Doctoral School of Information and Biomedical Technologies
Polish Academy of Sciences (TIB PAN)

SUBJECT: Development of DNA-based sensor for determination of autoinducers secreted by *Pseudomonas aeruginosa*

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DESCRIPTION:
The aim of the project is to investigate the properties of complex structures (assemblies) designed for determination of selected autoinducers (AIs) secreted by *P. aeruginosa*. Autoinducers are small signal molecules involved in the quorum sensing used by *P. aeruginosa* to detect their population density and coordinate group actions (such as the formation of biofilms). AIs are secreted by bacteria at the first stage of infection process, therefore their control may be used to prevent and monitor inflammation process. AIs produced by *P. aeruginosa* are *L*-homoserine lactones (AHLs), 2-heptyl-3-hydroxy-4-quinolone (PQS) and 2-(2-hydroxyphenyl)-thiazole-4-carbaldehydes (IQS). The step for creating recognition layer during biosensor design is one of the most challenging issues when developing sensor of any type. In this project, DNA-based sensing layers for PQS and IQS determination are proposed. As it was proven previously, that PQS and IQS are electrochemically active, and can be oxidized on carbon-based electrodes. However in order to assure selectivity, a bioreceptor should be implemented. Within the project the following steps is expected to be realized: selection of DNA strands as bioreceptors for IQS and PQS; optimization of surface functionalization with selected DNA strands, physico-chemical characterization of DNA-functionalized surfaces and evaluation of metrological parameter of DNA-based sensors. In the final stage of the research, the constructed bio-platforms will be tested in real samples.
Functionalized electrodes will be characterized using spectroscopic and electrochemical methods. The effectiveness of surface functionalization will be examined of FTIR, XPS and impedance spectroscopy and cyclic voltammetry. Additionally, the usage of EQCM will enable the quantitative comparison of modification protocols and activity studies of prepared electrodes.

Nanoparticles, such as Au nanoparticles, multiwalled nanotubes, graphene derivatives will be used in order to increase the sensitivity of DNA-based electrochemical sensors.

REFERENCES:
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[2] Fletcher M.P., Diggle S., Camara M., and Paul Williams P. Detection of 2-alkyl-4-quinolones using biosensors in Livia Leoni and Giordano Rampioni (eds.), Quorum Sensing: Methods and Protocols, Methods in Molecular Biology, vol. 1673, https://doi.org/10.1007/978-1-4939-7309-5_2, © Springer Science+Business Media LLC 2018.

[3] Hua Y, Ma J, Li D, Wang R. DNA-Based Biosensors for the Biochemical Analysis: A Review. Biosensors (Basel). 2022 Mar 20;12(3):183. doi: 10.3390/bios12030183.