The demand for bone implants such as joint replacement or dental implants, is growing as the world's population ages. Titanium has been widely used in the biomedical industry due to its high corrosion resistance in the human body environment and good biocompatibility. The main drawback of commercially pure titanium is insufficient mechanical strength, lower than for Ti6Al4V which is commonly used in medicine. Nevertheless, due to the unfavourable influence of Al and V on human health, extensive work is underway to investigate a new group of Al and V free titanium alloys with similar mechanical strength to Ti6Al4V. The binary, metastable β alloy (Ti-38Nb) possess this properties. The lower stiffness, more similar to human bone in comparison to Ti6Al4V is additional advantage of this alloy. An alternative way to enhance the mechanical properties of commercially pure titanium is nanostructuring by SPD (severe plastic deformation) methods. In addition to improved mechanical properties, nanocrystalline titanium possess also better corrosion properties in solutions simulating body fluids. While commercially pure titanium and its β alloys enjoys excellent corrosion resistance in laboratory conditions, *in vivo* tests (on humans and animals) have shown a potentiality for release of metallic ions into the peri-implant environment. Chronic inflammation around an implant which might result in loss is one of the possible consequences of an elevated level of metallic ions. It clearly demonstrates the importance of a detailed biomaterials corrosion analysis.

Typical corrosion tests of titanium for biomedical applications are usually performed in solutions such as physiological saline (0.9% NaCl), phosphate–buffered saline (PBS) or Ringer's solution. However, an implant in the human body is exposed to a range of other molecules including proteins and ROS (reactive oxygen species) produced by bacteria and immune cells during inflammation. The latest investigations have shown an unfavourable synergistic effect of proteins and ROS on Ti6Al4V corrosion resistance. A combination of proteins and ROS leads to a much higher rate of corrosion of (α+β) Ti-6Al-4V than either of them in isolation. Moreover, it was reported the β phase of Ti6Al4V was preferentially attacked in the corrosive solution. Taking into consideration previous findings, the corrosion behaviour of titanium in this complex environment is probably determined by the phase composition

Thus, **<u>the main objective of this project</u>** is to study the influence of the synergistic effect of proteins (albumin) and reactive oxygen species (hydrogen peroxide) on the corrosion resistance in phosphate-buffered saline (PBS) of modern Ti-based materials such as nanocrystalline Ti Grade 2 (α) and Ti-38Nb (β) and compare it with corrosion behaviour of widely used Ti6Al4V (α+β). **<u>The additional objective of this projects</u>** is the evaluation of grain refinement effect on the titanium corrosion resistance in above-mentioned environment.

In addition to corrosion testing, the planned research includes mainly detailed microstructure characterisation, surface topography, chemical composition and thickness of oxide layer analysis. It will give an opportunity to connect corrosion rate with the microstructure and surface properties.

Going forward, the planned project will have a significant bearing on the development of bio- and nanomaterials. The results will enable researchers to assess whether the standard corrosion solutions simulating body fluids satisfactorily reflect peri-implant environments and whether the synergistic effect is too high to be neglected in a standard biomaterials corrosion tests. The comparison of corrosion behaviour of α and β Ti-based materials in the realistic peri-implant environment contain proteins as well as products of inflammation will help to indicate which of this two group of biomaterials is more promising and have to be further developed.