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ELECTROSPUN POLY(3-HYDROXYBUTYRATE) MATERIALS WITH DESIRED FIBERS ALIGNMENT AND TARGETED MECHANICAL PROPERTIES

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Introduction Fibrous materials produced by electrospinning offer unique properties and versatile possible applications. However, despite the progress gained in terms of the electrospinning process, finding possibilities for tuning and improving the mechanical properties of these materials still remains a major challenge. In this respect, the focus of the present study is on the fabrication of electrospun poly(3-hydroxybutyrate) materials with controlled fibers alignment and desired mechanical properties.

Experimental part Poly(3-hydroxybutyrate) (PHB), chitosan and cellulose acetate (CA) were of analytical grade. By means of electrospinning onto rotating collectors – drum (smooth), blade and grid (patterned), the PHB fibers alignment was purposely tailored. Additional fibers alignment in the direction of collector rotation was achieved by increasing the collector speed from 600 rpm to 2200 rpm. Moreover, the effect of the coating of the electrospun PHB mats with chitosan or cellulose acetate on their mechanical properties was also assessed.

Results The detailed surface morphology, thermal behaviour and crystallinity of the PHB materials were characterized by SEM, DSC and XRD. It was shown that patterned collectors had a significant impact on fibers alignment only at lower rotation speed, whereas with the increase in the collector speed the fibers alignment increased in the direction of collector rotation. The materials strength was evaluated by tensile tests and indicated that PHB materials fabricated at lower collector rotation speed exhibited isotropic mechanical properties, whereas those at higher collector rotation speed – anisotropic. In addition, coating of PHB materials with chitosan or cellulose acetate enhanced their mechanical properties.

Discussion It was demonstrated that at lower rotation speed the collector type had influence on the fibers alignment, whereas the higher rotation speed led to their alignment in the direction of collector rotation. In addition, coating with chitosan or CA preserve the fibrous structure of the PHB mats. The obtained DSC results indicated that regardless of the mats morphology and fibers alignment PHB preserved its crystallinity.

Conclusions Both the collector type and rotation speed affected the PHB fibers alignment. This further had an impact on the crystallinity and the mechanical properties of the PHB mats. The tensile tests indicated that electrospun at lower collector speed PHB mats revealed isotropic mechanical properties, whereas those at higher collector speed – anisotropic. Coating of the PHB mats with chitosan significantly increased the Young's modulus, while the coating with CA results in improvement of the elongation at break.

Keywords: *electrospinning, patterned collectors, coatings, mechanical properties*

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