The Fiber Society 2016 Fall Meeting and Technical Conference
Ithaca, USA
10-12 October 2016
book of abstracts on CD-ROM

Charge Assisted Tailoring and its Effect on Surface Modification of Chitosan Nanofibers

Olga Urbanek[1], Pawel Sajkiewicz[1], Caroline L. Schauer[2]

[1] Institute of Fundamental Technological Research, Polish Academy of Sciences, Adolfa Pawińskiego 5b, 02-106 Warsaw, Poland
[2] Materials Science and Engineering, Drexel University, 3141 Chestnut Street, Philadelphia, PA 19104, USA

ourbanek@ippt.pan.pl

Polyelectrolytes are used on a broad scale in various medical applications, because of their unique properties and availability. Nowadays, this group of materials is used for wound dressings, tissue scaffolds or drug delivery systems through various processing methods. The processing of polyelectrolytes using electrospinning technique is fraught with difficulties arising from the excess of charges in the polymer solution, which leads to the instability of the stream due to the large repulsion forces in the polymer jet [1]. An appropriate selection of high voltage polarity on the spinning nozzle can affect the process efficiency and additionally influence the fibers' surface chemistry [2]. Chitosan is an example of a semi-crystalline polysaccharide, which is commonly used in biomedical applications. The protonated amino groups are responsible for the formation of polycations, which subsequently form compounds with natural and synthetic anions [3].

The aim of our research was to investigate the effect of the polarity applied to the spinning nozzle on the spinnability of polycaprolactone/chitosan nanofibers and the concentration of the amino groups on the fibers surface. Moreover, we investigate its effect on further bioinspired surface modification with chondroitin sulfate (CS). Nanofibers with 5-25% w/w of chitosan were studied, applying either negative or positive voltage on the spinning nozzle. This process was followed by a surface modification with chondroitin sulfate using layer-by-layer strategy to create polyelectrolyte complexes. The introduction of synthetic polymer molecules into the solution reduced solution viscosity and improves mechanical properties. Contact angle data indicated the correlation of applied polarity on surface composition in the chitosan blend fibers. For all blends prepared with negative charge on the spinning nozzle, significant increase of wettability is observed comparing to fibers prepared with positive polarity. SEM analysis indicates the effect of polarity on fiber diameter distribution and morphology. Additionally there is no effect of the polarity applied to the needle on PCL crystallinity as shown from DSC analysis. Mechanical tests of fiber mat and AFM analysis also indicate significant effect of polarity on the properties of PCL/chitosan nonwovens.

Acknowledgment: The project was supported by the National Science Centre Grant No. PRELUDIUM 2014/15/N/ST8/03757 and partially by The Kościuszko Foundation.

References

1. D. Terada, H. Kobayashi, K. Zhang, A. Tiwari, C. Yoshikawa, N. Hanagata, Science and Technology of Advanced Materials, 13(2012), 015003.
2. U. Stachewicz, C.A. Stone, C.R. Willis, A.H. Barber, J. Mat. Chem., 22 (2012), 22935- 22941.
3. Y. Liu, T. He, Ch. Gao, Colloids and Surface B: Biointerfaces, 46 (2005), 117-126.