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EFFECT OF LOW-TEMPERATURE PLASMA NON-SELF-SUSTAINED DISCHARGE ON CHEMICAL COMPOSITION AND MORPHOLOGY OF POLYLACTIC ACID SURFACE *

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The effect of argon flow non-self-sustained discharge plasma treatment on surface physicochemical properties of biocompatible scaffolds based on polylactic acid (PLA) was investigated. The PLA-based scaffolds were obtained by electrospinning on the Nanon-01 facility [1]. The plasma treatment conditions were following: the plasma gas – argon; the amplitude of discharge current – 5-10 A; working pressure – 0.3 Pa; exposure time – 5÷28 min. Surface modification by low-temperature plasma is used for alteration of the structure and physicochemical properties of PLA-based scaffolds, such as chemical compound, phase state, roughness etc.

X-ray diffraction analysis (XRD) before and after plasma treatment reveals diffraction patterns containing two distinct peaks at 2θ= 25,3°, 29,3°, corresponding to the crystallographic planes with indexes (015) and (216) [2]. After modification of PLA surface by low-temperature argon plasma, the main diffraction lines appeared: 2θ= 16.7°; 19.2°, corresponding to crystallographic planes with indices (110)/(200) and (203), that indicates the presence of α-shaped crystals (rhombic crystal lattice). The degree of crystallinity (χ_C) increases with increasing exposure time of plasma treatment. The enhance of χ_C was established from 28% (initial PLA) to the maximum value of 68% after 28 minutes of plasma treatment. The increasing of the degree of crystallinity indicates the orderliness of the PLA macromolecules packing. The non-self-sustained discharge plasma treatment of PLA surface leads to the increasing of carbonyl group band intensity, corresponding to the α-form of the PLA crystal structure, which indicates the destruction of polymer bonds.

According to the results by AFM spectroscopy, the roughness R_a is increased from 5 to 248 nm for plasma-treated scaffolds. It was found that roughness depends on the degree of crystallinity (Fig. 1). Increasing the scaffolds surface roughness submit a second-order polynomial law: $R_a = -15.429\ \chi_C^2 + 118.77\ \chi_C - 87.4$, while the approximation reliability coefficient $R^2 = 0.9612$. Increasing the surface roughness improves the adhesion and proliferation of cells on PLA surface.

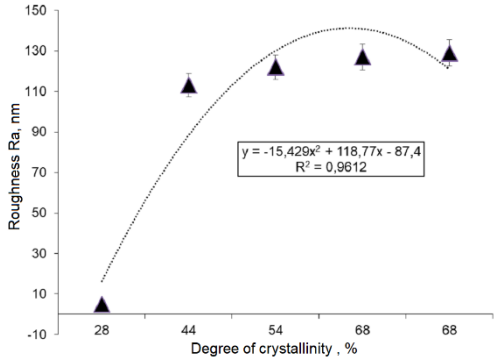

Fig.1. The dependence of the modified scaffolds PLA surface roughness from the degree of crystallinity

To sum up, argon flow non-self-sustained discharge plasma treatment is an effective technique for surface physicochemical property modification of biocompatible scaffolds based on PLA.

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