

“Opracowanie zintegrowanego systemu do oceny wybranych parametrów w procesie zwilżania metalicznych powierzchni w produkcji biosensorów”

mgr inż. Marcin Paweł Prządka

ABSTRAKT

The doctoral thesis was completed as part of the “Implementation Doctorate” program in cooperation with Food4Future Technologies Sp. z o.o. Its goal was to design and construct a workstation in the form of a device integrated with the production process, which would enable research on substrates with Au electrodes for sensor technology. The executed work can be divided into three stages, which include: determining the factors influencing the performance of biosensors, constructing a quality control system in the biosensor production process, and investigating the influence of the type of substrate and plasma modification of the Au electrode surface on improving the performance of biosensors.

A review of the literature showed that controlling the parameters of the bioreceptor layer deposition process is important in the production of biosensors. However, this issue has not yet been described to an extent that would allow for a reliable determination of the factors affecting the performance of biosensors. Therefore, as part of the work, the following tests were performed on selected batches of production substrates: topography of the Au electrode surface using an optical profilometer, wettability of the Au electrode surface using an optical tensiometer, and impedance response of biosensors using electrochemical impedance spectroscopy. Based on these tests, criteria were selected to assess the quality of biosensors at the production stage.

The second stage of the work involved the construction of a quality control system for the biosensor production process. The tasks performed during this stage included the design and construction of a laboratory station for testing the wettability and impedance response of test structures, as well as an integrated system for assessing the wettability of Au electrode surfaces in the biosensor production process.

The third stage of the work involved testing the influence of the type of substrate and plasma modification of the Au electrode surface in order to improve the performance of the biosensors. Research on the preparation of electrode surfaces for the production process showed that plasma modification cleans the surface of contaminants, resulting in better formation of the functional bio-layer on the Au surface, which increases the level of impedance response. On the basis of analyses of different substrates that can be used in the biosensor production process, the impact of, among other things, the degree of surface development on the parameters of the functional biofilm, and so on the impedance response of biosensors, was determined. The results of this research provide guidance on possible changes to the production process, which are promising due to the possibility of significantly increasing the sensor response by optimizing the biosensor manufacturing process.

The results of the research carried out as part of the doctoral dissertation were published in the form of four articles, including three in JCR-listed journals (IEEE Sensors Journal and Surface and Interfaces). They were also presented at five scientific conferences, including two international ones.

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Marcin Prządka