The first phenomenon that occurs after the introduction of the biomaterial into the biological environment is the creation of a biofilm on its surface. Biofilm is a form of aggregation of bacteria, fungi and other microscopic organisms in the form of thin deposits forming on various surfaces, contacting, for example, with body fluids. The natural bacterial flora of the patient is responsible for the formation of the biofilm. In order to prevent this type of phenomena from occurring, one should be aware of what affects such reactions, and it may be, for example, microscopic size of residual surgical tools resulting from the mechanical interaction of the tool with the tissue and the implant. The presence biofilm can lead to the disappearance of the surrounding osseous tissue and, as a result, disturb the osseointegration process. Currently, prevention of bacterial infections is carried out using antibiotic therapy, however due to many problems associated with the way of administering the drug and its effective action, new method of administering the drug to the patient are still being sought. Unfortunately, both in the case of instability of the implant and long-term bacterial infections, there is often a need to re-operate and replace the implant. This is associated with some huge costs but what is more important with patient discomfort and long-term hospitalization. In order to limit those negative consequences, the physicochemical properties of the surface layer of implants are formed. As of today, different approaches are used to apply new biomaterial modification techniques. So far, no satisfying study results were provided in this area of expertise. Numerous publications in the world literature (mainly in medical journals) confirm this activity. However, they most often present the most partial results of the research, which do not allow to fully assess the suitability of the produced coatings. In many papers, also the role of surface processing of metallic biomaterial are not emphasized. Therefore, the primary objective of the study is to observe the impact of physicochemical properties of the surface layers (bactericidal) on the processes occurring on the implants surface made of metallic biomaterials used in bone system.

The initial stage of this project includes developing the conditions for creating surface layers ZnO, SnO_2 and TiN by means of Atomic Layer Deposition (ALD). The use of these type of methods of surface processing is motivated by the necessity to ensure unchangeable geometric features, structural characteristics and mechanical properties of metallic biomaterials of the ground subjected to surface processing. For the produced surface layers a complex study of their corrosion resistance under conditions simulating the environment of osseous system will be carried out. In particular, the pitting and crevice corrosion resistance tests will be conducted. In addition, the layers will be subjected to testing by means of electrochemical impedance spectroscopy (EIS). The tests will be complemented with measurements of ions release after the declared time of retention of the tested samples in the physiological solutions (Ringer's solution). The results of these studies will be the basis for picking surface treatment options analyzed in further research tasks.

Within the scope of this project, for selected variants of surface processing, the studies on the chemical and phase structure, mechanical properties, surface topography and physical properties (electrical and magnetic) of layers will be done. Their effect will be determining the correlation between the microstructure, mechanical properties of metallic biomaterials, and the morphological structure and physicochemical properties of their surface. This will make it possible to indicate a more favorable variant of this process.

In the final stage, *in vitro* cytotoxicity studies will be carried out for such samples. In addition, an assessment of the surface susceptibility to the formation of a bacterial biofilm will be carried out. It will allow a more complex analysis of the processes that occur on the surface of implants once they are introduced to the osseous system. The research will make a significant contribution to the development of biomaterial engineering, and in particular surface layers used in the osseous system. The scope of research will enable a comprehensive analysis of the influence of structure and physicochemical properties of surface coatings, shaped by conditions of the technological process, on the processes occurring on the surface of implants after their introduction into the osseous system. The results may provide basis to develop more specific criteria for assessing the final quality of medical products used in osseous system, which will provide the required biocompatibility of implants and contribute to minimize the risk of postoperative complications. In consequence, this will increase the effectiveness of treatment, reduce complication rate and improve the quality of patients life. The obtained results will make a significant contribution to the explanation of processes occurring on implants surface using in osseous system.