Materials design for medical application – from clinical need to product ready for implementation.

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Abstract

The clinical need is a strong trigger for scientists all over the world to transfer their scientific idea into ready to use product. At the begging of this path, the deep understanding of specific clinical need is crucial for proper material design. Both, chemical composition and morphological structure need to carefully thoughtful in order to meet the specific application requirements. For this purpose the biomimetic approach is also used nowadays. The use of electrospinning as a method of material formation is the example of biomimetic approach. Moreover, this method let to prepare materials from broad spectrum of components, additionally bringing closer to solutions coming from nature. Using high voltage applied to the spinning nozzle through which polymer solution is extruded , the (nano)fibres may be easily formed. So obtained fibres may be a part of various medical products such as stents, wound dressings, drug delivery systems or cell scaffolds for tissue regeneration. What is important, the translation of electrospinning to the clinic, including the need to produce materials at large scale and the requirement to do so under Good Manufacturing Practice conditions is currently available.[1]

The researchers from Laboratory of Polymers and Biomaterials (IPPT PAN) are strongly focused on developing materials for medical applications. The designed medical products are mostly combination of electrospun fibres with other type of materials, formed from both natural and synthetic materials. The materials for application in tendon and ligaments regeneration were one of the first developed in the Laboratory. The aligned fibres, also covered with hydroxyapatite were produced in order to prepare cells scaffolds with gradient structure.[2] Also the hydrogels containing the nanofibers are developed as a proposition for nerve regeneration or scaffolds for cartilage.[3] Moreover, the innovative drug delivery system is developed, based on electrospun nanofiber carriers for the controlled delivery of brinzolamide for glaucoma treatment.[4] One of the mostly explored topics related to nonwovens, concern its application as a wound dressings. In the Laboratory the nonwovens modified with novel enzybiotic (*AuresinePlus*) were developed for treatment of *E.coli* contaminated wounds.[5] What is important, the *in vitro* experiments are translated into *in vivo*. The researchers from Laboratory of Polymers and Biomaterials have started the *in vivo* experiments on their vascular stents using big animal model.

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[1] Dziemidowicz, K. et al. (2021), *Journal of Materials Chemistry B*, 9(4), 939-951.
[2] Kołbuk, D. et al. (2020), *12*(3), 544.
[3] Niemczyk-Soczynska, B. et al. (2021), *Materials*, *14*(22), 6899.
[4] Cegielska, O., Sajkiewicz, P. (2019), *Polymers*, *11*(11), 1742.
[5] Urbanek, O. et al. (2021), *Pharmaceutics*, *13*(5), 711.