ELECTROCHEMICALLY-DRIVEN MOLECULARLY IMPRINTED POLYMER-BASED SENSOR FOR DETECTING THE NUCLEOCAPSID PROTEIN OF SARS-CoV-2

Maryia Drobysh[1], Vilma Ratautaite[1], Ernestas Brazys[2], Almira Ramanaviciene[3], Arunas Ramanavicius[1,2]

[1]Center for Physical Sciences and Technology, Department of Nanotechnology, Sauletekio av. 3, LT-10257, Vilnius, email: maryia.drobysh@ftmc.lt

[2]Vilnius University, Faculty of Chemistry and Geosciences, Institute of Chemistry, Department of Physical Chemistry, Naugarduko Str. 24, LT-03225 Vilnius

[3]Vilnius University, Faculty of Chemistry and Geosciences, Institute of Chemistry, NanoTechnas – Center of Nanotechnology and Materials Science, Naugarduko Str. 24, LT-03225 Vilnius

This is a comparative study of the utility of three different molecularly imprinted polymer (MIP) systems. These MIPs are based on polypyrrole with SARS-CoV-2 nucleocapsid protein templates. Notably, the nucleocapsid proteins are more structurally stable by a relatively low propensity for mutation compared to other SARS-CoV-2 antigens [1]. Such structural stability makes them an attractive target for diagnostic assays.

The three MIP systems examined in this study were based on screen-printed carbon electrodes (SPCE) modified with gold or platinum nano-structures.

Pulsed amperometric detection (PAD) was used to evaluate the three MIP systems. PAD is an electrochemical technique known for its label-free detection capabilities, eliminating the need for additional redox probes [3].

To evaluate the performance of each MIP system, calibration curves were constructed to quantify the response of the sensing systems to varying concentrations of SARS-CoV-2 nucleocapsid protein. In parallel, non-imprinted systems were included as controls to assess nonspecific binding, which is a critical factor in sensor development.

The study included the determination of analytical parameters such as limits of detection (LOD) and quantitation (LOQ) for the MIP1 system.

To confirm the specificity of the MIP1 system, a specificity test was performed using the receptor-binding domain of the SARS-CoV-2 spike protein as a control.

In conclusion, the most suitable and specific MIP-based sensor identified in this study is the MIP1 based on gold nanostructures. Continued research and development in this direction offer the potential for enhanced sensor applications in real sample analysis.

Acknowledgements: This project has received funding from the European Regional Development Fund (project No. 13.1.1-LMT-K-718-05-0033) under a grant agreement with the Research Council of Lithuania (LMTLT). Funded as the European Union's measure in response to COVID-19 pandemic.

References

1. X. Li, M. Xiong, Q. Deng, X. Guo, Y. Li, J Clin Lab Anal. **36**(7), e24534 (2022).
2. M. Drobysh, V. Liustrovaite, A. Baradoke, R. Viter, C-F. Chen, A. Ramanavicius, A. Ramanaviciene, Biosensors. **12**(8), 593 (2022).
3. V. Ratautaite, R. Boguzaite, E. Brazys, D. Plausinaitis, S. Ramanavicius, U. Samukaite-Bubniene, M. Bechelany, and A. Ramanavicius, Talanta. **253**, 123981 (2023).