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Tomsk Scientific Center SB RAS
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Abstracts

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Conferences

20th International Symposium on High-Current Electronics

14th International Conference on Modification of Materials with Particle Beams and Plasma Flows

18th International Conference on Radiation Physics and Chemistry of Condensed Matter

3rd International Conference on New Materials and High Technologies

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This book comprises the abstracts of the reports (presentations) for the oral and poster sessions of VI International Congress on Energy Fluxes and Radiation Effects (EFRE 2018). The Congress will combine four International Conferences regularly hosted in Tomsk: International Symposium on High-Current Electronics, International Conference on Modification of Materials with Particle Beams and Plasma Flows, International Conference on Radiation Physics and Chemistry of Condensed Matter, International Conference on New Materials and High Technologies. It will be a good platform for researchers to discuss a wide range of scientific, engineering, and technical problems in the fields of pulsed power technologies; ion and electron beams; high power microwaves; plasma and particle beam sources; modification of material properties; pulsed power applications in chemistry, biology, and medicine; physical and chemical nonlinear processes excited in inorganic dielectrics by particle and photon beams; physical principles of radiation-related and additive technologies; self-propagating high-temperature synthesis; and combustion waves in heterogeneous systems.

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SURFACE PROPERTY MODIFICATION OF BIODEGRADABLE POLYMER AND COMPOSITES BY LOW-TEMPERATURE ATMOSPHERIC PLASMA TREATMENT[1]

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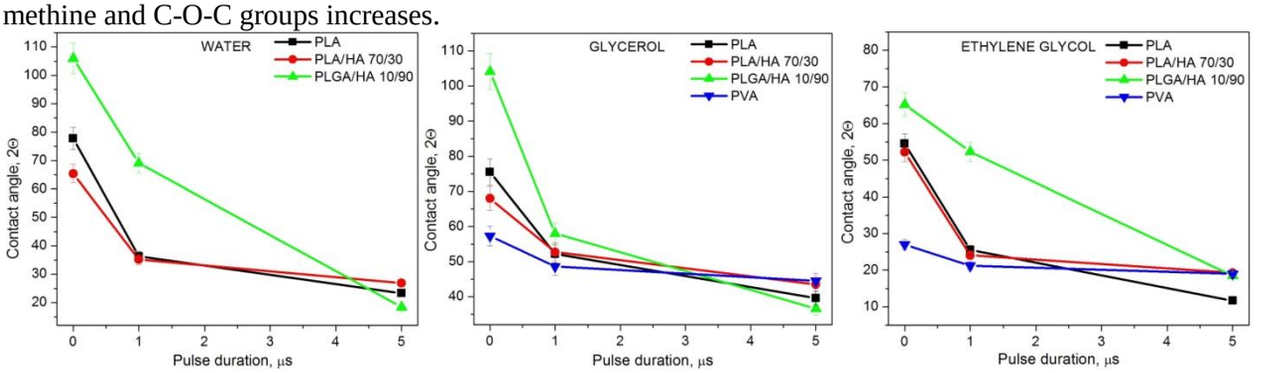
The effect of argon flow low-temperature atmospheric plasma treatment on surface physicochemical properties of biodegradable and biocompatible polymers (polylactic acid – PLA and polyvinyl alcohol – PVA) and composites based on polylactic acid and co-poly(lactic-glycolic acid) with hydroxuapatite (PLA/HA 70/30, PLGA/HA 10/90) was investigated. The plasma treatment conditions were following: the amplitude of discharge voltage – 300 V; the amplitude of discharge current – 40 mA; pulse duration – 1 and 5 μs; exposure time – 3 min; frequency – 100 kHz; the electron temperature – 0.3 eV; the plasma concentration – 5×10^{11} cm^{-3}. Influence of gas-discharge atmospheric plasma on polymer materials is accompanied by their surface property alteration as wettability, microhardness and surface resistivity which caused by destruction and new molecular bond formation, surface microrelief modification – smoothing or cratering [1]. X-ray diffraction analysis reveals that phase composition of the plasma-treated materials remains identical to the initial state; new peaks and diffraction line displacement are not occurred, however the intensity increasing and the peak narrowing of the treated samples indicate that the degree of crystallinity enhances. Infrared spectroscopy reveals that after plasma treatment of PVA, lines in the 1710 cm^{-1} region occur, distinctive for carbonyl (-C=O) stretching vibrations and related to surface oxidation [2]. This may be due both to local heating by plasma irradiation and to the presence of excess electrons from polymer chain scission. For other materials new line is not emerged; IR-spectra of the composites contain lines of both polylactic/glycolic acid and hydroxuapatite. In the IR-spectra of plasma treated PLA, the number of methyl, methine and C-O-C groups increases.



(a) (b) (c)

Fig. 1. The contact angle polylactic acid, composites PLA/HA 70/30, PLGA/HA 10/90 and polyvinyl alcohol depending on the irradiation conditions when wetted with: a) water b) glycerol c) ethylene glycol

Wettability of the materials after plasma treatment is significantly improved, as evidenced by a decrease in the contact angle when wetted with water, glycerol and ethylene glycol (Fig. 1), and also accompanied by an increase in free surface energy. Surface energy modification can significantly affect the bioavailability and surface cell absorption. Implants may have greater or lesser wettability, ability to adsorb cells that participate in electrochemical processes, and bioresorption characteristics. Microhardness of the plasma-treated samples is reduced. Surface resistivity of PL, PLA/HA and PVA does not change significantly, but the electrical conductivity of PLGA/HA increases by 3 orders of magnitude. Thus, it is shown that argon flow low-temperature atmospheric plasma treatment is an effective technique for biocompatible polymer and composite surface physicochemical and mechanical property modification.

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