In recent years, the rapid development of sensors for biomedical applications is observed because of the urgent need of non-standard diagnostic methods for fast and effective diagnosis of various diseases entities. The biosensor platform may be composed of many materials, which is confirmed in the literature, but particular attention deserve to titanium dioxide nanotubes (TNT) which are characterized by high surface development, good electrical conductivity, adsorption properties, thermal and chemical stability, ease of production and low cost of production. Improvement of the biosensor sensitivity is obtained by doping of metal nanoparticles, mainly gold nanoparticles. Silver nanoparticles (AgNPs) seem to be an alternative to these compounds, because they have similar electrical properties as gold or platinum nanoparticles. In addition, AgNPs are characterized by the best conductivity among metals and therefore can support more efficient electron transfer than other nanoparticles. Its advantage is also the ease and low cost of production and ease in binding with proteins in reaction with thiol (-SH) groups. These properties make the AgNPs seem to be the most promising compound to be applied in electrochemical biosensor construction.

There are several dozen of markers known nowadays, but many of the most frequently determined cancer markers are characterized by low diagnostic sensitivity in the early stage of the disease. Recent research suggests that the heat shock proteins (HSP) may constitute a marker of cancer aggressiveness or may enable monitoring of patients' oncological treatment. In the literature is confirmed the possibility of applying as a prediction (prognostic) marker in early stages of breast and pancreatic cancer, while to identify early stage of prostate cancer. Main aim of this research project is to evaluate the possibility of application of titanium dioxide nanotubes on a titanium foil created in the anodizing process and doped with silver nanoparticles as a platform of the electrochemical biosensor for determination of the heat shock protein level. In the first stage of the studies in the process of anodizing titanium foil will be formed titanium dioxide nanotubes layer. This platform will be thermally modified and doping silver nanoparticles of different sizes. Nanoparticles will be obtained by chemical reduction and photoreduction. The last step is to immobilize antibodies and antigens of HSP27 and HSP70.

Tests of Ti/TNT/AgNPs platform before and after modification will consist of quantitative and qualitative analysis with the use of scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDS), X-ray diffractometry (XRD), measuring the contact angle, zeta potential and electrochemical characteristics (open-circuit potential and electrochemical impedance spectroscopy). The Raman spectroscopy will be used to determine the mechanism of binding of these biomolecules to Ti/TNT/AgNPs platform. The effectiveness of the immobilization of biomolecules will be examined by rinsings spectrophotometric test.

The concept of modification of the Ti/TNT platform with silver nanoparticles of different sizes for electrochemical characterization have not been realized yet. In the literature doesn't described any attempts of immobilization of antibodies and antigens of HSP27 and HSP70 on such platforms and hence there is no studies on its functionalization. The proposed research will provide valuable information on the properties of Ti/TNT/AgNPs platform. In this project the effects of direct immobilization of antibodies and antigens of HSP27 and HSP70 using physical adsorption and covalent functionalization will be compared. It is assumed that the modification of Ti/TNT with silver nanoparticles improve the electrical conductivity of this platform, which will translate into improved sensitivity when using it as a base of biosensor. Basic research proposed in this project can facilitate in the future the possibility of applying heat shock proteins as biosensors biological receptor, wherein the analyte detection is based on antibody-antigen interaction. This is so important because in recent years a continuous increase of patients with cancers has been observed. Early detection and intensive monitoring might increase the 5-year survival indicator in case of some cancers even up to 95%, which seems to be even more justified to determine HSP27 and HSP70 levels as these proteins are early-stage markers.