Spectroscopic studies in micro- and nanoscale of the corrosion process and its inhibition of the modified metallic surfaces applied in implantology

Corrosion is a common phenomenon and serious problem which causes huge losses in many industrial sectors, such as i.e. energy, automotive, food, chemical as well in medicine. The medical implant industry has grown rapidly in recent decades, which has significantly improved the quality of life for millions of people. The most of implants are made of metals and their alloys due to their mechanical properties, corrosion resistance, low cost and biocompatibility. However, most metallic implants corrode when are in contact with body fluids (which contains different inorganic and organic molecules). Corrosion process of implants provides release of toxic and potentially carcinogenic metals. In addition, tissue in contact with a corrosive implant is exposed to a wide variety of bacterial and viral infections.

From this reason, the proposed research project focuses on an extremely important scientific issue related to the study of the corrosion process and undertakes actions that will eliminate its negative effects. Modification of the metallic surface is one of the best solutions for improving corrosion resistance, bioactivity or biocompatibility of used implants.

The scientific goal of the proposed project is initiate the corrosion process of metal samples used in implantology (stainless steel, titanium, nickel-titanium alloy) under various conditions and determination of corrosion products and their distribution on the surface of the investigated samples using spectroscopic methods. The main aim of the proposed project will be focused on investigation of the corrosion inhibition mechanism of the above mentioned samples using amino acids and amino acids modified by Au and Cu nanoparticles. The surface-enhanced infrared absorption (SEIRA), surface-enhanced Raman spectroscopy (SERS) and techniques linked atomic force microscopy (AFM) with spectroscopic methods (AFM-IR and AFM-RS) will be also used to study the inhibition process in micro and nanoscale. The use of amino acids as inhibitors carries many advantages. Amino acids are non-toxic, relatively cheap and play many important biological functions. On the other hand, the use of metallic nanoparticles enhance the spectroscopic signal and can also modify the corrosion inhibition process. Morphology of the corroded metal samples with and without applied potential inhibitors will be investigated by atomic force microscopy (AFM) and scanning electron microscopy (SEM).

Despite a number of studies provided in many research groups, there is still a great need to analyze these processes. The proposed research project presents an innovative approach to the corrosion issues, the use of spectroscopic methods which allow detailed identification of corrosion products, *in-situ* and *ex-situ* investigation of the corrosion inhibition processes in micro- and nanoscale (e.g. determination of structural changes occurring as a result of interactions between potential inhibitors and surface of the investigated metal samples). Progress in this area should provide a better understanding of corrosion processes and can improve corrosion resistance of materials used in implantology.