Coatings for Biomedical and Healthcare Applications
Room On Demand - Session D3

Biointerfaces: Improving the Cell Adhesion and Avoiding Bacteria. What Kinds of Coatings/Surfaces Should be Used?

D3-1 Very Thin Gold Films Deposited Collagen to Improve Skin Wound Healing in Animal Study, ***Sheng-Yang Huang (huangmochiqqegg@gmail.com)***, Feng Chia University, Taichung Veterans General Hospital, Taiwan; *P. Hsieh, R. Chang,* Feng Chia University, Taiwan; *C. Chou,* Taichung Veterans General Hospital, National Yang-Ming University, Taiwan; *C. Chung,* Central Taiwan University of Science and Technology, Taiwan; *J. He,* Feng Chia University, Taiwan

Collagen has been widely used in different forms for biomedical purposes. In combination with gold element, it may bring synergistic effect for more precise therapy. In this study, very thin gold film deposition on collagen fabric was conducted by high-power impulse magnetron sputtering (HIPIMS). Specimens with different deposition time (0, 6, 12, 24, 48 and 96 seconds) were prepared. Animals of 175-200 gm Sprague Dawley (SD) male rats were chosen for skin wound healing test and grouped according to the created full thickness wounds of back skin. In the experimental group, wounds were covered with coated collagen specimen and sterilized gauze, while wounds were covered with sterilized gauze only in control group. Visual observation for wound recovery was done during renewing dressing on a daily base. Histology study of wounded skin was performed on post-operative day 3, 7 and day 14. In addition to morphological observation, scoring of wound healing, consisting of neovascularization, collagen deposition and inflammatory cell infiltration was also calculated and compared. The results showed that an improved wound healing and less soft tissue fibrosis can be observed in the presence of very thin gold film. This animal study reveals that the use of such gold coated collagen material on skin wound is beneficial and promising.

D3-2 New Cytocompatible and Antibacterial Porous Ta_2O_5 Surface: Dental Implant Prototype, ***Luísa Fialho (luisa.gfialho@gmail.com)***, University of Minho, Portugal; *L. Grenho,* university of Porto, Portugal; *M. Fernandes,* University of Porto, Portugal; *L. Forte Martins,* Private dental practice - Dental Verde clinic, Portugal; *S. Carvalho,* University of Minho, Portugal

An innovative surface able to overcome the failures of the dental implants used nowadays, regarding their bioactivity and consequent capacity for osseointegration, was developed. The first functional treatment (plasma electrolytic oxidation (PEO)) develop a tantalum oxide (Ta_2O_5) surface in order to mimic the bone morphology and chemistry and consequently enhancing the surface bioactivity. Thereby, the anodizing parameters were optimized in order to achieve a porous structure enriched with calcium (Ca) and phosphorous (P), such as Ca/P ratio near to 1.67 (theoretical value of hydroxyapatite). The second treatment endows this surface with antibacterial activity. With this purpose, zinc nanoparticles (Zn NPs) were deposited onto the bioactive surfaces by DC magnetron sputtering with (or without) an additional thin carbon (C) layer, for NPs release control.

The morphological analysis by SEM and STEM revealed the formation of a micro/nano-porous oxide layer with incorporation of Ca and P. The deposition of Zn NPs did not affect the surface morphology and the NPs were around and inside the pores. The additional presence of the C layer slightly covered the nano-pores. The BF-STEM results showed that the Zn NPs had irregular shapes and a core-shell structure with two crystalline phases: HCP Zn and ZnO. The initial osteoblasts adhesion was ensured with a significant proliferation on the surface with Zn NPs. The surfaces with Zn NPs substantially reduced the planktonic bacterial with a greater sessile bacteria inhibition on the surfaces.

Furthermore, a preliminary prototype was created. A PEO-optimized Ta dental implant was developed to reproduce the bone surface morphology and chemical composition. Then, the Ta implants were inserted onto a pork jawbone and, by SEM and X-rays analysis, the surface fracture was analysed. The results showed a good adhesion and mechanical resistance of the anodic layer.

In sum up, these findings are promising for biomedical applications.

Keywords: tantalum oxide; zinc oxide nanoparticles; plasma electrolytic oxidation; magnetron sputtering; antibacterial activity; cytocompatibility.

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