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# DEVELOPMENT OF AN ELECTROCHEMICAL BIOSENSOR BASED ON POLYELECTROLYTE ASSEMBLIES

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**Introduction.** Polyelectrolyte layers have found widespread application in various fields, including biomedicine, chemical and food industries, as well as in sorption technologies and substance separation [1]. These materials are used to modify the surface of quartz crystal microbalances (QCM chips) to alter their physicochemical characteristics. An important aspect of the research is the study of the polymer layering process on various surfaces, where the efficiency of sorption is determined by the speed of molecular diffusion. The accumulation of polyelectrolyte on the surface leads to a change in charge, which in turn affects the adhesion of subsequent layers with a similar charge. Special attention is given to the ability of polyelectrolyte matrices to absorb bioactive macromolecules without losing their conformation and activity, which is crucial for working with proteins, enzymes, and antibodies. The development of such complexes paves the way for the creation of portable sensor devices used in "Lab-on-a-chip" systems for continuous monitoring of critical parameters and targeted delivery of pharmaceuticals [2].

**Main part.** In this study, the methodology for creating microscopic polyelectrolyte films using the layer-by-layer (LbL) technique is analyzed, with the aim of determining the optimal conditions for their formation. The study involved the creation of a polyelectrolyte matrix using the LbL method, analysis of the impact of the molecular weight of polyelectrolytes on their distribution on the substrate, and assessment of structural changes in the outer layers.

The formation of a polyelectrolyte film on the gold surface of a QCM chip, consisting of layers of positively charged polyethyleneimine (PEI) and negatively charged polystyrenesulfonate (PSS) using the LbL method, was investigated. This process involved sequentially passing polyelectrolyte solutions through a chamber with a QCM chip and recording the mass of each deposited layer.

The research showed that polyelectrolytes form globules of different morphology and size on the surface of substrates, affecting the adsorption of subsequent layers. The experiments revealed the formation of a heterogeneous structure of polyelectrolyte globules on gold QCM chips. However, reversing the flow of the solution led to an increase in the adsorption of PEI, promoting a more compact packing of polycationic PEI globules and, consequently, improving the adsorption of polyanionic PSS. Thus, changing the direction of flow can affect the structural organization of polyelectrolyte layers.

It was also noted that polyelectrolytes of different molecular weights are adsorbed on the surface of the QCM chip to varying degrees, with low molecular weight polyethyleneimine (1.3 kDa) being adsorbed in smaller amounts but contributing to a denser packing of globules. At the same time, changes in the structure of films formed from high molecular weight polyethyleneimine (25 kDa and 750 kDa) were not observed, which may be due to the larger size of the molecules.

**Conclusions.** Within the framework of the experiment, the hypothesis regarding the impact of changing the flow direction of the solution on the structure of polyelectrolyte layers was investigated. It was found that polyelectrolytes of different molecular weights exhibit varying sorption efficiencies on the surface of QCM chips, with a denser packing observed for polyelectrolytes with lower molecular weight.

## References.

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2. Rukhlyada K. A. et al. Universal Method Based on Layer-by-Layer Assembly for Aptamer-Based Sensors for Small-Molecule Detection //Langmuir. – 2023. – V. 39. – №. 31. – P. 10820-10827.