***Titarenko O. S.**, master student*
***Tychkov V. V.**, Candidate of Technical Sciences, Associate Professor*
***Trembovetska R. V.**, Doctor of Technical Sciences, Associate Professor*
***Halchenko V. Y.**, Doctor of Technical Sciences, Professor*
Department of Instrumentation, Mechatronics and Computerized Technologies
Cherkasy State Technological University

IMPROVEMENT OF VOLTAMMETRIC DETERMINATION OF GLUCOSE CONCENTRATION

Reliability and information reliability about the composition of biological objects and technological solutions depends on the properties of simple analytical devices that determine the desired component and correctly respond to changes in its concentration. Such a device in electrochemical systems is an electrode, on the surface of which concentration, separation, and determination of a substance can be performed simultaneously. The state of the electrode surface affects the peculiarities of the electrode processes that create the analytical signal. The properties of the electrode surface depend on the nature of the material, its manufacturing methods, and surface treatment methods.

Since the response signal in an electrochemical system is formed at the electrode/solution interface and depends on the state of the electrode surface, which is determined by the nature of the material, the presence of modifying substances, its homogeneity, etc., the result of the experiment largely depends on the correct selection of the indicator electrode. For this reason, great attention is paid to the electrode material, methods of modification and regeneration of its surface, which determines the working area of potentials, the magnitude of the response signal and the ability to achieve the established metrological characteristics. The requirements for electrodes are quite high: first of all, they must guarantee the electrochemical reaction at a high speed at low overvoltages.

Thus, the aim of the study is to investigate planar and bulk electrodes based on the characteristics of glucose solutions obtained by voltammetry.

Two types of electrodes were used for the experiment: bulk and planar. As a planar electrode, we chose the test strips for the TM GAMMA Diamond glucometer. This type contains three gold electrodes at the ends of which the enzyme glucose oxidase is coated, upon interaction with which glucose solutions become electrically active. A comparison electrode can be made on one strip of film along with the indicator electrode; it is only necessary to add, for example, silver chloride to the dye. If such a strip of polymer film with electrodes printed on it is dipped into the analyzed solution, an electrochemical transducer is obtained.

As bulk electrodes, we chose a carbon working indicator electrode, which has the advantage of a sufficiently high chemical and electrochemical inertness in aqueous solutions, and a silver chloride electrode, a comparison electrode consisting of a silver wire (spiral) coated with a low-soluble AgCl salt and immersed in a 1M KCl solution. A platinum wire was used as an auxiliary electrode.

The analysis of studies of voltammetric determination of glucose concentration in blood serum was carried out, the physical processes and regularities occurring in the electrochemical converter were studied. Glucose solutions in a wide range of concentrations were prepared. For each of the concentrations, 9 cycles of oxidation-reduction voltammetry were measured using planar electrodes with a potential scan [- 1.5 V, + 1.5 V] and a step of 0.025 V. The I(C) dependence was constructed for two types of electrodes: planar and bulk.

With an increase in the concentration of glucose in solution, the value of the current flowing through the electrode increases. This pattern is observed when using both types of electrodes. The surface structure of the planar electrode changes with the next cycle. The working surface of the bulk electrode remains constant during the experiment. The planar electrode has a higher sensitivity compared to the bulk electrode because the current in planar electrodes is much

higher than in bulk electrodes. In the electrode process, the limiting current has a mixed diffusion-kinetic character. Thus, the interaction of the combined structures of an electrochemical diffusion converter with liquid and solid-phase elements was investigated.

References:

1. Vanderlaan, E. L., Nolan, J. K., Sexton, J., Evans-Molina, C., Lee, H., & Voytik-Harbin, S. L. (2023). Development of electrochemical Zn2+ sensors for rapid voltammetric detection of glucose-stimulated insulin release from pancreatic β-cells. Biosensors and Bioelectronics, 235, 115409.

2. Yasir, A. S., Hameed, A. S., Ridha, N. J., Alosfur, F. K. M., Tahir, K. J., & Madlol, R. A. (2023). Enhancement of voltammetric properties of silver nanoparticles doped ZnO nanorods for glucose biosensing. Journal of Materials Science: Materials in Electronics, 34(4), 315.

3. Geetha, M., Maurya, M. R., Al-maadeed, S., Muthalif, A. A., & Sadasivuni, K. K. (2022). High-precision nonenzymatic electrochemical glucose sensing based on CNTs/CuO nanocomposite. Journal of Electronic Materials, 51(9), 4905-4917.

4. Si, Y., Li, J., Jhung, S. H., & Lee, H. J. (2022). Recent research trends in voltammetric sensing platforms for hormones and their applications to human serum analyses. Analytical Sciences, 38(1), 11-21.

5. Saeed, U., Batool, R., Hussain, D., Majeed, S., Najam-ul-Haq, M., & Fatima, B. (2022). MOF-based electrochemical sensors for glucose. In Metal-Organic Frameworks-Based Hybrid Materials for Environmental Sensing and Monitoring (pp. 207-216). CRC Press.

6. Khosravi Ardakani, H., Gerami, M., Chashmpoosh, M., Omidifar, N., & Gholami, A. (2022). Recent progress in nanobiosensors for precise detection of blood glucose level. Biochemistry Research International, 2022.

7. Zhang, J., Kuang, Z., Li, H., Li, S., & Xia, F. (2022). Electrode surface roughness greatly enhances the sensitivity of electrochemical non-enzymatic glucose sensors. Journal of Electroanalytical Chemistry, 919, 116541.