

Due to increase in the presence of factors that lead to acute coronary syndrome and population ageing, the myocardial infarction is one of the leading causes of morbidity and mortality in Poland. A large group is represented by patients in whom it is considerably difficult to diagnose this disease. The need to develop new, sensitive diagnostic methods has caused a rapid expansion of biosensors allowing to determine and monitor markers, whose concentration in the blood serum accrues as a result of insufficient cardiac muscle oxygenation. These disorders are a consequence of the blood perfusion changes on account of inflammatory and atherosclerotic processes in blood vessels.

The literature confirms that it is possible to use a lot of materials as a platform for determining biochemical markers. Special attention should be paid to titanium dioxide nanotubes, which are characterised by: large surface, bioactivity, biocompatibility and the ability to immobilize antibodies. Additionally, modification of the platform with gold nanoparticles improves the biomolecules stability and electrical conductivity. Other advantages of these structures are: quick and simple synthesis methods, increase in the transfer of electrons between the electrode surface and marked analyte, and strong adsorption of bioparticles while maintaining their bioactivity.

The literature confirms that in the myocardial infarction diagnostics it is possible to adopt markers with high specificity - troponin T, sensitivity during the first hours of hypoxia - heart-type fatty acid binding protein and marker related to the atherosclerotic plaque destabilisation processes - pregnancy-associated plasma protein A.

The objective of this project is to extend the current knowledge of titanium dioxide nanotubes platform modifications with gold nanoparticles and to check selected parameters in relation to proteins which are released into the bloodstream as a result of the cardiac muscle necrosis and atherosclerotic plaque rupture. The first stage of the research will involve the production of titanium dioxide nanotubes in the process of titanium foil anodisation and their thermal modification. The platform will be then doped with gold nanoparticles through the sputtering and chronoamperometry methods or deposition in the anodizing process. The last stage is the immobilization of monoclonal antibodies and antigens. The platform characteristics before and after modification will involve testing of microstructure, phase and chemical composition, contact angle and also identifying electrochemical characteristics. Efficiency of the gold nanoparticles immobilization process and, in further stages, biological elements will be examined through spectrophotometric tests of rinsings.

The concept of titanium dioxide nanotubular layers modification with gold nanoparticles has not been researched thoroughly so far. The results gained in terms of this project will allow to describe the mechanism of nanoparticles deposition on the developed platform, full characteristics of produced layers and devise a method for the cardiac muscle injury markers detection. The basis for the research is also the selection of the most important parameters for the platform conductivity (modification methods, concentration of solution and nanoparticles diameter) that will allow to improve its sensory properties. Until now, there has been no attempt at using this platform to monitor the concentration of the cardiac muscle necrosis selected markers and atherosclerotic plaque instability. The literature lacks in research on the production of a platform for simultaneous marking of troponin T, heart-type fatty acid binding protein and pregnancy-associated plasma protein A. There are also no studies comparing gold nanoparticles deposition methods. The project will also compare the immobilization of biological elements methods that employ electrostatic interactions and crosslinkers or streptavidin.

It is assumed that the use of nanoparticles will allow the improvement of the platform electrical conductivity. Primary research done as part of the project will contribute to develop a functional and sensitive biosensor for determining the cardiac muscle necrosis markers and factors related to the processes of the atherosclerotic plaque inflammatory processes. The use of a small matrix together with a simple testing technique will increase the pace of the quantitative determination of selected markers.