

References

1. V.V. Lebedev // *East-European Journal of Advanced Technologies*, 2012.– Issue.59.– P.21–23.
2. *Averko-Antonovich LA Chemistry and technology of synthetic rubber.– Moscow: Chemistry, 2008.– 357p.*

THE INFLUENCE OF PULSED e-BEAM TREATMENT ON PROPERTIES OF ELECTROSPUN PLLA SCAFFOLDS

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Nowadays bioresorbable polymers are widely used in regenerative medicine and tissue engineering due to its biocompatibility and biodegradability. Some structures made from these materials can be used for bones and soft tissues recovering [1]. One of the main aspects of biodegradable polymers application is a correlation between the rate of degradation and the speed of tissue regeneration. Poly-L-lactic acid (PLLA) has a low rate of degradation because of large molar mass and hydrophobic properties. Hydrolytic degradation of PLLA is a heterogeneous process, which undergoes by the invasion of water into the material. The autocatalytic nature often results in faster degradation of the inside of a PLA component. For this reason, PLLA characteristically degrades from the inside-out, giving hollow and porous structures before complete bioabsorption leading to the burst release. As a result, scaffolds might lose its mechanical and rheological properties resulting in its abruption in vivo.

In order to avoid this phenomenon and control the rate of degradation number of surface modification methods have been proposed. One of the most promising methods of polymer modification is the pulsed electron beam (e-beam) treatment because of its larger absorbed dose than continuous e-beam due to pulsed duration.

Materials and methods. The scaffolds were prepared using PLLA PL38 (Purac) solution in tri-

chloromethane (Ekros) with 4 % wt. The nonwoven materials were produced by electrospinning method using NANON-01A (MECC) device. The spinning cylinder 210×100 mm was used as a collector under following conditions: feeding speed was 6 ml/h, the potential on the needle was 20 kV, distance between the collector and needle was 190 mm [2].

E-beam treatment of nonwoven scaffolds was conducted using pulsed e-beam accelerator TEA-500 under following conditions: the diameter of e-beam was 5 cm, kinetic energy of electron beam – 350 keV, electron beam current – 6 kA, electron beam current pulse duration at half height – 60 ns. The thickness of titanium foil was 50 μm.

The process of scaffolds degradation was carried out in phosphate buffer saline (PBS) according to GOST R ISO 13781-2011, degradation of scaffolds proceeded under 70 °C, time of degradation – 1 and 7 days.

Investigation of molar mass was conducted by gel-permeation chromatography (GPC) using liquid chromatograph Agilent 1200.

Results and discussions. Results of measurements of molecular weight are presented in Table 1.

The results of GPC show that the reduction of molecular weight is depending on absorbed dose. It means that more scissoring chains are formed under degradation process. Significant decrease of molar mass stands at 25 kGy by reason of cleavage

Table 1. Dependence of molecular mass from absorbed dose

№	D, kGy	Molecular weight, g/mol		
		0 days	1 day	7 days
1	0	$(67.40 \pm 6.47) \cdot 10^4$	$(22.40 \pm 2.24) \cdot 10^4$	$(35.50 \pm 3.55) \cdot 10^4$
2	25	$(7.47 \pm 0.75) \cdot 10^4$	$(4.71 \pm 0.47) \cdot 10^4$	$(2.41 \pm 0.24) \cdot 10^4$
3	50	$(2.93 \pm 0.29) \cdot 10^4$	$(1.68 \pm 0.17) \cdot 10^4$	–
4	100	$(2.23 \pm 0.22) \cdot 10^4$	$(0.20 \pm 0.02) \cdot 10^4$	–
5	150	$(1.39 \pm 0.14) \cdot 10^4$	$(0.07 \pm 0.01) \cdot 10^4$	$(0.05 \pm 0.01) \cdot 10^4$

of carboxyl chemical linkages in backbone main chains. The destruction of carbon-hydrogen chemical bond in low-molecular PLLA fibers results in loss of molecular weight after treatment with doses higher than 25 kGy. After the process of degradation in PBS, scaffolds show the same tendency to lose molar mass. As a result, scaffolds degradation after irradiation of pulsed e-beam occurs faster than without modification.

In conclusion, pulsed e-beam treatment of PLLA scaffolds has a significant influence on its physical and chemical properties. E-beam irradiation leads to the decreasing of molecular weight and could be considered as a potential technology to control degradation rate of nonwoven scaffolds. Furthermore, pseudo-surface erosion after irradiation will help to avoid acid autocatalysis phenomenon.

References

1. Cairns M.L., Dickson G.R., Orr J.F., et al. // *Polymer Degradation and Stability*, 2011.– Vol.96.– №1.– P.76–83.
2. Kudryavtseva V.L., Bolbasov E.N., Ponomarev D.V., et al. // *BioNanoScience*, 2017.– P.1–9.

ON THE WAY TO HIGHLY EMISSIVE MATERIALS: INCREASING RIGIDITY BY INTRODUCTION OF FURAN MOIETY IN Co-OLIGOMERS

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Linear co-oligomers combining high luminescence efficiency and semiconducting properties are of great interest for organic optoelectronics¹. Single crystals of alternating furan/(BPFB)² or thiophene/phenylene (BPTB)³ co-oligomers (Figure 1a) demonstrated a promising combination of high charge mobility and high luminescence efficiency, BPFB outperforming its thiophene analogue. However the nature of these differences was poorly understood.

In this study we explored intramolecular factors affecting the optoelectronic properties of furan/ and thiophene/phenylene co-oligomers³. We demonstrated that BPFB exhibits almost twice higher (Figure 1b) torsional rigidity than BPTB solely due to more efficient conjugation. The increase of rigidity of BPFB with respect to BPTB was shown to facilitate hole, electron and exciton transfers. The higher rigidity of BPFB was also suggested to hinder one of the possible luminescence quenching pathways.

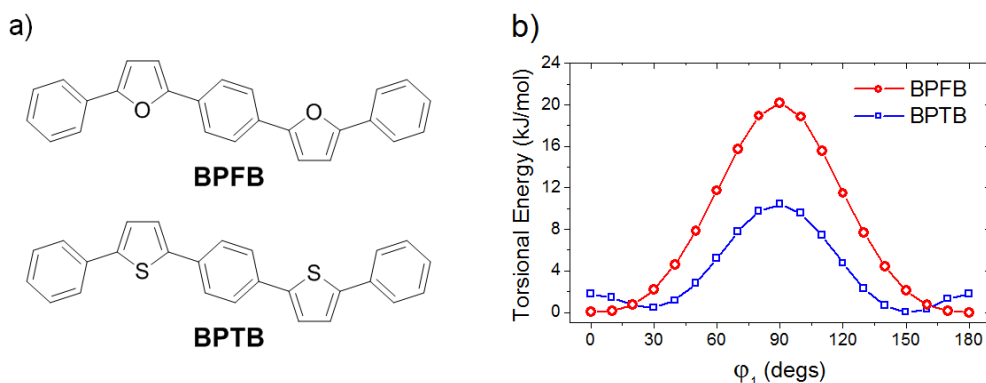


Fig. 1. (a) structures of studied compounds; (b) relaxed scans of the ground state PES of BPFB (red circles) and BPTB (blue squares)