BIOMEDICINE AND NANOTECHNOLOGIES

ORAL PRESENTATIONS

DEVELOPMENT OF FEMTOSECOND LASER ENGINEERED CELL-INSTRUCTIVE BIOMATERIAL SURFACES FOR APPLICATIONS IN TISSUE ENGINEERING

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Summary

Reconstruction of bone and dental tissue defects is a major challenge facing orthopaedics and dentistry. Temporary "platforms" of various materials for seeding different types of cell cultures and improving cell adhesion, proliferation and differentiation has been extensively researched. Composites comprising calcium phosphates, zirconia and natural polymers are widely used as biomaterials as they meet the requirements for successful platforms for bone and dental tissue repair and engineering. The creation of scaffolds with pre-designed topography will enable tissue engineering applications that require precise placement of cells within a specified pattern on a substrate with predefined geometric limits. Surface topography of the biomaterial affects cellular mobility, which is crucial for optimal functionalization. The fabrication of defined patterns, smaller than 100 μm, is difficult due to the brittleness of ceramic materials. In the recent years femtosecond laser microprocessing have been applied to modify surface of medical implants. In this study we have demonstrated surface texturing of chitosan, chitosan/ ceramics blends and bulk ceramic from Alumina toughened Zirconia (ATZ) and beta tricalcium phosphates (β-TCP) with 150fs and 340 fs laser pulses at 800nm and 1040 nm wavelength. Using femtosecond laser pulses, surface structures less than 100 μm were established on bio -polymer/ ceramic surfaces. The microstructured scaffolds were investigated by SEM, EDX, XRD analyses. The acquired experimental results demonstrate a path to optimize surface properties which affects cell-material interaction.

Key words: femtosecond laser texturing, functional surface, biopolymers, bioceramics, tissue engineering, dentistry, orthopedics

OBTAINING AND CHARACTERIZATION OF NANOCOMPOSITE POLYMER COATINGS: NEW MATERIALS FOR BIOMEDICAL APPLICATIONS

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Summary

In order to improve orthopaedic implant performance, the objective of this study was to develop technology for growing composite layers based on the plasma-polymerized

hexamethyldisiloxane (PPHMDS), filled with various detonation nanodiamond particles (DNDs). Some of the DNDs used in the experiment were modified by salinization (Si-DND) or silver (Ag-DND). The cytotoxicity test indicated that the cells survive and grow well in the presence of all the DNDs we used in the experiments. The surface of some of the samples was subsequently modified by ammonia plasma to reduce its hydrophobicity and study the influence of ammonia on the behaviour of osteoblast cells. The structural properties were examined by FTIR and UV spectroscopies, as well as SEM. The results showed that by varying the DNDs particles, it is possible to alert the morphological and chemical nature of the resultant composite layers. The cell experiments showed that the obtained composites are appropriate for medical application.

COATINGS OF TIN/TIO$_2$ DEPOSITED BY DIRECT CURRENT MAGNETRON SPUTTERING ON DIFFERENT SUBSTRATES FOR BIOMEDICAL APPLICATIONS

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Summary
In recent years, many authors have focused their efforts on methods of surface modification of materials. Coatings such as TiN and TiO2, deposited on different substrates, have many applications because of their good mechanical properties, resistance to corrosion and biocompatibility. Therefore, in this study, stainless steel 304L and titanium alloy (Ti5Al4V) substrates were coated by DC magnetron sputtered TiN/TiO2 multilayer. The samples of titanium alloy were pre-processed with a scanning electron beam. The phase composition, nanohardness, corrosion resistance and cytotoxicity on the coating deposited on the 304L substrate were investigated. The phase composition of TiN/TiO$_2$ coatings, deposited on Ti5Al4V substrates, was examined by X-ray diffraction. The hardness was investigated by nanoindentation test, and surface topography was evaluated using atomic force microscopy. Our results confirmed that the obtained TiN/TiO2 multilayer coatings deposited on the 304L substrate have good stoichiometry and do not suppress cell viability and spreading. It was found that obtained coatings are not cytotoxic and are biocompatible. The treatment with electron beam leads to an increase in the surface roughness from 8 nm to 25 nm for the deposition of TiN/TiO2 coatings on Ti5Al4V and a decrease in the hardness of the coatings - from 7 GPa to 6 GPa. The scratch tests of the coated samples confirm the decrease of the friction coefficient as compared with the uncoated substrates. The obtained results indicated the usefulness of the applied coating for biomedical application.
Key words: surface modifications, TiN/TiO2 coatings, biomedical applications

SURFACE MANUFACTURING OF CO-CR ALLOYS FOR BIOMEDICAL APPLICATIONS

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