Journal of Industrial and Environmental Chemistry
2020
ISSN 2591-7331(E)
Vol.04 No.5

Nanoporous, nanotubular and nanosponge-like titania coatings enhanced with adipose-derived stem cells - Preliminary in vitro studies

Michalina Ehlert

Nicolaus Copernicus University, Poland

Abstract

Recent efforts in the field of implantology have highlighted the significance of modifying implant surface topography and biomaterial composition to improve their biocompatibility. Titanium and its alloys are commonly used as biomaterials for orthopedic, dental or neurosurgical applications. Even though titanium based implants are typically expected to last ten years or more, their longevity is not assured and the lack of integration into the bone for long-term survival often occurs and leads to implant failure. Therefore, a planned modification of the surface of the alloys is strived to obtain a highly biocompatible coating with a strictly defined structure and architecture.

The goal of the presented study was to optimize the production of titania-based biomaterials with high porosity and defined nanostructure, which supports the cell viability and growth. We assessed the bioactivity of amorphous titania coatings of different nanoarchitectures (Nano porous, nanotubular and Nano sponge-like) (TNTs), produced on the surface of Ti6Al4V alloy by electrochemical oxidation. Samples were structurally and morphologically analyzed. They were also characterized in terms of wettability and mechanical properties. In-vitro biological research has been carried out of modified titanium alloy surfaces, aimed at assessing their ability to communicate with adipose derived mesenchymal stem cells (ADSC) and affect their activity. In parallel, proliferation of bone tissue cells - human osteoblasts MG-63 and connective tissue cells - mouse fibroblasts L929, as well as cell viability in cocultures (osteoblasts/ADSCs and fibroblasts/ADSCs) has been studied. The cell proliferation was studied using the MTT assay.

The results of our experiments proved that the Nano porous surface is favorable for ADSC, which produced huge amounts of extracellular matrix when they were cultured on the scaffolds alone or co-cultured with MG-63 osteoblasts. The number of osteoblasts seeded and cultured with ADSCs on TNT5 surface after 72h culture almost doubled when compared with unmodified scaffold and rose by 30% when compared with MG-63 cells growing alone.

Biography:

I'm Michalina Ehlert. I am a participant of implementation PhD studies in the field of chemistry, which I carry out both at the Faculty of Chemistry of Nicolaus Copernicus University in Toruń and in Nano-implant Ltd. The aim of my PhD thesis is to design and optimize the processes of producing nanocoatings based on titanium dioxide/titanates on the surface of metal implants produced in 3D technology and to enrich the produced systems with both chemical (silver nanoparticles, nanostructured hydroxyapatite) and biological (mesenchymal stem cells) individuals.

Speaker Publications:

1. Piszczek P, Radtke A, Ehlert M, Jędrzejewski T, Sznarkowska A, Sadowska B, Bartmański M, Erdoğan K Y, Ercan B, Jędrzejczyk W (2020) Comprehensive Evaluation of the Biological Properties of Surface-Modified Titanium Alloy Implants, J. Clin. Med. 9, 342.
2. Ehlert M, Roszek K, Jędrzejewski T, Bartmański M, Radtke A (2019) Titania Nanofiber Scaffolds with Enhanced Biointegration Activity—Preliminary In Vitro Studies, Int. J. Mol. Sci 20, 5642.
3. Radtke A, Grodzicka M, Ehlert M, Jędrzejewski T, Wypij M, Golińska P (2019) "To Be Microbiocidal and Not to Be Cytotoxic at the Same Time…"—Silver Nanoparticles and

Their Main Role on the Surface of Titanium Alloy Implants J. Clin. Med. 8, 334.
4. Radtke A, Ehlert M, Jędrzejewski T, Bartmański M (2019) The Morphology, Structure, Mechanical Properties and Biocompatibility of Nanotubular Titania Coatings before and after Autoclaving Process. J. Clin. Med. 8, 272
5. Radtke A, Ehlert M, Jędrzejewski T, Sadowska B, Więckowska-Szakiel M, Holopainen J, Ritala M, Leskelä M, Bartmański M, Szkodo M, Piszczek P (2019) Titania Nanotubes/Hydroxyapatite Nanocomposites Produced with the Use of the Atomic Layer Deposition Technique: Estimation of Bioactivity and Nanomechanical Properties. Nanomaterials 9, 123.
6. Radtke A, Grodzicka M, Ehlert M, Muzioł T, Szkodo M, Bartmański M, Piszczek P (2018) Studies on Silver Ions Releasing Processes and Mechanical Properties of Surface-Modified Titanium Alloy Implants. Int. J. Mol. Sci 19, 3962.

18th International Conference and Exhibition on Materials Science and Chemistry; Berlin, Germany -May 18-19,2020.

Abstract Citation:

Michalina Ehlert, Nanoporous, nanotubular and nanosponge-like titania coatings enhanced with adipose-derived stem cells - Preliminary in vitro studies , Materials Chemistry 2020, 18th International Conference and Exhibition on Materials Science and Chemistry; Berlin, Germany -May 18-19,2020. (https://materialschemistry.chemistryconferences.org/abstract/2020/nanoporous-nanotubular-and-nanosponge-like-titania-coatings-enhanced-with-adipose-derived-stem-cells-preliminary-in-vitro-studies)