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Fabrication and plasma modification of polymer scaffolds for regenerative and replacement medicine

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Materials that serve as analogues for the native extra-cellular matrix can be used in medicine to aid in either the reconstruction or regeneration of damaged tissue and organs. The main goal of this research was to develop novel physical processing techniques to fabricate and modify highly porous implantable biodegradable scaffolds. More specifically, this involves fabricating scaffolds using electrospinning, ink-jet bioprinting, gel sublimation techniques and finally modification of matrixes by plasma treatment in order to control chemical structure and morphology of scaffolds.
Poly(oxybutirate-co-valerate), (Aldrich, USA) and collagen type VII ("MakMedi", Russia) were used for preparation of polymer scaffolds by electrospinning, bioprinting and gel sublimation methods. ATR FTIR spectroscopy was used to analyze surface chemical composition before and after plasma treatment. The 3D morphology of polymer scaffolds was investigated by Nano Platform NTegra Tomo where Atom Force Microscope (AFM) was integrated with ultra microtome for studying the 3D structure of polymer scaffolds with space resolution 20 nm. Biocompatibility of polymer scaffolds was estimated by different biological tests: hemolysis, cell toxicity and cell proliferation experiments. Fibroblast cells NIH 3T3 were used for cell toxicity and cell proliferation testing experiments.
Porous scaffolds were treated by DBD discharge at different dosages (voltage 22kV, 5μs pulse duration). According to ATR FTIR and contact angle measurements plasma treatment leads to the formation of carboxylic groups and provides the increase of polymer surface energy and hydrophilicity. According to various biological testing procedures polymer scaffolds obtained by new fabrication technologies and treated by DBD plasma have shown no toxic reactions and improve cell proliferation behavior.

Keywords
biocompatibility
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