1. SUMMARY

<table>
<tr><td>Acronym/Short name</td><td colspan="6">CarLa</td></tr>
<tr><td>Proposal Full Name</td><td colspan="6">Ag/Si doped carbon layer for bio-medical application</td></tr>
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<tr><td>City</td><td colspan="2">Lodz</td><td>www:</td><td colspan="2">www.p.lodz.pl</td></tr>
<tr><td colspan="2">Total Project Costs (Euro)</td><td>670 270,00</td><td colspan="2">Requested Funding (Euro)</td><td colspan="2">637 500,00</td></tr>
<tr><td>Planned Starting date</td><td>01.01.2014</td><td>Duration (in months)</td><td>36</td><td>Total person months</td><td colspan="2">77</td></tr>
<tr><td rowspan="5">Call Topic</td><td>☐</td><td colspan="5">Integrated Computational Materials Engineering (ICME)</td></tr>
<tr><td>☐</td><td colspan="5">Secondary Raw Materials</td></tr>
<tr><td>x</td><td colspan="5">Design of New Interfaces, Surfaces and Coatings</td></tr>
<tr><td>☐</td><td colspan="5">Hybrid Composites</td></tr>
<tr><td>☐</td><td colspan="5">Materials for Energy Systems</td></tr>
<tr><td>Keywords (best describing the proposal´s content)</td><td colspan="6">Ag/Si doped carbon layers, medical applications of carbon layer, innovative antibacterial biomaterials, biomaterial modification to improve osteointegration.</td></tr>
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Publishable Abstract

This innovative R&D project is focused on the new technological dimension for the antibacterial and osteointegrated coatings. The CarLa project is connected with the topic of materials science and engineering (design of new interfaces, surfaces and coatings in form of Ag/Si doped DLC) including usage of nanotechnologies and production processes for coatings fabrication. Apart from the technological part, project consists also of coatings' characterization and mechanical properties estimation. Project predicts also the industrial partners (SMEs) and commercialization of the results, that is why it also includes the third part of research – biological tests. That consists of its multidisciplinary character. The aim of the project is to solve the global problem of society and medicine on the whole world. Through that project inscribes to the strategic aim of the M-ERA.NET Programme – increases interdisciplinary cooperation in order to create a powerful network to tackle European and global challenges – in this case post-implantation complications which are caused by the infections and/or allergy induced by alloying elements.

The expected results of this project will cover elaboration of Ag/Si doped carbon coatings, their mechanical verification, biological evaluation and testing under industrial conditions in order to introduce to the market the new safe product with satisfying osteointegration, antimicrobial and mechanical properties. The results of the CarLa Project are expected to be for the big benefit of the European industry

and society. The industry will get an ecological, simply, cheap and easy to implement technology in favour of healthier society – the offer of biomaterials with better properties giving faster healing processes for patients and lower risk of infection during and after implantation. Trough that it fulfills the efforts of new innovation oriented economy in EU.

Thanks to the technologies, which will be worked out in the frame of this project, new markets will be opened not only for these represented by the industry partners (dentistry and orthopaedia) within the confines of the project consortium. We also expect that technologies we are going to apply will have a wide range of potential to be used in many branches of industry, also apart from these provided by the SME partners. The cooperation in the frame of transnational consortium give us a chance to exploit international technology and market expertise.

Project Summary

The **CarLa** project is a common undertaking of **POLAND** and **ROMANIA** concerning one aim where each scientific partner conducts biological and mechanical investigations of new Ag/Si doped carbon layers deposited onto medical titanium alloy using six different methods in order to provide to the **market products in a form of antimicrobial medical implants with good mechanical properties and ability to accelerate the osteointegration process**. The role of industrial partners in the project is to verify the modified implants during control testing under industrial conditions.

According to the Global Biomaterials Market report (2009-2014) published by the World Marketand Markets, every year around the world about 100,000 artificial heart valves, 200,000 pacemakers and 1 million orthopedic implants are implanted. The increase is due to the use of biomaterials social demand increase from 8% to 15%. Growth factors are: aging population, increased public awareness, shorter approval process of biomaterials and complications after the implantation.
This last problem is widely discussed in literature. It was proved that most of post-implantation complications are caused by the infections and/or disorders induced by toxic reactions as a result of release of alloy elements from the implant. The most typical are: difficulties in wound healing, increase of bacterial and fungal infection risk, slowdown of osteogenic cells adhesion, slack of prosthesis due to bone disappearance around implant or allergic dermal eczema. It is estimated that allergy problem in implantology will be increasing for the next generations. Accordingly the post-implantation complications have not only clinical but also economic consequences. Clinical consequences are: longer period of antibiotic therapy and repeated surgical procedures, disability or even death. Economic effects are directly related to elongation of clinical procedures and generate additional costs (several billion € annually throughout Europe).

Taking above into consideration it is profitable to conduct proposed research and worked out new solution which being proposed on the marked give patients better/safer products and lower cost of clinical treatment. In this connection the main objective of the project is manufacturing of Ag/Si doped carbon coatings onto the titanium alloy medical implants. **The innovation** of proposed solution is based on **simultaneous introduction to the carbon coating two elements with different properties**. This will result in the improvement of the existing solutions and also broaden the range of their possible uses. The presence of **silver** in the coating will ensure a broad spectrum of antimicrobial action, though protecting the implant against the disadvantageous influence of bacteria and fungi causing biofilm associated infections, local inflammation and other implant-tissue reactions. The addition of **silicon** will lead to the enhancement of mechanical properties of the coating and promote osteointegration. This will **result** in **shortening the healing process of patients** and allow using of proposed solution for the modification of the long-term implants surfaces.

Despite of the fact that the subject of doping of carbon coatings by different elements is on the European scientific map and many research results can be found in this field, there is a lack of reports concerning the mechanical and biological properties of Ag/Si doped carbon layers synthesized with use of the technologies proposed in CarLa. The results of this project will bridge the gap in the state of the art of submicron structures modifications.

The high scientific level of the proposed project, the novelty of the scientific problem to be undertaken, and well-composed team of professionals with complementary expertise and big experience in the work entrusted to them, ensures that the project will be implemented in a timely manner and at the highest level of science and its results will have a chance to be published at top rank journals worldwide trends and be implemented into the market.