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POLYELECTROLYTE MULTILAYERS IN MINIATURIZED IONSELECTIVE ELECTRODE CONSTRUCTION FOR HEALTHNET MONITORING

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Abstract. Due to the emergence of new functional materials and the development of technologies for processing big data, ion-selective electrodes (ISEs) have shown great potential for routine and portable detection of ions of different nature. Various methods of electrode modification are used to improve the electroanalytical properties of ISEs. We propose using ISEs based on carbon fiber with immobilized polyelectrolytes layers by Layer-by-Layer (LbL) deposition.

The analysis of biofluids for monitoring human health requires reliable analytical tools. The electrochemical method is the most popular way due to high sensitivity and selectivity, rapid response, and good compatibility. Ion-selective electrodes have found widespread applications in the area of clinical diagnostics and have shown great potential for routine and portable detection of ions of different nature. Sensor platforms that use fibrous textile offer great promise for creating wearable devices.

We propose using ion-selective electrodes to create flexible electrochemical devices based on carbon fiber (CF). The CF was used as a conductive substrate due to its low cost, commercial availability and the possibility of using for measurement in microvolumes of the samples. An essential stage in creating electrodes is modifying the fiber with solutions of polyelectrolytes (PEs). The working surface of the electrode was nanostructured using a Layer-by-Layer (LbL) assembly. The LbL procedure includes step-by-step electrostatic assembly of oppositely charged particles on the substrate's surface, which allows the formation of a coating of broad functionality. Thus, the layers of polyelectrolytes adsorbed on the carbon fiber surface form a pseudo internal solution. On the other hand, they act as an ion-electronic transducer.

The adsorption of PEs layers was studied by QCM measurement and method of scanning electron microscopy. It was proved of formation polyelectrolyte complex, probably, due to their electrostatic interaction. According to the obtained data of electrochemical impedance, we can assert that the membrane is permeable to determining ions; therefore, charge transfer occurs since the resistance values change with a change in concentration.

Ionselective electrodes were obtained for each ion, including potassium, sodium, and calcium, and pH electrodes. Their electroanalytical characteristics have been studied. In particular, the electromotive force (EMF) was measured between the ISE and a commercial Ag/AgCl reference electrode. Calibration plots for sodium and calcium ions show the Nernst response over a concentration range of 10^{-4} to 1 M. The ISM for potassium ions determination shows a low slope concerning the Nernstian.

Thus, we have developed ion-selective electrodes based on carbon fiber, modified with polyelectrolytes, selective to potassium, sodium, calcium and pH ions. The adsorption of polyelectrolyte layers has been studied using scanning electron microscopy (SEM) and quartz crystal microbalance (QCM). The electroanalytical characteristics of the obtained electrodes were

studied. In the future, the developed electrodes will be used in biological fluids to determine the main parameters. Then it is necessary to combine several sensors into a one-touch platform. After that, the sensor platform is integrated into various devices with software to transmit and transform the analyzed object's received data.