing critical health challenges across human, animal and environmental domains. To evaluate the matrix effects on the performance of the biosensors, artificial nucleic acids will be spiked into various matrices, such as plasma, serum, river water and extracted DNA samples. The impact will be investigated in terms of specificity and sensitivity using light-chopped chronoamperometry.

VALIDATION

Real samples from each application area will be analyzed using both the novel biosensing technology and PCR. For **infectious diseases**, we will detect viral dengue RNA in patient serum samples in collaboration with Prof. K. Ariën (Institute of Tropical Medicine). **Environmental DNA** in water samples will be screened with Prof. R. Brys (Research Institute for Nature and Forest). For **antimicrobial resistance**, human and environmental samples will be analyzed in partnership with Prof. S. Van Puyvelde. Additionally, **cancer** biomarkers in tissue and liquid biopsies will be examined with Prof. T. Vandamme, Prof. K. Zwaenepoel, and Prof. S. Koljenović (Antwerp University Hospital).

Institute of Tropical Medicine Antwerp · UZA · University of Antwerp · Instituut Natuur- en Bosonderzoek

More info

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References

[1] Trashin et al., Singlet oxygen-based electrosensing by molecular photosensitizers. Nat Commun, 2017.
[2] Daems et al., Singlet oxygen-based photoelectrochemical detection of single-point mutations in the KRAS oncogene. Biosens Bioelectron, 2024.
[3] Shanmugam et al., Singlet oxygen-based photoelectrochemical detection of DNA. Biosens Bioelectron, 2022.