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TIBIO: A new generation of Titanium Biomaterials

PROJECT DESCRIPTION

Although titanium and its alloys belong to the most promising biomaterials, but their low wear resistance and release of constituents to the tissues limits their long term applications. So there is a big need to develop a new generation of titanium biomaterials using surface engineering methods.

The main solution in solving these problems is to develop a new generation of titanium biomaterials by producing surface layers $TiN + Ti_2N + \alpha Ti(N)$, $Ti(C,N) + Ti_2N + \alpha Ti(N)$, $NCD + Ti(C,N) + Ti_2N + \alpha Ti(N)$, $Ti_3P + Ni(P)$ types with a strictly specified microstructure, chemical and phase composition, friction coefficient, porosity and surface topography with good adhere to the substrate (diffusion character), high hardness, high frictional wear resistance, high resistance to biological corrosion and, in they guarantee an increase of wear resistance to biological corrosion, eliminate the release of implants components into the human tissue thereby preventing the activation of harmful inflammatory processes.

These glow discharge treatments and so called hybrid methods based on low-temperature plasma treatments permit producing such surface layers on titanium alloy with a good wear resistance without any deterioration of their high resistance to corrosion. These processes are fully controllable and permit to treat parts of sophisticated shapes, thanks to which titanium alloys of improved properties can be widely used in medicine. The technique parameters of the glow discharge nitriding, carbonitriding and hybrid methods combined glow discharge processes and PLD, IBSD or chemical electroless method for producing $Ni(P)$ coating provided changes in the microstructure of the surface layers and their phase composition, which created different microenvironment for cell growth. The investigated nitrided and carbonitrided layers were characterized by rapid and stable growth of fibroblasts to different extents and were resistant to biological corrosion. They are not toxic and biocompatible with human fibroblasts and osteoblasts culture.

The investigation relating to the production of composite layers of the type: nitrided diffusion layer or Ti_3P on a titanium alloy was presented. It has been found that the temperature of the glow discharge processes affects the topography of the diffusion surface layer produced, this having an effect on the adherence of the NCD coating. The characterisation of the NCD layers produced on carbonitrided layer by IBSD method is also presented.

These technologies can be applied for the fabrication of bone implants designed to operate in contact with blood and for the production of medical instruments



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PARTNERS

Project coordinator: Faculty of Materials Science and Engineering, Warsaw University of Technology, **Poland**

Project partners: Institute of Nuclear Physics Polish, Academy of Sciences, Kraków, **Poland**
Department of Physics, University of Kuopio, **Finland**
Department of Medicine, Helsinki University Central Hospital, **Finland**
The Children's Memorial Health Institute, Department of Pathology, **Poland**

PROJECT DURATION AND TOTAL PROJECT COST:

Duration: 01/01/2007 – 31/12/2010

Cost: 520.000 Euro

CONTACT:

Coordinator: Jerzy Robert Sobiecki

e-mail : jrs@inmat.pw.edu.pl

Tel : +48 22 6608547