7th European Symposium on Biomaterials and Related Areas

BioMAT 2023

Book of Abstracts

Triaxial electrospinning of core shell fibers for drug delivery

S. Tabakoglu[1*], D. Kołbuk[1], P. Sajkiewicz[1]

[1] Institute of Fundamental Technological Research, Polish Academy of Sciences, Pawinskiego 5B, 02-106 Warsaw, Poland
*stabakog@ippt.pan.pl

Electrospun nanofibers demonstrate the required qualifications for effective and controlled drug delivery in tissue engineering applications. The triaxial electrospinning technique, which combines three nanofibrous layers: a core, an intermediate and a shell layer, is a unique technology, creating a broad perspective for drug delivery systems. Triaxial electrospinning is developed for eliminating significant drawbacks of uniaxial and coaxial approaches related mostly to insufficiently sustained and controlled drug release, limited drug solubility, problems with loading multiple pharmaceuticals, and insufficient biocompatibility. [1]

The main objective of this research is to optimise the triaxial electrospinning procedure in order to produce homogeneous fibers and see favourable effects on drug release. The fibers were manufactured using a combination of biodegradable synthetic and natural polymers, including gelatin, poly(lactic-co-glycolide), and polycaprolactone. Natural polymers mimic the extracellular matrix's natural chemical composition, while synthetic polymers strengthen the mechanical properties and maintain essential physicochemical characteristics of the system. As a pharmaceutical model, Rhodamin B was inserted into particular layers.

Preliminary studies, including the optimization of triaxial fiber production, will be addressed. The formation of homogenous free-bead fibers was confirmed by microscopic images as the result of several experiments. Additionally, it was found that, as expected, an outer layer shields the fibers. Images from scanning transmission electron microscopy (STEM) demonstrated that a shell layer covers the middle layer surrounding the core layer (Fig. 1). We were able to choose process variables that ensure core-shell fiber structure. The release properties from triaxial and coaxial fibers were investigated using rhodamin B in preliminary in-vitro testing. The findings demonstrated that triaxial fibers significantly reduced initial burst release when compared to coaxial fibers.

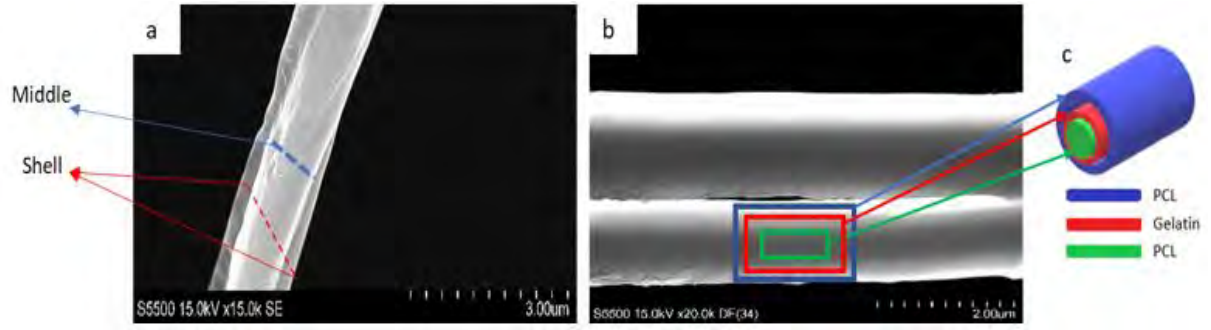

Figure 1. STEM (a,b) images of the selected samples in optimal parameters. (a) SE mode showing general architecture of triaxial fiber: shell layer covers core including middle and inner layer. (b) DF mode showing deeper composition of triaxial fiber: each of three layers represented by darkness differences. Different letters represent different samples produced under different process parameters; (c) representative of the expected fiber structure.

Our research suggests that triaxial fibers have promising attributes for use as encouraging delivery systems for drugs in biomedical applications.

References

[1] S. Tabakoglu, D. Kołbuk and P. Sajkiewicz, *Biomater. Sci.*, 2022, Advance Article, DOI: 10.1039/D2BM01513G.