CARBON-BASED COATINGS ON TITANIUM SUBSTRATE, LASER MODIFED TO CONTROL ENDOTHELIUM CELL GROWTH

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Introduction

Engineering of biomaterials requires a thorough understanding of cell-material interaction. The project concerns the surface modification of the material with its destination in the regeneration of the cardiovascular system. Modulation of surface parameters like topography, chemistry or microstructure have direct influence onto cellular response [1-4]. Nanopatterned surfaces are an effective tool for manipulating the type, number, spacing and distribution of ligands for cell adhesion receptors on the material surface. As a consequence, these surfaces are able to control the size, shape, distribution and maturity of focal adhesion plaques on cells, and thus cell adhesion, proliferation, differentiation and other cell functions. Control of cell phenotype involves a variety of signaling pathways and transcriptional regulators. This multifunctional signaling molecule is part of adhesion contacts in the endothelium and is able to translocate into the nucleus to activate genetic programs and control proliferation and the fate of the cells. Laser interference lithography, consisting in the creation of organized periodical surfaces based on selective material ablation offers the possibility to create 2D and 3D patterns on surfaces. The project concerns a novel approach of the surface modification. The surface modification should give an influence on the micro-vessel formation for the heart endothelium cells.

Materials and Methods

Migration channels were prepared by laser ablation. Thin, nanometric fragments of the coating with a length of 50 nm were removed in half of its thickness. The process of ablation takes place during a laser pulse as a result of interaction of laser radiation (absorption and scattering) with ejected material in liquid form. During the surface treatment of the material with pulsed laser radiation with the density of energy appropriate in time (power density) the following phenomena occur: absorption of radiation and thermal or photochemical effects. The desired reflection requires a low level of radiation. Arousal requires. Electronic transmission microscopy. The analysis of the structure of migration channels was carried out using Transmission Electron Microscopy (TEM).

For TEM analysis thin films were prepared on the cross-section from the migration channel border to the unmodified surface. The influence of nano- and micro patterns on adhesion, directed growth and proliferation of endothelial cells was evaluated. The surface parameters that determine the proper formation of endothelial monolayer and blood vessel formation were characterized.

Results and Discussion

Carbon-based coatings, are among the most promising plasma-based coatings for cardiovascular implants. These are generally characterised by improved haemocompatibility and nontoxicity. Moreover, by controlling the coating deposition parameters and doping, exceptional physicochemical properties of these materials could be modified. Surface modification with laser interference lithography enables controlled cellular growth and growth control (FIG. 1).

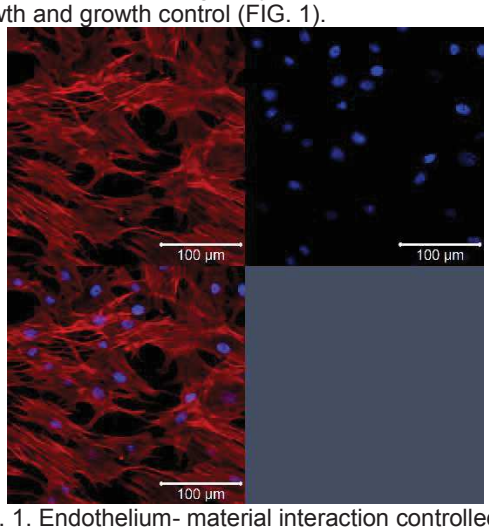

FIG. 1. Endothelium- material interaction controlled by laser modified surfaces.

Conclusions

The control of endothelial cell growth also influences true proliferation and potentiates the formation of vascular-like structures. The formation of proper and dense monolayer endothelial cells on the surface enables effective inhibition of blood clotting.

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