

COMPARATIVE STUDY OF PLASMA INFLUENCE AND STERILIZATION EFFECT ON THE POLYLACTIC ACID FILMS SURFACE PROPERTIES

E.O. FILIPPOVA, N.M. IVANOVA, V.F. PICHUGIN

Tomsk Polytechnic University, Lenin str. 30, Tomsk, 634050, Russia, katerinabosix@mail.ru, +79132856796

Polylactic acid is bioactive and biodegradable thermoplastic aliphatic polyester widely used in medicine. There are a lot of medical devices based on polylactic acid such as suture materials, bone plates, abdominal nets, stents, scaffolds for tissue regeneration, and drug delivery systems with controlled degradation [1]. Using the polylactic acid as an implant for ophthalmology particularly for bullous keratopathy treatment [2, 3] is the perspective direction for creating implants of new type. In view of the fact that the virgin surface of polylactic acid has a nonwetable surface we need to treat the material for creating desired properties. All medical implants should be sterilized before operation. The requirements to methods of polymeric material sterilization are very strict due to the need to preserve the shape of the graft and material properties. Sterilization by steam (moist heat) and γ -irradiation are widely spread in the medicine practice. Steam sterilization and effect of γ -irradiation can change physical and chemical properties of materials and can be cause of its destruction.

The aim of this research is the comparative study of plasma influence and sterilization effect on the polylactic acid films surface properties.

Materials and methods. The polylactic acid films of 25-30 μm thickness was made by dissolution of polylactic acid in CHCl_3 . After films preparation the materials surface was treated by low-temperature plasma. The barrier discharge of plasma was carried out using cold plasma source. Low-temperature plasma had 25 kV voltages, 5 kHz frequency, 2 W/cm^2 of the power density. The temperature of treated surface did not exceed 40°C. Plasma treatment time was 30, 60 and 90 seconds. The sterilization was carried out in two ways. The first mode was steam sterilization (temperature was 120°C, pressure was 0.11 MPa). The second one was γ -irradiation of Co^{60} radionuclide with 1 kGy dose. The surface properties were studied using laser scanning microscopy and atomic force microscopy.

Results showed that the virgin films have roughness parameters: R_a 0.27 - 0.333 μm , R_q 0.4-0.42 μm , R_t 2.2-2.5 μm , R_v 1.23-1.4 μm , R_z 1.65-1.9 μm . The polylactic acid films had two different surfaces: more smoothing (R_a 0.27 μm) and more rough (R_a 0.333 μm), which is associated with the manufacture of these films. The plasma treatment and γ -irradiation of Co^{60} decreased roughness parameters by a factor of 1.3. This effect was explained by the free radicals formation on the polymer's surface and surface smoothing after low-temperature plasma treatment. Steam sterilization decreased roughness parameters by a factor of 2.6, which is associated with deformation the thin polymer's film after heating and pressure influence.

REFERENCES

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