



SUCCESS STORIES

DIAHAP: New carbon-hydroxyapatite nanocomposites on metallic bases applied in medicine

PROJECT DESCRIPTION

To produce a successful biomaterial which will survive in the body for a long time, the materials need to be developed specifically for clinical applications. The primary requirements are biocompatibility that is the material is not toxic and has appropriate mechanical properties in terms of stiffness and strength.

In a human body are created very strict criteria for both metallic materials applied as implants and for layers created on their surfaces. Good biocompatibility, high adhesion, corrosion-resistant are required to application given materials in the implantology. Traditional biocompatible materials, such as metals have a lot of desired properties, such as strength and chemical inertness. However, in some applications these properties need to be even further improved, especially in applications where the implanted material comes in to contact with blood. Metals are highly thrombogenic and can quickly clog an artery if implanted into it, resulting in strokes and other drawbacks. A coating with a nanocrystalline diamond (NCD) layer reduces this problem. The coating of NCD can also have other positive effects, such as improved biocompatibility and hardness.

Carbon layers used in medicine are very interesting materials because of their biological and mechanical qualities. Such coverings are characterized by high biocompatibility degree and ideal bioinertness which result from no immunological reply of organism to implant with carbon layer. They also raise corrosion-resistant of metallic implant. Biocompatibility of metallic implants is able to meaningful raise by generating on their surface a thin hydroxyapatite film. Hydroxyapatite is a material that is very similar to natural bone in its microstructure. It is also very biocompatible and allows the bone to form rapidly into its structure. When the bone is rebuilt, the hydroxyapatite does not have to be surgically removed, because it creates one solid structure which is the main advantage. However, there is major problem which is poor adhere of these layers to implant surface. This problem may be solved by application of carbon film as transient layer between metallic base and hydroxyapatite. The aim of this project is develop a method of production composite covering: carbon film/ hydroxyapatite on metallic implants used in medicine.

This new composite will be characterized by good adhesion and biocompatibility. It will protect organism against metal ion (after dissolving of bioactive HAp on the surface of implant will be left bioinert carbon film) and eliminate possibility of bacteria colonization on the surface of metallic implant (forming of bacteria film on the NCD layer is limited) as result of removing separation Hap from base. Such produced nanocomposites will find application in the orthopedic and neurosurgery implant production. Medical firms producing long-periodical implants report demand at materials, from which will be produced restorable implant. Such implant permanently and strongly will join with tissue and simultaneously protect organism against negative influence of metallic elements. Newly elaborated composite will perfectly perform these conditions. Hydroxyapatite surface will respond superb with organism joining with it and this formed tissue will be secured against metallic ions by nanocrystalline diamond.



SUCCESS STORIES

PARTNERS:

Project coordinator: Technical University of Lodz, **Poland**

Project partners: Military University of Technology, Warsaw, **Poland**
The National Institute for Laser, Plasma, and Radiation Physics, **Romania**

PROJECT DURATION AND TOTAL PROJECT COST:

Duration: 01/01/2009– 31/12/2011

Cost: 390.000 Euro

CONTACT:

Coordinator: Agata Niedzielska
E-mail: nieagata@p.lodz.pl
Tel: +48 42 631 22 77