BIOCOMPATIBILITY RESPONSE AND CONNECTED PROPERTIES OF DIFFERENT TYPE OF SOL-GEL COATINGS ON 316L STAINLESS STEEL SUBSTRATE

Anna Donesz-Sikorska[1,3], Jakub Grzesiak[2,3], Agnieszka Smieszek[2,3], Justyna Krzak-Ros[1], Krzysztof Marycz[2,3]

[1] *Institute of Materials Science and Applied Mechanics, Wroclaw University of Technology, Poland;*

[2] *Electron Microscopy Laboratory, University of Environmental and Life Sciences, Wroclaw, Poland;*

[3] *Wroclaw Research Centre EIT, Wroclaw, Poland*

Introduction

It is commonly known that properties of implant surface determined the living tissue response . The surface of metallic implant materials characterized by properties which is differ from those which favour the integration of an implant with tissue. Researchers are attempting to improve the surface layers of metallic materials to at least some extent, diminish these problems [Simchi, 2011]. One of method of obtaining the coating materials is sol-gel which gives a huge potential in the development of the material [Arcos, 2010]. Authors conducted the synthesis of oxide sol-gel materials such as TiO_2, SiO_2, and hybrids, in order to improve the surface properties of 316L stainless steel - often used implant material.

Methods

SiO_2, TiO_2 and SiO_2/TiO_2 coatings were synthesized by sol-gel method and were applied onto 316L stainless steel by dip-coating. To synthesis following precursors, in proper ratios, were used: methyltriethoxysilane (MtEOS), tetraethoxy-silane (TEOS) for SiO_2, titanium(IV)ethoxide (TiEO) for TiO_2, tetraethoxysilane (TEOS) and titanium(IV) ethoxide (TiEO) for SiO_2/TiO_2. Coatings were annealed in 250˚C for 12h. The surface morphology and topography of the coatings were determined using a Scanning Electron Microscope (SEM) and Atomic Force Microscope (AFM). To evaluate wetting, contact angle was measured. Elemental analysis and chemical structure evaluation were performed using EDX analysis and Raman spectroscopy.

Materials were put into rat adipose (Ad) and bone marrow (BM) mesenchymal stem cell (MSC) cultures to check cytotoxicity (Alamar Blue assay) and biocompatibility (electron and fluorescence microscopy) of obtained surfaces.

Results

Silica and silica/titania coatings (I,III) were homogeneous, without cracks (fig.1a). Titania coatings (II) had more robust topography compared to the silica coating (fig.1b).

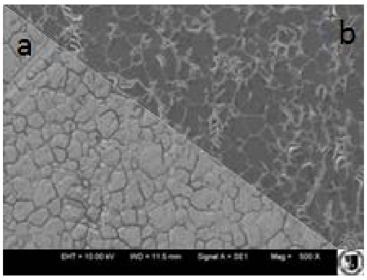

Figure 1a and 1b.

Mapping of distribution of elements in the coatings shows uniform distribution of Si and Ti in all surface (fig.2), the oxide structure was proved by Raman spectroscopy.

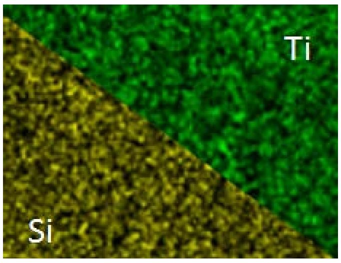

Figure 2

None of materials showed cytotoxic effect on cultured cells. Material II showed increased proliferative potential in comparison to control and great adhesive properties.

Discussion

The measured properties of the coatings meet the requirements imposed on biomaterials. Material II showed the most biocompatibility, so it could be used in orthopedic implants. Further work is founded on the modification of the parameters of coatings to improve their properties.

References

Arcos D., *et al*, Acta Biomaterialia 6: 2874-2888, 2010.

Simchi A., *et al*, Nanomedicine: Nanotechnology, Biology, and Medicine 7: 22-39, 2011.

Acknowledgments

The research was supported by Wroclaw Research Centre EIT+ under the project “Biotechnologies and advanced medical technologies”- BioMed (POIG.01.01.02-02-003/08) financed from the European Regional Development Fund (Operational Programme Innovative Economy, 1.1.2).