DEVELOPMENT OF MOLECULARLY IMPRINTED POLYMER ON MAGNETIC PARTICLES

Gabrielė Slaboševičiūtė[1,2], Ernestas Brazys[1,3], Vilma Ratautaitė[1], Arūnas Ramanavičius[1,3]

[1]State Research Institute Center for Physical Sciences and Technology (FTMC), Department of Nanotechnology, Sauletekio Ave. 3, Vilnius LT-10257, Lithuania

[2]Vilnius Tech, Faculty of Fundamental Sciences, Department of Chemistry and Bioengineering, Sauletekio ave. 11, Vilnius LT-10223, Lithuania

[3]Vilnius University (VU), Faculty of Chemistry and Geosciences, Institute of Chemistry, Department of Physical Chemistry, Naugarduko str. 24, Vilnius LT-03225, Lithuania

gabriele.slaboseviciute@ftmc.lt

Molecularly imprinted polymers (MIPs) are synthetic receptors with highly specific recognition sites for target molecules. They have shown great potential as substitutes for biological receptors (e.g., antibodies and enzymes) in many areas, including molecular chemosensing, separation and purification, enzyme-like catalysis, drug development, and various biomedical applications. MIPs are stable, easy to make, and have high affinity and selectivity [1].

The typical molecular imprinting procedure consists of a few steps: 1) self-assembly of functional monomers, crosslinkers, and template molecules to create pre-polymerisation complexes; 2) chemical or electrochemical polymerisation; 3) removal of the template molecules from the obtained polymer, which generates the binding sites in the structure of the polymer, which are specific or complementary to the template molecules [2,3]. This characteristic is helpful for sensor development for specific detection. Traditionally, MIPs are prepared by bulk polymerisation as monoliths. However, this method has several drawbacks, such as a limited amount of binding sites near the surface, inaccessible recognition sites within the polymer bulk, or non-uniform morphology. In particular, imprinting of large, high-molecular-weight macromolecules, especially peptides and proteins, remains a significant challenge due to their large dimensions, complex structures, and limited solubility and stability in solution [1]. A solution to overcoming these disadvantages is the use of magnetic nanoparticles. This study presents some aspects of molecularly imprinted biosensor development, with polymerisation occurring on magnetic nanoparticles.

In this study, cobalt ferrite ($CoFe_2O_4$) magnetic nanoparticles (MNP) were employed as a platform to develop a MIP-based sensor. During chemical synthesis, MIP polymerisation was carried out directly on the surface of the magnetic nanostructures, followed by removal of the template molecules to generate specific recognition sites. The synthesised MIP-coated MNP were used for spectrophotometric and electrochemical measurements to determine the polymer-template interactions. The electrochemical measurements were carried out in a three-electrode electrochemical cell comprising magnetic glassy carbon working electrode (GCE), a platinum grid counter electrode, and an $Ag/AgCl_{3MKCl}$ reference electrode. The interactions of the MIP-coated MNP on GCE with the template molecule were investigated by cyclic voltammetry (CV), electrochemical impedance spectroscopy (EIS), and differential pulse voltammetry (DPV).

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