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Abstracts

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Conference topics

Beam and plasma sources
Fundamentals of modification processes
Modification of material properties
Coatings deposition
Nanoscience and nanotechnology

ATMOSPHERIC PRESSURE DISCHARGE PLASMA SOURCE FOR BIOCOMPATIBLE POLYMERS TREATMENT [1]

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The parameters of the plasma source of the atmospheric pressure discharge for the modification of biocompatible polymers with a low threshold of resistance to temperature are investigated. The optimal operating conditions were as follows: argon flow rate of – about 1 l/min; discharge voltage magnitude – about 300 V; discharge current magnitude – about 40 mA; pulse duration – 1 - 5 μs; pulse repetition rate – 100 kHz; electron temperature – about 0.3 eV; plasma density – about $5 \cdot 10^{11}$ cm^{-3}.

In these conditions the optical emission spectra of discharge plasma were investigated. The intensity of the lines of excited argon atoms is three orders of magnitude greater than the intensity of the lines corresponding to the second positive nitrogen group. Lines of excited atoms of copper - the material of the electrodes of the discharge system, were not observed.

The dependencies of the temperature vs the flow rate of the argon jet passed through the discharge was also investigated. The temperature range was determined (40-50^{0}C) at which the surface treatment of polymer samples was carried out without their thermal destruction.

The samples of polymeric materials: polylactide, polyvinyl alcohol, composite materials based on polylactide and hydroxyapatite, as well as a lactide-glycolide copolymer were treated with the plasma of atmospheric pressure gas discharge. Dependences of the surface resistance of experimental samples on plasma exposure regimes show that an increase in the total processing time, as well as the average discharge power, leads to a clear decrease in the surface resistance for samples based on a lactide-glycolide copolymer and hydroxyapatite. Also, an increase of discharge average power leads to an increase in the hydrophilicity of polymer surfaces after their direct contact with the plasma of this discharge (fig. 1).

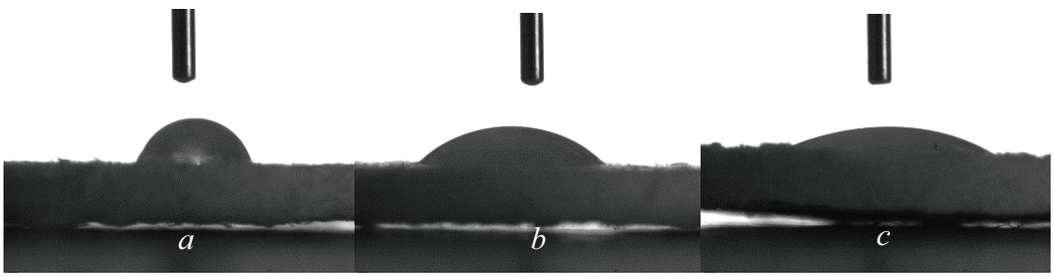

Fig. 1. Photos of water droplets on the surface of polylactide: *a* – original sample and sample treated with heated argon; *b* – after plasma treatment with mean power 1 W; *c* – after plasma treatment with mean power 5 W.

Special attention should be paid to the result showing that the effect of only one argon jet heated to the same temperature as in the discharge, but without the discharge, does not change the surface resistance and wetting conditions of the polymers. Evidently, the modification of polymeric materials occurs as a result of the complex effect of a gas-discharge plasma, involving collisions with their surfaces of heated neutral molecules, charged particles, optical radiation, and the temperature effect contribution is not predominant.

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