POLYMER CARRIERS MODIFIED BY PLASMA AND FUNCTIONALIZED WITH Au NANOPARTICLES AS SUBSTRATES FOR MOUSE 3T3 FIBROBLASTS

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Polymers have been often applied in biology and medicine for construction of tissue replacements. However, the inert surface of the most polymers is not able to support and control cell adhesion, migration, proliferation, differentiation and other cell functions. Hence, the modification of polymer surface led to achieve appropriate properties. The polymer surface can be modified by plasma discharge by which the polymer surface chemistry and morphology is changed. Plasma treatment leads to creation of radicals, unsaturated bonds and new chemical groups, mainly oxygen containing groups. Oxidized groups increase the wettability of polymers, which supports adsorption of cell adhesion-mediating extracellular matrix (ECM) molecules in appropriate spatial conformation increasing accessibility of specific sites in these molecules by cell adhesion receptors. In addition, other surface properties of polymers are altered by plasma etching which strongly influence cell-material interaction. Radicals and unsaturated chemical bonds which are created by plasma can be utilized for grafting new chemical groups, biomolecules and nanoparticles. The biomolecules grafted on the polymer surface, such as amino acids, RGD-containing oligopeptides (i.e., ligands for integrin receptors), ECM molecules, enzymes, hormones, and also carbon and gold nanoparticles, not only have specific biological effects on cells but also change physical and chemical properties of the polymer surface, and by this way they support its bioactivity.

This study is focused on physicochemical properties and biocompatibility of modified polymers. The studied materials were poly(L-lactide) (PLLA) foils, nanofibrous PLLA meshes and polyethylene terephthalate (PTFE) foils. PLLA and PTFE foils were modified in plasma with Ar+ ions for time intervals of 50, 100 and 300 s with power 8 W, and then grafted with Au nanoparticles.

Changes in the surface wettability were determined by reflection goniometry. The presence and concentration of Au nanoparticles were examined by X-ray Photoelectron Spectroscopy (XPS). For the biocompatibility testing, the polymers were seeded by mouse embryonic fibroblasts of the line 3T3, i.e., the cells often utilized as a feeder for keratinocytes. The cell adhesion and growth was evaluated by the number of cells, their morphology and the size of cell adhesion area in the 1st, 3rd and 6th day after seeding.

The results indicate that the water drop contact angle increases with the time of exposure to plasma, which means that the wettability decreases. However, the following exposure of plasma-irradiated polymers to a sodium citrate solution (i.e., a storage solution for Au nanoparticles) and grafting with Au nanoparticles decrease the contact angle, i.e., increase the material surface wettability. Our tests of biocompatibility indicate that the modification of the polymer surface influences positively the cell behavior. The cells adhered at higher numbers and by a larger cell adhesion area on modified polymers; it was mainly manifested on PTFE.

Acknowledgements

Supported by the Grant Agency of the Czech Republic (Grant No. P108/10/1106) and by the Academy of Sciences of the Czech Republic (Grant No. KAN400480701).